INTEGRATING RENEWABLE ENERGY TECHNOLOGIES INTO CITIES THROUGH URBAN PLANNING: IN THE CASE OF GEOTHERMAL AND WIND ENERGY

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When I look behind to passing years and think about that long-term of studying, I see this dissertation as a product of a long-lived adventure, of an exhaustive journey to unfamiliar territories, foreign lands, unaccustomed terrains and to deep waters. While walking through the path, I sometimes lost the way and sometimes the hope and light, and even the health. I am grateful to everyone who helped and guided me in finding the way, who gave me hand when I was down, and who gave me power and encouraged when I was in despair.

ABSTRACT

Focusing mainly on renewable energy, the overall aim of this dissertation is to introduce energy and energy related environmental considerations into the context of Turkish planning and urban policies. If planning in Turkey should contribute to combat with the reality of climate change and to improve local environmental quality, renewable energy considerations are required to be incorporated into planning process. With regard to characteristics of renewable energy utilization, this study seeks to answer the questions of how planning can promote the widespread use of renewable energy sources, how renewable energy integrated planning policies can be formulated and implemented, how renewable energy integrated planning process can be put into practice, and how renewable energy technologies can successfully be integrated into cities.

With the objective of defining renewable energy integrated planning process the research conducted to explore these how questions is based on the idea of learning from other's experiences. In view of that the study focuses on understanding the European perspective and learning from the experiences of the member states. While exploring how questions and converting the defined process into Turkish context the research is carried out at both national and local scale. Integrated policy approach is taken into consideration with regard to the capacity of institutional framework comprising integration between the national energy-renewable energy, environmental and planning policies. At the local scale, the research focuses on integration of renewable energy technologies into cities and the renewable energy integrated planning approach in the case of geothermal and wind energy developments and source potentials of the city of Izmir.

ÖZET

Günümüz iklim değişimi gerçeği karşısında ve sürdürülebilirlik ilkeleri doğrultusunda, küresel ısınma hızının azaltılması, hava kirliliğinin önlenmesi ve tükenir fosil yakıtların kullanımının ve bu yakıtlara bağımlılığın azaltılması yönünde teknoloji aracılığıyla yenilenebilir enerji kaynaklarının yaygın kullanımının sağlanması benimsenen en temel stratejilerden biridir.

Eğer planlama pratiği ve sistemi sürdürülebilir kalkınmaya doğru izlenecek yolda bir katkıda bulunacak ise, eğer planlama politikaları küresel ve yerel çevre sorunlarını gözetecek, çözüm getirecek ise yenilebilir enerji kaynaklarının ve bu kaynaklardan yararlanılmasına ilişkin konuların planlama sürecine dahil edilmesi, planlama pratiğinde ele alınması ve planlama politikaları ile yenilenebilir enerji politikalarının, enerji ilişkili çevresel politikaların entegrasyonunun sağlanması gerekmektedir. Bu temel kabule dayalı olarak, bu tezin amacı yenilenebilir enerji entegre planlama sürecini tarif etmek, ortaya konulacak sürecin Türkiye gerçeğinde nasıl hayata geçirilebileceğini tartışmak ve yenilenebilir enerji teknolojilerinin kentlere entegrasyonunun nasıl sağlanılabileceğine yanıt aramaktır.

Avrupa odaklı bu çalışmada, başkalarının deneyimlerini inceleyerek öğrenme yaklaşımı benimsenmiştir. Bu doğrultuda, yenilenebilir enerji entegre planlama sürecinin tarif edilmesine ilişkin yürütülen çalışma yenilenebilir enerji kaynaklarının kullanımı ve sosyal, çevresel ve mekansal etkileşimlerinin temel başlıklarının ve sorunların belirlenmesi, Avrupa Birliği düzeyinde yenilenebilir enerji ve mekansal kalkınma politikaları arasındaki ilişkilerin ve entegrasyonun incelenmesi, yine Avrupa düzeyinde enerji sektörünün planlama sistemine bakışının irdelenmesini ve Danimarka, İsveç, Hollanda ve İngiltere örneklerinin ulusal yenilenebilir enerji politikaları ve uygulama araçları, AB politikaları ve ulusal politikalar arasındaki uyumluluk, enerji sektörü kurumsal yapısı ve planlama ilişkileri, hakim planlama yaklaşımı, idari yapı ve planlama sisteminin yenilenebilir enerji politakalarına yaklaşımları, yenilenebilir enerji gelişimlerine yönelik mevzuat ve aktörleri kapsayan kurumsal çerçeve içinde planlamanın yeri ve rolü, ve kurumsal ve düzenleyici çerçeve kapsamında gerçekleştirilen, özellikle rüzgar enerjisi, planlama pratikleri doğrultusunda incelenmesine dayanmaktadır.

Üç aşamada gerçekleştirilen çalışmanın sonuçlarına ve bulgularına dayalı olarak tarif edilmeye çalışılan yenilenebilir enerji entegre planlama sürecinin Türkiye'de uygunabilirliği açısından öncelikli olarak sektörel yapılar, aktörler, politikalar ve mevzuat incelenmiş, son dönem yeniden yapılanma sürecine ilişkin getirilen yasal düzenlemeler ve öneriler gözönünde tutularak enerji/yenilenebilir enerji-çevre-planlama ilişkileri ve entegrasyonu doğrultusunda bir değerlendirmeye gidilmiştir.

Çalışmanın bir sonraki aşaması, İzmir ili jeotermal ve rüzgar enerjisi kaynak potansiyelleri ve mevcut gelişimlerin incelenmesi ve değerlendirmesine dayalı olarak yenilenebilir enerji entegre planlama yaklaşımının örnek üzerinden açıklanmasını ve önerileri içermektedir. Kaynak potansiyelleri ve bu kaynaklardan yararlanılmasına yönelik mevcut uygulamaların planlama süreçleri, kurumsal çerçeve ve mevzuat açısından ele alınarak incelenmesi ve değerlendirmesi neden yenilenebilir enerji entegre planlama ve nasıl sorularına açıklık getirmektedir.

Özellikle belirtmek gerekirse, yenilenebilir enerji kaynakları ve bu kaynaklardan yararlanma amacına (elektrik enerjisi veya ısı) dayalı teknolojiler itibarı ile "yenilenebilir enerji kaynakları ile planlama" ve "yenilenebilir enerji kaynaklarının kullanılması için planlama" şeklinde iki ayrı ifade üretilmiştir. Jeotermal enerji kaynaklarının sürdürülebilirliklerinin ve yenilenebilirliklerinin sağlanması, kaynağın korunması, arama, geliştirme ve işletme çalışmalarının etkin gerçekleştirilmesi anlamında tanımlanmış jeotermal rezervuar alanlarının özel koruma alanı olarak ele alınması gerekliliği çerçevesinde jeotermal enerji kaynakları ile planlama, bu kaynaklardan bölgesel ısıtma sistemlerine dayalı ısınma amaçlı yararlanılması açısından da, mekansal yapı, kentsel yoğunluk ilişkileri itibarı ile jeotermal enerji kaynaklarından yararlanılması için planlama ifadesi kullanılmıştır. Bu ifade yenilenebilir enerji kaynaklarının kentlere entegrasyonu bağlamında kentsel politika yaklaşımına da karşılık gelecek şekilde kullanılmıştır. Diğer yandan rüzgar enerjisinden elektrik üretimi amaçlı yararlanılmasına karşılık rüzgar enerjisi ile planlama ifadesi uygun görülmüştür. İfadenin bir diğer vurgusu elektrik enerjisi üretiminin merkezi yapısına karşılık gelmektedir.

Balçova-Narlıdere jeotermal bölgesel ısıtma sistemi gelişimlerini yerel teşebbüs olarak ele alınarak, ilin diğer alternatif teknoloji ve yenilenebilir enerji kaynak potansiyelerine sahip olması ve aynı zamanda ulusal doğal gaz politikasına dayalı olarak, doğal gazlı merkezi ısıtma sstemlerinin kurulmasının gündemde olması nedeniyle yerel kaynakların rasyonal kullanılmasına ve ulusal ve yerel enerji politikalarının çakışmasından kaynaklanacak sorunlara çözüm olarak, jeotermal enerji kaynaklarından yararlanılmasının uzun vadede "yerel enerji planlaması" ve "kentsel ısıtma planlaması" çerçevesinde ele alınması ve kentsel çevre yönetimi-enerji verimliliği ve yenilenebilir enerji kaynaklarının ısınma amaçlı kullanımlarının etkinliğinin sağlanması, kentsel ekonomik kalkınmaya katkıda bulunması amacı ile "kentsel enerji yönetimi"ne yönelik bir organizasyona gidilmesi önerilmiştir.

Rüzgar enerjisi örneğinde, Avrupa örneklerine dayalı olarak, herhangi bir düzenleyici çerçeve geliştirilmemesi durumunda, rüzgar tarlası gelişimlerinin yerseçimleri, ölçek ve dağılımları ve rüzgar enerjisi sektörünün yapılanma ve yerel kaynakları kullanma biçimi nedeniyle sosyal, çevresel etkilerin gündeme gelebileceği, planlama ve diğer koruma kararları ile çelişir gelişimlerin doğabileceği ve ulusal gerekler ile yerel faydalar arasında çatışmaların çıkabileceği varsayımda bulunulmuştur. Bu varsayım, son dönemde üretim lisansı alan rüzgar enerjisi projelerinin incelenmesi ve değerlendirilmesi, ve rüzgar tarlası projeleri için uygulanan mevzii imar planı ve plan değişikliği süreçlerinin üç ayrı proje örneğinde ele alınması ile desteklenmiştir. Nasıl bir planlama yaklaşımı sorusu Danimarka, İsveç, Hollanda ve İngiltere uygulamalarının, kurumsal çerçevelerdeki farklılıkları gözeten, karşılaştırılmalı değerlendirilmesi ile verilmiştir.

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BOT	Build-Operate-Transfer
CHP	Combined Heat Power
DH	District Heating
EIA	Environmental Impact Assessment
EIE	Electric Power Resources Survey and Development Administration, Turkey
EMRA	Energy Market Regulatory Authority, Turkey
ESDP	European Spatial Development Perspective
EU	European Union
GEOCEN	Geothermal Energy Research Development Test and Education Center, Izmir Institute of Technology
GHG	Greenhouse Gases
IEA	International Energy Agency
kW	Kilowatt
kWh	Kilowatt-hour
KP	Kyoto Protocol
MENR	Ministry of Energy and Natural Resources, Turkey
MPWS	Ministry of Public Works and Settlements
MW	Megawatt
MW_t	Megawatt-thermal
NEAP	National Environmental Action Plan, Turkey
NECC	National Energy Conservation Center, Turkey
NIMBY	Not-In-My-Backyard
PV	Photovoltaic
RES	Renewable Energy Sources
SPO	State Planning Organization, Turkey
TEN	Trans-European Networks
UNFCCC	United Nations Framework Convention on Climate Change

CHAPTER 1

INTRODUCTION

Since early 1990's, there has been a growing interest on the development of renewable energy technologies and their widely utilization in both developed and developing countries. Unlike energy crises of the 1970s, the main reason behind is the energy related environmental crises, thus the main concern is environmental security, rather than energy supply security.

The main environmental security issue, which is scientifically proved, politically accepted and globally felt, is the global warming, in other words the climate change. It is suggested that there would be a need to move towards a 60 % reduction in global carbon emissions in order to constrain this global environmental threat. Accordingly, at Rio in 1992, it has recognized that sustainable development could not be realized without major changes in the world's energy system, and Agenda 21 called for new policies and programmes to increase the contribution of environmentally safe and sound, and cost-effective energy systems, particularly new and renewable ones, less polluting and more efficient energy production, transmission, distribution and use. By the adoption of the UN Framework Convention on Climate Change (UNFCCC), followed by the Kyoto Protocol (KP) –legally binding agreement, the use of renewable energy sources and the development of renewable energy technologies have become one of the key elements of a strategy for mitigating both global and local environmental threats, and for sustainable energy future.

On the other hand, since the increasing concentration of greenhouse gases within the atmosphere has its roots in local activities, the cities -the major energy consumers- have become focal points in order to take action towards establishing sustainable energy systems and cultures. Taking action in cities has also been the tenet of Agenda 21, in terms of improving quality of life so as to achieve urban sustainability –sustainable cities. It can be said that the importance of cities, in energy and environmental context, have well coincided with worldwide social and economic changes. More competitive nature of new world economy, information industry and the associated network society not only necessitate changes in energy market and energy systems, but also shape new style of future energy demand.

As a result, the cities have already begun to experience a transition from fossil-fuel economy to de-carbonized economy, associated with the recognition of meeting their growing energy demand in a sustainable way with the help of technology and innovation in advancing towards efficient energy systems integrated with new and renewable energy sources.

However, this transition to a new energy paradigm, and the adoption of renewable energy technologies is not an easy move, and evolving leisurely and incrementally. Therefore, the acceleration in progress in the adoption of renewable energy technologies is slow and low. The problem is not a technological question or the level of maturity of renewable energy technologies. Indeed, the global renewable energy resource potential is large and the development of technologies is rapid and straightforward. However, there is inertia in physical, social and institutional environments, and high initial costs of new technologies cause resistance to a radical and rapid change.

Despite these obstacles, some political grounds, cities and regions, investors and developers, and the users have faced that there is no choice but to change, if they are to reduce substantial amounts of carbon emissions and achieve targets. Actually, much of the effort and support has been given by the international, national, regional and local organizations. International agreements have provided preconditions for setting market forces to work on the basis of internationally adjusted legal framework, and various organizations have supported by developing strategic policy frameworks and programmes, and providing dissemination of knowledge and experiences. Moreover, the EU ambition in the field of renewable energy and in reducing carbon emissions has considerable influence on the move towards sustainable energy futures, and sustainable cities, as well.

As a consequence, a new pattern of energy supply using renewable energy sources, generating power by small scale systems involving, to some extent, manufactured plants rather than the constructed ones, and operating on a more decentralized base in a liberalized market, has begun to constitute a basis for new technical, social and institutional infrastructures.

On the other hand, since the installation and operation of new technologies have taken place within a short time period contrary to the lengthy construction period of large-scale conventional power plants, the consequences of the renewable energy developments, both negative and positive, have become apparent instantly. The developments that have realized throughout the world –especially in Europe- since early 1990s has brought about some environmental and social impacts at the local level. When compared with the impacts of fossil fuel systems, the environmental impacts of renewable energy are small and not hazardous but locally perceived impacts are significant to consider. If the local impacts are ignored, strong public opposition becomes a major constraint to renewable energy developments. Moreover, the utilization of renewable energy sources which are diffuse in form, and the installation of new conversion systems on urban and rural areas, and on landscapes have become a challenge to existing land use decisions, to prevailing planning practices and systems of many countries. On the other side, planning procedures have also recognized as a constraint on renewable energy developments.

There is no doubt that the utilization of renewable energy resources will influence the pattern of growth and land uses, and the renewable energy technologies will shape the spatial structure, the landscapes and cityscapes of tomorrows urban and rural environments. The response of planning system and planning practices to this trend, and the contribution of planning to move towards sustainable development through promoting the widespread use of renewable energy sources is the question that this study seeks to explore.

1.1. Definition of the Problem

The context related to adoption of renewable energy technologies outlined in the above paragraphs has not been in the agenda of Turkish political grounds and of national policies.

Since Turkey had no commitment under KP, the global environmental objectives have not been a legitimate concern and an imperative to realize radical technological changes and to take actions towards a transition from a fossil-fuel economy to de-carbonized renewable energy economy. If it is to be mentioned the reason for not signing the Protocol was the economic implications of the compliance and the government had argued that the country did not have the financial or technological capability to meet emission reduction commitments.

Though per capita CO_2 emissions, CO_2 intensity of energy, CO_2 intensity of GDP, and per capita emissions of sulphur oxides (SO_x), nitrogen oxides (NO_x) and total suspended particular (TSP), which are all associated with energy use, are lower than OECD average, the level of emissions have grown significantly due to increasing energy use associated with economic development (IEA 2001). The adopted approach for reducing GHG emissions is the implementation of incremental innovations in the field of energy saving technologies and end-user energy efficiency measures, such as heat insulation at buildings. Such technological innovations of energy efficiency improvements do not require any shifts towards a new technological paradigm and follow the already existing technological trajectory by increasing the efficiency of existing technologies.

While air pollution is a severe problem in many Turkish cities, the air quality standards are less stringent than the standards recommended by the World Health Organization, and there is a lack of regular monitoring of pollutants (IEA 2001). The introduction of natural gas into residential use through DH systems is the key policy in dealing with the air pollution caused by fuel consumption for space heating. Although the SO_2 and TSP levels have shown decrease in the cities of Ankara, Istanbul and Bursa where residential areas are supplied by natural gas, many cities still remain exposed to high levels of pollutants, which also cause considerable health problems.

With the goal of progressive economic development the principal energy policy in Turkey is meeting the growing energy demand in a secure and continuous way with lower costs. Due to scarce financial resources, it is aimed at meeting energy demand through private and foreign investments and the Electricity Market Act enacted in 2001 has the goal of creating a competitive energy market in which the private and foreign investors can operate in obstacle free, reliable, stable and transparent market conditions. Within the frame of energy policies renewable energy sources are promoted as a strategy for reducing dependency on imports and providing security of energy supply through diversifying fuel types by increasing the use of domestic sources. Since there is no strategic national policy framework for renewable energy, it is the Electricity Market Act, its issued regulations and therefore the energy market principles that constitute basis for electricity generation based on renewable energy sources.

Since early 1970’s, energy –a non-traditional planning element- has been pronounced in the domain of planning literature and practices. Planning authorities in developed countries were responded to energy scarcity crises through energy conscious planning and design approaches aiming at reducing energy consumption, through recognizing the influence of planning practices on patterns of energy demand, and in some countries, such as Denmark and Sweden, energy considerations have been integrated into the planning process within the framework of a strong national commitment to energy efficiency comprising local heat supply planning. Those countries, where energy has been a topic in planning, are now responding to renewable energy considerations.

On the other hand, since energy policy has always been concentrated on energy supply side with a strongly centralized structure, energy has never been an issue of planning policy and practice in Turkey.

Moreover, the contribution of Turkish planning system to renewable energy is not a question since there exists neither a strategic national renewable energy policy nor a carbon emission reduction policy associated with indicative quantitative targets. Renewable energy technologies are at their early stage of development. Due to very few numbers of schemes developed in small-scale, renewable energy developments, in particular wind energy, are not experienced as yet a considerable challenge to land use decisions and planning.

However, there is a growing interest on the utilization of renewable energy sources especially from the side of developers and investors, and the energy sector that wishes to create capital. This study argues that the utilization of renewable energy sources can cause local conflicts, significant environmental and social impacts, and can constraint wise of local resources if it is purely left to the market principles and if developments are mainly driven by the actors of the energy market.

If it is to be mentioned, it is that possible negative impacts of renewable energy technologies and the question of the compatibility of renewable energy developments with other land uses which gave rise to formulation of this dissertation, and the roots of the study relying on a personal curiosity dates back to 1999.

It was the period that the first wind turbines, as commercial wind farms, were blossomed in our landscapes and the wind energy industry was appeared in the stage with a rush of project proposals. The approved BOT projects especially in the region of the Çeşme Peninsula, and also the theoretical wind source potential of the region were triggered the anxiety of what would happen when all the approved projects begin to operate? What if all applications tend to be approved and be implemented, or what if all source potential of the region is to be exploited without any control mechanism and regulation?

It was worried because the region was rather sensitive with its designated conservation areas as experienced by participating as a planner in the revision studies of Master Plan of Çeşme. Interested in pursuit of the wind energy developments and their consequences especially in European countries, it was thought that the wind energy developments in the region of Çeşme would be a challenge to land-use decisions. It was also conceived that the projects would bring impact on landscape due to the number and size of the projects that might even be resulted in local opposition.

However, later at the commencement period of the dissertation study, that wind energy movement was already faded because of several reasons such as, the political instability accompanied by economic crises of 1999-2000, the deficiencies related to energy sector and also the emphasis given to natural gas at the first place. That time of recession was then followed by accelerated governmental actions oriented towards European Union, in a manner of being prepared for EU accession. This ambition associated with manifold actions characterizes the current picture in the country comprising rapid transformations and reform movements.

While getting prepared for EU accession, major adjustment to the liberalization policy of European energy sector was provided by the enactment of the Electricity Market Act, and the Draft Law on Renewable energy as a response to EU Directive is now at the National Assembly for approval. After the cancellation of BOT projects by the Act, no turbine was installed during the transition period of the market. However, the mid-2002 was the beginning of a new phase of wind energy industry, a new phase of rush of project proposals comprising application to the EMRA. Following the Electricity Market Licensing Regulation issued in July 2004, the Authority made its first announcement on licensed electricity generation projects on November 2004.

The approved wind energy projects announced just before the finalization of the dissertation study reinforced the initial anxiety and validated the necessity of renewable energy integrated planning proposal of this dissertation even though the projects are not realized yet.

1.2. Aim and Scope of the Study

In accordance with the context outlined in the initial section of this chapter and the problems defined in the previous sub-title, the aim of this dissertation is to introduce energy and energy related environmental considerations into the context of Turkish planning.

Focusing mainly on renewable energy, this study seeks to define a planning path towards sustainable development in which the utilization of renewable energy sources and technologies is a crucial strategy; to combat with the reality of climate change, thus to reduce the rate of global warming, to improve quality of life and local environmental quality; to meet the demands of both present and future generations in a way reducing the level of dependency on non-renewable energy sources and providing rational use of resources.

If planning in Turkey should contribute to global and local environmental objectives and to move towards sustainability, renewable energy considerations are required to be incorporated into planning process, is the goal statement of the study.

Therefore, this dissertation suggests that planning should encourage the harnessing of renewable energy sources through making space for renewable energy developments and promote their widespread utilization through spatial structure arrangements that can enhance the viability and efficiency of renewable energy technologies in a way providing their compatibility with the other land uses, with natural and built environments, and managing their negative impacts so as to attain environmentally sound and socially acceptable patterns of renewable energy developments.

Such an ambitious goal of introducing renewable energy integrated planning approach necessitates identifying an appropriate institutional framework within which renewable energy integrated planning policies can be formulated and implemented or within which renewable energy integrated planning can be put into practice. In this respect, this dissertation has two research objectives:

- Defining renewable energy integrated planning process
- Defining how this renewable energy integrated planning process can be put into practice in Turkey, and how renewable energy technologies can successfully be integrated into Turkish cities.

If the main assumption behind the goal and objectives is to be stated; as a consequence of not only the external forces (such as the UNFCCC signed in May 2004, and the EU policies, programmes and legislation), but also the internal pressures to be occurred as a result of progressive economic development, a strong commitment to move towards sustainable development, thus the institutionalization of energy-environmental policies supported by an integrated policy approach in which planning should definitely contribute and be an integral part, will be among the key questions for Turkey in the very near future.

When the global environmental objectives become a legitimate concern as a national priority requiring a strong political commitment to sustainability, the successes and failures will certainly be dependant on the route and the elements to be formulated for achieving the requirements and the desired evolution of development. Accordingly, the study establishes itself mainly on the European basis. However, the scope is not to investigate or predict neither the European impact nor the response of Turkey within the given context. The overall aim is to present a frame of guidance drawn through examining the routes and elements adopted at the EU level and by the member states, and to learn from their experiences.

Within this perspective the dissertation study adopts a comprehensive approach and seeks to be inclusive so as to recognize various dimensions, views from different angles, and thus from all related sectors. Accordingly, it is aimed at keeping the frame of the study broad due to the fact that not only energy/renewable energy integrated planning but also renewable energy policy is novel in Turkey. In this respect, while focusing on integrating renewable energy and planning at the local scale, integrated approach is taken into consideration with regard to integration of renewable/energy-environmental and spatial policies at the national scale.

1.3. Method

As mentioned before, the objective of the dissertation is to define a process, and it is a qualitative study but which does not seek to prove a hypothesis. However, there exist assumptions and these are the beliefs that an integrated policy approach is needed if the reality of climate change, thus the concept of sustainable development necessitates wide-spread use of renewable energy sources with great amounts through advanced technologies; integration between energy/renewable energy-environmental policies and planning policies is needed not only for promoting renewable energy developments so as to contribute to renewable energy policy but also for providing their compatibility, their being in harmony with the social, environmental and spatial contexts. Moreover, such an approach and integration is required to be adopted in Turkey not only for increasing the utilization of renewable energy but also for preventing possible environmental and social problems that can be encountered in the very near future.

With the purpose of defining a process, the study itself is a process of discovery in which the path to follow evolved in the course of the study even by trials and errors, losing sight with swaying movements, turning back to starting point and formulating new questions, re-reading the texts that re-readings leading new understandings, outcomes and also new questions to find out.

At the initial phase of establishing the frame of the study, the attempt was to identify the relationships between renewable energy technologies and spatial variables, and introducing these relations within the frame of traditional planning approach. However, provided by the readings on experiences it was recognized that such an approach purely based on existing knowledge and experience with more emphasis given to technical aspects rather than the procedural dimension would have fallen short in achieving research objectives, and it might have been even conflicting with the main goal and the assumptions. Eventually, the study turned into a learning process, learning through examining European perspective and experiences of member states, and was directed to understand practices, processes and their consequences, and to understand the main arguments included in the relevant literature about the concepts related to process.

In the organization of the contents of the dissertation, Chapter 2 addresses historical evolution of energy issues and energy-planning relations within the scope of two break points: the energy crises of 70's and the environmental crises of 90's. The periods before and after these crises have different characteristics, and each has its own consequences leading to different meanings and values, and significant changes in the energy sector. There is no doubt that these changes have direct impact on all sectors of our modern society. The characteristics of these periods and the associated concepts are given as background information in order to provide better understanding for recent changes in the energy sector and their relations with urban planning processes. Chapter 2.2 includes introduction of energy integrated planning, which comprise mostly energy conserving or energy efficient urban planning. This approach is the response of planning to the energy problem of 70's and 80's. It aims at planning for an environment with relatively low intrinsic energy requirements by reducing the need to use energy for given purposes, such as transport or heating, and meeting unavoidable energy requirements in efficient ways by obtaining the greatest possible use out of a given primary energy input. The main focus is on energy implications of urban form and different spatial structures. At present, that relationship between energy efficiency and urban form are taken into consideration through compact city and green city concepts within substantive approach of planning for sustainable development.

With the aim of introducing the renewable energy concept comprising renewable energy sources which are naturally occurring and replenishable and the technologies, which convert these site-specific sources into useful energy forms as electrical energy and heat, and for the purpose of understanding characteristics of these sources and the conversion technologies that are essential in terms of social, environmental and spatial implications and for developing appropriate policies and strategies, substantial information on wind and geothermal energy is provided in Chapter 3, and further information related to biomass and solar energy is included in Appendix A.

In relation to this wide range of sources and the conversion systems, chapter 4 of the study addresses the question of renewable energy at first as an urban policy approach through the concept of *integration of renewable energy technologies into cities* (Figure 1.1). In general, the idea behind the concept of integration of renewable energy technologies into cities is regarded as the technological solution for sustainable development, in particular for urban sustainability. Before concentrating on urban dimension of renewable energy, it is aimed at reviewing the prevailing views, paradigms and approaches that explains the emphasis given to technological dimension

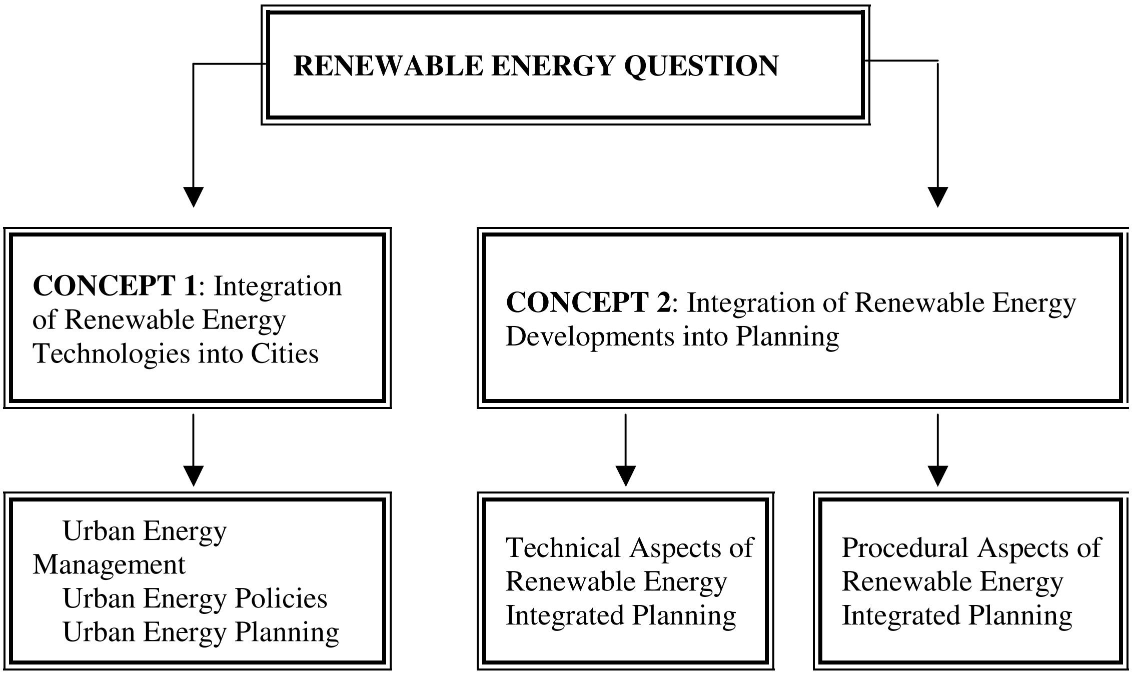

Figure 1.1. Renewable energy question in the study

of renewable energy as a solution to environmental problems. As included in Chapter 4.1, the reviewed approaches are *appropriate technology* and *ecological modernization*, and the *innovation theory* and *green techno-economic paradigm*, and *liberalization* as market paradigm and *market mechanisms* as a solution to environmental problems.

Based on the contributions of Droege (2002), Mega (2002), and Nijkamp and Perrels (1994), chapter 4.2 explains why cities should adopt renewable energy technologies and what are the potentials of cities in order to be able to combat climate change and to improve quality of life in the framework of new technological paradigm. Particular emphasis is given to *urban energy management* and *urban energy planning* and to *urban energy policy* options in terms of how cities can introduce and implement technological innovations at the urban level for achieving urban sustainability.An urban energy planning based on technological innovations can comprise a set of different and complementary energy policy strategies involving industrial cogeneration, DH/CHP systems, PV systems, passive and active solar thermal systems, urban waste management and energy production. As it is defined, renewable energy policy is "the combination of the application of a specific technology, the mixture of the organizational and financial structure and the promotional activities" (Capello et al.1999, p: 47). This definition indicates that the availability of any resource or technology, or the choice of a certain strategy does not automatically mean that this particular option can easily be implemented since successful deployment of new technologies require the existence or development of suitable social and institutional contexts, a technical infrastructure, suitable financial networks, a skill base along with the appropriate pattern of social acceptance. In this respect, focusing on renewable energy dimension of urban energy policy, chapter 4.3 addresses how question through explaining the critical factors that can facilitate or inhibit possible course of action for integrating renewable energy technologies into cities. Any attempt to formulate and implement a renewable energy strategy necessitates identification, assessment and evaluation of critical conditions concerning financial, organizational and social factors, and the techno-economic features of renewable energy technologies.

The concept of *integrating renewable energy developments into planning* refers to planning policy dimension of renewable energy question. Accordingly, it is aimed at investigating the role of planning in that process of integration and the challenges of the developments to planning policies. In this regard, the research is conducted to examine the extent and context of this interdependent integration that has taken place for a decade, and focused on the procedural dimension at a broader scale. The study on defining planning process consists of three phases, and the initial phase comprises the studies of literature survey and a form of content analysis carried out concurrently and proceeded at three levels.

At first, the survey was conducted to the questions of how renewable energy sources and technological developments are addressed in planning literature? and what are the key issues and topic under discussion in planning literature? Undoubtedly, the available planning literature did not provide much about the concept of renewable energy, and to the research objective. Reviewing the contents and citations, and conducting further keyword search, the survey was then expanded to a wider context of literature. That broader frame provided substantial references not only on diverse aspects of renewable energy developments but also on cross/multi-disciplinary characteristics of the concepts, studies and practices in relation to renewable energy and planning interactions. The related literature that constitutes the basis for analyses is outlined in chapter 2.3.

In order to proceed systematically and be able to define a process depending on the gathered and analyzed texts, the design of the study on renewable energy integrated planning process is then adjusted to the frame of grounded theory approach (Table 1.1). Since the focus of the study is on developing a context based, process oriented description and explanation of the European experiences, it fits well with the inductive, contextual and procedural characteristics of grounded theory[1].

Within this frame, the first phase mentioned is the initial category of information formed through reading the texts from literature. Accordingly, it is identified that the main issue of concern are: land requirements and environmental impacts of renewable energy technologies; the visual impact on landscape as a matter of aesthetic and amenity; public attitudes towards renewable energy developments; and the contribution of planning systems to renewable energy policies, including also the challenges to land-use planning.

In order to understand the extent of these identified issues each of them is taken into consideration as a distinct but interdependent concept related to the interaction between renewable energy and planning, hence to renewable energy integrated planning process. Included in chapter 5, the outcomes of the investigation on the concepts, supported by additional literature constitute the basis for the context, or in other words for the question of why integration is necessary and how? One of the key findings is the involvement of public into process, which has also always been the question of planning.

As it is observed in early 1990's, the issue of renewable energy is addressed in terms of the challenges of changes in the energy sector to land use planning. After mid-1990's, considerations on renewable energy are taken place in conjunction with the arguments on the concept of sustainability and sustainable development, and on planning for sustainability. What constitutes the recent agenda is the response of planning system to national renewable energy policies and targets.

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[1] Grounded theory when developed by two academic sociologists Glaser and Strauss in the 1960s, was a reaction to the a priori theoretical orientation in sociology, to the dominance of quantitative research methods in which a theory is formed then an empirical study is carried out to prove the hypothesis. Therefore, grounded theory refers to theory developed inductively from a corpus of data, a theory systematically verified by the collection and analysis of data, and a theory grounded in data from the field especially in the actions, interactions, and social process of people and that is reviewed and revised as necessary at any point in the process. Grounded theory assumes that there is an issue which needs to be researched with a systematic approach to generating new conceptualizations of what is going on in newly emerging areas of study. It tends to be oriented towards practical action rather than the abstract ideas. The research questions are required to be broad, flexible and free enough to explore the issue in depth. Analysis begin at the start of data collection, and analysing and theorising run alongside each other, through a set of steps that is thought to guarantee a good theory as the outcome. It has three basic elements: concepts, categories and propositions. They are formed through the method of coding: open coding, axial coding and selective coding. Categories are higher in level and more abstract than their concpts they represent, and they provide the means by which the theory can be integrated. Concepts are the basic units of analysis, which is conceptualisation of data that theory is developed (Creswell 1998, Pandit 1996 and Borgatti).

Table 1.1. Design of the study on renewable energy integrated planning process

CATEGORY	CONCEPTS	DATA
Environmental, Social and Spatial Context	Land requirements & environmental impacts Landscape aesthetic & visual impact Public attitudes Challenges to land-use decisions Contribution of planning to renewable energy policies	Literature
European Context	Planning in European sense & spatial development policies Trans-national cooperation Regional policies & programmes Renewable energy targets Authorization and permission procedures	ESDP document Papers related to ESDP& Interreg IIC White Paper on renewable energy EU Directive 2001/77/EC Reports of Ener-Iure, Predac and Decent projects
National Context	Aspects of prevailing approaches in planning and energy sector Compatibility with European context Administration and Planning system Institutional framework for renewable energy Renewable energy planning practices	Policy and legislation documents Related papers

Accordingly, planning academics define renewable energy debate as a policy discourse, which is constructed across a complex field comprising environment, planning, economic and rural policy, all underpinned by a discourse of sustainable development (Stevenson and Richardson, 2003), and a policy field which comprise new models of policy process that acknowledge the recursive relationship between policy and action, and in which new institutions, multi-organizational clusters of public and private actors involve in policy and programme implementation (Hull, 1995b). Due to the complex and contested nature, and the involvement of different stakeholders with conflicting views, approaches *of collaborative, communicative, consensus-building, negotiation*, and *deliberative planning* are all commonly appreciated and recommended by all the authors and academics who contribute to the issue of renewable energy policies.

In the course of content analysis in literature, it is noticed that there are considerable differences between countries and even within countries in experiencing the interaction of planning and renewable energy developments, and in the contribution of their planning system to renewable energy policies. With respect to the differences in their governmental structure, in administrative and planning systems, each country has distinct features in terms of how national and local governments and planning authorities approach to the question of renewable energy, how planning authorities introduce renewable energy issues in their planning practices, and how they deal with the tensions and conflicts introduced newly by these unaccustomed developments. Moreover, each country has also different understanding and definition of renewable energy, thus different set of policies, strategies and support mechanisms.

Furthermore, EU policies have significant impact on national policies and practices including both energy and planning sectors. It can be said that to some extent, it is that EU influence which causes tensions and conflicts or successful implementations. It is noticed that planning system is seen as a bottleneck from the viewpoint of energy sector. That approval and permitting procedures are regarded as a major constraint for the development of renewable energy technologies and for achieving generation targets. Accordingly, the British and Dutch experiences have the worst reputation in the literature of energy domain. The common expression used is the contribution of planning system to renewable energy policies, and what is common in planning practice is addressing renewable energy issues within traditional task of promoting orderly development of technologies in existing physical and institutional environment, determining planning applications and plan alterations as approval process.

In regard with these observations and interpretations, it is decided to take a closer look at EU policies, programmes and legislation in order to have a better understanding of their influences on member states, and on the integration of renewable energy and planning policies at EU level. At this second phase, the data gathered and analyzed for the category of European context involves the document of European

Spatial Development Perspective (ESDP), White Paper on Renewable Energy, EU Directive 2001/77/EC, and the reports of Ener-Iure, Predac, and Decent projects.

From the point of planning domain, the documents are read in accordance with the questions of what constitute basis for the integration of policies? At what extent and in which context does the ESDP incorporate renewable energy? What is the level of integration between renewable energy and spatial development policies within Community Initiatives? All the related text and further considerations on the ESDP and Interreg II C are given in chapter 6.1. In brief, it is the spatial development policy approach that comprises European spatial planning based on strategic planning approach, calls for incorporation of policies through European understanding of sustainable development –as an integrative concept, and considers renewable energy as a regional policy.

From a counter perspective, the texts related to energy sector are examined so as to understand at what extent European renewable energy policies and legislation have reference to planning policies and procedures, in which context planning related issues are included in the renewable energy sector, and given in chapter 6.2. With the aim of understanding the recognition of spatial planning as a bottleneck the study on European context is extended through the questions related to the concept of authorization and permitting procedures: What are the main reasons behind the perception that planning is a bottleneck? What is the key issues pertained to authorization and permission procedures cause constraint on renewable energy developments? The analyses in chapter 6.2 and 6.3 elucidate the commonly used expression of planning systems' contribution. The explanation is that the Directive on the promotion of electricity produced from renewable energy sources in the internal market obligates member states to remove barriers in their legislative and regulatory frameworks to increase market penetration, thus to achieve EU quantitative targets. Administrative, planning and permitting procedures are required to be improved to allow national targets be met. Since the choice of method and means to meet obligations is left to member states, the national successes and failures depend vastly on the adopted frames and mechanisms. Therefore, the next stage necessitates understanding national contexts, in terms of interpreting the phenomena of planning systems' contribution to renewable energy in different countries.

In this respect, the third category of the study is based on national contexts and aims at investigating the experiences in different countries, discerning differences and similarities and interpreting the national stories with respect to the concepts of the two other categories. It is intended to understand the distinct features including both efficiency and deficiencies of the national contexts in responding to renewable energy within the structure of energy sector, in integrating renewable energy, environmental and spatial policies, and in planning practices realized within the institutional framework.

As included in chapter 7, Sweden, Denmark, the Netherlands, and the U.K are the selected countries for in-depth analysis. The selection of these countries among other member states depends, to some extent, on the availability of related data especially in the language of English. However, each case has its own unique characteristics, which are valuable in reflecting the dynamics of the interactions, and for explaining the level of integration of renewable energy issues into planning practices, and the context and extent of that integration. Each case is examined through the concepts of; i) special characteristics of approaches in planning and energy, and the influence of the European perspective ii) administrative structure and the planning system, iii) institutional framework for renewable energy developments including the main actors, policies and legislation, iv) the distinctive experiences of planning with and/or for renewable energy especially in the case of wind energy.

The data used for analyses include both academic and practice papers. Most of the papers, reports and the documents of legislation and policy and practice were gathered from online downloadable files through Internet research. Since the use of information technologies, the exchange of experiences and the dissemination of knowledge are among the priorities of EU policies and programmes especially in the field of renewable energy development, not only it is easy to access data but also the quality is valuable.

In the organization of chapters, the Turkish case is also presented within the category of national context though the Turkish context and the aim of the analysis is different than the rest of the cases. In particular, the study on Turkish case draws the framework for discussions and evaluations related to research objective of introducing renewable energy into cities and planning process in Turkish context while the study on Swedish, Danish, Dutch and British cases constitute basis for the objective of defining process.

In Turkey, though there has been a progress in the development of renewable energy technologies in recent years, the concept is yet novel in policy grounds. There is considerable academic research mainly on technical and economic feasibility of technologies. Few examples of contributions and studies done that are connected with the context of this dissertation are: the introduction of *solar city* (1993) and *solar village* concepts, and the thought of *solar consciousness* and *solar civilization* (2000) through a series of publications by Göksu; the articulation emphasizing the role of local governments and efficient use of renewable energy technologies through rational local policies and the suggestion of developing renewable energy technologies within the context of village-town model (*Köy-kent modeli*) by Atagündüz (2001); the recognition of planning practice and legislation as one of the key action fields in the study of national photovoltaic strategy, carried out by Sarıgerme solar based electricity generation working group (2001); and a dissertation by Erbaş (2000) on determination of basic principles and criteria for residential area planning concerning variety in energy supply sources.

The contribution of planning system to renewable energy is not a question since there is no strategic national renewable energy policy. Neither a renewable energy nor an indicative carbon emission reduction target exists. Because the number of schemes are few and developed in small-scale, renewable energy developments are not experienced as yet a challenge to planning. Being now in a transition period, the restructuring process of the country involves major paradigm shifts, radical changes in all sectors. Therefore, in Turkish case given in chapter 7.5, it is attempted to examine the context based on current institutional frames drawn by recent legal arrangements and legislation documents on agenda. In this respect, sectors of planning, energy and environment and the administration are taken into consideration separately, and the policy and legislation documents, which are selected through scanning documents of each sector by keyword and relevancy of content, are analyzed in order to identify the context and extent of energy-renewable energy, renewable energy-environment, energy/renewable energy-planning, and energy/renewable energy-environment-planning relationship included in the documents, thus established in policy grounds, and to evaluate at what extent current legal and institutional arrangements do present a capacity for renewable energy integrated planning (Table 1.2).

In chapter 8 of the dissertation, it is endeavored to fulfill research objectives, mainly the definition of renewable energy integrated planning process. Basing on the outcomes and findings of contextual studies, the process is explained through technical and procedural aspects of planning. Though the focus is on the concept of renewable

Table 1.2. Outline of the study on Turkish case

SCOPE	PURPOSE	DATA
National level	Examining and evaluating the capacity for renewable energy integrated planning	8. Five Year Development Plan National Environmental Action Plan EIA Regulation Air Quality Control Regulation Circular on Air Quality Control EMRA legislation Regulation on energy generation by private developers Draft Law on Renewable Energy Draft Law on Development Law No. 5197, Law No. 5216, and Law No. 5215
Local level (Izmir case)	Examining and evaluating existing practices related to geothermal energy utilization Proposing geothermal energy integrated planning approach	Reports of GEOCEN Articles related to Izmir case and legislation Documents from Geothermal Energy Company Draft Law on Geothermal Energy Interviews
	Examining and evaluating existing practices related to wind energy developments Proposing wind energy integrated planning approach	EMRA announcements Studies done previously on Alaçatı wind farm Plan reports of Germiyan, Mazı, and Datça wind farm projects Interviews

energy, this study emphasizes the concept be considered within a wider frame of energy integrated planning, thus of the energy concept (Figure 1.2).

In order to translate renewable energy concept into operational terms and issues for planning, it is categorized into two with respect to type of utilization: The use of renewable energy for the purpose of electricity generation, and the utilization of renewable energy for heat generation or space conditioning. In relation to this classification and considering the characteristics of sources and utilization technologies,

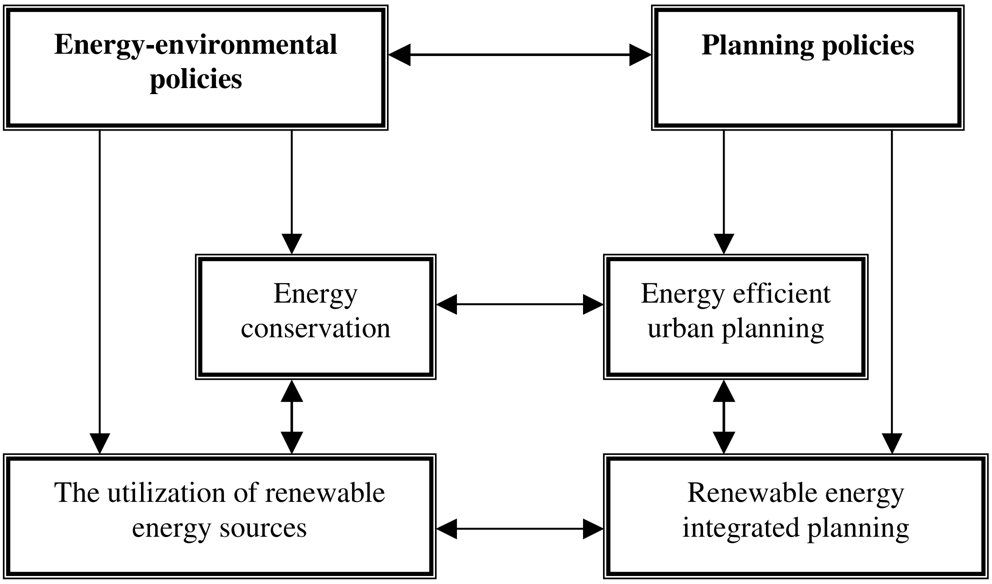

Figure 1.2. Illustration of energy integrated planning

the expressions used are: planning with renewable energy, and planning for renewable energy utilization. These suggested expressions also explain the relationship between sectors of energy and planning or the capacity for incorporation. In this respect, while planning with renewable energy comprises considering land requirements, locational aspects and site selection, and the compatibility with other land uses and designated areas, it can refer to high level sectoral decision to be conformed to or trade-off between national and local interest where the energy sector is highly centralized and also driven by market mechanisms. On the other side, planning for the use of renewable energy is suggested mainly to deal with compatibility of urban structure and (heat) supply systems which also corresponds to the concept of integrating renewable energy into cities, thus to urban energy policy approach. In the case of semi-to-decentralized systems the practice can embrace both planning for and with renewable energy. The technical aspects of planning process are explained through data required, site selection and energy density/energy demand in chapter 8.1.

As procedural aspects explained in chapter 8.2, the key factors associated not only with renewable energy integrated planning but also with successful, environmentally economically and socially sound renewable energy developments are: an integrative strategic framework comprising energy/renewable energy-environment-spatial development policies at the national level; formulation and implementation of this framework through a collaborative work, coordination and cooperation both vertically and horizontally in which all policies, policy instruments and actions are to be coordinated and be conveyed at the same direction through mutual trust and shared views covered by common frames of reference. These procedural aspects, in other words the institutional framework is explained through the influence of the institutional aspects of energy sector comprising ownership, organization and regulation, and the influence of institutional aspects of administration and planning system.

Accordingly, given in chapter 8.3, evaluation of Turkish context results in that recent legal arrangements related to administration and the considerations related to planning approach and system provide a reasonable capacity for integrating renewable energy technologies into cities. However, renewable energy is merely a concern of electricity generation in energy market aiming liberalization; a concern of energy efficiency in environment sector that energy efficiency is mostly corresponded to control of heat loss and heat gain in buildings by heat insulation regulation and promoting district heating systems based extensively on natural gas; and energy efficiency and environmental issues are not concerned in energy sector. In short, the context examined in the dissertation does not support a capacity neither for renewable energy integrated planning nor for promoting the utilization of renewable energy; especially environmentally and socially sound manner.

Following the attempt of defining renewable energy integrated planning process comprising procedural and technical aspects and evaluating the capacity in Turkey, further study carried out in relation to Turkish context involves the attempt of defining renewable energy integrated planning approach in the cases of geothermal energy developments and wind energy potentials of Izmir. Adopting a bottom-up perspective and focusing on local scale, and examining current developments and planning practices it is aimed at clarifying why renewable energy integrated planning is required and how this suggested approach can become operational.

Considering the characteristics of geothermal sources and exploration and exploitation activities given in chapter 3.4 and in sub-titles of chapter 9.1, the case of geothermal energy is addressed as a special designated area and its utilization for heating purposes as heat supply urban infrastructure. The proposal of geothermal energy integrated planning within a frame of process and comprising the approaches of planning with geothermal sources/fields and planning for their utilization by district heating systems, is based on the study of identifying existing problems through examining and evaluating Balçova-Narlıdere geothermal field and Balçova-Narlıdere geothermal district heating developments by the use of data involving the reports of GEOCEN, the articles about Balçova-Narlıdere geothermal district heating system, the documents taken from Geothermal Energy Company, the documents of legislation and the related articles, and notes of interviews with the agent from Izmir Provincial Authority and the urban planners in municipalities. Besides suggesting a planning approach, this dissertation recommends an adoption of urban energy management scheme, institutionalization of local energy planning at the provincial level and heat supply planning at municipal level so as to increase energy efficiency, provide rational use of local resources and improve quality of life and air quality in respect of local sustainable development. Regarding geothermal energy developments as a local initiative of Izmir, the study proposes geothermal energy utilization be addressed within a wider frame of developing district heating systems supplied by local, renewable energy sources objective.

In the case of wind energy, included in 9.2, the initial concern is investigating the source and development potentials in Izmir in connection to recent profile of wind energy sector; social, environmental and design aspects of Alaçatı wind farm; and planning and building permission procedures applied to wind farm projects. In the following emphasizing likely problems, the proposal of wind energy integrated planning approach is build upon the evaluation of conveyed studies by considering the contexts given in chapter 5, chapter 6.2.3 and 6.3, and chapter 7. Analyzing the EMRA announcements, and considering EMRA legislation and Draft Law on Renewable Energy, it is identified that the tendency is towards medium to large scale wind energy developments, which are mainly driven by energy market principles, the decision-making process is top-down due to national interest of electricity generation and exclusive because of highly centralized structure of energy sector, though aiming at transparency, the process is quite unclear and the developers are rather secretive. In accordance with these findings and due to Piecemeal Development Plan practices together with the absence of knowledge and specific measures for assessing proposed plans and plan alterations, this study maintains that wind energy be questionable in the condition of unregulated developments.

As it is apparent, each stages of this dissertation study, and each title and sub-title of the stages embrace several distinct outcomes and findings in relation to research objectives. In the organization of the contents and in writing the text, it is intended to be rather informative since the context is novel, and multi/interdisciplinary. Moreover, the aim of presenting the knowledge gathered in detail and also with the use of quotations is to elucidate the scope of the researcher because the study as a whole is moderately interpretive and be open for further explanations and arguments that can be done by readers in their own assessments of the contexts and concepts.

On the other hand, the writing of study fails in making connection explicit and in reducing confusion between lines in the overall composition. This failure is conditional on the use of limited time and the use of language. Due to the method of study, most of the time was consumed during collecting, analyzing and interpreting the mass of data related to the study on defining the process. The collection of the relevant data for evaluating the Turkish context was also problematic; most of the (Draft) Laws and Regulations were issued lately in six months ago. During the period of the study, the proposal of Draft Law on Development replaced with a new one, completely different than the former one. In that case, this dynamism in the transformation period of Turkey necessitated updating data regularly, which caused significant changes and delays in the writing of texts. The problem in the use of language is about falling short in combining various terminologies coherently, in translating different languages of diverse sectors, disciplines and fields, and different languages of policy and practice in each sector and discipline into a single language of the study.

However, it is believed in that this dissertation be a substantial reference for planners, local and other governmental authorities, and for the engineers and the developers who seeks being sensitive about social, environmental and spatial implications of technological developments.

Though its weaknesses mentioned above, this dissertation is valuable in terms of its comprehensiveness and inclusiveness in addressing renewable energy question and in integrating this question into planning. It is assumed that the study will provide a significant contribution to Turkish planning literature, education and practice, and will be a reference point for further discussions and arguments and for new research studies. Finally, the originality of this dissertation study, relying on its context, is its attempt of defining and introducing renewable energy integrated planning as a process, and its attempt of addressing geothermal and wind energy developments as a problem of planning.

CHAPTER 2

CONTEXTUAL and CONCEPTUAL BACKGROUND

2.1. Changes in the Energy Sector

In the context of this research the history of energy sector is addressed under two break points: the energy crises of 70's and the environmental crises of 90's. The periods before and after these crises have different characteristics, and each has its own consequences leading to different meanings and values, and significant changes in the sector. There is no doubt that these changes have direct impact on all sectors of our modern society.

Therefore, the aim of this chapter is to present a background information in order to provide better understanding for today's features of energy issues and their relations with urban planning processes.

2.1.1. Energy Economy and Urbanization: From Industrial Revolution Till 1980's

Control over the energy sources and energy transitions from the use of dispersed organic sources through wind and water power to large scale exploitation of fossil fuels can easily be linked with major shifts in the history of human civilization. The beginning of modern phase of human history with the Industrial Revolution can be linked with the introduction of new sources of energy. Consequently, the use of fossil fuels can be regarded as the second great transition in human history after the advent of farming.

It was that coal mining areas that had become the sites for industrial cities. It was that steam engine –at first powered by wood and then stoked with coal- which had given humans significant amounts of portable, controllable mechanical energy for the first time, and the powered locomotives and ships had constituted the real force behind the growth of cities of capitalism and colonialism.

Then, the use of oil, the development of internal combustion engine, and the discovery and use of electricity expanded the available supply of energy making possible the heat, transport machines and the communication systems which support modern civilization. It was that fossil machine age, as an outgrowth of earlier stages of the Industrial revolution and then advanced by the industrial application of available energy supply had given rise to the mechanization of manufacturing, inspired by the Frederick Winslow Taylor's and Henry Ford's ideas.

Energy had become a *permitting factor* (Owens 1986) in the process of urbanization and exerted an intense influence on the location and direction of urban development during the twentieth century. Transport technologies and energy supply networks increased personal mobility and provided urban growth and sprawl at decreasing densities.

Till 1970's, the built environment had gradually responded to both the steadily increasing energy availability and the economic growth of 1950's and 1960's in an energy intensive manner. As well, the decades following the Second World War were the period of reconstruction and development within which countries found themselves able to take advantages of the large quantities of cheap oil available.

However, those tremendous times of world turned into turmoil when the price of oil quadrupled virtually overnight in 1973. That rise in oil prices in 1973/74 and 1979 had triggered economic recession since high growth had led to higher costs for raw materials including oil, and the oil importing countries were the biggest sufferers (Eden and Bending 1989).

In that circumstances the availability of energy at a reasonable price, in other words, the cost and security of supply gained importance, and nations began to implement policies aimed at reducing dependence on oil imports and their vulnerability with respect to excessively fluctuating energy prices through conservation and the development of alternative sources in order to deal with the energy problem and to ensure economic growth.

Before 1970's energy planning was equal to energy supply planning which was based on continuing high growth in demand and sought to solve the energy problem by producing more energy to meet the requirements. However, after the crises and due to the slower economic growth *energy policy* [2]had gained importance in the industrialized

[2] *Energy policy,* as defined by the World Energy Council (WEC), in the dictionary published at the Madrid Congress in Sep. 1992, is: "That part of national (or international) policy that is concerned

world and there had been a shift of emphasis from energy supply to energy demand considerations. Consequently, the concept of *energy conservation*[3] was introduced, and all possible means of reducing energy consumption[4] were put into agenda in all sectors. That was the occasion for including energy considerations in urban planning studies and practices for the first time.

However, in the mid-1980's world fossil fuel prices were fallen sharply and the energy situation was moved "from scarcity to glut" (Owens 1990, p. 54), and "…something like a counter oil shock" (Sfligiotti 1997, p. 34) was taken place. In that case, the attention given to the energy problem, at least in its security and cost aspects had begun to diminish.

On the other side, the scene of the world economy in 1980's was the slower economic growth through saturation and maturation. With respect to that Eden and Bending describe the prospect of energy demand of that period as below:

> Heavy industries were declining and service sectors were growing, household demand for energy was leveling off, and transport demand was growing more slowly. Saturation effects, structural and technological changes all combined to reduce national energy intensities. The resulting lower growth in energy demand meant that natural gas was more readily available to replace oil for domestic and industrial use…. Lower growth in electricity demand… led to a sharp fall in the use of oil for electricity production. (p.16)

That was a fall only in the energy market however fossil fuel dependency of world economy and society had continued and seems to be continued. Due to that fossil fuel dependency, Peter Droege (2002) refers to all contemporary urban constructs as fossil cities, with the expressions that the new cities of the 19th and 20th century were "a

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with the production and supply of energy, its conversion, storage, distribution and utilization and with the formulation of measures aimed at equating anticipated overall demand for energy with the presumed availability nationally and internationally of sources of energy; such a policy would take account of the potential for energy conservation, in particular of finite fuel resources as well as of the environmental impact" (cited in Kleinpeter 1995, p: 6)

[3] *Energy conservation,* as defined by the WEC, is: "the policy embodying the actions taken to ensure the most efficacious use of finite energy resources. Examples of such actions are energy savings, rational energy use, substitution of one energy form by another, e.g. fossil fuel by renewables.

The term 'energy conservation' is mainly used at a national or macro-economic level. At the micro-economic level the term 'energy management' is preferred. Energy conservation is mainly linked with rational energy use. This is the utilisation of energy by consumers in a manner best suited to the realisation economic objectives, taking into account social, political, financial, environmental and other constraints. The concept of rational energy use includes not only the notion of energy efficiency as the ratio between final energy and useful energy at the user's level but also the important aspect of managing the national energy resources, reducing the dependency from energy imports (Kleinpeter 1995, p. 34)

[4] It is given as a result of implemented policies the amount of energy used to produce one unit of gross domestic product (GDP), as being an indicator for energy intensity, fell by approximately 20 per cent between 1973 and 1985 (Nijkamp and Perrels 1994, p. 16)

product of the rising combustion economy" (p. 90) and the rapid expansion of cities was "a direct outcome of the fossil fuel economy" (p. 87). As he considers Brasilia, Canberra and all of the British New Towns are fossil fantasies come true; Greater London strategy, the satellite city concepts, Copenhagen finger plans were all driven by the rise of the fossil fuel economy and its promises; the great modern design movements Italian futurism, constructivism in the early Soviet Union, De Stijl in the Netherlands, the Bauhaus in Germany, declarations of the International Modern Architectural Congresses, and the American style were all admiring the fossil fuel powered industrial transformations that underpinned broad urban structure changes via high-energy intensive technologies. Finally, he argues that as a result of the razing of pre-fossil cities through radical modernization buildings became disconnected from their climate and cultural context due to the end of local resource dependency.

2.1.2. Environmental Concerns, Global Concepts: After Mid-1980's

After mid-1980's when the economic anxiety diminished, the rationale for energy conservation has become dominated by growing concern on environmental externalities associated with energy production, processing and end use, in other words on alarming manifestations of environmental degradation; air pollution, acid rain, deforestation, radioactive waste, the greenhouse effect of increasing concentrations of carbon dioxide in the atmosphere. The fear from risks associated with energy systems has become more apparent and increased after the Chernobyl accident occurred in the spring of 1986.

However, the biggest challenge of the 1990's and the major subject of Earth Summit held in Rio de Janerio has been the question of *climate change*[5]. Since 1990, the problem of global warming and its prediction has been the subject of Scientific Assessment Reports by Intergovernmental Panel on Climate Change (IPCC). Although there is still considerable uncertainty about the degree of warming, its timing and the geographical extent of the consequences of drought, flooding, and other climatic hazards, the predictions and observations give a collective picture of the global

[5] Climate change in IPCC usage refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the Framework Convention on Climate Change, where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere (IPCC 2001).

warming[6]. Accordingly, signed at the Rio Conference and entered into force in 1994, the climate change issue was given prominence by the UNFCCC.

FCCC is the primary international mechanism for encouraging use of sustainable solutions to the climate change, placing a particular responsibility on developed countries to adopt policies and measures designed to mitigate climate change by limiting emissions of greenhouse gases (GHG). It has no legally binding commitments, but outlines the principles, aims and institutional procedures. After the World Climate Conference held in Berlin in 1995, the first legally binding commitment was realized with the adoption of the KP in 1997, under which industrial countries (North America, Europe, Japan, Australia and new Zealand –Annex I nations in the FCCC) will reduce their combined emissions of greenhouse gases by 5,2 % of 1990 by the period 2008-2012 (Byrne et al. 2001, Reddy et al. 1997).

The six gases defined as greenhouse gases for the purpose of the KP are: CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's) and sulphur hexofluoride (SF_6). In order to reach the targets, a set of market-based policy instruments has been created in which emissions can be reduced at lowest cost through newly created markets for GHG emissions trading and other innovative policy initiatives, such as the use of renewable sources of energy. The general belief is that if properly designed, the global policy of the new market can constitute the atmosphere as a well-managed environmental property sustained in the interest of present and future generations, an idea broadly consisted with environment-development arguments promoted by the Brundtland Commission (Byrne et al. 2001).

In Our Common Future/Brundtland Report of the World Commission on Environment and Development (WCED 1987) efficient use of energy is encouraged through the expression of "a low energy path is the best way towards a sustainable future" (cited in Reddy et al. 1997). However, the Commission also recognizes the importance of renewable energy sources in its report: (cited in IEA 1998)

[6] Global average surface temperature is predicted to increase by 1.4° – 5.8° C during 21st century. Warming will be greater in Northern America and northern/central Asia. Average sea level will rise globally by 0.09 to 0.88 meters between 1990-2100. During 20th century it rose between 0.10-0.20 meters primarily due to thermal expansion and melting from glaciers and ice caps. The intermediate effects of ice melts are loss of biodiversity in Polar and Sub-Polar ecosystems and the flooding of coastal areas.

> The need for a steady transition to a broader and more sustainable mix of energy sources is beginning to be accepted. Renewable energy sources can contribute substantially to this... The Commission believes that every effort should be made to develop the potential for renewable energy, which should form the foundation of the global energy structure for the 21st century.

Moreover Agenda 21, produced at the Rio Summit in 1992 as a blue print for how the world's nations can work individually and collectively towards sustainable development, recognizes that present energy course is unsustainable. Chapter Nine of Agenda 21, "Protection of the Atmosphere" includes (cited in Reddy et al. 1997):

> Energy is essential to economic and social development and improved quality of life. Much of the world's energy, however, is currently produced and consumed in ways that could not be sustained if technology were to remain constant and if overall quantities were to increase substantially. The need to control atmospheric emissions of greenhouse and other gases and substances will increasingly need to be based on efficiency in energy production, transmission, distribution and consumption, and on growing reliance on environmentally sound energy systems, particularly new and renewable sources of energy.

While local authorities were called on to draw up Local Agenda 21's to promote sustainable development at the local level, Agenda 21 recommended a series of concrete actions to promote sustainable energy.

In the Habitat II Conference on Human Settlements, held in Istanbul, Turkey in June 1996, energy was described as integral to sustainable development issues, especially in relation to the human habitat and urban environment. Building on the topic of housing and shelter for the urban people living in poverty, energy was addressed not only as an input necessary for development, but also as a social issue impacting living conditions, human health, personal security and the quality of shelter. In Chapter IV of the Habitat Agenda, which provides detailed recommendations, it is asserted that:

> Current dependence in most urban centres on non-renewable energy sources can lead to climate change, air pollution and consequent environmental and human health problems, and may represent a serious threat to sustainable development. Sustainable energy production and use can be enhanced by encouraging energy efficiency, by such means as pricing policies, fuel switching, alternative energy, mass transit and public awareness. Human settlements and energy policies should be actively co-ordinated.

Accordingly attention was drawn to the need for all sectors of society, both public and private, to take coordinated action with regard to facilitating the conditions to bring about sustainable patterns of energy production and use.

Besides global warming and climate change, another threatening factor is the depletion of fossil fuels. It is scientifically recognized that reserves of oil, natural gas, coal and uranium supplies will expire well before 2100. In other words, their stocks are finite and are diminishing because of the use by human activities. Their depletion is, therefore, another reason, which necessitates reduction in energy consumption, rational use of energy sources and the use of renewable energy technologies. In accordance with the WCED definition[7] of sustainable development, the protection and prudent management of natural sources, and the minimal use of non-renewable sources are also among the basic characteristics of sustainability to be attained by the development process.

As a result, from the beginning of 1990's, environmental concerns received political attention and have turned into international and national policies. Due to the risks associated with energy production and consumption, closer integration between environmental and energy policies have been provided. Under the influence of both global and local energy-environment threats, and as a response to global agreements, international commitments, regional policies and local initiatives a great diversity of action plans have been implemented by national and local governments, energy producers, industries, and consumers, in a way using the notions of sustainability and sustainable development as an over-arching concept.

2.1.3. Structural Changes and Trend Towards Renewable Energy Economy

Since late 1980's driven by the new technologies for information processing and control, a new phase of structural change has been in progress. The globalization of international finance and investment, and the restructuring of multinational companies have all accelerated that change (Eden and Bending 1989), and the economies in the world have become much more competitive and thus more cost sensitive (Nijkamp and Perrels 1994).

In relation, cities and city-regions have gained importance as centers of capital and information, and consequently they have begun to experience a process of economic restructuring, accompanied by technological transformations, socio-demographic changes together with spatial adjustments. In that ongoing competition most cities exhibit drastic change patterns varying from rapid decline to rapid growth,

[7] "Sustainable development is a development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs".

or change in the degree of specialization in the economic system. Meanwhile 'the quality of life' and 'environmental quality' issues, having great impact on the prosperity of cities and regions, have begun to receive more attention. Accordingly, in the process of restructuring governments have been trying to find "a new development pace which is economically viable without eroding the environmental amenities that make up the foundation stones of social economic progress now and in the future" (Nijkamp and Perrels 1994, p. 6). As it is suggested "a good quality of life is often an important locational motive for new entrepreneurs… favorable environmental quality is a explicit locational criteria for quite a few advanced technologies" (p. 27). Moreover, it has been widely recognized that improving environmental quality and quality of life is very much dependent on the improvements in energy production and consumption, in terms of energy efficiency and the use of clean energy resources.

As mentioned in the previous sub-title, since mid 1980's the trends towards a service-oriented society, or in other words, de-industrialization process has provided less energy intensive production methods, and therefore increase in energy efficiency. However, globalization as a complex set of global economic, communications and cultural changes, and the 'informationalization of economy' (Hall 1997) is very much driven by the profoundly fossil energy mode the world operates in (Droege 2002). At present, 'information' is the central 'raw material' for the informational industries. The accessibility of this raw material is provided by the advanced technologies of electronics, and this process is the real marriage of electricity and information (Hall 1997). All information systems, and telecommunication systems, for instance the Internet –a vital global and largely urban network of networks- relies fundamentally on fossil fuel operated hardware, conduit-based webs, and wireless communication systems (Droege 2002). As a result, the globalized urban systems with their infrastructure networks are inherently vulnerable to the fact of fuel depletion. This is an important factor, which motivates innovations in the field of clean-alternative energy supplies incorporated with modern cities operating on a highly competitive market.

In conjunction with competitive economies, the energy sector has also exhibited dramatic shifts with the changes in the global political climate. Especially in Europe with the move towards the completion of internal market, the emerging trends are deregulation, decentralization, diversification and market orientation (Nijkamp and Perrels 1994, p. 16):

Deregulation: the removal of unnecessary administrative, institutional and bureaucratic barriers.

Decentralization: devolution of the responsibility for energy policy (and production) from centralized energy agencies towards decentralized agencies at local and regional levels.

Diversification: transition from a single resource orientation towards a multiple resource orientation.

Market orientation: tendency to be more competitive on the basis of market signals and prices.

Since the effectiveness and feasibility of any policy depends mostly on the institutional setting in which the systems operates, the institutional aspects of energy sector has also gained importance.

In terms of ownership, organization and regulation, the structure of energy production, supply and distribution shows a considerable variety among European countries. Ownership structures range from entirely publicly owned energy systems to those privately owned utilities dominate the system. Depending on the specific fuel source and the political structures, organizational configurations range from nationalization/centralization to privatization/decentralization. There is a tendency to separate electricity production from distribution in order to gain economies of scale in production as well as to reorganize distribution at the regional or local level aiming at increasing competition in production and a consumer orientation among distribution companies. With the trend towards a stronger market orientation, and deregulation and privatization, seeking to use market mechanism as a competitive tool for increasing efficiency, public-private partnership as new organizational forms for local energy provisions and distribution are becoming increasingly popular (Nijkamp and Perrels 1994).

There is interdependency between the changes in the energy sector and the development and utilization of renewable energy technologies. The emphasis given to clean and alternative energy sources is stimulating the given organizational configurations, and the trends towards decentralization, deregulation and diversification are encouraging extensive exploitation of local and alternative energy sources, and further technological innovations.

Since the future world could not be powered entirely by fossil fuels due to the reasons of both environmental threats and the limited availability of sources, the trend towards de-carbonized, renewable energy economy, assisted with the information technology would inevitably shape the image of cities, the landscapes of rural areas, patterns of land uses and organization of spatial structures.

2.2. Energy Integrated Urban Planning

With increasing emphasis on energy issues and especially on energy conservation policies of the period of energy crises, a considerable amount of academic research on energy, spatial structure and planning has been carried out. A degree of consensus about the characteristics of energy efficient urban form and the policy implications of the theoretical work has been emerged. Many planners have recognized the potential contribution of land-use planning to energy conservation, and positive steps have been taken to translate theory into policy and practice, and thus to integrate energy dimension into land-use planning process. Davis, California and Portland, Oregon in USA, Aarhus in Denmark, Stockholm in Sweden, and Milton Keynes, Newcastle upon Tyne in the UK are among the best known examples of energy integrated planning.

Until early 1990's the terms *energy efficient*, *energy conscious*, and *energy conserving* have become common expressions used for to indicate spatial structures, urban forms, and planning and design approaches to provide rational use of energy, and to control the possible spatial implications of changes in the energy system.

Below sub-titles include the review of theoretical work and their findings, and Susan Owens' contribution to energy integrated planning in literature.

2.2.1. Theoretical Studies on Energy and Spatial Structure Relations

An early plea for an active role of urban planning in energy policy was made by Odell in 1975. The below paragraph from Odell's article *Settlement and Energy* (cited in Lundqvist et al. 1989, p. 2) points to the essence of modifying energy intensive settlement parts as an integral part of energy policies:

> …the required changes in both the transport and the electricity/heat systems in our settlements pose a set of problems that will confront architect, city planners, administrators, urban and regional economists, etc. they have to restructure the patterns and forms of settlements so that the alternative, more energy conservationist systems can not only be made to work, but also, be acceptable to the citizens of societies all over the world with their continuing expectations of rising living standards.

According to Owens (1986) energy efficiency in the built environment can be achieved in two ways. One is to plan for an environment with relatively low intrinsic energy requirements by reducing the need to use energy for given purposes, such as transport or heating. The other is to meet unavoidable energy requirements in efficient ways by obtaining the greatest possible use out of a given primary energy input. Those two distinct aspects constitute a convenient point for an analytical framework in considering the energy-spatial structure relationships. After establishing the framework, the spatial variables can then be related to energy needs and energy efficiency at various scales of development, and between place and within place energy consumption. In that regard, Owens categorizes the number of different theoretical approaches in exploring the energy-spatial structure interactions in five broad study areas:

- The studies on the response of spatial structure to energy constraints,
- The empirical comparison of energy consumption in different geographical areas and energy implications of different spatial structures,
- The studies of estimating the energy requirements associated with alternative hypothetical spatial pattern and evaluating the alternatives in terms of energy efficiency,
- To identify the spatial requirements of energy saving measures, energy supply or the harnessing of renewable energy sources,
- The combination and extension of the above methodologies into normative planning and evaluation of specific ideas.

The questions of those research subjects are: how might urban form respond to future energy constraints? What are the characteristics of energy efficient form at different scales? What is the relationship between spatial structure and systems of energy supply, distribution and demand? and How could energy considerations be integrated into the spatial planning process? The first three include the theoretical issues but the forth refers to development of energy integrated planning. Apart from these, further studies comprise urban energy planning or in other words, urban energy modeling, including district heating planning in which most of the contributions are from Scandinavian countries.

Response of Spatial Structure to Energy Constraints: Energy constraints are defined as: a) the price of fuel, b) physical availability, and c) the source of energy, supply and its distribution system. Each constraint has very different implications for spatial structure, and much research in that study area involves the use of urban models.

Main assumption is that the urban structure would respond by becoming more energy efficient if energy was to become scarce and experience in the medium to long term (Owens 1989).

The study of Beaumont and Keys in 1982, including adaptations of the Lowry model with energy costs represented in the deterrent effect of distance/cost parameter, results in reduction of both the total amount of travel and the separation of different activities in the urban system.

Romanos (1978) and Dendrinos (1979) use urban equilibrium models based on utility analysis of the residential location decisions with energy costs included in the transport budget. The result of the model with higher energy prices is a closer juxtaposition of residential areas and employment centers (Owens 1989, 1990). In the models of Romanos and Dendrinos, it is assumed that "the residential location decision by households is the result of a trade-off between accessibility and space or amenity, the former decreasing and the latter increasing with distance from the center employment and service facilities are assumed to be concentrated" (Owens 1986, p. 19). In relation to that an increase in energy costs in those models results in greater centralization. Moreover, residential space heating requirements are assumed to increase with distance from the center due to the dwelling densities. Additionally, instead of a single, compact, centralized urban area, building the sub-urbanization of employment centers into his analysis, Romanos model predicts a pattern of decentralized concentration as the emerging equilibrium in a situation of energy constraints.

Another approach is the application of dynamical systems theory to the location of shopping centers. In the model, it is assumed that "a simple geometric model of an urban area combined with a standard spatial interactive shopping model would predict that energy constraints might lead to decentralization of retail facilities in terms of size and location" (Owens 1986, p. 19), "return to the corner shop from the supermarket" (Owens 1990, p. 61)

All these models, that their results are depended on the assumptions of the models that they are based, suggest that if physical separation of facilities increased in the absence of energy constraints, it will decrease again if energy becomes more scarce and expensive. Moreover, energy constraints might reinforce the phenomenon of counter-urbanization in terms of flow of people and jobs out of the metropolitan areas not into suburbs but into small and medium-sized towns, smaller communities of peripheral and rural regions.

On the other hand, Owens criticizes the tendency of modelers to assume aspects of individual behavior are elastic with respect to energy constraints. Accordingly, she emphasizes that an effective analysis of possible spatial consequences of energy constraints would build upon an understanding of both the causal factors behind spatial change and the social response to changes in energy availability (Owens 1986, 1987).

Since energy is a commodity purchased by individuals and institutions, there are many ways in which people respond to increasing energy prices or fuel scarcity, and some of which do not have obvious spatial implication. For example, if the demand is inelastic –if the energy consumed in the journey to work is indispensable- consumption of some other commodity may be given up, or if the demand is elastic, a switch to a more efficient car may reduce it. In accordance with that, surveys conducted after the oil crises in the USA have given some evidence that "fear of periodic non-availability of energy for journey to work might encourage relocation to a greater extent than would fuel price increases" (Owens 1986, p. 14). The situation for space heating is much more complex than for travel in terms of the ways in which people adjust to increases in the price of fuel for space heating since they may prefer changing fuel type, tolerating lower temperatures or eliminating wastes.

In brief, in short to medium term people can respond to energy constraints in different ways, which can result in less energy consumption, but the impacts on spatial structure can occur on the longer term. Accordingly, while examining the use of models in spatial responses to energy constraints, Owens concludes that "predicting the spatial impact of energy constraints using urban models is a hazardous business" (1989, p. 233).

Energy Implications of Different Spatial Structures: When the efficient use of energy sources became a legitimate concern through energy conservation policies of energy crises period, the research in the field of land use planning was focused on defining energy efficient spatial structure at different scales of development. The studies described in the above sub-title had provided some insight into energy efficient characteristics. Following research had included the empirical comparisons of energy consumption in different geographical areas. Conclusions about the energy implications of different forms were drawn by correlating patterns of energy use with structural variables. However, there had been a problem of defining and quantifying the various dimensions of existing forms since existing state of urban structures was a product of a long process of evolution. Additionally, there had been considerable variation in energy demand patterns due to climate, socio-economic and many other factors tends to obscure any variation which might be attributed to spatial structure, and moreover, empirical work had mainly been concerned with transport energy requirements which was rather inconclusive.

Energy Requirements of Alternative Hypothetical Spatial Patterns: The third approach, which includes the evaluation of alternative hypothetical spatial patterns, has most commonly been employed. Those studies of alternatives being investigated in laboratory conditions with variables have been more advantageous than the empirical work. To model alternative hypothetical structures incorporating energy assumption parameters and to compare the results in order to identify which characteristics of urban structure encourage energy efficiency, conducted studies are ranging from entirely abstract to alternatives developments patterns for existing geographical areas. The models used to explore energy-spatial structure relationship at the urban scale are simple linear programme and gravity models, adaptations of Lowry-type models and integrated land-use/transportation models. Again, much emphasis is given on transport energy requirements.

The model developed by de la Barra and Rickaby is based on a random utility formulation and provides a comparative cost-benefit analysis in transport and in domestic space heating, against land rents, multi-model transport costs and general accessibility. This study, which is widely known in the literature, compares six settlement patterns by means of the TRAUNUS, involving three component sub-models: a land-use model (locates residential population and service employment in each zone and predicts both the rents/land prices and the daily flows of people), transport model (calculates the cost of trips between each part of zones), and an evaluation model (Rickaby 1987, Rickaby and de la Barra 1989).

In that study, the base case development pattern was developed from the studies of the spatial distribution of developed land and of the shape of development statistics were combined to produce an archetypical city regional configuration and an associated fifty-two zones distribution of population, employment and services. The modifications of the existing configuration were all based on published speculations about the ways in which settlement patterns might be altered in order to save fuel in buildings services, transport, or both (Rickaby and de la Barra 1989). This research suggests that though a compact city may well use less fuel than a more dispersed settlement, the most fuel efficient arrangement for a high mobility society may be to surround existing cities with clusters of smaller, economically interdependent sub-centers, such as that proposed by Ebenezer Howard.

At the urban and intra-urban scale the emphasis is given to reduce energy needs for transport. It is suggested that reduction in energy use can be achieved by arranging land uses so that there is less need to travel or organizing land-use patterns so that most conducive to public and non-motorized transport.

On the other hand, the structural variables used in many studies on energy efficient systems are: the size, the shape of the settlement, density, and interspersion of land uses. Regarding *urban size* as a structural variable, it is given that identifying an ideal urban size for energy efficiency is not possible. The relationship with size can be either negative or positive. However, the range of facilities offered in any particular settlement, the deterrent effect of distance, levels of car ownership, availability of public transport are all influential factors in the relationship between size and energy consumption.

Shape is an elusive concept and usually defined in terms of transport network, embodying a large variety of assumption and criteria for evaluation. Theoretically, there is a general consensus that circular settlements are inefficient in terms of transport and energy requirements, and linear or rectangular forms are advantageous (Owens 1986, 1987).

Among structural variables *density* has received much attention in. Theoretical studies have supported the negative correlation between urban density and transport energy consumption. Keyes, by reviewing a number of studies and making a cross-sectional analyses of different existing geographical areas has pointed to the influence of the physical separation of activities reduced by high densities or encouraged by low densities as an important factor in energy consumption (Owens 1986, 1990). However, Owens emphasize that “it is not the case that energy efficiency can be achieved only with very high densities, nor should high density be confused with high-rise development” (1986, p. 32).

On the other hand, the question of density-urban form-energy relationship has turned into a debate in the pages of Journal of American Planning Association. That debate includes the study of Newman and Kenworthy (1989) on gasoline consumption in cities, and Gordon and Richardon’s reply to their study. Newman and Kenworthy, analysing a range of data collected for thirty-two cities around the world, including ten in the USA, concludes that the physical characteristics of cities such as population density, job density and the dominance of city center is the most important and single determinant of energy consumption. Accordingly, they suggest physical planning policies particularly re-urbanization and reorientation of transportation policies as a means of reducing gasoline consumption and automobile dependence. On the contrary by criticizing this planning approach and the validity of the empirical study, Gordon and Richardson (1989) suggest that the price system (pricing, regulation and taxation) is the only way to determine energy efficient structures.

Interspersion of activities as a structural variable indicates to reduce physical separation of activities through decentralizing jobs and services and relating them to residential areas. Comparative analysis of alternative urban forms and incremental development patterns have all found decentralization of employment and service opportunities to be relatively efficient in terms of travel and energy requirements.

Estimated actual energy savings that can be provided by energy efficient structures are as follows. In accordance with modeling experiments, shape is accounted for a variation up to about 20 % in transport energy requirements, the variation of up to 130 % by the interspersion of land uses and the combination of shape, density and the spatial arrangements of activities factors lead to variation of about 150 % in transport energy. Additionally, in *within place* energy consumption, urban forms associated with higher densities can be up to three times more energy efficient than equivalent detached dwellings (Owens 1989). Table 2.1 shows potential savings at the intra-urban scale.

As a result it can be said that it is not possible to define an ideal energy efficient urban form since energy demand is the outcome of complex interactions between many different factors including both spatial and non-spatial variables. However, a pattern of *decentralized concentration* together with *compact nucleated* or *linear grid* urban structures are accepted as rather advantageous.

Spatial Requirements of Energy Supply: The forth approach, involving identification of spatial requirements of energy supply and conservation measures, is more normative and makes use of technical considerations, models, and working experiences. Under energy conservation policies, and energy efficient urban planning and design approach, the particular concern is on passive solar energy, siting in relation to micro-climate, and district heating and combined heat power (DH/CHP) systems. Instead of the term *renewable energy technologies*, the most common terms used for alternative energy supply are *free ambient sources*, *appropriate energy technologies*, *local technologies*, *local energy sources*, or *future energy supply systems*. If used, the term renewable energy comprises mostly active solar energy/systems.

Table 2.1: Potential energy savings at the intra-urban scale (Owens 1986, p. 68)

Structural variable	**Mechanism**	**Possible saving**
Shape	Travel requirements	Variation up to about 20 %
Interspersion of activities	Travel requirements	Variation up to 130 %
Combination of structural variables (shape, size, land-use mix, etc.)	Travel requirements (trip length and frequency)	Variation up to 150 %
Density/built form	Space heating	200 % variation between forms
Density/clustering trips ends	Viability of public transport	Savings up to 20 %
Density/land use mix	Viability of DH/CHP Travel requirements	Energy efficiency improved by up to 100 % Variations of up to 130 %
Density/siting/orientation	Space heating	Savings of at least 20 %

Owens states that, "in theory, new or expanded urban areas could be planned to accommodate the most appropriate energy technologies, or at least not to foreclose energy supply options for the future" (1989, p. 237). Accordingly, while planning new developments structurally compatible with a desired energy supply and conservation strategy, she emphasizes that it is necessary to determine an optimal strategy by considering both the physical constraints and the characteristics of new energy systems. Because spatial structure has influence on the viability and competitiveness of energy supply and conservation options; existing infrastructure can cause limitations for the introduction of new energy technologies; in different geographical areas, different supply systems may be feasible or non-viable for non-structural reasons; and spatial structure at local scale to some extent dictates which energy conservation technologies are feasible.

On the other hand, in terms of energy efficient urban forms compactness and mixed land uses allow the economic introduction of DH/CHP systems. This form is quite compatible with the small-scale exploitation of solar power, even though it introduces constraints on the siting, orientation and spacing of buildings. As it is given, passive solar systems can quite readily be incorporated at densities of up to 125 persons per hectare (pph) and could be compatible with higher densities even up to 200 pph with design ingenuity (Owens 1987). Moreover, the densities of 140-180 pph could be compatible with passive (or small scale active) solar systems as well as permitting the introduction of DH/CHP systems (Owens 1989). Linear grid structure, permitting higher linear density of development in which integration of land uses is achieved by concentrating origins and destinations of trips onto a small number of routes, is more compatible with quite extensive use of renewable energy sources.

However, extensive use of solar energy necessitates lower densities than above given values. Therefore, developing new residential areas on the urban fringe or beyond through low density housing on large plots could facilitate the exploitation of solar energy. But, such a development pattern can cause loss of amenity. Due to density and orientation solar designs might result in rigid, repetitive layouts with little aesthetic appeal.

Moreover, it is also recognized that the use of renewable energy sources would involve the exploitation on a small and decentralized scale rather than through centralized technologies. Therefore, reliance on small and intermediate scale technologies would require a spatial structure of dispersed, relatively small-scale settlements while urbanized areas would continue rely heavily on centralized energy sources. In short, it is assumed that the exploitation of local energy sources would inevitably have some effect on the future urban form and structure.

Urban Energy Modeling: Due to dramatic events in the global energy systems and the vulnerability of modern societies to these crises of energy and environment, more emphasis has been given to comprehensive approaches including both demand and supply side of energy issues at urban and regional level. The research has been conducted to strategic planning of urban and regional energy systems including spatial energy analysis and modeling efforts, however, in a way keeping in mind that planning for energy systems (demand-supply) involves considerable amount of uncertainties.

In the energy sector, energy demand models are exceedingly varied, covering different sectors and countries, and ranging from purely econometric models to physical energy flow models. Consumer response to energy prices is the key question in an economic context. In a physical flow model, the concern is on the stock of energy appliances or of buildings energy is used, and the way in which changes in those stocks affect energy use (Eden and Bending 1987)

In estimating or modeling energy futures, to deal with uncertainties such as global/national economic situation, short-term price fluctuations or environmental consequences are all very crucial. Besides these there are also uncertainties in key areas that concern the key consumers. Personal transport, services and housing sectors are directly affected by consumer choices. As Owens emphasizes the need for considering consumer behaviors, Schipper (1989) points out key consumer uncertainties with respect to energy efficiency at different sectors.

In *housing sector,* there is enormous energy efficiency potential in terms of appliance efficiency, insulation levels and equipments, etc. which are required to be guided by standards, or by financial incentives. More crucial, the question lies at the consumer behavior. For example, the amount of time people spend time in their homes, and how they spend their time, the amount of heating /the level of thermal preference, the size of the home, and the kinds of appliances used are all functions of life-style. In *service sector,* including commercial and public buildings, energy use patterns are determined by the functions in the building for which space comfort and information are the two that dominate. The uncertainties lie in the extent of the sector in the future whether measured in floor-space, value added, or people-hours spent in the building. Fuel or electricity use can differ in terms of per employee, per unit area, or unit output across the major sectors. In *personal transport sector* the pattern of automobile use is a sensitive function both of distance between work, home and leisure as well as how often it is moved. The uncertainty lies not in the basic need travels, but in the leisure time travels. When people choose move around more, they will indirectly make big energy choices. How much do people want or need to travel? What kinds of modes or cars, and which fuels? At present, these mentioned uncertainties are under discussion in terms of cultures of information age and network societies.

On the other hand, since the use of primary energy for space heating and transportation can be influenced to a large extent by the spatial arrangement of activities, and by the spatial interactions between energy supply and demand, these interdependencies are defined by the concept of *energy density,* which refers energy consumption per unit area. In regard with Hafele's statement (cited in Lundqvist, 1989):

> The way humans settle on the land and use it is a key to understanding energy supply and demand. The settlement pattern introduces large inhomogeneities in energy demand densities, which in turn influence the potential both for exploiting natural energy sources and for transporting and distributing energy. (p.6)

and considering that there is a strong relationship between energy densities and the costs of network supplied, energy forms such as DH/CHP, the possibilities of using local renewable energy sources, and the environmental impacts of energy technologies, Lundqvist describes the settlement pattern and the competitiveness of energy supply options and energy conservation interactions as in below Figure 2.1.

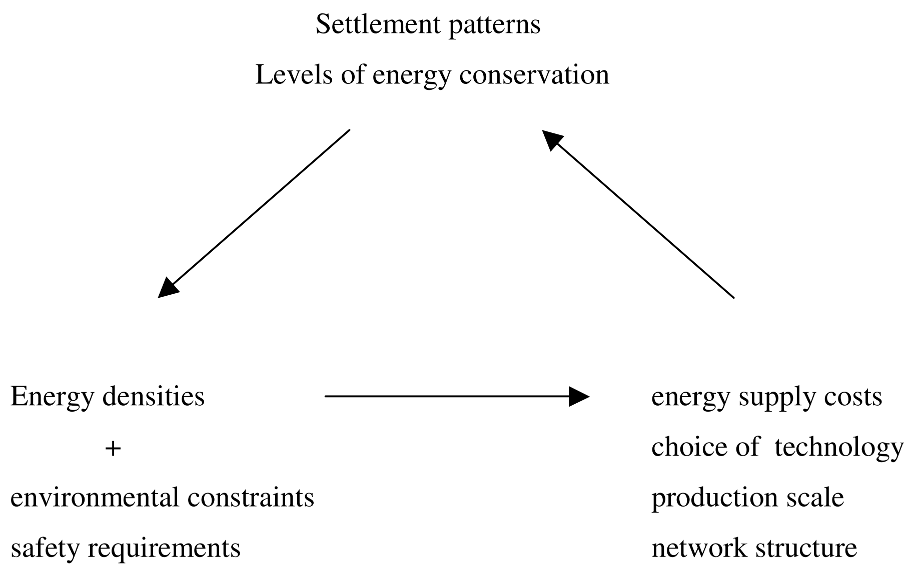

Figure 2.1. Interaction between settlement patterns, the competitiveness of energy supply options and energy conservation (Lundqvist 1989, p: 6)

In his widely known model system for strategic metropolitan energy studies, future energy densities, produced by the model divides Stockholm county into 105 zones, which are linked to comprehensive analysis of the energy supply systems covering the competitiveness of DH/CHP schemes, investment costs and heat losses, and the possibility of introducing renewable energy forms like active or passive solar heating, and heat pumps of various scales and types. An energy density of 30 kWh/m^2 is considered necessary for economic feasibility of district heating schemes. The overall design and the three main stages of his model are given in Figure 2.2.

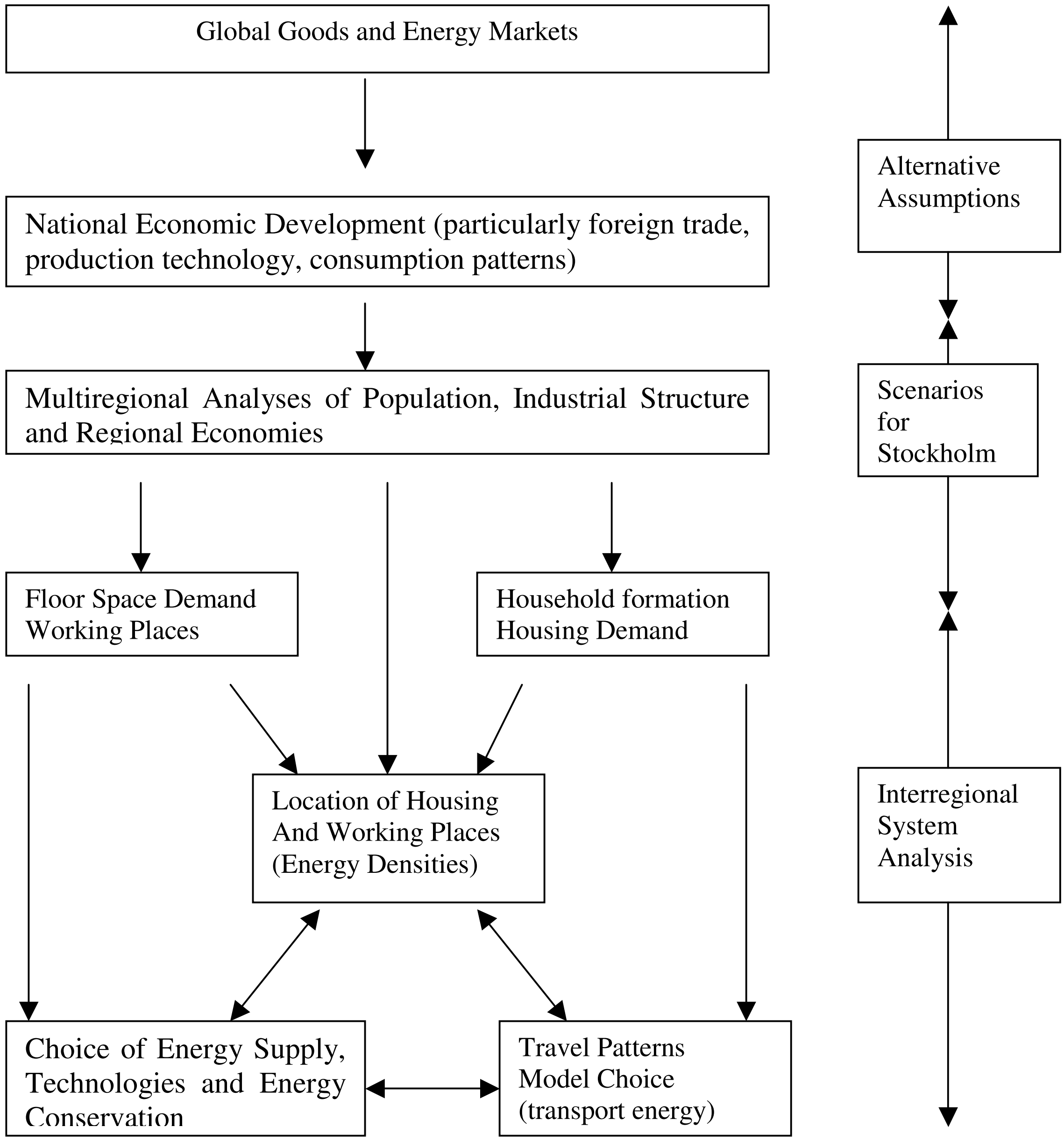

Figure 2.2. A model system for metropolitan energy studies (Lundqvist 1989, p. 251)

Rather than the use of urban models, such kind of urban energy modelling provides closer integration between planning, simplicity in understanding relations and in translating theory into policies and practices.

2.2.2. Energy Integrated Urban Planning Process

Owens, through reviewing the studies done during mid-1970's-mid-1980's and criticizing the energy deterministic view of these theoretical work, states that "the object of energy conscious planning is not to minimize energy use per se, but to plan for a physical environment which permits people to carry out daily activities using energy as efficiently as possible" (1990, p. 64). She suggest that planners should be aware of the energy implications of alternative development policies, include energy efficiency among their objectives, and "be involved with all aspects of the energy system" (1981, p. 197). Her further suggestions on how energy considerations can be integrated into planning process are included in the following figure 2.3, and tables 2.2 and 2.3.

However, while advocating integration of energy dimension into planning, she also points out that "energy can and should only one of many considerations in land use planning" (1990, p. 55), and takes attention to the limitations of planning since planning is a highly imperfect process with or without energy considerations. Moreover, it is emphasized that energy integrated planning is best achieved as an integral part of a broader change in philosophy towards the use of resources and a set of policies including short-medium and longer term objectives.

2.2.3. Recent Considerations on Energy Integrated Planning

During the period of available cheap energy planning policies were developed and implemented with almost no concern for any relationship between the physical and social environment and systems of energy supply distribution and use. During 1970's-1980's when energy conservation policies gained attention due to physical scarcity and cost fluctuations, the concepts of energy efficient/energy conserving urban forms, and the practices of energy integrated planning have arisen as a response to energy constraints of that period.

However, when the prices fell as dramatically as they rose in 1970's and the incentives to use resources efficiently removed, or in other words when energy scarcity turned into glut the emphasis given to energy dimension in planning has decreased, and energy integrated planning, which characterizes the planning approach of that period, has lost its significance especially in practice. Policy makers and planners have again

Decision to adopt planning

Goal formulation: identification of objectives

Assess current situation and problems, for example, high dependence on energy availability. Goals might include 'conservation of non-renewable resource'. Identify energy-related objectives, for example, 'reduce inelasticity of energy demand in the built environment' or 'make land-use patterns as energy efficient as is compatible with other objectives'.

Study of possible courses of action with aid of models

Include potentially 'energy efficient policies amongst those for evaluation. Consider energy implications of alternative policies, for example, effect on energy requirements for transport and heating and on potential for new technologies.

Evaluation of alternative by reference to values and costs-benefits

Include energy implications in overall assessment of costs and benefits of alternatives. Identify any conflict between energy-related goals and objectives and others. Decide on priority to be afforded to energy considerations.

Action through public investment or control over private investment

Most relevant policy levers in relation to energy considerations will be those affecting interspersion of land uses, degree of centralization, densities, and possibly orientation and layout. Non-spatial policies, for example, in relation to transport, may also have an effect on the energy budget.

Review (monitoring) of state of system

Monitor changes in the energy budget in the planning area.

Figure 2.3. Planning process with energy considerations (Owens 1986, p. 72)

Table 2.2: Simple energy-spatial structure interaction matrix (Owens 1986, p. 73)

	A	**B**	**C**	**D**	**E**	**F**	**G**
Energy requirements for transport	X	X	X	X			
Energy requirements for space heating		*	*	X	X	X	
Potential for efficient public transport system	X	X	X	X			
Potential for walking/cycling	X	X	X	X			
Potential for introducing of CHP/DH	X	X	*	X	X		
Potential for use of renewable energy sources				X	X	X	
Energy investment in infrastructure	X	X	X	X			
Energy requirements for industry		*					X

A location and degree of dispersal of residential development
B location and degree of dispersal of industrial development
C location and degree of dispersal of services
D density of development
E built form, layout, orientation
F siting in relation to microclimate
G industrial structure

X interaction * possible interaction

Table 2.3: Sample checklist of energy considerations for use in the study of alternative planning policies (adapted from Owens 1986, p. 73)

1. How will the policy influence travel requirements? Will the physical separation of activities be reduced or increased? Will people be traped in expensive travel patterns if fuel prices rise? Does policy encourage or discourage the use of private car, public transport, walking/cycling?
2. Does the location of new development take sufficient account of microclimate?
3. Would the development densities implied, a) encourage or discourage the use of energy efficient built forms? b) permit the use of passive solar energy fro space and water heating? c) permit the economic introduction of DH/CHP now or in the future?
4. Does the policy encourage decentralization of employment and services? If so, how does the loss of economies of scale compare with potential savings in transport energy requirements?
5. Is new industry likely to be energy intensive? Could less energy intensive industries be encouraged by industrial location, or any other policies?
6. Could the policy be modified in any way to improve energy efficiency whilst still meeting all the other objectives?
7. In comparison with alternative policies under consideration, is this policy energy efficient/energy intensive/robust?

ignored energy issues as before energy crises period. Many governments have continued to place more emphasis on energy supply than energy conservation.

On the other hand, it should be kept in mind that energy availability and energy systems are flexible that they change rapidly within a short time period. But there is inertia in the built environment, and land use planning is a long-term process within which turnover of infrastructure is slow. That inflexibility presents an inescapable physical constraint to modification not only in energy systems but also in many areas. Accordingly, since the outcomes or the benefits of energy efficiency policies and energy conserving plans could not able to be received immediately, energy conservation issues have been left to market forces.

What is more is that the relative importance of energy issues depends on how energy is perceived. As far as energy is considered in isolation and for its own sake rather than the services it facilitates, the concept of energy stay as an abstract issue for planners. In relation to that the integration of energy and planning issues mostly depends on the political willingness and awareness, and the institutional context. For example, the decentralized systems in Denmark and Sweden, and governmental commitment to community heating have made integration of energy and urban planning a necessity.

Though there has been considerable academic research providing fundamental knowledge, the complexity of modeling exercises have been incomprehensible to the practicing planners, who needs advice, simplicity and transparency.

In the last decade, energy efficiency has become taken into account under urban sustainability and sustainable development considerations. The concept of *compact city* has constituted a debate topic in terms of urban form-transport energy consumption relationships. Within a wider framework of sustainable urban form, the arguments focus on two distinct urban models: compact city and green city.

Similar to Gordon and Richardson’s statement (1997, p. 97): “Energy resource constraints are a weak argument for promoting compactness, the link between high-density development and reduced VMT (vehicle miles traveled) and hence reduced energy consumption, is by no means clear”, Breheny (1992, 1995) questions the energy saving potential of urban containment policies, and identifies six contradictions arising from compact city idea. One of them is the inconsistency between desire for compact city and the development of renewable energy sources; contradiction between reducing transport energy consumption through higher densities but encouraging the exploitation of solar energy and wind power which necessitates lower densities.

Despite these arguments, there has been a strong political commitment to compact city idea. The European Commission has promoted the compact city on environment and quality of life grounds, and many governments have made the concept a central element of planning as a means of reducing the need to travel, reducing associated CO2 emissions and thus, contributing to achievement of sustainable development. Therefore, instead of the term energy integrated urban planning, energy efficiency has become an integral part of planning for sustainability, with a closer integration between land use planning and transportation, of designing sustainable cities, and of improving quality of life through renewal and regeneration.

2.3. Renewable Energy Considerations in Literature

One of the early contributions to the renewable energy question in planning journals comes from James A. Throgmorton, who also proposes a rhetorical approach to planning through examining a particular case which involves five-year political conversation about electrical power planning in the city of Chicago (1993), and who claims that planning can be thought of as a form of persuasive and constitutive storytelling about the future for the vision of sustainable city and about how sustainable places can and should be created (2003). In his article *Community Energy Planning: Winds of Change from the San Gorgonio Pass*, published in Journal of the American Planning Association in 1987, he calls attention to unclear role of local planners in guiding the changes in the electric power industry.

First of all, he introduces rising energy prices, technological innovation, and environmental opposition as the factors causing the electric power industry to change. Then, he addresses the role of planners by assessing the experience of wind energy development around Palm Springs, and the guidance provided to planners by the available literature on community energy planning. His argument is that the spatial framework upon which planners rely is a necessary but insufficient component needed in a time of turbulence and change. In addition to promoting orderly development of energy technologies within the existing physical and institutional environment, he suggests planners should develop strategies to link the diverse interests and objectives of consumers, developers of new energy technologies, environmentalists, and utility employees who generate, transmit, and distribute electric power into a coherent and unifying model of change.

The later contribution is the special feature of the journal Land Use Policy. The first issue of volume 12, published in 1995, focus on the nature of the challenges that renewables present for the management of land use and the responses, which are being made. In his introductory paper, *Energy, land use and renewables: a changing agenda*, Gordon Walker identifies the nuclear accident at Chernobly, international pressures for free trade and open markets, and the internationalization of environmental concerns concentrating on global warming as the main factors causing change in the energy policies of many countries, and resulting as the rise of renewable energy and the management of energy demand. Asserting that such changes in the energy scene have direct impacts on land use, he emphasizes the need for further research and understanding on environmental, social and perceptual implications of renewable energy which are closely related to land use.

The other papers included in the issue are: *Local strategies for renewable energy: policy approaches in England and Wales* by Angela Hull; *Wind power: challenges to planning policy in the UK* by Merylyn McKenzie Hedger; *Political conflict over waste-to-energy schemes: The case of incineration in New York* by Matthew Gandy; *Biomass energy in Western Europe to 2050* by D. O. Hall and J. I. House; *Renewable energy and the public* by Gordon Walker; and *Large-scale wind power in Denmark* by Olof Danielsen.

Moreover, in 1995, Hull's second paper *New models for implementation theory: striking a consensus on wind farms*, published in the Journal of Environmental Planning and Management, examines development control decisions on wind farm implications since 1983 by the district council in Wales and emphasizes the importance of socio-political context for understanding the dynamics of policy making and the need for co-production with active stakeholders for successful wind energy planning.

In her third paper *Windfarms in the UK: the arguments for and against,* published in Ekistics in 1997, Angela Hull outlines the advantages and disadvantages of the wind energy technology and makes suggestions for reducing negative impacts of developments, including siting considerations.

Per Christensen and Henrik Lund's paper *Conflicting views of sustainability: the case of wind power and nature conservation in Denmark*, published in European

Environment in 1998, discusses to balance the conflicting issues of wind power and nature conservation on the ground of proper planning together with the social organization of the technology through local involvement.

Volume 15 of Renewable Energy, dated September 1998, includes two cases from Italy; *Moving towards municipal energy planning- the case of Palermo: the importance of non-technical issues* by Butera, introduces successes and failures of the several initiatives being implemented such as the development of municipal energy plan –since the municipal energy plan is a compulsory document for all the Italian settlements with more than 50.000 inhabitants, according to a law enforced in 1991, and the participation of the city of Palermo to Zeus project and Altener and Apas programs of European Union. The second paper *Town planning and the use of renewable energies near Rome*, by Francesca Sartogo introduces the pilot case studies developed by PRAU (Progettazione per il Restauro l'Architectura e l'Urbanistica) as the Ecological urban island, Peri-urban ecological island, and Territorial ecological island projects. In the case of peri-urban ecological island study, Saline Ostia-Antica is proposed for the APAS RENA Renewable Energies Area 4 Urban Planning program, regarding the territorial and urban planning of the city of Rome through maximizing the use of renewable energies with the objective of zero emission town.

As Walker claims that the rise of renewable energy technologies and the management of energy demand are the two consequences of the changes in the energy scene, in the paper *Cities, regions and privatized utilities,* published in Progress in Planning in 1999, Simon Marvin, Stephen Graham and Simon Guy explore the socio-spatial implications of emerging utility strategies within UK cities and put emphasize on that new technologies, management styles, marketing strategies, environmental priorities and commercial goals have dramatically re-configured patterns of utility provision and infrastructure within cities and regions which are to be considered during urban development. In the earlier paper *Demand-side management in the electricity sector: implications for town planning in the UK,* published in Land Use Policy, the authors –Aine Kelly and Simon Marvin- examine the relationship between the land use planning system and demand-side management (a subset of least-cost planning). It is assumed that DSM measures would provide connection between the two systems but their case studies show that the linkage is very weak in current implementations. Although these two articles do not cover the renewable energy, the issues are directly related with the utilization of renewable energy technologies.

Wolsink's paper *Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support,* published in R*enewable Energy* in 2000, discusses syndrome of Not-In-My-Back-Yard (NIMBY) in the case of wind power developments. By comparing the Dutch implementations with German experiences, he argues that institutional constraints are more important than public acceptance not only in the case of wind power but also in the implementations of other renewable energy developments. By giving reference to Patsy Healey, he claims that better implementation of renewable energy developments requires building up institutional capacity, through collaborative approaches.

The article *Our visual landscape: managing the landscape under special consideration of visual aspects,* by Christian L. Krause and published in Landscape and Urban Planning in 2001, including 'wind mill power plant effects' and 'wind mill power plant location' as keywords, provides a methodological approach to analyze and evaluate the degree of impairments by wind power stations.

In terms of visual impact assessment, another paper is published in Environment and Planning B, 2002. In his paper, *Determination of thresholds of visual impact: the case of wind turbines,* Ian D. Bishop introduces a computer based study aiming at to determine the relative perceived size of a rotating turbine, its typical contrast level with its surroundings, and the effect of atmospheric scattering on that contrast, and put emphasis on the importance of distance considerations in any visual impact modeling.

The two more papers published in the year of 2002 present similar standpoints in addressing the issue of renewable energy. 'The city', 'technological innovation' and 'sustainability' are the distinct concepts highlighted by the authors in each article. In his comprehensive article *Renewable energy and the city: urban life in an age of fossil fuel depletion and climate change,* published in Bulletin of Science, Technology & Society, Peter Droege introduces the IEA Solar City program and network, that focuses on the energy supply and technology side, but embedded in a total town planning and design strategy that also includes institutional arrangements, and the solar city concept which is structured into three thematic areas of inquiry (sustainable-energy focused urban planning strategies; targets, baseline studies and scenario development; and urban energy technology, industry and business development) and two general investigation programs for operation (best practice cases and on learning in action).

In the second article *Cities and energy: the sustainability (r)evolution*, Voula Mega presents European experiences, which are carried out especially by the European

Commission and/or through EC programs and policies, and associated organizations (published in Ekistics).

Among more recent articles, published in 2003, the focus is mainly on wind energy developments. Jamil Khan, in his paper *Wind power planning in three Swedish municipalities,* published in Journal of Environmental Planning and Management (Vol. 46, No.4) recognizes 'the siting of turbines', 'the ownership of turbines' and 'citizen participation' as three important aspects of wind energy development, and he compares the planning strategies of three Swedish municipalities, together with analyzing the influence of planning strategies on aspects of wind power development. In accordance with his comparison, there are differences in actual development of wind power in different municipalities since the capacity for planning and political attitude towards wind power are distinctive in each local authority. In Sweden, local governments are the key actors in formulating the local policies. In that circumstance, Khan argues that there is a need for stronger policy measures at the state level in order to achieve national goals, by supporting local governments.

In the article *Avoiding confrontation: securing planning permission for on-shore wind energy developments in England,* published in Planning Practice & Research (Vol. 18, No.1), Marcus Beddoe and Andrew Chamberlin address the general recognition that planning system is a significant obstacle to the development of renewables –especially on-shore wind energy developments in UK, and they propose recommendations to avoid confrontation in the planning system over locating wind turbines. In analyzing the planning actions, they categorize the areas of conflict as: information provision, processes and qualitative assessment. They define lacking of information on the technology and awareness in local authorities; absence of baseline data on operational requirements; and un-quantified consultant responses about environmental impacts as the major causes of confrontation.

The third paper *Policy integration for sustainable development: exploring barriers to renewable energy development in post-devolution Wales,* published in Journal of Environmental Policy & Planning (Vol. 5, No. 1) recognizes the conflicts in renewable energy developments as classic challenges of implementing sustainable development. Instead of focusing merely on wind energy, the paper manifests the issue as a renewable energy policy discourse, comprising energy, environment, planning, economic, and rural policies. By exploring the current policies and practices of the recently devolved administration of the Welsh Assembly the authors, Ruth Stevenson and Tim Richardson, argue that the current scene is the reproduction of unsolved tensions even though the vertical and horizontal institutional change due to devolution has provided potentials and opportunities. The authors recognize the contested values, the unresolved conflicts over core environmental values as the derivation of diverse positions and deficiencies of implementation. They conclude suggesting new arenas provided by devolution to function for deliberative policy making.

CHAPTER 3

RENEWABLE ENERGY SOURCES and TECHNOLOGIES

Renewable energy is the term used to describe a wide range of naturally occurring, replenishable energy sources — in particular, sun, wind, water and a range of biomass resources. Though renewable energy is the common term, other expressions used are: flux energies, soft energies, new energies, etc. The energies may be continually renewable (permanent flux), renewable in short cycles or time periods (to some extent, energy from biomass or wood), partially renewable (e.g. geothermal) or totally renewable (Kleinpeter 1995). These sources are diffuse in form and site-specific in nature.

Renewable energy technologies produce marketable energy by converting natural phenomena into useful energy forms -as electrical energy and heat. These technologies use the energy inherent in sunlight and its direct and indirect impacts on the Earth (photons, wind, falling water, heating effects, and plant growth), gravitational forces (the tides), and the heat of the Earth's core (geothermal) as the resources from which they produce energy (Dinçer 2000). These distributed technologies provide exploitation of renewable energy sources at the point they occur.

Following sub-titles include information about characteristics of wind and geothermal sources, and the conversion and utilization technologies related to these sources. The information related to biomass and solar energy systems, and the current market and development trends of these technologies are included in Appendix A.

3.1. Wind Energy

The large-scale motion of the atmosphere is produced by the sun's energy falling on the earth. The sun heats the surface of the earth unevenly, the heated air becomes lighter and starts to rise and at the poles the cold air starts sinking. The areas of high and low pressure cause streams of air to flow horizontally from one region to another. That is the wind, and on a global scale, air flows from the hot regions towards cooler poles, while cold polar air runs back towards the equator. In addition to that, the constant rotation of the earth causes the flow from the equator to the poles to be deflected towards the east, and the return flow towards the west. The highest wind velocities are generally found on hilltops, exposed coasts and out at sea. Mountains, oceans, valleys and other features of the terrain create local wind patterns that change from season to season, from hour to hour.

The concept of capturing the kinetic energy of wind and converting it into useful mechanical work was first conceived in antiquity and the oldest source of power applied by mankind. Wind energy has its origin in the Asian civilizations of China, Tibet, India, Afghanistan, and Persia. Through civilization the use of wind power spread from Asia to Europe. The widespread use of windmills in Europe dates back the 11th and 12th century for grinding grain and pumping water. We all know the famous Dutch windmills used for water pumping, and in the Mediterranean area several islands are known for their old picturesque windmills. Later, in 1891 Denmark became the first country in which scientists and engineers began a dedicated effort to implement wind technology as a basis for electrification (Andersen 1999). However, the modern wind energy utilization was initiated in the 1970's, and since 1980's generating clean electricity from the wind has made the most significant commercial progress in just two decades.

3.1.1. Wind Turbines

The wind energy system mainly depends on the extraction of energy from the wind by the wind turbine. The main components of a wind turbine are; the rotor, the transmission system, the generator, and the yaw and control systems. The power available for a wind turbine is equal to the change in kinetic energy of the air as it passes through the rotor and the amount of energy contained in wind energy depends on its speed. The power in the wind is proportional to the cube of the wind speed or velocity (Walker and Jenkins 1997). Depending on local wind speeds, a turbine produces an annual average power that is some proportion of its maximum rated power typically up to 30 %.

In principle, there are two different types of wind energy conversion devices: Those that depend mainly on aerodynamic lift and those, which use mainly aerodynamic drug. Low speed devices such as traditional windmills and some water pumping devices are driven by the drug forces, while modern turbines for electricity production are driven by the high speed lift type. High-speed turbines rely on lift forces to move the blades, and the linear speed of the blades is usually several times faster than the wind speed.

Wind turbines are also classified into two according to rotor types, as horizontal-axis and vertical-axis machines. Vertical axis turbine uses an array of curved blades shaped like an eggbeater to turn a vertical shaft. The drive system and electric generator or gearbox sits on the ground within easy reach of maintenance and repair. In the much more common horizontal-axis turbine, the axle on which the two or three bladed rotor turns runs parallel to the ground. A vertical-axis turbine accepts wind coming from any direction without having to change its alignment, while horizontal-axis systems must turn about in response to any wind shift. However, horizontal-axis turbines operate more efficiently over a wider range of wind speed, and many turbines employ sophisticated, computer controlled systems to vary the angle at which the blades meet the air, to increase the amount of captured wind energy.

The applications of wind turbine technology is grouped mainly in three: Small stand-alone wind turbines for water pumping, battery charging, heating, etc., hybrid energy systems combining intermediate size wind turbines with other energy sources such as photovoltaics, hydro and diesel and/or storage used in small remote grids or for special applications such as water pumping, battery charging or desalination, and large grid connected wind turbines (Andersen 1999).

There are two strategies for generating power from large grid connected turbines. One is the use of large numbers of turbines in a wind farm, and the second approach is the use of huge single turbines. While grouping standardized mass-produced turbines provides saving money, huge turbines provide savings through the size of their rotors since doubling the area swept by the rotor doubles the power output. Commercial wind turbines have evolved from units of 20-60 kW in the early 1980s, with rotor diameters of around 20 m, to 200-250 kW the state-of-the-art machine in 1991 and 600 kW the most competitive machine in 1997, and now to the generators of single turbines of 5,000 kW with rotor diameters of over 100 m (Figure 3.1), (Andersen and Jensen 2000, EWEA 2003a).

This increase in the size and technology know-how, coupled with the economy of scale gained by mass production, has reduced the cost of wind power considerably. Today the average cost per kW of installed wind power capacity varies from 900 €/kW to 1,100 €/kW. The turbine comprises about 80% of this total cost. The operation and maintenance costs, including repairs and insurance is account for 20% - 25% of total production costs per kilowatt hour, at some 1.2 c€/kWh over the lifetime of the turbine (20 years). When all cost elements are considered together, the cost of wind power ranges from approximately 4 - 5 c€/kWh at sites with very good wind speeds to 6 - 8 c€/kWh at sites with low wind speeds (EWEA 2003a). A typical wind turbine has a 'pay-back' time (energy balance) of less than a year of operation. For example, the energy invested in a state-of-the-art 600 kW wind turbine is repaid over 3–4 months (Andersen and Jensen 2000). The external costs –the environmental and social costs which are not reflected in the market price- of the wind energy is less than 0.26 c€/kWh while those for coal-fired generation range from 2 to 15 c€/kWh. As it is calculated in 2000, a total of approximately 15 million tonnes of CO_2 production was avoided across 28 European countries, through wind energy generation (EWEA 2003a).

As it is seen from the wind turbine technology and reduced costs, wind energy is a dynamically expanding industry; a mature technology while it is clean and safe at the same time. Over the past decade, global installed capacity has increased from 2,500 megawatts to just over 40,000 MW at the end of 2003, at an annual growth rate of near 30 %. In terms of overall capacity, Germany is still the world market leader with 14.609 MW installed (37 % of the worldwide capacity), followed by the USA (6.370 MW, 16 %), Spain (6.202 MW, 16 %), Denmark (3.110 MW, 8 %) and India (2.110 MW, 5 %) (WWEA 2004). By the end of 2003, the total installed capacity in Europe is 28,706 MW. The installed capacity in EU-15 is 28,440 MW, and this capacity covers 2.4 % of total EU-15 electricity consumption, equivalent to the household electricity needs of 35 millions of EU citizens (EWEA 2003b).

In terms of the scale of wind energy developments, there has been a change in the market segmentation of wind projects recently. The trend from turbines on farms to wind farms has currently shifted to offshore wind farms. Since 1995, when the 75 % of the world market was distributed in small, privately-owned, stand-alone turbines –ranging in size from single installations of 200 kW to clusters of turbines up to 5 MW, and 24 % in commercial or utility-owned wind farms –ranging in size from 5 MW to 100 MW or more, but typically between 20 and 50 MW, the distribution has shifted to 46 % in small, dispersed developments to 53 % commercial and utility-owned wind farms (BTM Consult 2001).

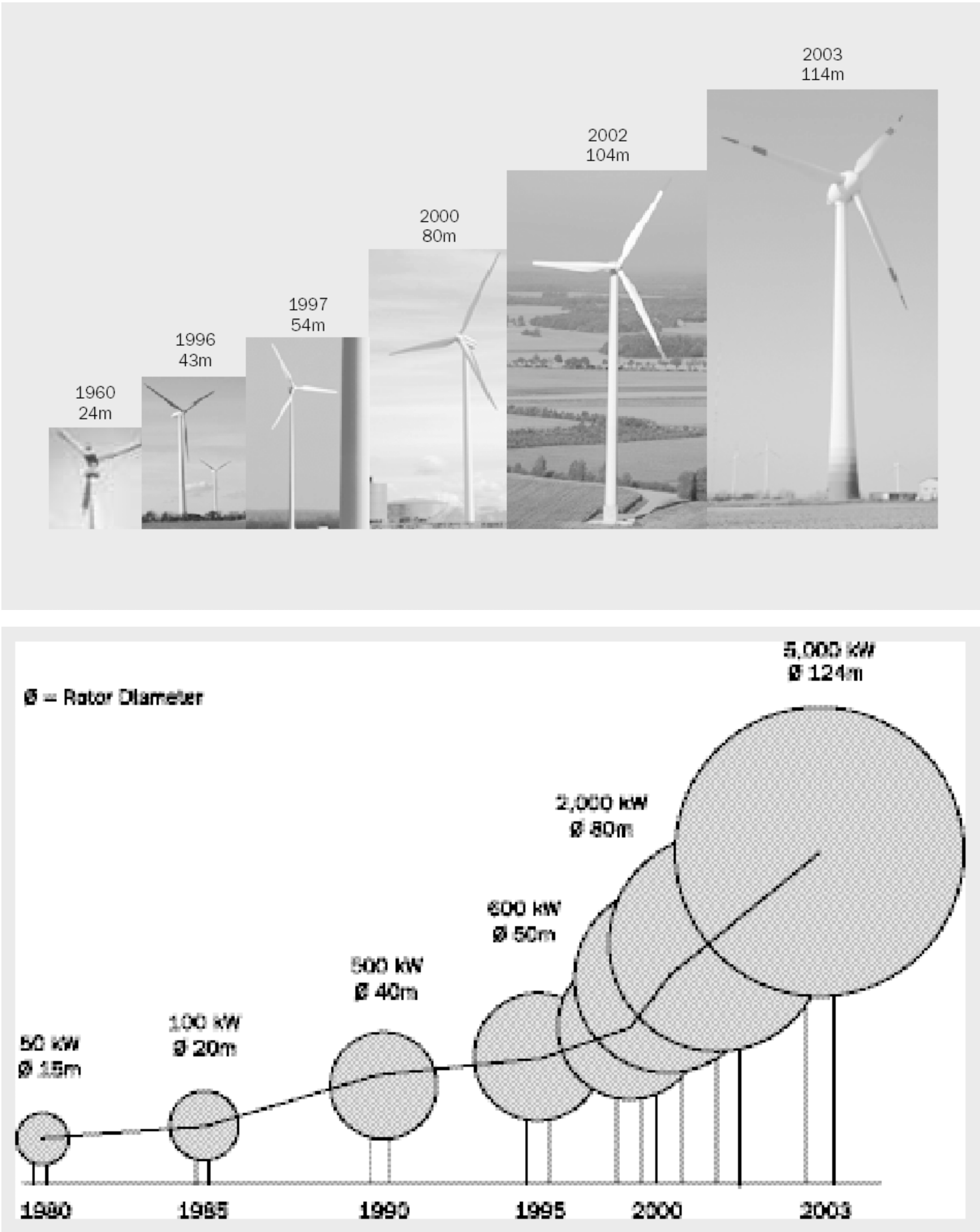

Figure 3.1. Growth of wind turbine size (EWEA 2003a, p.15)

3.1.2. Wind Farm Design

Planning a wind project, using wind turbines of known cost and performance requires consideration of economics, governmental and environmental issues. It requires a feasibility study, which is based upon information about all aspects of the implementation and operation of the project including technical, economic, and organizational data. The technical data required in designing a wind farm that the turbines, foundations to support the towers, access roads and the electrical infrastructure are the main components, includes wind resource assessment, electrical grid system, land availability and ground conditions (Walker and Jenkins 1997, EWEA 2003a).

Since the economics of a project depend on wind speed, having an accurate knowledge of the wind resource[8] is crucial for both site selection and design. The existence of a wind atlas (national, regional or local) showing the distribution of wind speeds on a broader scale is vital for guiding developments and they serve to indicate where on-site measurements could be taken. On-site measurement using an anemometer provides the best and most accurate resource data. Computing the data gathered through monitoring both velocity and wind direction continuously as 10 min. or 1 hour average values and covering at least one year, together with the meteorological data taken from a nearby existing station constitute the basis of resource data. Subjective observations on site and the use of local knowledge are also valuable.

At the next stage, the prediction of energy production of a wind farm requires inputs of turbine characteristics, roughness of the wind, topography and surface ground cover over the site and surrounding area, and the wind farm layout. At present, the computer programs are used to optimize wind farm design that specifically designed models allow energy estimations of different options of layout, turbine and hub height with respect to topographical and surface ground cover features of the site.

In designing turbine layout, which is also called wind farm *micrositing*, the overall aim is to maximize electricity production while minimizing infrastructure, operation and maintenance costs, and socio- environmental impacts. On the other hand,

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[8] In estimating the potential energy resource of an area, the global calculations provide "theoretical" resource knowledge. Calculations done by considering technical constraints result in the estimation of a "technical" resource and, finally, considerations of planning, environmental and social issues result in the estimation of a so-called "practical" resource (EWEA 2003).

the turbine spacing is the key element of the layout design. The appropriate spacing for turbines is strongly dependent on the nature of the terrain and the wind rose at a site.

For implementation of a wind energy project, the availability and the accessibility of the site are important factors. The required area of land depends on the size of the turbine. For example, the required area for the foundations of 200 kW grid-connected turbines is in the order of 100 m^2. The ground conditions determine the cost of the foundations. In general, simple slab foundations are used for the turbines and the size of the slab may be increased for poor ground conditions. Though rocky ground allows the use of small-diameter turbine foundations, it may increase the costs of trenching for the power collection cables. Approximately 200-300 m^2 are required for the control building and service area. As a rule of thumb wind farms require 0.08 to 0.13 km^2/MW (8–13 MW/km^2). Wind farms have the advantage of dual land use. 99 % of the land occupied by a wind farm can be used for agriculture or remain as natural habitat. They are generally located in open countryside or semi-industrial sites (Walker and Jenkins 1997, Andersen 1999, EWEA 2003). Once the permissions and authorizations are obtained, a 10 MW wind farm can easily be constructed within two months, producing enough power to meet the consumption of over 4,000 average households.

Another significant issue in wind farm design is grid connection. A wind farm requires connection to the electricity network, which necessitates technical, economic and regulatory considerations and evaluations. At present, rapid increase in the scale and number of wind power production, and their penetration into the grid has raised number of issues. Fluctuating output of wind farms is a problem to be solved in terms power quality and grid stability. The technical characteristics of wind generation are different to those of conventional power stations, around which the existing systems have evolved. The grids have been designed for large-scale central generation, whose power is transported outwards through the transmission and distribution systems. So, there is an incompatibility between the existing network and the distributed generation. In general, large-scale wind farms are connected to transmission networks. Distribution networks are designed for power to flow downwards from the transmission network to the customers. Connection to distribution network, which is also called as embedded generation, changes the magnitude and the direction of power flow, which can cause technical problems to arise (EWEA 2003a).

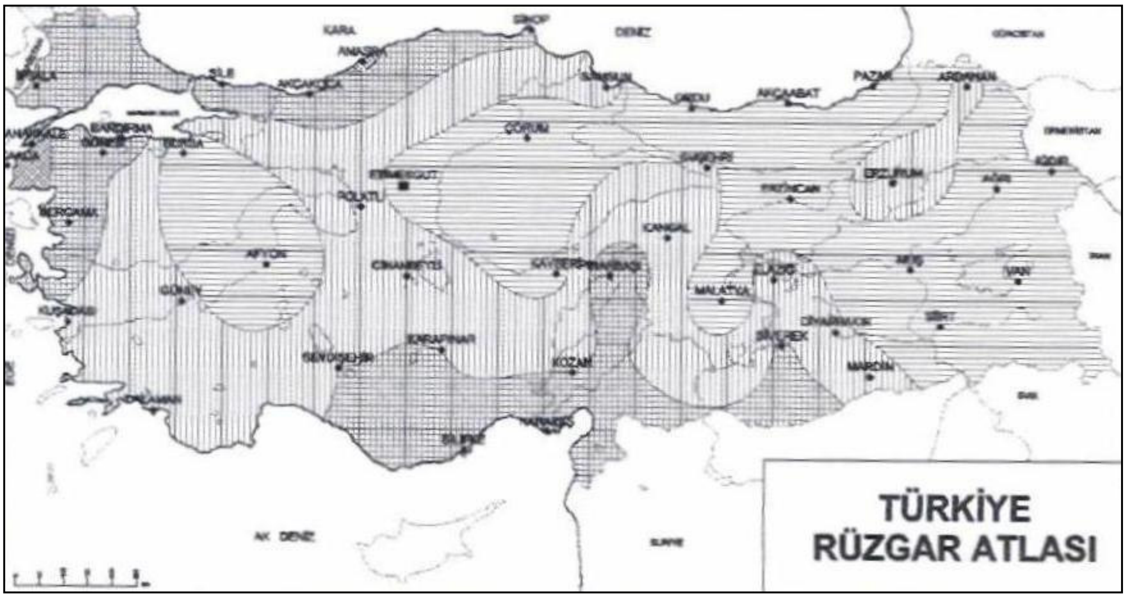
Since wind farms locate mostly in remote areas, the existence of a network and its conditions are necessary from the point of whether the network is suitable for connection or the construction of new circuits is required. Locations near to transmission network are desirable in terms of the cost of connection. The individual transformers of the wind farm are connected to underground cables in an internal grid, which takes the power to a substation or interconnector. The substation usually contains another transformer which steps the voltage up from the internal grid level to the distribution or transmission level. The capacity of the substations is, therefore, significant to allow connection.

From the point of environmental advantages, wind energy is a clean technology mainly due to the avoidance of air pollutant emissions, since it causes no direct atmospheric emissions. Visual intrusion and noise are experienced as disadvantages of wind power. Turbines with a hub height of 40–80 metres and a blade length of 20–40 metres form a visual impact on the landscape, however this effect on amenity is rather subjective. A more objective case of visual impact is the shadow flickering -the effect of moving ‘shadows’ from the rotor blades. This is a problem in situations where turbines are sited very close to workplaces, dwellings or main traffic arterials (Andersen and Jensen 2000, EWEA 2003). In the case of noise impact, acoustic emissions from wind turbines are composed of a mechanical and an aerodynamic component, both of which are a function of wind speed. The nuisance caused by turbine noise is one of the important limitations of siting wind turbines close to inhabited areas. The acceptable emission level strongly depends on local regulations. Furthermore, in some areas turbines can reflect electromagnetic waves and wind turbines may interfere with telecommunication links, and also have impact on bird life.

3.1.3. Wind Energy in Turkey

Turkey has substantial wind source potentials. Total theoretically available potential for wind power is estimated as around 88.000 MW annually. Wind Atlas of Turkey, published in 2002, was prepared through conducting onsite surveys and evaluation of data taken from 45 of 96 meteorological stations distributed homogenously over the country. The atlas (Figure 3.2) shows that the regions of Aegean, Marmara, West Blacksea and East Mediterranean are favorable.

Electricity generation through wind power for general use was first realized at Çeşme Altınyunus Resort Hotel in Izmir, in 1986. The installed turbine with a 55 kW nominal wind power capacity, with 24.5 m. hub height and 14 m. rotor diameter, meets about 4 % of total energy consumption of the hotel. In the year 1998, two wind power plants began to operate at the same locality in Alaçatı, Izmir. One of them is an auto-producer involving 3 Enercon E-40 wind turbines of 580 kW, and the second one is a wind farm consisting of 12 Vestas V44/600 turbines, with a total installed capacity of 7.2 MW. The second wind farm including 17 turbines with total installed capacity of 10.2 MW started to operate at Bozcaada Island in 2000. Therefore, the total installed capacity in Turkey is 19 MW.



	Kapalı Araziler [2]		Açık Araziler [3]		Kıyılar [4]		Açık Deniz [5]		Tepe ve Bayırlar [6]	
	ms^{-1}	Wm^{-2}	ms^{-1}	Wm^{-2}	ms^{-1}	Wm^{-2}	ms^{-1}	Wm^{-2}	ms^{-1}	Wm^{-2}
	> 6.0	> 250	> 7.5	> 500	> 8.5	> 700	> 9.0	> 800	> 11.5	> 1800
	5.0-6.0	150-250	6.5-7.5	300-500	7.0-8.5	400-700	8.0-9.0	600-800	10-11.5	1200-1800
	4.5-5.0	100-150	5.5-6.5	200-300	6.0-7.0	250-400	7.0-8.0	400-600	8.5-10.0	700-1200
	3.5-4.5	50-100	4.5-5.5	100-200	5.0-6.0	150-250	5.5-7.0	200-400	7.0-8.5	400-700
	< 3.5	< 50	< 4.5	< 100	< 5.0	< 150	< 5.5	< 200	< 7.0	< 400

[2] Settled areas, forests and agricultural lands (roughness level 3),
[3] Open lands (roughness level 1),
[4] Coastal areas (roughness level 1),
[5] Open sea, 10 km away from coast (roughness level 0)
[6] Hills

Figure 3.2. Wind Atlas of Turkey and wind potentials at 50 m. above surface

3.2. Geothermal Energy

Geothermal Energy is heat (*thermal*) derived from the earth (*geo*). It is the thermal energy contained in the rock and fluid (that fills the fractures and pores within the rock) in the earth's crust. In most areas, this heat reaches the surface in a very diffuse state. In the production of geothermal energy, wells are used to bring hot water or steam to the surface from underground reservoirs. Geothermal energy has often been accepted as a renewable energy resource, but they are not, especially on the time scale usually used in human society. It is emphasized that "they are renewable only if the heat extraction rate does not exceed the reservoir replenishment rate" (Barbier 2002, p. 19). Therefore, the reinjection of fluids into the reservoir is significant for the sustainability of the resource.

Geothermal resources are classified as low temperature (less than 90°C or 194°F), moderate temperature (90°C - 150°C or 194 - 302°F), and high temperature (greater than 150°C or 302°F) (Figure 3.3). The highest temperature resources are generally used only for electric power generation. Uses for low and moderate temperature resources can be divided into two categories: direct use and ground-source heat pumps.

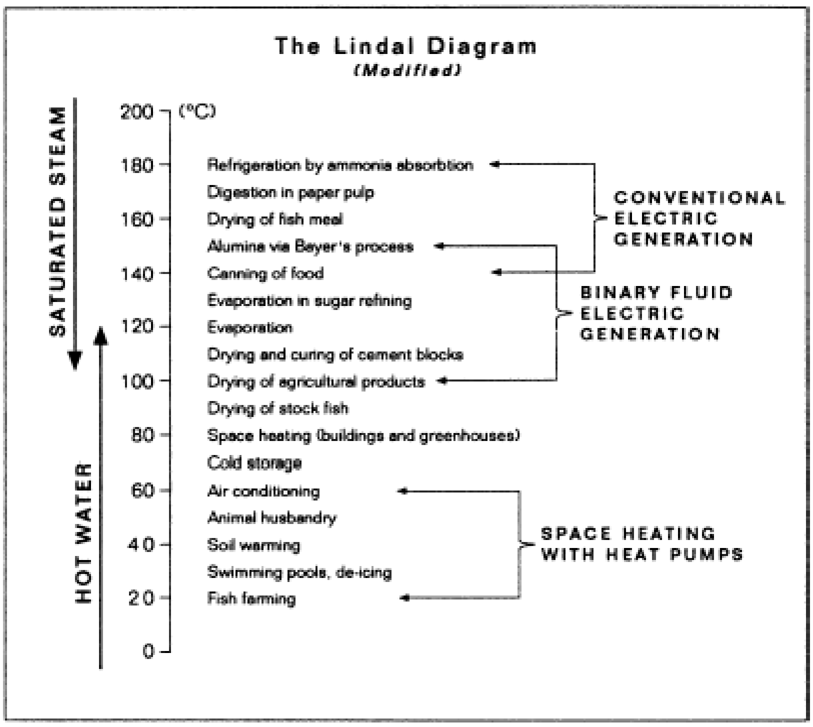


Figure 3.3. The Lindal diagram on typical fluid temperatures (Barbier 2002, p. 40)

The applications of geothermal energy for direct use include space heating –both district and individual heating systems, geothermal heat pumps, bathing and swimming, greenhouse heating, aquaculture pond heating, agricultural drying, industrial uses, cooling, and snow melting. Worldwide installed capacities and annual energy uses of those given direct use applications are given in table 3.1, and figure. 3.4.

District heating is one of the most common and efficient utilization of geothermal energy. It is estimated that about 75 % of 42,926 TJ/year utilization (total use in space heating) is for district heating. The majority of the district heating systems is in Europe where France and Iceland are the leaders. Other countries with extensive district heating systems are China, Japan and Turkey. The U.S, on the other hand, dominates the individual home heating systems use, which is typical of Klamath Falls, Oregon and Reno, Nevada (Lund and Derek 2001).

Table 3.1: Categories of geothermal energy utilization worldwide (Lund and Derek 2001, p.33)

	Capacity MWt		Utilization TJ/year	
Category	2000	1995	2000	1995
Geothermal heat pumps	5275	1854	23,275	14,617
Space heating	3263	2579	42,926	38,230
Greenhouse heating	1246	1085	17,864	15,742
Aquaculture pond heating	605	1097	11,733	13,493
Agricultural drying	74	67	1038	1124
Industrial uses	474	544	10,220	10,120
Bathing and swimming	3957	1085	79,546	15,742
Cooling and snow melting	114	115	1063	1124
Others	137	238	3034	2249
Total	15,145	8664	190,699	112,441

Geothermal development is a consequence of a group of closely interrelated activities, which include earth science and engineering technologies. Earth science activities predominate during the fluid recovery phase of a project, whereas the engineering technologies prevail during the utilization phase. The developments on site have three stages. The initial stage, which is usually called geothermal reconnaissance, is to conduct surveys of moderate cost that will provide the rapid assessment of large areas of territory through aerial and satellite photographs, geological, geophysical and geochemical studies, and drilling of gradient wells, and permit to select the most promising areas within the territory. The surface investigations in the selected areas form the prefeasibility phase, while the subsequent feasibility phase consists of deep exploratory drilling, well and reservoir testing. The cost of this stage is higher since drilling is cost intensive. The final phases of the project are those of development and exploitation which entail reservoir engineering studies, further drilling and the construction of surface plants and equipments (Barbier 2002).

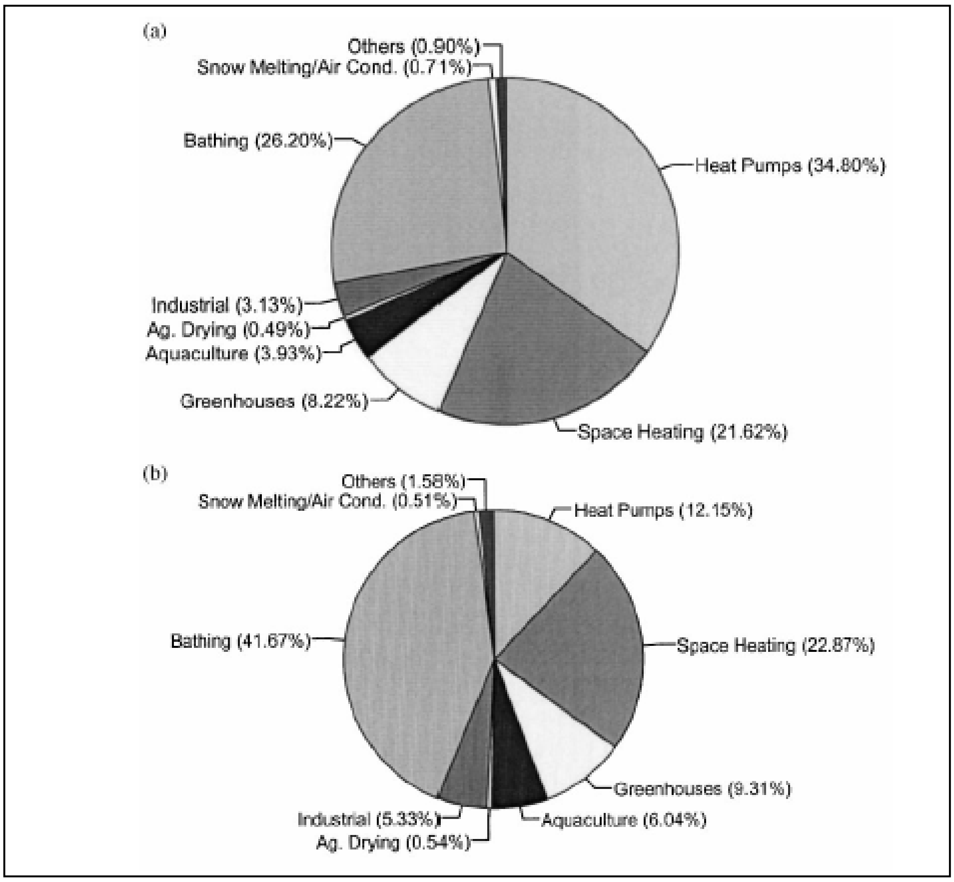


Figure 3.4. a) Categories of capacity in % for 2000, b) Categories of energy use in % for 2000 (Lund and Derek 2001, p. 33)

In geothermal development for the generation of electricity, about 50 % of total costs are related to the identification and characterization of reservoirs, and above all, to the drilling of production and reinjection wells. Of the remainder, 40 % goes to power plants and pipelines, and 10 % to other activities. Therefore, the cost of the geothermal kWh (2-10 US cents) is characterized as a high share of capital cost and relatively low operation and maintenance costs. These projects are more site-specific than oil and gas projects as geothermal fluids are normally used at the geothermal field. It is uneconomical for the modest energy content of the geothermal resource to be moved over long distances due to the high cost of insulating the pipelines to avoid heat losses. In general, it is assumed that development costs are difficult to predict because of the uncertainty involved in drilling, and that the cost of drilling is the main obstacle to geothermal development.

If environmental impact geothermal energy is to be considered, it is given that the carbon emission levels are well below the figures for natural gas, oil or coal-fired power stations per kWh generated, such as; 0.01 – 0.4 kg/kWh of carbon dioxide compared to 0.5 – 1.1 kg/kWh of carbon dioxide from fossil fuels. Moreover, geothermal plants do not emit nitrogen oxides. However, site-specific chemical content of the fluids causes pollution of air and bodies of water. Steam from geothermal fluids has a content of non-condensable gases (CO_2, H_2S, NH_3, CH_4, N_2 and H_2) that ranges from 1.0 to 50 g/kg of steam. Geothermal gases in steam may also contain ammonia (NH_3), traces of mercury (Hg), boron vapors (B), hydrocarbons such as methane (CH_4) and radon (Rn). Boron, ammonia, and to a lesser extent mercury, are leached from the atmosphere by rain, leading to soil and vegetation contamination. Boron, in particular, can have a serious impact on vegetation. These contaminants can also affect surface waters and impact aquatic life. Therefore, water pollution of rivers and lakes is a potential hazard in power production and the management of spent fluids. Geothermal fluid passing through a heat exchanger and reinjected without exposure to the atmosphere does not discharge either gas or fluid to the environment during normal operation. Reinjection through wells drilled into selected parts of the reservoir is the most common method of disposal. Wells newly drilled or during maintenance have a noise level of 90-122 dB at free discharge, and 75-90 dB through silencers.

3.2.1. Geothermal District Heating Systems

A geothermal district energy system consists of one or multiple wells or in some cases even well fields, well and circulating pumps, transmission and distribution piping, central or individual building heat exchangers, peaking/backup boilers and/or thermal storage units and a system for metering.

The first step in developing a project of geothermal district heating systems is conceptual planning which has to cover all studies of technical, economical, political feasibility aspects. The technical feasibility, design and control of the system are directly related with the heat load characteristics of the region. These characteristics are; peak heat load, changing of the heat load according to the exterior temperature, heat load intensity spectra, and the annual load factor (Toksoy et al. 2003a).

The heat supply depends on the thermal capacity and the temperature of the geothermal fluids extracted from the production wells. Geothermal heat supply can be calculated by using the equations [1] and [2]. On the other hand, in estimating the total heat load or demand, thermal energy required for heating a dwelling depends on both the climate of the region and the thermal insulation of the dwelling. In order to provide thermal comfort and maintain the temperature at a constant value over time, the heat flow that enters the dwelling must be equal to the heat flow that is lost from the dwelling. Heat losses occur due to conduction and ventilation. Heat losses due to conduction can be calculated by means of Eq. [3]. Ventilation heat losses, which correspond to the energy required to heat the fresh air that enters the building at outside temperature (T_e) up to the room temperature (T_i) can be estimated through Eq. [4]. As a result of the calculations, the total of heat losses constitutes the thermal power requirement of the dwelling. Finally, the annual heat load, in other words the energy demand, which is a function of the degree-hours and a load factor, representing an average percentage of utilization during the operation period, can be calculated by equation 5 (Agioutantis and Bekas 2000).

$$P_g = M_g \times (T_{gi} - T_{go}) \qquad [1]$$

P_g = geothermal heat supply (W)
M_g = thermal capacity of the geothermal fluid mass flow (W/ ºC)
T_{gi} = temperature of the geothermal fluid at the wellhead (ºC)
T_{go} = disposal or return temperature of the geothermal fluid (ºC)

$$M_g = Q_g \times \rho_g \times \gamma_g \qquad [2]$$

M_g = thermal capacity of the geothermal fluid mass flow (W/ ºC)
Q_g = geothermal fluid volume flow rate (m^3/h)
ρ_g = density of geothermal fluid (kg/m^3)
γ_g = specific heat of the geothermal fluid (Wh/kgºC)

$$P_c = A \times U \times (T_i - T_e) \qquad [3]$$

P_c = conductive heat loss (W)
A = exposed surface area (m^2)
U = average heat loss coefficient (W/m^2 °C)
T_i = internal temperature (°C)
T_e = external temperature (°C)

$$P_v = 0.8 \times V \times C_p \times \rho_a (T_i - T_e) \quad [4]$$

P_v = ventilation heat loss (W)
V = volume of the building (m^3)
C_p = specific heat capacity of atmospheric air (Wh/kg°C)
ρ_a = density of the air (kg/m^3)

$$Q_d = (Q_{total} \times L_f \times Degree\text{-}hours\ ) / T_r \quad [5]$$

Q_d = annual energy demand (Wh)
Q_{total} = total heat loss (W)
L_f = load factor (%)
T_r = return (rejection) temperature (°C)

The cost of energy is the most crucial factor in the development of renewable and alternative energy technologies. Like most renewables, geothermal district energy must compete with low-cost fossil fuels that do not pay their full external costs. Geothermal district energy is also hampered by uncertainty about what it will cost when implemented in any given community with its unique geography of supply and demand. Moreover, the cost of the delivery system requires that a significant share of the population of a community agree not only to adopt it but also to pay for the construction of the delivery system.

There is interdependency between the cost effectiveness and the connection and financial contribution of users to the system. However, a mass of adopters thus their financial participation can be attained if a reasonable economic incentive is provided to customers. Construction, retrofit ad heating costs are unfavorable if they are not compensated with sufficient savings and benefits. In this respect, the benefits to be had from connecting to the system are those arising from reduced heating costs and an attractive payback period, consequently. According to the studies done on payback periods necessary to trigger an action on energy measures “less than five years” is an acceptable time period (Rafferty 2003, p. 7).

On the other hand, community acceptance of connecting to district heating system can be difficult to measure and forecast. Especially, in the absence of an exhaustive survey of inhabitants, it is not possible to know which particular buildings and dwellings will connect. Therefore, different levels of user participation are to be considered in cost estimations, such as 100 %, 50 % and 33 % participation rates. The economies of scale in geothermal district heating stem from spreading the fixed costs of the well, heat exchanger, and trunk pipelines over more users, and from using larger diameter pipes, and can be achieved only by expanding the size of the service area to capture more costumers. However, expanding the service area increases the pipeline network development costs, and may necessitate the construction and operation of substations due to heat loss. In that circumstance, the economies of scale can be offset by the additional costs of increasing the service area to gain economies of scale (Sommer et al. 2003).

Therefore, geothermal district heating would be most economically feasible in urban areas with high population density. Urban densities would allow the capital costs to be spread over a large enough customer base without excessive pipeline or substation costs. Moreover, it is apparent that the lack of mobility of the energy from its source location is the greatest hurdle faced by the geothermal energy. Geothermal fluids can be moved only several kilometers without losing too much heat. In that case, due to its low temperature geothermal district energy again necessitates the spatial concentration of users as the primary determinant of the viability of the district heating system. This spatial concentration of energy demand is called as *thermal* or *heat load density*, and that heating (and cooling) load densities that is the heating/cooling requirements per unit area, are required to be relatively high in order to achieve economic feasibility and system efficiency.

According to the study done by Whalman in 1978, in which numerous district heating systems in Sweden were evaluated in order to establish the relationship between district heating viability and heat load density, the favorability ratios [Eq. 6] base on the geography, proposed service area and heat load are as below (Bloomquist and Boyd 2000):

$$\text{Study Area Favorability Ratio} = \frac{\text{Study area net density of annual heat use (KJ/ha/year)}}{\text{Minimum heat sales needed for system-wide operation (KJ/ha/year)}} \qquad [6]$$

<u>Favorability Ratios:</u>

>5.16	Very Favorable
3.75 – 5.16	Favorable
1.49 – 3.74	Possible
0.89 – 1.48	Questionable
<0.89	Unfavorable

Whalman's study was validated by Brewer later in 1998, and the relationship between heat load and economic viability was given with respect to urban structure characteristics (Table 3.2).

Table 3.2: Economic viability based on heat load (Toksoy et al. 2003)

Urban structure	**Heat load density**		**Favorability for district heating**
	MW/ha	**Kcal/hm2**	
City center, skyscrapers	> 0.70	> 60	very favorable
City center, multi-storey buildings	0.51 - 0.70	44 – 60	favorable
Sub-center, commercial buildings and multi-family apartments	0.20 - 0.51	18 – 44	possible
Two-family houses	0.12 - 0.20	10 18	questionable
single-family houses	< 0.12	< 10	unfavorable

3.2.2. Geothermal Energy Utilization in Turkey

Turkey is located on the Mediterranean sector of the Alpine–Himalayan Tectonic Belt and is among the first seven countries in abundance of geothermal resources around the world, and among the first five leader countries in its geothermal direct use applications. However, the share of its potential used is only about 2 %. Until now, 400 geothermal production wells and 300 gradient wells have been drilled. 305 of total wells were drilled by the MTA. The regional distribution of the wells drilled by the MTA is: 87 % in western Turkey, 11 % in mid-Anatolia, and 2 % in eastern Turkey. High enthalpy geothermal fluids exist mostly in west of the country. The distribution of geothermal fluid temperatures by region is given in table 3.3.

The equivalent of 61,000 residences are currently heated by geothermal fluids. A total of 665 MW_t is utilized for space heating of residential, public and private property, and 565,000 m^2 of greenhouses. Geothermal fluids are also used in 195 spas (327 MW_t), bringing the total direct use capacity to 992 MW_t. The target for the year 2010 is to install 500 MW_e for power generation, 3500 MW_t for space heating and 895 MW_t for spas. By 2020, 8300 MW_t (1.25 million residences equivalent) of heating and 2300 MW_t of spas will be completed (Mertoğlu 2003, Lund 2001).

Table 3.3: Temperature distribution of well outputs by region in Turkey (Hepbaşlı and Çanakçı 2003, p: 1289)

Western Turkey		Middle Anatolian		Eastern Turkey	
Temperature range (°C)	Percentage of region	Temperature range (°C)	Percentage of region	Temperature range (°C)	Percentage of region
240–250	1	90–100	5	160–170	6
230–240	2	80–90	4	80–90	6
220–230	2	70–80	4	70–80	6
200–210	5	60–70	4	60–70	16
190–200	11	50–60	17	50–60	16
170–180	5	40–50	34	40–50	38
130–140	2	30–40	32	30–40	12
110–120	7				
100–110	3				
90–100	21				
80–90	5				
70–80	8				
60–70	7				
50–60	9				
40–50	7				
30–40	5				

At present there is one geothermal power plant already operating at Kizildere and one due for construction very soon at Germencik (in Aydın-Germencik geothermal field). Kizildere geothermal power plant was built by a consortium including GIE and ENEL (Italian Electricity Company) between 1981 and 1984, put into operation in February 1984. The installed capacity of the power plant, which is currently operated by the state-owned electricity company TEAS, is 20.4 MW_e and the generation capacity is 108 GWh (Mertoğlu et al. 2003). Moreover, part of the CO_2 separated in the condenser in the Kizildere power plant is piped to a liquid CO_2 and dry-ice factory installed next to the power plant, where about 120,000 t/year of dry ice and liquefied CO_2 are produced for the carbonated beverage industry. The initial installed capacity of the power plant at Germencik, which is constructed under the BOT (Build-Operate-Transfer) programme, would be 25 MW_e, with plans to expand it gradually to 100 MW_e.

In terms of greenhouse heating, the installed capacity is 131 MW_t and the total area of greenhouses heated by geothermal energy is 565,000 m^2 (Table 3.4). There is a high potential for geothermal applications in the tourism sector. Apart from heating residences, geothermal fluids are also used to heat the hotels, motels, and facilities in thermal spas in Turkey. The demand for balneological use of geothermal water is increasing, too. Thermal and balneological facilities increase the variety and number of tourists and the extension of the high season to 12 months instead of the 4–5 months of a conventional tourism season.

Table 3.4: Geothermal greenhouses by location, area and capacity in Turkey (Mertoğlu et al. 2003, p. 424)

Geothermal greenhouses in Turkey

Location	Area (m^2)	Capacity (MW_t[a])	Location	Area (m^2)	Capacity (MW_t[a])
Sanliurfa	106,000	24.5	Dikili	120,000	24
Simav	120,000	33	Gölemezli	1000	0.2
Sindirgi	2000	0.4	Seferihisar	6000	1.06
Afyon	5500	1.5	Bergama	2000	0.4
Kizildere	10,750	2.4	Germencik	500	0.1
Balcova	100,000	17.6	Edremit	49,620	8.7
Kestanbol	2000	0.4	Ezine	1500	0.3
Saraykent	2000	0.6	Niksar	500	0.14
Tekkehamam	8000	1.8	Kizilcahamam	5000	1.45
Yalova	600	0.12	Gediz	8500	2.1
Kozakli	4000	1.2	Canakkale-Tuzla	50,000	9

[a] Load factor of 0.6.

Geothermal district heating systems are the main geothermal utilization in Turkey. First district heating systems in the country were the geothermal systems, and that the district heating system applications in Turkey were started with large-scale, city-based geothermal district heating systems (Mertoğlu et al. 2003, Mertoğlu 2001). There are 11 city-based geothermal district heating systems in Turkey (Table 3.5). The first application dates back to 1987, and since then, a great deal of experience in the technical and economic grounds has been attained.

Table 3.5: Geothermal district heating systems in Turkey (Mertoğlu et al. 2003, p. 423)

Town	Geothermal heating capacity (in residential equivalent)	Integrated geothermal application[b]	Year of start-up	Geothermal water temperature (°C)	Geothermal heating fee paid by the customer (US$) (2002/2003 winter season)[c]
Gonen	3400	B, I	1987	80	27
Simav	3200	B, G	1991	120	26
Kirsehir	1800	B	1994	57	21
Kizilcahamam	2500	B, G	1995	80	21
Izmir-Balcova	11500	B	1996	137	19
Afyon[a]	4500	G	1996	95	25
Kozakli[a]	1000	G	1996	90	28
Izmir-Narlidere	1500	-	1998	98	19
Diyadin[a]	400	B	1999	70	n.d.[d]
Sandikli	2000/5000	B	2000	70	14
Salihli	2000/20,000	B	2002	94	15

CHAPTER 4

INTEGRATION OF RENEWABLE ENERGY TECHNOLOGIES INTO CITIES

Integration of renewable energy technologies into cities, formulated as initial concept of renewable energy question addressed in this study, refers to integration of new advanced technologies into urban environments through urban energy planning and management in order to achieve urban sustainable development. This definition and the main concept, therefore, consists of three sub-concepts; technology as a solution to both global and local environmental problems, city as a unit of action, and urban energy management and planning as a course of action, process of using the tool of technology in the framework of integrated energy-environmental strategies.

The following sections introduce the context and extent of these sub-concepts with the aim of explaining why cities should adopt renewable energy technologies and how cities can employ their potentials and how they can introduce and implement technological innovations at the urban level for the purpose of local sustainability.

4.1. Renewable Energy: Technological Solution to Environmental Problems

Renewable energy systems are regarded as sustainable technologies or *sustainable energy supply systems* and promoting their development and widespread use is viewed as a *technological solution* to sustainable development. The introduction of renewable energy technologies into energy production system is seen as *a new pattern of energy production* based on smaller scale generation systems operated on a more decentralized base in a liberalized market.

From the viewpoint of *decentralist* tradition, the emphasis on technology can be explained by *appropriate technology* –sometimes called as *alternative technology*- approach that its origin relies on the term *intermediate technology* defined by E. F. Schumacher in 1973: "technology of production by the masses, making use of modern knowledge and experience, conducive to decentralization, compatible with the laws of ecology, gentle in its use of scarce resources and designed to serve human person instead of making him the servant of machines" (cited in Roseland 2000, p. 91). Central tenet of appropriate technology is that a technology should be designed to fit into and be compatible with its local settings, and aims at promoting the creation of self-reliant communities. The characteristics of self-reliant communities are; low resource usage coupled with extensive recycling, preference for renewable over non-renewable resources, emphasis on environmental harmony, emphasis on small-scale industries, and a high degree of social cohesion and sense of community. The physical and social images of these characteristics can be exemplified as passive solar design, active solar collectors for heating and cooling, small wind turbines or PV's to provide electricity, roof-top gardens and greenhouses, permaculture and worker-management craft industries. Schumacher's note on renewable energy sources (cited by Todd 1997):

> A civilization built on renewable resources, such as the products of forestry and agriculture, is by this fact alone superior to one built on non-renewable resources, such as oil, coal, metal, etc. This is because the former can last, while the latter cannot last. The former cooperates with nature, while the latter robs nature. The former bears the sign of life, while the latter bears the sign of death.

With respect to *techno-economic framework* of innovation theorists, renewable energy technologies as a new pattern of energy generation is a part of a *green techno-economic paradigm* in which technological and social patterns both interact and change. In this new paradigm, new strategic technological outlook develops from and interacts with newly emerging environmental value system, which is conditional on changes in institutional and social infrastructure (Elliott 2000). *Innovation theory* is used in linking the concept of sustainability and the new energy paradigm. If sustainability necessitates a continuous *invention* of new opportunities and a permanent aspiration for a better world comprising evolutionary change and adaptive responses to new technologies, *innovation* –creative destruction- is the key to progress (Mega 2002). Implying a radical shift to the creation of new ideas, products and processes innovation is the politics of implementing inventions. In other words, it is a process involving a thorough change and opening up range of opportunities and an organizational restructuring that allows new products, concepts and ideas to bring about the desired transformation and progress.

The technological and institutional innovations, thus the role of technology as a solution to environmental problems is supported by *ecological modernization theory* which has emerged as an attempt to understand these developments within sociological debate on the nature of modernity. Contrary to the disindustrialization idea of appropriate technology approach based on Schumacher's work of *Small is Beautiful,* ecological modernization theory is relying on Huber's *super-industrialization* idea that meant addressing environmental problems through transforming production via the development and application of more sophisticated technologies. Developed from the mid 1980s, the theory has been used in both a descriptive and prescriptive way concerning the development of industrial society as an attempt to deal with environmental problems. In the mid 1990s, it is regarded as an empirical phenomena that is detectable in the transformation of the institutions of the modernity as representing the reflexive reorganization of industrial society in the face of ecological crises, and as a policy discourse composed of a set of storylines concerning the link between environment and economy mobilized by members of discourse coalitions to promote specific interests (Murphy and Gouldson 1998, Murphy 2001).

Ecological modernization sees environmental problems as a result of industrialism, and tends to view the environment in terms of energy and material flows through physical and social systems. Core themes of the theory explored by number of different academic perspectives are as follows. Macro-economic restructuring is a central element of ecological modernization involving the sectoral composition of national economies with a shift from heavy industry to less resource intensive and environmentally burdensome sectors; combining higher levels of economic development with lower levels of environmental impact. In practice, it is a government-led programme of action based on strategic planning and innovative policy instruments with industry as the center of attention. In that case, driving innovation is one of the main functions of governmental intervention. In other words, the state and the strict environmental regulation has a significant role in driving the process of innovation[9], especially through helping companies to overcome short-term barriers to innovation that commonly prevent them exploiting the longer term environmental and economic benefits of new technologies and techniques. Therefore the theory of ecological

[9] Definition of innovation as a process is "the search for and discovery, experimentation, development, imitation and adoption of new products, new processes and new organizational set-ups" (cited in Murphy 2001, p. 9). This definition covers the implementation of environmental management system at the micro level, while it means switch from product to service delivery at the macro-economic level. From economic perspective, innovations can be either radical or incremental. In the field of energy production, the switch between fuels using existing plant can be seen as radical or incremental depending on whether or not it is contrasted with the possibility of developing new gas fired power plants or promoting diffuse energy production through a renewable energy network. Radical innovations involve discontinuous change and the introduction of new technologies and techniques, and often rely on incremental improvement for their success. Incremental innovations involve gradual improvement of existing technologies and techniques, however a periodic introduction of discontinuous change is a prerequisite for successful phases.

modernization is based on the belief that there is no necessary conflict between environmental protection and economic growth (Murphy and Gouldson 1998, Murphy 2001).

In accordance with *market paradigm of liberalization*, the approach for renewable energy technologies is their development in market conditions and their penetration into competitive electricity market. Actually, liberalization of energy market, aiming at reducing the price of electricity through competition, does not provide much opportunity for radical innovations to combat climate change and deliver persisting environmental benefit (Weinberg 2001). Moreover, since it is the cheapest energy that wins in the competition, the winners are not the environmentally benign power systems. However, what market offers as a solution to environmental problems is the translation of environment into the language of market through the use of tradable economic instruments, which means representation of environmental goods and evils as tradable commodities (Crookall-Fallon and Crozier-Cole 2000). Correspondingly, while experimenting a number of mechanisms and stimulation measures in order to provide value to renewable energy sources so that businesses can operate according to known economic principles and to increase their competitiveness in the generation mix, the electricity sector is also trying to develop tradable economic instruments, which embodies the environmental benefits of renewable energy generation. The methods used are generally grouped into two concepts: i) to create the market and let capital flow to it; such as, a certain percentage of the generation to be composed of renewable generation, or green market certificates, etc., and ii) to create the capital and by from the market; such as tax policies, Non Fossil Fuel Obligation experimented in England, etc. It is suggested that creating market works best at a wholesale or central generation level and that creating capital is more effective at the retail or distribution level (Weinberg 2001).

4.2. Renewable Energy in Cities: Urban Energy Management and Urban Energy Planning

Depending on the fact that all GHG emissions are directly or indirectly generated locally as spatial concentration of economic activities implying a concentration of energy use resulted in concentration of emissions and air pollution, cities are considered as focal point of departure.

With reference to the role of technology and innovation in meeting growing energy demand of cities in a secure, reliable and sustainable way and in enabling a smooth transition from fossil-fuel economy to renewable energy economy, Mega (2002), defining cities as "huge, untapped reservoirs of ideas, enthusiasm, commitment and labor", as "places where creativity concentrates" further articulates that:

> From a new idea to its grafting into a mainstream policy, the birth, growth and death of an innovation depend on a city's creative assets and their mobilization towards meeting urban challenges. As nobody holds the monopoly of innovation, the recognition of the creativity of every individual actor and willingness to accept shared responsibility are essential. All approaches require vision, strategy and planning, concerted action and effective coalitions to build on radical change and incremental progress. ….Cities must harness the power of new technologies and social innovation to explore their truly endless frontiers and optimize their concentration of knowledge and information. (p. 32)

Accordingly, she suggests that incorporation of cleaner, renewable energy be achieved if an appropriate comprehensive planning is developed for urban areas, which also requires a new local socio-economic environment to facilitate the penetration of new technologies into market.

With visioning of cities as net renewable energy producers, Droege (2002) takes attention to the role for cities as translating international and national agreements into local level, grappling with the issues of technological innovation, equitable emissions targets, the prospect of urban carbon trading and the pursuit of full integration with mainstream of urban management. Therefore, investing in renewable energy and promoting development of advanced industries not only reduce fossil-fuel dependency of cities but also provide being capable of competing nationally as well as internationally. Arguing limited capacity of efficiency and conservation measures to reduce fossil fuel use and combat global warming, he suggests a systematic integration of renewable energy products, systems and processes in cities through sustained and comprehensive action.

Addressing renewable energy in cities as a key element for urban sustainability, Nijkamp and his colleagues propose clear definitions of renewable energy policies in line with urban energy management and planning. In the framework of sustainable urban development, renewable energy is considered as an integral part of energy-environmental planning strategies that concentrates on urban dimension of energy policy (Table 4.1). Renewable energy technologies can be addressed as components of urban energy supply systems, which can be one of urban energy policy area (Table 4.2).

The institutional setting in a country determines to a large extent the maximum policy space available for an urban energy and environmental policy. In countries with strongly centralized energy supply structures, cities have limited influence on the local supply systems. It is certain that actions towards urban sustainability strategies can be taken successfully in an institutional structure of decentralized energy and related environmental policy. Therefore, the involvement of one identifiable decision-making agency at the urban level comprising the organizational options of urban energy planning and/or urban energy management is of major importance that can enhance the institutional effectiveness. Accordingly, the role of local authorities is defined as coordinator and animator of an integrated energy-environmental planning characterized by flexibility, innovation and public support (Nijkamp and Perrels 1994).

The state of the local economy is another important factor on the actual possibilities of carrying out a local energy programme. Together with market orientation in the urban energy sector and introduction of public-private partnership configurations as organizational forms for local energy provisions, urban energy management is suggested as a means of improving local economy, providing higher degree of competitiveness and more affordable distribution of scarce resources as well as reducing environmental problems, and urban energy planning based on technological innovations is defined as a set of different and complementary energy policy strategies comprising industrial co-generation, DH/CHP systems, PV systems, combined urban waste management and energy production, and institutional reforms in the structure of utilities (Capello et al. 1999). The existence of a planning framework plays an important role in the development of urban energy supply systems based on technological innovations. A comprehensive planning involving the physical, institutional and operational allocation of competence, responsibilities and restrictions, provides successful and complementary implementations and development of urban energy supply systems (Nijkamp and Perrels 1994).

In urban energy-environment management and planning, development of energy and environmental indicators, such as saving indicators, GHG indicators, renewable and non-renewable energy use, household consumption patterns, etc. are necessary for compassing strategies and actions, and for assessing and evaluating achievements and performance of policies and programmes. In terms of strict energy efficiency, local standards are preferable to the adoption of nation-wide emission standards (Nijkamp and Perrels 1994, Capello et al. 1999, Droege 2000, Mega 2002).

Table 4.1. Framework for energy-environmental planning for urban sustainability

ENERGY POLICY OPTIONS FOR URBAN SUSTAINABILITY

Energy-environmental strategies	**Determinants**	**Policy fields**	Organizational aspects
• Reducing the growth in the actual use of scarce energy • Increasing technical energy efficiency • Wide-spread introduction of new sustainable energy technologies	• Institutional factors • Attitudes and behavior of citizens • Urban structure and morphology	• Urban planning and design • Conservation and strict regulatory energy policies • Stimulation programmes • Market based energy policies • Policies encouraging technological innovations	• Urban energy management • Urban energy planning

Table 4.2. Urban energy supply systems as a policy option

URBAN ENERGY POLICY AREAS: URBAN ENERGY SUPPLY

Policy Options	Critical conditions for actions	Favorable conditions
• Urban energy supply systems → • Urban waste management • Urban transport systems • Information, communication and marketing • Management of the municipal building and vehicle stuck • Development of integrative urban energy-environmental concepts	• Institutional frameworks for energy planning activities and energy policy (energy planning, environmental or urban planning) • Supplier systems organization and ownership, and related decision structures • Financial possibilities or constraints • Energy pricing and competition between different energy sources • Socio-cultural environmental and traditions for energy supply systems	• Existence if a legal background to initiate an organization dealing with planning and construction activities in the energy sector • Participation of all competitive energy supply systems in planning activities • Financial capacity of the organization in charge of the implementation of the energy planning • Partial control of tariff policies applied to the consumers • Follow-up procedures to ensure successful implementation

In terms of urban energy management and planning, cities and local authorities are supported by several international and regional organizations. For example, in relation to the EU Communication on urban question, the opinion adopted in Barcelona on 12th March 1998: "Energy is also a territorial policy". In this respect, it is Energie-Cités an Association of European Municipalities that contributes to the development of partnership among municipalities by encouraging experience and know-how exchanges in the fields of energy management, the development of renewable energy sources and the reduction of pollutant emissions and GHG emissions, to strengthen the role and capabilities of local authorities in the areas of energy consumption, distribution and production in short in local energy planning, to provide support in creating local energy management teams and set up a municipal energy programme and to disseminate information. Urban energy planning is defined as (Energie-Cités 1994):

- Having and overview of the whole of one's territory in terms of energy and environment,
- Identifying ways of achieving significant improvement of the energy situation with regard to consumption, production and distribution,
- Having the means to measure the energy and environmental impact of one's policies, and to monitor the situation over time.

It is given that a municipality, being able to play a dynamic role in urban energy planning, acts at the levels of:

- Energy production and the optimum utilization of local and renewable energy sources,
- Energy distribution,
- Energy consumption in the public and private sectors.

Accordingly four main functions, requiring working together with relevant actors, are assigned to municipalities:

- Municipality as energy consumer
- Municipality as energy producer and distributor
- Municipality as city regulator-developer
- Municipality as motivator

Solar City programme and network of IEA focuses on the energy supply and technology embedded in urban planning and design strategy and promotes a community-wide, rural and urban energy and emissions accounting system as well as performance targets that are linked to urban development and reform initiatives. It has three thematic areas of inquiry; sustainable energy focused urban planning strategies, targets baseline studies and scenario development and urban energy technology, industry and business development, and two general investigation programs to operate across these are; best practice cases and learning in action.

The OECD group on Urban Affairs addresses different aspects of energy dimension of urban areas and emphasizes the necessity of urban energy management through the project of “Environmental Improvement through Urban Energy Management”, which includes a series of monographs and workshops. In Urban Energy Handbook (OECD 1995) it is given that,

- Cities can act as initiator of innovative experiences in the energy field
- Participation and support of local communities are necessary
- Participation of municipalities in the production and distribution of energy in order to avoid conflicts of interest when implementing innovative energy programs
- Participation of municipalities to facilitate the co-ordination and integration of sectoral policies and to integrate energy considerations at the beginning of the decisional process
- An explicit national framework which sets the medium and long term objectives, which affirms the security of energy provision and environmental protection, which identifies the institutional and financial instruments to achieve those objectives
- The full cost of different energy technologies should include not only economic but also environmental and social factors.

The cities and regions of North America are engaged in the principles of *community energy planning* (CEP), which means the consideration of energy supply and demand in the design and development of regional districts, municipalities and neighborhoods. It involves land use and transportation planning, site planning and building design, infrastructure design and efficiency and planning for new energy supply options. It is suggested that integrating community and energy planning and by considering the impact of plans and policies on energy demand, community planners can minimize their energy requirements, save money, increase local economic activity and reduce environmental problems. The B. C. Energy Aware Committee –a group of public and private agencies and companies- aims at promoting and encouraging CEP by educating governments, officials, planners and developers on how to integrate energy into local planning processes, use local resources in the design and operation of communities and identify local strategies.

4.3. Critical Factors for Integrating Renewable Energy Technologies into Cities

The developments in the field of renewable energy technologies and their adoption by political grounds, cities and regions, investors and producers and the users have shown considerable progress in recent years. However, the acceleration in progress, actually, in the adoption process is rather slow due to several factors. It is certain that each technology depending on their characteristics requires different set of policy and implementation strategies, new learning processes, new competences and organizational solutions at both the demand and supply side and also implying high adoption costs. Therefore, the availability of any source or technology, or the choice of a certain strategy does not automatically mean that this particular option can easily be implemented since there can be many obstacles preventing an efficient implementation of renewable energy system in a city.

In their study of investigating benefits and feasibility of renewable energy policy potentials in urban areas, Nijkamp and his colleagues (Capello et al. 1999), by using Pentagon Prism approach, categorize critical conditions into five broad areas: technological factors, organizational factors, financial factors, environmental and social factors, and user related factors (Table 4.3). Since the cost of energy, thus the economic aspects of renewable energy developments is the most important factor in decision-making process, the researchers emphasize also the techno-economic features of renewable energy technologies through the factors of technological indivisibilities, complementary technologies, adjustment and sunk costs as part of critical conditions in the adoption process.

<u>*Technological factors*</u> depend on the level of technological sophistication of the used system or resource. In general, it is the *R&D activities* stimulates technological progress in renewable energy systems, however achieving a significant improvement requires high R&D costs. In the early stages of technology adoption and in the case of insufficient national support the reliance on foreign technologies and experiences is preferred. But a sufficient level of know-how for local applications and thus

qualification of human resources is crucial. On the other side, since the source of energy is directly related to the prevailing *climatic characteristics* of a region (intensities of wind, solar radiation, natural heat sources from earth, presence of large quantities of water, etc.) renewable energy technologies are site specific that necessitates be exploited where it occurs. Therefore, the location of the supply and the demand for energy on that location is critical. Besides locational factors, *efficient size of technology* is essential for achieving an optimal regime of energy production. For example, in the case of DH, the large size allows greater efficiency but it requires more complicated and expensive technologies that can decrease the profitability of the development. For PV systems or wind power large scale provides more energy production however, involving very high costs together with the land requirements. In that case, small and medium size developments are more appropriate and efficient.

Organizational factors refer to institutional and management aspects such as political willingness, structure of the energy supply system, division of responsibilities and market conditions. Political willingness and awareness is very significant for the evolution of renewable energy technologies, which have high initial costs that require support systems by national government. The *political attitudes* range from a fairly leisurely incremental approach to radical programmes for adopting renewable energy technologies. However, governments generally prefer energy efficiency improvements on the already existing technologies where the technological change do not require any disruptive shifts towards a new technological paradigm. In relation to *institutional inertia*, Elliott (2000) claims the problem as a mismatch between new technology and the existing support infrastructure, arguing that renewable energy technologies are trying to establish themselves in an institutional, organizational and financial context, which is based on conventional types of energy technology. That means the support system of large scale concentrated forms of energy do not suit to the acceptance and management of many renewable energy technologies that are diffuse in form and smaller in scale. The institutional inertia can also be explained with the *vested interests in the status quo*. There is strong forces defending the technological and institutional status quo and fossil fuels interests deny even the reality of climate change. As articulated by Mega (2002):

> Any innovation creates the conditions for its won demise. The more established a system, the more difficult to change. Vested interests resist change, and resistance increases when innovations touch the core interests or boundaries of

> institutions. This is particularly relevant for energy, because infrastructures, investments and practices are long-lived and well established. (p.32)

Financial factors, financing aspect of renewable energy initiatives, are crucial for innovative projects. The high initial costs especially for large-scale projects necessitate proper financial schemes. Most of the large projects have been financing by international, European programmes and governmental schemes. Bank consortiums aiming to participate and financial participation of users are such financial models used. Actually, to obtain funding is relatively easier, in the case of small-scale developments and local ownership that banks invest in these local projects. In addition to the investment cost, profitability is a decisive factor for energy producers. Once the initiative financed by a private or governmental scheme, the operation of the project should be profitable for the producer. Different technologies have different payback periods and also maintenance costs of projects represent a variety due to technological simplicity or complexity.

User related factors refer to potential existence of users and their behaviors. The public attitude or socially acceptance of new technologies is an important issue. In general, the behavior of users is mostly affected by the technical reliability, the quality of the service, economic cost and financial support. The customer demands the cheapest package of energy supply and the service in best quality. If the environmental and energetic advantages of the technologies not accompanied by economic savings, the public remains passive or reacts. The process of promoting the awareness among people gains importance. Governmental intervention by developing pilot demonstration projects and informing people has a vital role in social acceptance. The existence of potential users is critical for the implementation of projects. Some technologies require participation of large users, and there can be lack of sufficient user where potential supply exists.

Environmental and social factors: Renewable energy technologies are welcomed on environmental grounds as they are clean and carbon free. However, each technology due to its own characteristics has some impacts on local environment, and their widespread use inevitably involve some changes in land use patterns, spatial structures and landscapes. In the case that the use of renewable energy technologies causes significant changes in lifestyle and consumption patterns of the society public reactions and opposition occurs as a constraint on the development of projects.

Table 4.3. Critical factors for the adoption of renewable energy technologies

	Photovoltaic systems	**Wind energy systems**	**Biogas from disposals**	**Incineration of waste**	**DH with non-renewable sources**	**DH with renewable sources**
Technological factors	R & D costs are high Configuration of technology is simple Climatic conditions are significant	The cost of technology depends on wind speed Technology is quite simple	R & D costs are at acceptable levels at present Technology is widely available and implemented Technical compatibility with existing disposal plants Availability of complementary technologies Sunk costs can emerge Strategic role for integrated waste management	Particular climatic conditions can affect the incinerator characteristics with costly environmental and technical consequences Resort to foreign experiences Technical incompatibility regarding variable composition of waste Need for specific know-how	Consolidated and widely available technology Technical compatibility with old thermal plants and water, gas and oil network Large strategic role in energy supply system Reliable technology A large size of implementation should be achieved through gradual pattern of development	Technology is available Technical compatibility with DH and gas-oil The variable composition of refuse causes unsafe performances Stronger safety parameters are needed Sufficient high level of R & D.
Financial	Sunk costs of appliances Low maintenance costs Pay-back periods are long	High initial costs for land, turbines and connection to the network Low costs of maintenance	Relatively short pay-back periods High initial location costs	High R & D costs High sunk costs when old incinerators have to be substituted Resort to governmental subsidies	High R & D costs Self financing or public financing initiatives High initial costs Low maintenance costs	Profitability is more at risk than DH with non-renewable source due to high initial costs Subsidy schemes are not resort to third part financing

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Table 4.3. (cont.)

	Photovoltaic systems	Wind energy systems	Biogas from disposals	Incineration of waste	DH with non-renewable sources	DH with renewable sources
Financial factors	Financial participation of users is not beneficial National subsidy schemes are insufficient Prices of other energy sources are more competitive			Relatively short pay-back periods in cases of private management Resort to tools of third part financing, participation of users Incinerators have a lower cost/benefit ratio when they are not connected to a large-scale or small DH		
Organizational factors	Strong political, organizational willingness is necessary to bear high costs The market is not free Low cost of management due to the simplicity	The market is becoming more competitive Small to medium scales are more appropriate Low management costs	Problems can occur in the organizational cooperation if too many actors involved in production, transmission and selling of energy Problems may arise when energy producers and waste managers coincides	There is a need for integrated waste management Staff qualification, high specialization is required	Integrated energy companies facilitate coexistence between DH and methane Organizational and political cooperation is required to face high investment costs Technical qualification costs Market conditions are favorable when DH and methane are not	Large commitments in organizational cooperation are needed High initial costs Technical re-qualification costs

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Table 4.3 (cont.)

	Photovoltaic systems	Wind energy systems	Biogas from disposals	Incineration of waste	DH with non-renewable sources	DH with renewable sources
Ecological/Social factors	Saving of non-renewable energy sources Reducing carbon emissions Visual impact Orientation and the nature of spatial structure is significant for system efficiency Availability of land or space for small scale installations	Substitution of non-renewable energy with cleaner sources Various environmental impacts such as noise, shadow flickering change in landscape, visual intrusion Public resistance due to these impacts Availability of land The compatibility of wind farms with the other land uses	Synergies with integrated waste management the advantages, even in terms of reduction of bad smells are not yet perceived as important by the public Disposal treating activities are irritating	Reduction of methane, bad smells and space problems Air pollution due to incineration Dislike for the general concept of waste incinerators	Large energy saving Reduction of air pollution Location problems in the case of central plants Visibility and other impacts are accepted when there are economic advantage	Initial location costs and technical studies for environmental impacts Energy saving Air pollution from incineration reduction of refuse in disposal Nimby syndrome
User-related factors	Critical mass of users is difficult to be achieved High technical reliability for users that have panels to be connected to electric network installed on roofs or walls	System reliability is set off by discontinuity of the source	The success of this technology depends on the attitude of public toward separated waste collection and their willingness to change their habits	Optimal reliability for users	High technical reliability for users Resistance by users to modify their habits for what concerns the timing of energy supply Large users or high dwelling density	High technical reliability for users Large users or high dwelling density

4.3.1. Techno-Economic Features of Renewable Energy Technologies

The adoption of incremental innovations of renewable energy is very much influenced by the relative prices of technology. In other words, the price of energy input factors related to the production of energy is the most important variable in the decision-making process of adoption. Accentuated by Nijkamp and his colleagues (Capello et al. 1999), indivisibilities, complementary assets, adjustment and sunk costs are the features that influence the costs of adoption of renewable energy technologies.

Due to technological *indivisibilities*, renewable energy technologies require substantial additional development or market penetration and an achievement of a mass production in order to exploit economies of scale in the use of the new capital stock before they can produce under efficiency goals and make significant contributions to national energy supplies. Mass production lower the high fixed capital costs. The technologies, which are most dependent on mass production and whose economic value very much depends on mass production to guarantee optimal production levels are active solar space and water heating systems, small to medium sized wind energy systems, parabolic troughs and small PVs. The achievement of a critical mass of users is a significant factor in terms of creating a self-sustained integration mechanism, especially in the development of CHP systems combined with local DH. In this case, the number of potential users, who, at the same time, share the implementation costs of the plant, definitely influences the profitability. Related with mass production and critical mass of users, enormous R&D efforts and appropriate information and commercialization campaigns are necessary.

Another indivisibility issue is the environmental awareness, and the willingness to pay for environmental protection by all actors, such as producers, governments and users. Ecological awareness of local governments is essential to achieve social consensus on some renewable energy technologies. Strong local resistance can be faced if and ecological culture is not widely developed.

In relation to technological indivisibilities, radical changes in the urban planning system is required if renewable energy supply technologies are introduced at the urban level. This change necessitates strategic integration between different urban functions together with a new stock of knowledge and experience. The development of CHP/DH systems can be promoted; through planning and developing the infrastructure needed by identifying the possible sites or structures that are owned or operated by municipalities or other local authorities, and through preparing plans for new developments and arranging land uses and spatial structures by taking all required technical aspects of energy systems into account. The arrangement of new industrial, commercial and residential areas can make CHP systems possible and efficient. The strategic integration of energy supply and planning is vital for passive and active solar energy technologies. Solar energy principles should be taken into account in planning, design and orientation of new residential areas.

Renewable energy systems require a set of *complementary technologies* for their implementation. Since they are systemic, a radical change in the core technology implies changes in all complementary technologies. For example, a radical change in DH system necessitates a change in the distribution grid, or a new distribution gird if energy produced by a discontinuous source like wind and sun, and sophisticated electronic systems to manage and run the electric distribution network when energy is produced and inserted in the network by more than one agent. Accordingly, all these changes require a new technical know-how and training of staff, which results in additional costs.

Adjustment costs are the costs of shifting from one technological paradigm to another. The cost of development and management of a new distribution grid after the installation of a new plant is a sample for adjustments costs for energy suppliers. In some cases, the cost of new transmission lines can be too expensive. Up to 1987, the maximum economically viable transmission distance of new DH distribution network was up to 30 km for hot water and 3-5 km for steam depending on the heat load and fuel price. It can be more economic to construct new heat plant production units at short distances from the demand centers than to construct a long transmission line. Adjustment costs for users differ in value when it is a new development or a retrofit development. The costs are lower in new developments but the retrofit cost of converting from a conventional heating system to a new one in existing houses and buildings can be unaffordable. It is easier to incorporate solar energy systems into new buildings especially when they are implemented as part of the design and construction of buildings. However, old housing stock is inevitably subjected to high retrofit costs. Therefore, the rate of introduction of solar energy into residential areas is directly related with the rate of construction of new buildings.

Conventional systems supplying energy from fuel and fossil energy sources are incompatible with the supply from new energy sources like wind and sun. Therefore, in the case of introduction of new supply systems over existing networks *sunk costs* arise. The distribution of energy supplied by renewable energy sources via existing urban, regional and national electricity networks is possible and be useful during the initial stages of market penetration. However, it is not an adequate and efficient strategy for long-term, full penetration due to technical inefficiencies in terms of high losses in produced energy.

A renewable energy technology that favors local environmental quality, reduces global GHG and provides cost saving in energy use can be offset by investment costs in technology development and network adjustment and operation costs due to inertia in social environments. That trade-off between benefits and costs is indispensable.

4.4. Concluding Remarks

If cities are centers of energy demand and facing severe environmental problems, and if renewable energy is a solution to improve air quality, to combat climate change and to reduce fossil-fuel dependency radical change is vital for widespread use of renewable energy sources in cities.

As renewable energies embrace a wide spectrum of options ranging from solar, biomass, wind energy to geothermal and CHP applications, each option requires different set of policies and implementations strategies, new learning processes, competences and organizational solutions at both the demand and supply side. In this respect, a decentralized renewable energy policy is the combination of the application of a specific technology, the mixture of the organizational and financial structure and the promotional activities, and the setting of each application in each city is unique.

This definition emphasizes the course of action comprising the design, selection and implementation of renewable energy strategies, the investigation of the renewable energy potentials in terms of benefits and of feasibility and the setting of an appropriate framework within which renewable energy policies and programmes can successfully be implemented depends on the consideration and assessment of technological, organizational, financial and social aspects comprehensively. If it is to be mentioned that the references used here in this chapter of addressing urban dimension of renewable energy are all based on investigation and analysis of a number of local initiatives, programmes and policies implemented in European cities and municipalities. Therefore, it can be said that the progress in the field very much necessitates dissemination of knowledge and exchange of experiences.

It is necessary to consider renewable energy as a part of urban energy policy comprising energy conservation and efficiency policies in the framework of energy-environmental strategies. It can be said that the utilization of local resources can stimulate decentralization, and decentralization implies local management. Urban energy planning in conjunction with local climate protection and carbon emission reduction policies, can enhance energy and environmental strategies with feasible and concrete measures at local scale, and also improves socio-economic conditions by providing flexibility, cost-efficiency, competition and employment, and renewable energy sources and technologies provide reliable energy supply. In that case, a decision-making agency at the urban level is necessary for institutional effectiveness of energy and environmental planning.

As the pattern of development and urban planning decisions determine the energy consumption of all the sectors and actors of the city, and the production and use of energy has impact on land use and spatial structure, urban planning and design can manage and control that interdependent interaction and can shape urban environments for efficient energy production, distribution and consumption.

CHAPTER 5

INTERACTIONS BETWEEN RENEWABLE ENERGY AND PLANNING: ENVIRONMENTAL, SOCIAL AND SPATIAL CONTEXT

With respect to research objective, the initial attempt is to identify the relations and interactions between the concepts of renewable energy and planning within environmental, social and spatial context. By reading the texts through the questions of how renewable energy developments are addressed in planning literature, and what are the key issue or topics under discussion in the broader frame of literature, it is identified that the main issues of concern are: the land requirements and environmental impacts of renewable energy technologies, the question of landscape aesthetics, public attitudes, and the planning system.

This chapter includes further investigations and interpretations on topics above by considering each issue as a distinct but interrelated concept. The gathered knowledge in this part constitutes basis for the propositions of renewable energy integrated planning concerning environmental, social and spatial context.

5.1. Land Requirements and Environmental Impacts

Most of the arguments on renewable energy technologies focus on their land requirements and the potential environmental and social impacts. Although renewable energy technologies often cause fewer environmental problems than fossil energy systems, they introduce new conflicts. At a global scale the environmental benefits of renewable energy are largely, and undisputed with major contributions in reducing global emissions of greenhouse gases. However, the benefits are less clear and far more disputed at a local scale.

Due to tapping more diffuse forms of energy, these technologies require greater areas of land. Because of that, the general belief on renewable energy technologies is that they are land hungry. Therefore, land availability is one of the basic parameter. Since they require large amounts of land, the utilization of renewable energy sources competes with agriculture, forestry, and other essential land-use systems. In relation to that, the availability of required land is seen as a potential constrain on renewable energy developments, and considered as an essential factor also in assessing the resource capacity of any region.

It is given that "for every megawatt of electricity produced a nuclear power station occupies 630 sq m, compared to solar at 100.000 sq m, hydro-electric at 265.000 sq m and wind at 1.700.000 sq m" (Walker 1995, p. 4). On the other hand, while energy crops are the most land intensive renewable energy source (approximately 60 ha/GWh/year), building integrated PV systems occupy less amount of area (IEA 1998). A modern wind farm use 1 % of the total land area it occupies, and the wind turbines and their bases occupy only 0.2 %. The land for wind farm is approximately 0.08 to 0.13 km^2/MW (8-13 MW/km^2). A typical wind farm of 20 turbines might extend over an area of 1 square kilometer, but only 1 % of the land area would be taken out of use, the remainder can be used for other purposes, especially for agriculture (Andersen 1999).

The most significant environmental benefit of renewables is that they reduce three main atmospheric emissions: carbon dioxide (CO_2), sulphur dioxide (SO_2) and oxides of nitrogen (NO_2). Most renewables produce few or no emissions during operation. However, the other parts of their life cycles produce emissions associated with the energy expended during the stages. As given in the study report of IEA (1998), life cycle stages comprise resource extraction, resource transportation, materials processing, component manufacture, component transportation, plant construction, plant operation, and decommissioning. Together with the emissions, the environmental burdens associated with each stage of the life cycle vary from technology to technology. Moreover, the range of impacts from an individual renewable energy scheme also differs on the basis of life cycle stages. Within the context of this study rather than the full range of impacts, below table 5.1 includes the summary of potential environmental impacts of technologies and the main mitigating measures. On the other hand, the most important environmental burdens perceived by the public are visual and noise impacts. In table 5.2 and 5.3, technologies are categorized in terms of their visual and noise impacts.

Table 5.1: Potential environmental impacts of renewable energy technologies

Technology	**Potential Environmental Impact**	**Mitigation Measures**
Photovoltaics	Emissions of toxic chemicals during materials' processing and component manufacture.	Adoption of existing safety regulations and good practice.
	Land use - loss of habitat.	Avoidance of ecologically sensitive areas; re-establishment of local flora and fauna. PV systems incorporated in facades require no land.
	Loss of visual amenity.	PV systems incorporated in facades have minimum impact; large-scale schemes should avoid scenic areas.
	Uncontrolled dumping in landfills	Recycling of PV modules.
Solar Thermal	Thermal or chemical pollution of water bodies.	Adoption of existing safety regulations and good operating practice.
Electric	Land use - loss of habitat.	Avoidance of ecologically sensitive areas; re-establishment of local flora and fauna.
Wind	Visual intrusion.	Avoidance of scenic areas; modeling of zone of visual intrusion; choice of color, structure type and layout or turbines; screening.
	Noise.	Careful site selection; application of statutory or recommended noise limits at nearest properties; use of modern, high standard turbines.
Small-Scale Hydroelectric	Visual intrusion.	Careful site selection, landscaping, choice of materials.
	Changes to local ecosystems habitats, water quality and flow	Avoidance of ecologically sensitive areas; re-establishment of local flora and fauna; maintenance of minimum levels of water flow.
	Mortality in fish and disruption of spawning and migration.	Incorporation of fish ladders, passes and screens.

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Table 5.1 (cont.)

Geothermal	Emissions of hydrogen sulphide during operation.	Widely used processes available for removal of gas; no emissions if binary plant is used.
	Noise and visual impacts.	Careful site selection, screening of site and good working practices.
	Degradation of natural features.	Careful site selection, fluid re-injection into wells.
	Pollution of ground and surface waters.	Effluent treatment, ponding of wastewater and its re-injection into deep wells.
	Ground subsidence.	Fluid re-injection into wells to maintain well pressure.
Energy Crops	Emissions from combustion.	The combustion of carbon from organic origins is CO_2 neutral, because the carbon was originally sequestered from the atmosphere. Other emissions can be limited (where necessary) by various abatement techniques.
	Noise.	Careful site selection.
	Changes to local ecosystems.	Careful site selection - energy crops may improve biodiversity if planted on agricultural land.
All Waste Technologies	Noise, odour, visual intrusion from plant and transportation of wastes and other operations.	Careful site selection.
Wet Agricultural Wastes	Emissions from combustion of CH_4.	Combustion of gas oxidises CH_4 to CO_2 and thus reduces global warming potential.
Landfill Gas	Emissions from combustion of CH_4.	Combustion of gas oxidises CH_4 to CO_2 and thus reduces global warming potential.
Waste Incineration	Emissions of toxic compounds (heavy metals, dioxins, etc.) and acid gases from combustion.	Proven abatement techniques reduce emissions to safe levels.

Table 5.2: Facilities with potential noise impacts (CEC 1993)

Facility Type	Potential Noise Impact
Most facilities during construction	Equipment and delivery noises
Facilities with solid delivery (Biomass, Municipal Solid Waste)	Delivery equipment noises
Biomass facilities	Fuel chipping/grinding
Facilities with pressure release valves (Cogeneration, Biomass, Geothermal)	High pitched steam release valve noise
Wind Power	Turbine noises and vibration

Table 5.3. Renewable energy technologies with potential visual impacts (CEC 1993)

Technology	Potential Visual Impact
Wind Turbines	Large tracts of land Highly visible locations (ridges) Change from rural to industrial
Solar Facilities	Large tracts of land Concentration of sunlight Change from rural to industrial Vegetation removal, scarring
Geothermal Electricity Facilities	Large plants Cooling tower plumes Drilling equipments Change from rural to industrial Vegetation removal, scarring
Combustion Facilities	High exhaust chimneys Emission plumes Massive appearance
Transmission Lines	Industrial element Long linear facilities Impacts can depend on tower type

5.2. Renewable Energy Landscapes and Aesthetic Question

The issue of visual impact that caused by the novel technologies is among the main topics of discussion related to renewable energy developments in conjunction with the concepts of environmental impact and public attitudes. In fact, it is necessary to distinguish the condition of visual impact and environmental hazard. Visual impact is a matter of aesthetics. In the case of renewable energy especially wind energy developments the problem is about the visual changes in the landscape. In other words, it is the interference with rural landscape aesthetics or with local visual amenities.

Actually, rural areas are places of conflicting economic and cultural demand and subject to change owing to patterns of land use, agricultural techniques, ownership structure, transportation systems, in short the growth. Also, the rural landscapes are not only a workplace but also a playground for urban dwellers seeking revitalization, a highway for the tourist, and now a resource site for energy. In this respect, the interpretation of the rural landscape is subjective and selective depending on both cultural influences and individual preferences. Landscape is perceived as beautiful if its character meets the existential needs of the individual, and the landscape, as scenery is beautiful not only by virtue of its appearance but also its evolutionary history symbolizing memories, past lives and expressing cultural, historical continuity. In that case, the quality of landscape has more to do with feeling and knowledge than visual perception alone.

The landscape is fixed in the eye and mind of the individual but the land is changing though slowly. Accordingly, the main landscape problem especially in the case of wind power can be given as the impact of the rate of change. The turbines alter the landscape more entirely and more rapidly than any other type of land use even in a day. This is a contradiction between the inertia of perceptions and the immediate and unavoidable visual changes. For Pasqualetti, it is the intrinsic spatial contradictions of wind energy that he also calls it as a paradox of power: “No other energy landscape is simultaneously so intrusive yet benign, so dynamic yet site-specific, so hated by some yet championed by others, so chaotically distributed in one place while being neatly regimented in another” (2002, p. 156)

In order to reduce public resistance and gain their acceptance it is generally argued that the wind industry should change the way it introduces wind turbines to the landscape in a way grasping the landscape as a social arena, understanding the social landscape through establishing dialogue with people concerning how they make use of their surrounding and what they feel is important to protect in the landscape, and striving to be a good neighbor (Hammarlund 2002, Short 2002, Gipe 2002). Moreover as Righter states "the future of the wind energy field is a matter not only of engineering, but of the social sciences and the humanities" (2002, p. 38).

Besides the required changes in industry, it is also suggested that it is necessary to define a new environmental aesthetic –redefinition of values, to alter present public perception of landscape (Short 2002), to educate the public about the desirability of wind energy (Righter 2002) informing that "our electricity has a cost, that it comes from somewhere… our energy demand has a price, that someone must pay it. As wind power expands, we will come to appreciate more fully the advantages that this form of generation promises over other sources: that it poisons no trees, heats no air, triggers no cancers, drowns no canyons, and kills no seals" (Pasqualetti 2002, p. 168).

Moreover, the use of the language of art is suggested as a tool for the question of wind energy landscape aesthetics (Short 2002, Nielsen 2002, Righter, 2002). That is the participation of landscape architects at the planning stage of projects, seeking the compatibility of landscape and technology and presenting the outcome by using various visualization techniques. Likewise, it is necessary to consider landscape planning as an integral part of all stages of planning, a planning instrument to put nature conservation objectives into practice spatially (Krause 2001). Below sub-title includes a set of measures that can be used as a guide for local planning and building regulations and for designing wind farm projects.

5.2.1. Wind Farm Design Criteria

In general, the extent and specific configuration of turbines vary with the terrain and local planning regulations. However, wind energy has still not been specifically included in environmental and planning legislations of many countries.

With regard to the planning and assessment of wind energy developments Hammarlund, the Swedish geographer, points out the difficulty of defining general criteria for the location of wind turbines since each landscape is unique, and puts emphasis on a standardized landscape concept.

Regarding the design of wind farms Nielsen (2002), the Danish landscape architect, identifies that it is the landscape with its shapes and contours indicates the direction and extent of the development, and the character, structure and topography form the basis of any project. Considering wind turbine as a gigantic sculptural element –a land-art project, the actual design, spacing, height, type of turbines and surface treatment, therefore, inevitably depend on the potential of the landscape. Accordingly the designer seeks to enhance the contours and contrasts and to make machines and the landscape as a coherent unit.

In wind energy landscapes, form and function are inseparable elements. In terms of functional aspects;

- For optimal functioning, wind turbines must be erected so that they intercept the wind,
- Turbine spacing should provide that turbines themselves do not obstruct the flow of the wind from one to the next.

The aesthetic aspects of a wind project (the knowledge is based on long-term experiences and observations of Nielsen and Gipe) are:

- *Visual order,* as the first commandment of aesthetics;
  - Locating an array of wind turbines to be seen as a clear coherent unit, in geometric, often linear formations in contrast to the landscape
  - A wind farm be delineated in a clear, instantly recognizable in a simple way both at close range and from a distance, by identifiable shapes as a closed system with a quadratic, rectangular or triangular form and by creating rhythm and order in the internal geometry. Curved lines can be difficult to distinguish at a distance but the given formation of the landscape can underline and accentuate such forms
  - In flat and open landscapes the retreating rows of turbines in a wind farm create perspective that reveal the depth and distance of the landscape
- *Visual unity and uniformity,* as reducing visual clutter, creating harmony;
  - To encourage the eye to follow across a line of turbines without abruptly halting at a visual interruption, preventing the missing tooth effect
  - Long lines of turbines on large arrays should be separated by open undeveloped zones to create distinct visual units
  - Using greater spacing among turbines, preventing the effect of dense turbine forest

- Limiting the number of turbines in a cluster. Although some landscapes absorb large arrays, small clusters are preferred. However, the acceptable number of turbines differ with respect to different communities
- The rotors, nacelles and towers of all machines in an array are not required to be identical but should appear similar
- Removing ancillary structures from hilltop sites to avoid cluttering the skyline
- Harmonizing necessary ancillary structures by using local materials, featuring traditional building styles
- Color of turbines. In general, a light tan is suggested as suitable in arid environments and a light gray or off-white in temperate climates. However, some argue that the color of turbines should not contrast sharply with the surrounding landscape which leads to the use of gray or off-white. Others argue that there should be no attempt to obscure them since they cannot be hidden. Apart from these, whte is preferred as a symbol of purity that conveys an intrinsic and powerful message about wind energy though it presents a higher contrast

- *Protection of land and landscape*, reducing environmental impacts;
  - Minimizing earth moving and controlling erosion by avoiding steep slopes, road construction especially in steep terrain where the cut bank and spill slopes causes disturbance on landcape and leads to accelerated erosion. Respecting land and avoiding mountaintop removal
  - Minimizing roads, and using existing roads if possible. Eliminating unnessary roads, allowing buffers of undistrubed soil near drainages, ensuring revegetation of disturbed soils, restoring original contours, and designing erosion-control structures reduce the level of distrubance and the risk of erosion. The use of existing roads, farms trucks or driving overland to install and service turbines rather than grading and constructing new roads
  - Minimizing staging areas and crane pads. Staging areas are temporary facilities for assembling towers and rotors, and crane pads are used as a platform for the large cranes used to erect the tower and turbine. Creating crane pads can lead to extensive earth-moving and in steep terrain, those pads can cause additional disturbance

- *Operation and maintenance*, the condition of wind farm operation has also considerable impact on the appearance and thus the public perception;
  - Keeping them spinning. If turbines are seen spinning, they are perceived as functioning and therefore, benefial. If they do not turn, the simplest expectation from a turbine is violated
  - Removing non-operating turbines. In regard with the public perception, it is also necessary to fix broaken turbines quickly and remove those are unrepairable completely and as soon as possible.

5.3. Public Attitudes Towards Renewable Energy Technologies

Though renewable energy is seen as a crucial element in the development towards sustainability, specific renewable energy projects are controversial at the local level. Therefore, many renewable energy projects face the problem of local public opposition even though they are generally seen as good for the environment. This crisis is generally defined as the *local conflicts* concerning the *sitting of renewable energy facilities*. Such conflicts, influencing the public acceptability are seen as a significant constraint on the exploitation of renewable energy technologies. Therefore, there is a need for sensitive understanding of the reasons of conflicts, and the nature and extent of public attitudes. This knowledge of conflicts and attitudes are also essential in terms of planning process. Because, in most cases it is the planning approval process that provides the forum within which the pressures of public debate is felt, and where planning authorities have to deal with intense conflict and debate.

The issue is so much critical for all actors and fields associated with renewable energy. Therefore, there are much surveys and written documents, and considerable work on that subject in the literature. Here in this part, the aim is to point out the key aspects of the issue of public attitudes. The fundamental topics, which are identified through reviewing the related literature, are: perceived impacts of renewable energy developments, the Not-In-My-Back-Yard (NIMBY) syndrome, institutional and organizational factors, public trust and public participation, and local benefits.

As an initial step to understand what the public thinks about renewable energy developments, Gordon Walker (1995) calls attention to the problem of defining *who the public is*. He asserts that the public is far from the commonly treated meaning, as amorphous mass. Then, he divides the *public opinion* into two. Firstly, he mentions *representative views,* which are gathered through national level polls to reveal a representative picture of public support for the development of renewable energy. According to these polls, which are artificial in their context, and simplistic and abstract in their analysis, the general public opinion appear to be strongly in favor of renewable energy. The second category of public opinion includes the *local views,* which are based upon the potential or actual experience of particular developments, and comprise *active* and *passive* publics. Walker further claims that it is the passive public views, which present the real majority opinion. Moreover, it is the active public, who are represented by pressure and interest groups, and heard at demonstrations and project inquiries, and who are strongly and loudly opposed to particular projects. However, the views of those objecting to development may not be reflecting the majority of community opinion.

5.3.1. Perceived Impacts of Renewable Energy Developments

It is recognized that, in general, it is not the *direct environmental impact*, which determines the public attitude, but the *perceived impact*.

In accordance with the local scale surveys, it is identified that arguments against wind power generally include: noise pollution causing annoyance; spoiled scenery; interference with natural areas, particularly bird endangerment; unreliability of the energy supply (wind power as an unreliable technique); and the (supposed) expensiveness of wind as a source of energy. However, since the weight of these factors depends more on the terms used in the questionnaires, the relative significance of the factors remains unclear.

In order to have a more sensitive understanding, the questions of relative significance and the impact of perceptions on attitudes were investigated by sophisticated research techniques, based on social-psychological knowledge, carried out on different locations. The results of several researches shows that the strongest impact on the attitudes concerns the aesthetic value of wind turbines. In other words, the perceived impact on scenery is the most decisive factor for one's standpoint. In general, it is observed by the researchers that (Wolsink 2000, Krohn and Damborg 1999);

- Concerns about reliability and electricity prices don't have significant impact,
- The attitude toward wind power is not influenced by thoughts about the

interference factors such as noise, birds, shadow flicker, which are causing annoyance,

- The annoyance factor may not be significant for the attitude, but it does have a direct impact on the intentions to resist wind projects,
- The size of a wind turbine project also insignificantly influences the public attitude towards a project.
- It is the characteristics of the selected site, type of landscape, which are more crucial for the attitudes of local people.

5.3.2. NIMBY Explanation for Opposition

Renewable energy developments are not at the status of locally unwanted land uses (LULUs), however, opposition to wind power and the sitting of other renewable energy facilities is often equated with the Not-In-My-Back-Yard (NIMBY)[10] syndrome: people are in favor of wind power, but are opposed to wind turbines in their own area.

Even though some individuals' attitudes towards local wind power plants can be characterized as NIMBYism, it is argued that the syndrome is a minor factor for most people opposing local projects. It is also asserted that the NIMBY-explanation is a too simplistic way of seeing people's attitudes, which does not consider the issue of distributive justice and tends to pay little attention to the views of local people who are genuinely worried about the environmental impacts. Thus, it is reinforcing a conflict instead of contributing to solving it (Krohn and Damborg 1999, Wolsink 2000, Khan 2001).

[10] The NIMBY concept is often considered as common sense, but it actually represents a specific social dilemma or game-situation. These concepts are important subjects for economists (who refer to them in game theory) and psychologists (social dilemma theory) when studying the provision of public goods. These theories explain why some public goods are not produced within a society, even though all individuals in that society want that good to be provided. The unintended outcome of such a dilemma is not optimal because of each individual's utility maximising decisions. Although everyone would be better off if the public good were produced, this does not happen due to each individual's decision not to co-operate. In the individual decision-making process, personal costs and benefits are calculated, and this stimulates so-called free rider behaviour. Originally, opposition against generally useful facilities has been defined as a multi-person prisoner's dilemma, the most widely known game-theoretical situation. According to NIMBY-logic, local residents oppose a project in their aim to maximize their own individual utility. Because they are in favor of wind power, they will welcome all turbines not built in their vicinity. They minimize the personally perceived impact of wind turbines by blocking their development. According to the social dilemma, if people refuse to co-operate at all locations, wind power developments cannot be built anywhere (Wolsink 2000, p. 52).

In order to make a distinction among the broad range of attitudes, Wolsink (2000, p. 57) defines four types of resistance:

- *Resistance Type A*. A positive attitude towards wind power, combined with opposition to the construction of a wind farm anywhere in one's own neighborhood. This attitude-behavior combination reflects the only true NIMBY standpoint.
- *Resistance Type B*. Rejection and opposition to a wind farm in the neighborhood because one rejects wind turbine technology in general. This position is sometimes called `NIABY', or Not-In-Any-Backyard. This kind of opposition is based on concerns about the general consequences of wind power on the scenery.
- *Resistance Type C*. A positive attitude towards wind power, which becomes negative as a result of the discussion surrounding the proposed construction of a wind farm. This type shows the significance of the dynamics in attitudes, as it reflects a NIABY attitude resulting from changing risk perceptions during the decision-making process.
- *Resistance Type D*. Resistance created by the fact that particular projects are considered faulty, without a rejection of the technology as a whole. This type advocates the generation of wind power, but only under some conditions. This opposition is particularly limited to proposed wind farms on specific locations, as it is based on concerns about the consequences of a wind power plant, on primarily the scenery and, to a lesser degree, on interference and nuisance.

It is emphasized that all four types of behavior-motive combinations can exist with the sitting of any facility, but one dominating during a particular effort, and moreover attitudes can change during the different phases of project.

5.3.3. Institutional and Organizational Factors

In the development of renewable energy technologies, institutional constraints are considered as more important than public opposition. What is more is that the nature and extent of the institutional and organizational settings have direct impact on public attitudes. Generally, it is seen that in a sitting issue, where investors, environmental organizations, competitive land-users, local inhabitants, politicians and local authorities are the potential actors, the local opposition manifests itself in a way organizations operate and the behavior is shaped by the conditions of regimes.

Although sitting of renewable energy plants is recognized as one of the most important factor in the development process, the electricity sector, where they have dominant position, tend to view the sitting issue as merely a market imperfection or a bureaucratic obstacle. Thus, they create little institutional capacity for successful sitting of facilities (Wolsink 2000).

Public concerns, reflecting aspiration for collective engagement and when powered by pressure and interests groups, have significant role in the approval and development of the project. The role of media amplification is also emphasized (Walker 1995, Upreti and Horst 2004). Accordingly, it is claimed that the public's negative view of the technologies is formed generally not by experience but rather by ignorance, misinformation, prejudice and fashion that is manipulated by word of mouth as well as by media and lobby groups (Short 2002).

In the case of wind power, where the potential sites are geographically concentrated in ecologically sensitive areas, the environmentalists often consider the development of wind energy facilities as problematic from a conservationist perspective.

However, Khan criticizes the role of environmental movement organizations (EMOs) in support of renewable energies. In his report (2001, p. 27), he states that:

> If we compare renewable energy facilities with other facilities that imply risks to the local area, such as hazardous waste plants, chemical factories and infrastructure projects, people's reactions do not differ very much concerning the reasons for an opposition or the worries that the new facility bring about. What differs, however, is the standpoint of environmental movement organizations towards renewable energy.

Khan explains his arguments on that dilemma in the cases of Swedish EMOs and wind power. In his paper, it is given that both the Swedish Society for Nature Conservation (SNF) and Greenpeace (GP), which are two of the most important EMOs in Sweden, see renewable energy as a viable alternative to fossil fuels and nuclear energy, and argue for substantial increase in the use of all forms of renewable energy. But, it is noticed that the two organizations have very different relations with people at the local level. As it is given, SNF is a highly decentralized organization, having 300 local branches and the latter, GP, is completely centralized one, which works on a national basis and interacts frequently with the local people. The attitudes of local branches of SNF towards wind energy are characterized as ambiguous. That means, they are in favor of wind power in their local area but none of them work actively to promote it. It is interpreted that this double attitude originates from a belief that the energy problems can be solved by other technologies rather than large-scale exploitation of wind power. It is also assumed that EMOs, whose role is protesting environmentally harmful activities, are hesitant due to the risk of losing their reputation in a case of defending something that people view as an environmental threat. This is the dilemma of EMOs working at the local level.

Wolsink (1999) addresses the question of environmental organizations attitude in the case of wind power proposals cancelled by the national environmental organization Wadden Vereniging (WV), in the Waddensea region (internationally significant wetland area). In Waddensea case, though majority of the board members accept wind turbines in the region and do not support the official standpoint, the WV has a reluctant policy. In Dutch case, the reason for that reluctant policy is interpreted as the offending nature top-down style of planning in wind energy projects.

On the other hand, there are lots of formalized network organizations which co-ordinate the local opposition, especially against wind power throughout the European countries. The work of these kinds of organizations can be interpreted as representation of some form of social movement, instead of environmental movement. For example, as given by Khan, the organization Swedish Landscape Protection, aims to keep down the development of wind power in a way representing local people who feel that the environment is being threatened.

5.3.4. Public Trust and Public Participation

As mentioned before, the people who oppose a renewable energy facility are not actually negative to renewable energy per se. What they are critical of is the chosen location and more significantly, the way it has been chosen. In relation to that it can be said that the concept of trust has a very important position on public attitudes. The common situation is that the public is distrustful of government policy makers, developers and other public bodies, while environmental non-governmental organizations and other types of pressure groups are seen as more trustworthy. The public, alienated from decision-making, believe that developers put profits over their welfare without knowing or caring about how it might affect the people living there. Thus, the developers are seen as environmentally unfriendly. Moreover, they are suspicious about the site selection process due to the belief that the site is chosen simply because the developer found a cheap farm property for sale, and then, manipulated as the selected site is the best, without searching for alternative locations (Upreti and Horst 2004, Kahn 2001).

It is noticeably commented that, in fact, it is the *top-down, technocratic planning process, and speed-up legislation*, and the classic *decide-announce-defend model* which create public *mistrust*, ultimate local conflicts and even antagonism, and where the main concern is that the public want to be informed and be involved in at the very beginning of planning process, especially during the site selection phase (Kahn 2001, Walker 1995, Upreti and Horst 2004, Krohn and Damborg 1999, Wolsink 2003). Therefore, it is necessary to have planning processes that are open and allow for an early and substantial public participation in order to gain the trust of public for a project.

Accordingly, the tendency of involving the public in a project only with public hearings about ready-made plans, and considering the opinions of an engaged little group as an opinion of general public has very little to gain public acceptance. In regard with the belief that the public is more supportive if they have given a fair chance to influence the developments, it is necessary to involve people in the project through establishing dialogue at early stages, consulting directly with the people most affected, respecting their thoughts and also benefiting from their local knowledge (Hammarlund 2002, Short 2002). As Pasqualetti states that:

> The success of wind power depends on how well the wind industry learns to incorporate the public into decisions, both for the opportunities this allows for broader dissemination of information about wind power and for the suggestions the public can bring to the discussion about their concerns and how to accommodate them. (p. 169)

5.3.5. Conflict of National Needs and Local Interests

In general, the development of renewable energy schemes is largely driven by central governmental targets, together with the subsidies to achieve this target. The negative outcomes of these top-down, elite decisions at the local level can be regarded as the conflicts of national needs and local interests, and the conflicts between global environmental benefits and local environmental and social costs. In conflict over sitting and location of renewable energy developments, developers and national policy makers often use utilitarian ethics to justify the localization of development, and local communities have to accept them because of their global and national advantages.

The unclear local benefit is among the factors, which affects public perception of a proposed project negatively. Therefore, the case is again that the public is supportive if there are clear local benefits.

In the case of wind power, the opinions noticed about the turbines are articulated as "government-sponsored money-making machines" (Schwan 2002, p. 134), "if turbines can make electricity, they can also make money" (Pasqualetti 2002, p. 163). Therefore, it is a profit that local people also wants to benefit through acquiring equity shares of the project. In accordance with the success stories, it is apparent that there is a strong correlation between the share of wind power development in a country and the degree of local ownership; for example, Danish success in wind energy and the tradition of partnership and local ownership. In some cases, it is the developers who apply schemes to ensure local financial participation instead of national or regional intervention. In some other cases, wind farms are seen as a diversification of rural economy, as windfall for the farmers and a means to stall agricultural decline. In short, several projects would never have thrived without the engagement of the local people (Christensen and Lund 1998, Uyterlinde et al. 2002, Reiche and Bechberger 2004).

5.4. The Contribution of Planning to Renewable Energy Developments

As recognized through analyzing the texts, the main focus of literature is mostly on decision-making process and the role of planning system, including the issues of problems with and within planning systems in contributing to development of renewable energy technologies.

In early 1990's, the issue of renewable energy is addressed in terms of the challenges of changes in the energy sector to land use planning. After mid-1990's, considerations on renewable energy are taken place in conjunction with the arguments on the concept of sustainability and sustainable development, and on planning for sustainability. With the commitment to achieve sustainable development there has been a trend towards closer integration between energy and environmental policies, and other policies at the national level. Accordingly, the role of planning system in contributing to national energy-environment policies, thus to sustainable development has gained more importance. However in a way introducing new debates and new tensions to the arena of land use planning where conflicts between different types of interests, actors, and values have traditionally been handled. What constitutes the recent agenda is the response of planning system to renewable energy policies, especially to the targets of international agreements and specifically to EU renewable energy targets.

Within this perspective, planning academics define renewable energy debate as *a policy discourse, which is constructed across a complex field comprising environment, planning, economic and rural policy, all underpinned by a discourse of sustainable development* (Stevenson and Richardson 2003), and *a policy field which comprise new models of policy process that acknowledge the recursive relationship between policy and action, and in which new institutions, multi-organizational clusters of public and private actors involve in policy and programme implementation* (Hull 1995b).

Due to this complex and contested nature, and the involvement of different stakeholders with conflicting views, approaches of *collaborative, communicative, consensus building, negotiation, and deliberative planning* are all commonly appreciated and recommended by all the authors and academics who contribute to the issue of renewable energy.

Instead of a renewable energy integrated planning approach, such as energy integrated planning -energy efficient/conscious/conserving urban planning which has established and become widely used in the literature since 1980's, the common expression used for addressing the renewable energy and urban planning relationship is the challenges of renewable energy technologies, in particular wind energy, to land use planning. That means, in practise, urban planners participate in renewable energy issues within the perspective of their traditional task, which is promoting orderly development of energy technologies within the existing physical and institutional environment that their practises mostly involve determining planning applications, plan alterations and approval process.

In relation to this narrow task, from the viewpoint of energy sector -both the developers and decision-makers- planning system, due to approval and permitting processes, is a major constraint for the development of renewable energy technologies. On the other hand, it is the conflict between national energy policies and local interest, and planning authorities lack of proper knowledge and experience on how to deal with issues related to renewable energy developments, which cause problems within planning systems. However, it seems that the overall problem is the absence of a strategic framework building an integrated policy approach for guiding planning practices.

In relation to wind energy, Khan (2003) defines three conflict conditions that are central to land use planning. First, it is the conflict between public and private interests where land-use planning is aiming at protecting public interests against private. For wind power, he exemplifies the conflict as the interests of private landowners who want to install turbines on their own land against the public interest to protect landscape, or weighing the interests of neighbors who might be worried about visual impact and falling house prices against the public interest to increase renewable electricity generation. Second condition includes the conflict between national and local interest, which are similar to developments such as highways, waste treatment facilities and conventional large-scale energy generation and transmission facilities. These developments are highly favourable from a national point of view but pose risk and disturbances to local communities and environments. Thirdly, it is the potential conflict between the environmental protection and economic growth, both of which are basic components of the concept of sustainable development. In terms of the relationship between economy and environment, Khan states "at the national level, wind power is primarily promoted out of environmental motives, while it needs economic support to be implemented. At the local level, however, an important driving force can be the economic benefits of wind power for the community, while the (local) environmental effects are often seen as a threat" (p. 565).

In addition to above conflicts, he further defines three situations occurring due to the characteristics of wind power as a challenge to land-use planning. First, he considers the cumulative effect. Even though the individual projects are moderately in small-scale, several projects scattered within a certain area can appear very big and troublesome, and it is the local planning authorities that are responsible for reducing or controlling that cumulative impact. The second situation includes the need for assessing the visual impact. In general, there are no objective grounds to measure visual impact, and the level of impact depends entirely on personal preferences and perceptions. In that case, understanding public attitudes and allowing their participation to decision-making is significant in terms of dealing with visual impact. Third is the overlapping of most suitable windy locations with high landscape values and of conservation.

In addition to the knowledge gathered through analyses and related interpretations above, the contributions of Owens and Pasqualetti, and the findings of the study carried out by Nijkamp and his colleagues are taken into account as an input for research objective in terms of land use planning as part of process.

Since early 1980's, Susan Owens has given much of the effort to the need for considering energy issues in urban planning. Though her main focus is on energy conscious/efficient urban development, she has given considerable attention to the inclusion of the use of renewable energy sources as part of energy integrated planning. After 1990's, she addresses energy dimension in conjunction with the concept of sustainable development. Claiming that land use planning can contribute sustainable development through its influence on patterns of energy demand, she suggests, "urban areas could be planned to accommodate the most efficient combination of energy supply systems and conservation measures" (1992, p. 87). In that regard, she identifies the integration of the planning of the built environment with that for energy supply and conservation as an important ingredient of planning for sustainability. She further points out that taking energy integrated planning in isolation would likely to have less impact on urban energy issues and thus on achieving urban sustainable development. Therefore, it is emphasized that policies at different levels should be coordinated and all policy instruments such as public investments, fiscal measures, information and regulation, etc. should work at the same direction.

As a matter of fact, one of Owens' earliest article, published in International Journal of Environmental Studies in 1981, and in which the physical and socio-economic impacts of energy supply facilities was considered and the ability of planning system to respond to energy developments was discussed, provides a more comprehensive arguments on the integration of energy supply considerations in urban planning. Though the energy supply facilities in consideration comprise oil, gas and coal resources, the context of defined problems, the questions addressed are all the same as recent arguments and conflicts encountered through renewable energy developments. If the statements and propositions included in the article are to be outlined:

- At the local level, major energy facilities have significant impacts, many of them detrimental, and will often greatly change any existing plans for the area,
- Planners have the important responsibility of ensuring that such developments, when they do go ahead, proceed with minimum possible adverse effects upon

the local community,

- There is probably no other area where such a large number of developments arising directly from national policy, is likely to put such sustained pressure on the planning system,
- In decisions about the sitting of energy facilities, planners will inevitably be at the centre of the ‘national needs versus local interests’ controversy,
- There is apprehension that land use, environment and other legitimate planning considerations will represent a constraint to the extent they prevent the implementations of certain energy policy options,
- Such concerns do not necessarily imply approval for these energy policies, which might be threatened. If such constraints indeed exist they should be taken into account during the formulation of energy policy. If ignored, the constraints can cause bitter conflict or even civil disobedience,
- It is essential that planners should learn as much as possible from the impacts of developments which have already taken place and that they should develop sound technologies for assessing the likely impacts of proposed investments,
- Energy developments deserve particular attention from planners, due to the reasons of: their numbers, their variety, their scale, their complexity, their technical uncertainty, and their relation to sensitive national policy.

What is different in today’s situation is the nature of energy supply facilities, associated with local, renewable resources, the concept of sustainable energy supply and the changes in the energy sector.

Professor of Geography Martin J. Pasqualletti, by defining that “reducing the environmental impacts of energy development is one of the dominant, daunting, and vexing problems of our time” (1990, p. 99), addresses the environmental relationship between energy development and land use, and proposes a land use perspective to reduce and manage the impacts of energy developments, and states that “considerations of land use are the most important environmental consideration in the development of these resources” (p. 125).

Taking all oil, coal, hydropower, nuclear, and the alternative sources solar, wind and geothermal developments into consideration, he claims that environmental impacts of energy developments are various, such as, air pollution, water pollution, land requirements, aesthetic intrusion, noise, subsidence, etc., and suggests land use as a consolidating ingredient in order to understand and manage those diverse impacts through a single and common theme.

In accordance with his land use perspective, the emphasis of problems shifts from originator to receptor. This means a shift from a resource specific to site-specific environmental emphasis. Therefore, the problem is not the result of inherently bad or polluting resources, but rather the compatibility of different types of land use, or in other words land use sensitivity to pollutant deposition. Moreover, the land use conflicts most often arise due to threatened change. He exemplifies that change as: "If offshore oil is developed, the shoreline will change. If *x* resource is developed the wilderness will be degraded. If *y* resource is used, the urban environment will have to change to accommodate it" (p. 125).

On the other side, focusing on urban energy policy as a central point of departure for urban sustainability, and identifying institutional factors, attitudes and behavior of public, and urban structure and morphology as three major determinants for successfully realization and wide-spread use of renewable energy technologies Nijkamp, Capello and Pepping (1999) consider urban land use planning as one of policy fields. In this respect, as part of their qualitative analysis of renewable energy policies of case cities the authors illustrate the relationship between urban characteristics and the potential of renewable energy policies as in table 5.4.

Table 5.4: Relationships between urban characteristics and renewable energy technologies (Nijkamp, Capello and Pepping 1999, p. 226)

Renewable energy technology / **Urban characteristics**	**Photovoltaics**	**Solar water heating**	**Wind**	**District heating**
Population density	-	-		+
Income per capita	+	+	+	
Dwelling density	-	-		+
Dwelling age				+
Dwelling ownership	+	+		
Energy use per capita				+
+ positive influence, - negative influence				

5.5. Concluding Remarks

The knowledge gathered through a form of content analysis of texts in relation to environmental, social, and spatial structure and land use context provide us the general explanations for why renewable energy and planning policies are required to be integrated, why renewable energy developments are to be considered in land use planning, and to some extent for the question of how?

At this stage, it can be suggested that planners should respond to these rapid developments and associated changes in a way reducing their environmental and social impacts at the local level, and promoting their utilization so as to achieve gains at both global and local scale. They should promote not only orderly and harmonious development of technologies within existing physical environments and their feasibility depending on spatial structures, but also develop skills and strategies to link and involve the diverse interests and objectives of public, developers of renewable energy technologies, environmentalists, utilities, and decision-makers, in short all stakeholders. However, as it is already known the planners role are very much influenced by the political and decision-making system, and the position of planning system in that governmental and administrative system, and the prevailing or espoused planning approaches. It is this procedural and institutional dimension that further studies in the following chapters seek to investigate.

CHAPTER 6

INTERACTION BETWEEN RENEWABLE ENERGY AND PLANNING POLICIES: EUROPEAN CONTEXT

In terms of understanding the interaction and integration between renewable energy and planning policies at the EU level, the research questions of European context are: What constitute basis for the integration of policies at European level? At what extent and in which context does the ESDP incorporate renewable energy? What is the relationship between renewable energy and spatial development policies within Community Initiatives? At what extent European renewable energy policies and legislation have reference to planning policies and procedures? In which context planning related issues are included in the renewable energy sector? What are the main reasons behind the perception that planning is a bottleneck? and What is the key issues pertained to authorization and permission procedures cause constraint on renewable energy developments?

6.1. European Spatial Development Perspective and Interreg IIC

During the last decade, spatial planning has gained considerable significance in EU. Rather than planning for Europe, the context of concern is formulating strategies for better co-operation between Community sectoral policies, which have substantial spatial impacts, and between Member States, their regions and cities.

Spatial planning is a Euro-english term used to refer to a concept of planning[11] which does not equate precisely to any actual planning system of EU Member State. Employed by the European Commission, it is a neutral umbrella term embracing all the varying member states' approaches to managing spatial development (EC 1997). It refers to the "wide range of public policies and institutional mechanisms at various

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[11] The terms used for planning are; "town and country planning" in the UK, "raumplanung" in Germany, "ruimtelijke ordening",in the Netherlands, and "aménagement du territoire" in France. Such terms represents a meaning to the Member State where they are used, and not directly transferable from one situation to another since their use and meaning were developed through time in response to the particular legal, socio-economic, political and cultural forces of the country (EC 1997).

levels of government that are explicitly intended to influence the future distribution of activities in space" (Bishop, Tewdwr-Jones and Wilkinson 2000, p. 312); it co-ordinates and integrates sectoral policies and their spatial dimension through a territory based strategy, "the pursuit of spatial policy for a region in such a way that components of that policy reinforce each other, also that they take account of the characteristics of the region" (Healey et al. 1999, p. 340); and "seeks to identify and address the contradictory effects of sectoral policies, and the opportunities for synergy through the territorial strategy" (Cullingworth and Nadin 2002, p. 81) within which traditional land use planning is only one of the sectoral policies. Moreover, that concept of *spatial development* as defined by Eser and Konstadakopulos (2000, p. 790), "encompasses a broader and perhaps more modern understanding of spatial planning, as well as of the coordination of sector policies", and allows the delineation of the activities at the EU level from spatial planning activities at the lower governmental levels. Lastly, spatial planning in European sense is "public policy and actions intended to influence the distribution of activities in space and the linkages between them. It will operate at EU, national and local levels and embraces land use planning and regional policy" (EC 1997, p. 156)

With the trend towards an institutionalization of European planning, there has been a political acceptance of the need for strategic spatial development at a European level. That acceptance was coincided with the introduction of the Single Market (Maastricht Treaty 1992) with all the effects it might have on spatial development. In the light of that context, the affairs on spatial planning and policies have been conditioned by the development of European Spatial Development Perspective (ESDP), and seen as an important step in the progress towards European integration.

Provided by a series of informal ministerial meetings within 10-year time span, the preparation process of the ESDP is described as a new style of European cooperation, and a new mode of governance that the essence lies in mutual learning and mutual trust. Accordingly, as Faludi (2000, p. 246) states "ESDP does not present commonly accepted spatial concepts… there is evidence of a shared view of the EU territory" and "European spatial planning must be seen as part and parcel of an emergent system of European multi-level governance" (2002, p. 1) within which power is exerted at multiple levels of government.

That ESDP process as brought up in the above paragraphs can be clarified through Healey's institutionalist perspective on defining strategic spatial planning. The authors (Healey et al. 1999, p. 342) defines strategic planning, as a deliberative plan-making: "is an active social process which builds on and transforms established ways of doing things (institutional relations) and accepted ways of looking at things (policy agendas) in order to create locally new institutional capacities for influencing the future", and such a process can "generate ways of understanding, ways of building agreement, of organizing and of mobilizing so as to exercise influence in political arenas" (p. 343). Their addressing of spatial planning as a social process for developing and maintaining territorial relationships through resources of trust, pervaded with shared knowledge and covered by common frames of reference, can easily be correlated to the content and context of the ESDP.

The ESDP is highly interrelated with the field of *regional policy*. However, it is necessary to distinguish two types of regional policy. First one is a regional policy[12] embracing single administrative regions, and the second one is a regional policy aiming at overall (national or European) economic and social cohesion, and also stimulating economic activities in less favored regions via the regional policy promoted by the European Regional Development Fund.

Since the development of planning depends on the development of its context, planning can only be understood in connection with its context, including the norms and values of the society, and the planning system. Therefore it is necessary to recognize the context of the ESDP, and also the context of planning in EU member states. The agendas of spatial planning in most European planning traditions[13] comprise land-use allocation in terms of accommodating growth, its geographical distribution in order to achieve spatial justice, growth management in relation to infrastructure provision and environmental conservation, and improving the amenities of settlements (Healey et al. 1999). As a result of contention on four major spatial planning traditions in EU Member

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[12] *Regional policy* focuses on the administrative regional level, which is complicated by the fact that the term region describes different things in different countries and contexts. *Regional planning* is planning for a region, usually undertaken by regional but maybe undertaken by national government or local authorities working jointly. It will generally be strategic planning but with different degrees of integration between land use and other sectoral planning (EC 1997, p. 156). *Strategic planning* is the preparation of strategy framework, identifying the broad patterns of growth but not detailed land allocations or zoning. Strategic planning is generally long term and comprehensive, bringing together social, economic and spatial considerations (EC 1997, p. 156)

[13] The planning traditions identified by the EU Compendium of Spatial Planning Systems and Policies are: the regional economic planning approach (highly advocated by the French); the comprehensive integrated approach (as seen in Germany); the tradition of land use management (UK example); and the urbanism tradition (characteristic of Mediterranean states). In addition to that according to the study done by Newman and Thornley (1996) and with the criteria of legal and administrative styles, there are five planning families in Europe: a Nordic, British, Napoleonic and Germanic family, as well as a family formed by the countries of the former Eastern bloc.

States, it is the *comprehensive integrated approach,* which is adopted in planning for Europe, in the ESDP.

Since spatial planning is not mentioned in the Treaty, the ESDP is non-binding. So, there is no primary juridical reason for the EU institutions to assure activities in this policy field. As indicated in the final conclusion of the document, the ESDP does not provide for any new responsibilities at Community level. It will serve as a policy framework for the Member States, their regions and local authorities and the European Commission in their own respective spheres of responsibility. Therefore, its effect will depend on the intensity of voluntary implementations and on "the level of political support it receives, and upon the strength of the arguments in favor of a spatial planning approach to policy coherence and cross-sectoral policy development" (Williams 2000, p. 61). Moreover, it is also emphasized that invoking of a discourse is essential for policy networks to promote specific issues and new policies; supplying bridging, persuasive and even amorphous concepts are needed to gain the ear of policy makers and the acceptance of actors involved. In this respect, it is the environmental policy and the concepts of sustainability or polycentric system of cities are all such kind of invoking and integrating concepts provided by the ESDP.

At present, there is no formal Community competence in spatial[14]. However, Structural Funds, Cohesion Fund, Common Agricultural Policy, all have impact on physical planning directly or indirectly. Beside these, EU regional policies comprise also Community Initiatives, such as INTERREG, URBAN, LEADER and EQUAL. Among them, *Interreg* is the instrument directly related to the ESDP. The first Interreg initiative was adopted in 1990. That initiative was followed by Interreg II, which had three distinct strands:

- Interreg II A (1994-1999): cross-border co-operation
- Interreg II B (1994-1999): completion of energy networks
- Interreg II C (1997-1999): co-operation in the area of regional planning

In order to promote trans-national co-operation in the field of spatial planning, it was strand II C, which was added to the Community Initiative Interreg in 1996 during

[14] But there are in any case competences in a number of sectors related to spatial planning, such as regional, transport, environment, agriculture or urban polices. For instance, in the field of environmental policy, the EU directive on Environmental Impact Assessment (85/337), on Strategic Environmental Assessment, SEA, (directive 2001/42/EC), Habitats Directive (Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora), and Birds Directive (Council Directive 79/409/EEC on the Conservation of Wild Birds) directly affect the procedures for physical planning in all Member States.

the course of the ESDP process. Transnational co-operation in spatial development projects sharing common organizational, administrative and financial structures has been tried out for the first time under Interreg IIC. This exercise is now being continued under Interreg IIIB[15].

Interreg IIC is supposedly an implementation instrument for the ESDP. The ESDP forms the framework with long-term spatial development objectives, and Interreg implements its targets. The ESDP has a top-down approach including the tradition of rational comprehensive planning. On the contrary, Interreg IIC has a project-based passed, which can be interpreted as a bottom-up approach. The projects are chosen in a competitive situation, and the main results of the programme are the project results. Thus, the understanding of planning is not scientifically based, and the focus is on economic integration (Nadin and Shaw 1998, Moll 2002). Interreg IIC is also claimed as an example of the incrementalist tradition, in particular the "perspective incrementalism" (German approach). It means the many small steps are not completely disjointed, but follow together a perspective path.

In general, the Interreg IIC Initiative has included the promotion of a harmonious and balanced development of the territory of the European Union, fostering transnational co-operation in the field of spatial planning, contributing to improving the impact of Community policies on spatial development and the co-operation between Member States and their regions on a pro-active approach to common problems, and also provided funding for spatial planning. As Nadin and Shaw claim, it is the increasing economic interdependency of nations, which causes increasing transnational collaboration on spatial planning. As a consequence, it has encouraged local authorities and other public bodies to take part in transnational planning projects. There are seven Interreg IIC regions, which have their own separate programmes:

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[15] Recent Interreg programmes contributing to the period 2000-2006 is made up of again three strands:
- *Strand A: Cross-border co-operation* between adjacent regions aims to develop cross-border social and economic centres through common development strategies (successor of Interreg IIA).
- *Strand B: Trans-national co-operation* between national, regional and local authorities aims to promote better integration within the Union through the formation of large groups of European regions (successor of Interreg IIC).
- *Strand C: Interregional co-operation* aims to improve the effectiveness of regional development policies and instruments through large-scale information exchange and sharing of experience (new strand).

North Sea Region	: Denmark, Germany, Netherlands, Sweden, UK, and Norway
Baltic Sea region	: Denmark, Finland, Germany, Sweden, and Baltic States
Atlantic Area	: Ireland, France, Portugal, Spain, and UK
South West Europe	: France, Portugal, and Spain
Western Mediterrenean Latin Alps	: France, Greece, Italy, and Spain
The Adrianube region	: Austria, Germany, Greece, Italy, the central and south-east European countries
North West Metropolitan Area	: Belgium, France, Germany, Ireland, Luxemburg, Netherlands, and UK.

Having a project-based approach, it is again the Interreg IIC programmes that include the formulation of spatial visions[16]. Baltic Sea Region has taken a lead with their spatial vision drawn up entirely, and followed by the North Sea Vision.

6.1.1. Relation Between Energy and Spatial Development Policies in the ESDP

Since the ESDP is an instrument to provide the co-ordination of community policies through improved spatial coherence, the aim here in this sub-title is to examine how the co-ordination between energy/renewable energy issues and spatial planning is addressed within the document of European Spatial Development Perspective.

The document of ESDP consists of two parts: *Part A*, "Achieving the Balanced and Sustainable Development of the Territory of the EU: The Contribution of the Spatial Development Policy", contains a series of 60 policy options and ideas on spatial development; and *Part B* "The territory of the EU: Trends, opportunities, challenges" features spatial development issues of European significance and the selected programmes, together with the detailed recommendations on how to apply the ESDP to a variety of spatial scales and contexts with supporting analysis and reasoning. The policy aims and options are based upon three general objectives (EC 1999, p. 11):

- Development of a balanced and polycentric spatial development and a new urban-rural relationship
- Securing parity of access to infrastructure and knowledge
- Sustainable development, prudent management and protection of natural and cultural heritage.

[16] The ESDP offers no overall vision of spatial policy. In fact, a spatial vision is neither feasible nor desirable at the scale of Europe (Faludi, 2000)

Among the initial considerations included under the title of "EU Policies with Spatial Impact" in Part A, it is the Trans-European Networks[17] (TENs) which has direct spatial impact. As it is pointed out, TEN measures in the energy sector influence spatial organization through two main mechanisms:

- The production and transmission of energy influencing land use, and
- The distribution of energy and consumption technologies influencing the organization of territory via induced changes in consumers' behavior.

The document also recognizes that the routing of lines or establishment of power plants through both electricity and gas trans-European networks have impact on local planning in a way raising difficulties linked to complex ratification procedures, varied technical and ecological constraints and acceptance on the part of the population. Accordingly, renewable energies are considered as promising since they help to reduce the environmental impact of the energy sector, and favor decentralization and locally applicable solutions reinforcing flexibility of the system.

Though Community policies have no immediate spatial character, they are mostly supported by a number of spatial concepts, especially in the cases of; delimitation of areas eligible for financial support and determination of assistance rates, improvement of infrastructures, use of spatial categories, development of functional synergies, and integrated spatial development approaches. In the report, the approaches for improving spatial coherence of energy policies are explained as below:

- *Improvement of infrastructure:* the interventions with the policy of TEN, as finance of energy infrastructures, exert a direct impact on the territory due to linear (high-voltage lines) and location-related (power stations) aspects of energy infrastructures.
- *Development of functional synergies:* Within the framework of some Community policies, spatial elements are taken into account to establish functional interdependencies and to emphasize synergies. In the case of energy policy, this is exemplified as "the exploitation of solar energy in harmony with town planning objectives" (EC 1999, p. 19)

[17] The EU Treaty obliges the Community to contribute to the organisation and development of Trans-European Networks (TENs) in the areas of transport, telecommunications and energy supply infrastructure. This mandate should serve the objective of a smooth functioning of the Single Market as well as the strengthening of economic and social cohesion. (EC 1999, p. 14)

- *Integrated spatial development approaches:* Beyond functional interactions and the development of synergies, a number of Community activities seek to develop integrated and multi-sectoral approaches with a strong spatial dimension; such as Interreg II C.

Through analyzing the policy aims and options recommended in the ESDP document in regard with the three objectives, the detected suggestions with respect to energy-spatial development relations comprise below considerations:

- *Wise and resource saving management of the urban ecosystem:* one of the options for the policy aim "dynamic, attractive and competitive cities and urbanized regions" within the objective of "polycentric spatial development and a new urban-rural relationship" includes the prudent management of the urban ecosystem. It is suggested that:

> An integrated approach with closed cycles of natural resources, energy and waste must be pursued in order to reduce burdens on the environment. Through this approach, both waste production and the consumption of natural resources could be limited (particularly in the case of resources which are not renewable or which regenerate slowly). Air, soil, and water pollution could also be reduced. (p. 23)

Accordingly, *common energy system* for households is given as a measure for a prudent environment policy.

- *Efficient use of resources:* under the policy aim "indigenous development, diverse and productive rural areas" within the same objective polycentric spatial development and a new urban-rural relationship", the suggestions include:

> In the rural areas of the EU there is a considerable potential for renewable energy: solar energy; wind energy; hydroelectric power and tidal energy; energy from biomass; and even from urban waste near large towns and cities (methane production). This opens up interesting prospects for economic diversification and environmentally friendly generation of energy. This potential should be activated for the efficient use of resources. (p. 24)
>
> Use of the potential for renewable energy in urban and rural areas, taking into account local and regional conditions, in particular the cultural and natural heritage. (p. 25)

- *Contribution to climate protection:* under the policy aim "preservation and development of the natural heritage", with respect to the objective of "sustainable development, prudent management and protection of natural and cultural heritage" it is recognized that spatial development policy can make an important contribution to climate protection through energy-saving from traffic reducing settlement structure and location, as well as making contributions through the increase use of CO_2-neutral, renewable energy sources. Policy option 44: "Promotion of energy-saving and traffic-reducing settlement structures, integrated resources planning and increased use of renewable energies in order to reduce CO2 emissions" (p. 32)

- "Strategies for the sustainable development of landscapes and the evaluation of the landscape potential for exploiting renewable energy resources" is given as one of the measures for information and co-operation at regional level in terms of close cooperation between regional and local authorities in the field of sustainable development (p. 44).

Under section 3 of Part B, Baltic Sea Region (BSR) is given as example for spatial visions, however the outline included in the document has no reference to energy/renewable energy. On the other hand, goal 7 of the VASAB 2010, which combines 4 basic values and 14 goals in a common vision and action programme, includes that "energy production relies increasingly on renewable and environment-friendly sources of energy" and energy systems are regarded as "strings: effective and sustainable links between cities" (CSD/BSR 1998, p. 15).

The recent studies on further development of the spatial vision include examination of energy and spatial planning relationships.

For example, Baltic CHAIN (Clearing House And Information Network) project, born in Aarhus, Denmark in 1998 as a joint mission of ten countries (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Poland, Russia, and Sweden) aims to increase the efficiency of energy sector in the region and to reduce environmental impact with strong emphasis on greenhouse gases reduction. The project is supported by Interreg IIC programme, and its main goal is to create and maintain an information network in the Internet environment and dissemination of information on energy efficiency and possibilities for renewable energy use in BSR. One of the ongoing study taken within the framework of the Baltic CHAIN project and the tasks of Interreg IIC is providing a synthesis report about spatial and energy planning in the BSR, mapping the national energy strategies and the spatial planning issues for each of the ten countries in order to provide basis for a co-coordinated approach in regional strategic planning, e.g. by taking energy efficiency and renewable energy questions into account and promoting integration between them in order to create visions for the future development of spatial planning in the Baltic Sea Region (Blechschmidt 2000). Attention is given to the spatial and energy planning systems of Baltic States -East and Middle European countries, and their abilities responding to EU policies and directives, and the ESDP (Blechschmidt 2001). It is given that the next phase of the Baltic Chain Project would focus on development, dissemination and implementation of local energy planning and on identifying energy efficiency and renewable energy potentials as well as combined heat and power systems, etc. in coordination with VASAB 2010, the Baltic 21 co-operation, and OPET organizations (Baltic Chain 2001).

6.2. Planning and Renewable Energy Relations in Energy Sector

From a counter perspective, the aim here in this part is to look at how renewable energy-spatial planning relations and sectoral co-ordination is addressed within European energy sector, its strategic policy framework and legislation. Below paragraphs include general frame of EU renewable energy policy.

The exploitation of renewable energy sources is a high Community priority for reasons of security and diversity of supply, environmental protection and sustainable development, and of social and economic cohesion.

Committed to the Kyoto Protocol the European Union has agreed on a common greenhouse (GHG) reduction of 8 % by the years 2008-2012 compared with 1990 level. To facilitate that objective, the Commission in its communication on the Energy Dimension of Climate Change has identified a series of actions including prominent role for renewables. Moreover, in conjunction with the three key Community energy policies –improved competitiveness, security of supply and protection of the environment- it is also recognized that promoting renewables is an important factor to achieve those aims, and a comprehensive strategy for renewables and a comprehensive action plan for implementing policies in a way ensuring the co-ordination and consistency at Community, national and local levels are necessary.

An initial step was taken by adoption of a Green Paper[18] in 1996. The European Parliament in its Resolution on the Green Paper recognizes that renewable energy has

[18] Commission *Green Papers* are documents intended to stimulate debate and launch a process of consultation at European level on a particular topic (such as social policy, the single currency, telecommunications). These consultations may then lead to the publication of a White Paper, translating the conclusions of the debate into practical proposals for Community action (Green Paper, EU Glossary).

an important role in combating the greenhouse effect, in contributing to the security of energy supplies and in creating jobs in small and medium enterprises and rural regions, and therefore, the EU urgently needs a promotion strategy which will tackle the issues of tax harmonization, environmental protection and standards, and internalization of external costs, and ensure that the gradual liberalization of the internal market will not place renewables at a disadvantage.

Consequently, adopted in 1997, it is that White Paper[19] "Energy For the Future: Renewable Sources of Energy" which defines the strategic goals and main features of action plan as directed towards the goal[20] of achieving a 12 % penetration of renewables in the Union by 2010.

6.2.1. European Renewable Energy Policy

The main titles included in the White Paper as representing the features of the Action Plan are: Internal Market Measures, Reinforcing Community Policies, Strengthening Co-operation Between Member States, Support Measures, Campaign for Take-Off, and Follow-up and Implementation.

In analyzing the document, below are the observed measures, which are related to urban energy and planning, measures that are likely to have influence on urban energy, spatial structure and spatial planning, and measures suggesting integrated approach.

- *New Bioenergy Initiative for Transport, Heat and Electricity*: This proposal included among Internal Market Measures in section 2.2.3, comprise actions for increasing market shares of liquid biofuels, biogas and solid biomass, and clean energy generation from municipal waste either by thermal treatment, landfill gas recovery or anaerobic digestion. In this regard, CHP is considered as of paramount importance for the success of biomass implementation, and district heating and cooling is the vital measure to maximize financial and economic

[19] Commission *White Papers* are documents containing proposals for Community action in a specific area. When a White Paper has been favourably received by the Council, it can become the action programme for the Union in the area concerned (White Paper, EU Glossary).

[20] This overall objective is a political –not a legally binding- tool, within which each Member State should define its own strategy and its own contribution to the overall 2010 objective. The legislative action will only be taken when the measure at national level would be insufficient or inappropriate and when harmonisation is required across the EU (EC 1997b).

benefits of cogeneration. Therefore, new district heating or cooling networks are proposed as an outlet for co-generation with biomass.

- *Improving Building Regulations: its impact on town and country planning*, which is considered again under Internal Market Measures in section 2.2.4. This section recognizes that energy consumption in the domestic and service sector can be significantly reduced by more use, in retrofitting as well as for new buildings, of renewables such as solar energy. It is also suggested that through adopting a global approach and integrating measures of rational use of energy - for the building envelope as well as heating, lighting, ventilation and cooling- with the use of renewable energy technologies, total consumption in building sector could be reduced by 50 % by 2010. Some specific measures proposed for promoting the use of RES in buildings are as below:
  - Incorporation of requirements on the use of solar energy for heating and cooling in building approvals under current legislative, administrative and other provisions on town and country planning should be considered;
  - Promotion of active solar energy systems for space heating and cooling and warm water, e.g. solar collectors, geothermal heating and heat pumps;
  - Promotion of passive solar energy for heating and cooling;
  - Encouragement of PV systems to be integrated in building construction (roofs, facades), and in public spaces.
- *Integrating Renewable Energy in the EU's Regional Policy*: In accordance with Reinforcing Community Policies, reinforcement of renewable energies in Community policies, programmes and budgets, making renewable energies better known and increasing awareness among all those bearing for Community programmes, the statement for integrating renewable energy in the EU's regional policy is as below:

> Decision-making criteria must reflect the importance of renewables' potential for less favored regions (which are in general dependent on energy imports), peripheral and remote areas, islands, rural areas, in particular those lacking traditional energies. In those areas RES have a high potential for new job creation, for the development of indigenous resources and industrial and service activities (particularly in objective 1 areas). The latter also applies to industrial areas under reconversion and cities (future objective 2). New incentives should also be undertaken in the tourism sector as the great potential of renewable energies in this area is still largely unexplored. (section 2.3.5).

- *Agriculture as a Key Sector for Doubling the Share of Renewables*: The Commission considers agriculture as a key sector for the European strategy of doubling the share of renewable energies in gross energy demand in the EU by 2010. It is proposed that the Common Agricultural Policy could contribute to increase standards of living an income in rural areas by supporting the biomass energy sector, supporting the regions by co-financing innovative, demonstrative and transferable renewable energy projects, such as the installation of combined solar, wind and biomass heat and electricity production under a Community initiative such as the LEADER programme (section 2.3.6).
- *Co-operation, Dissemination of Knowledge and Institutionalization*: Great emphasis is given to strengthening co-operation between member States, dissemination of knowledge and institutionalization for successful implementations. In section 2.5.1 of Support Measures:

> In order to achieve the objectives for renewables, a major effort will be required to harness the potential, influence and experience of all manner of associations and bodies such as citizens' groups (grass-roots organizations), relevant non-governmental organizations, and pressure groups including the international environmental protection organizations.
>
> At local and regional level, the creation of energy agencies under the SAVE II programme allows local authorities to play an important role in the promotion of renewable energies, mobilizing local partnership, focusing on practical actions and of becoming a key initiator of policies at local level.
>
> The setting up of effective networks is important in order to convey information on renewables at all levels –from the technological to the financial to the local public environmental concerns. A major feature of the Commission effort in this area will be the use of Internet websites.

- *Renewable energy networking* is suggested in terms of exchanging experience and increasing effectiveness through transnational co-operation. The proposed initiatives are (in section 2.5.4):
  - Networks of regions, islands and cities aiming at 100 % energy supply from renewable energies by 2010,
  - Networks of universities and schools pioneering renewable energies,
  - Renewable energy technology research and technological development networks,
  - Renewable energies twinning of cities, schools, farms, etc.

Chapter 3 of the Paper includes the proposal of *Campaign for Take-Off*. The Commission proposes a campaign for take off of renewables in order to assist their large-scale penetration, and ensure coordinated approach. In the campaign within which 1,000,000 Photovoltaic Systems, 10,000 MW of Large Wind Farms, 10,000 MW_t of Biomass Installations, and Integration of Renewable Energies in 100 Communities are defined as key actions, and town and country planning bodies are considered as one of the potential actors.

As part of this campaign, integration of renewable energies in 100 communities programme comprises selection of a number of pilot communities, regions, cities and islands which can reasonably aim at 100 % power supply from renewables. On a small scale, the units could be blocks of buildings, new neighborhoods in residential areas, recreational areas, small rural areas, or isolated ones, such as islands or mountain communities. On a larger scale, solar cities can be identified, large rural areas, and administrative regions such as islands. The role of local and regional authorities as well as energy centers is emphasized in implementation of this project. After the publication of the White Paper, further development of RES has been incorporated within the 5th RTD Programme[21], and also supported by the ALTENER II programme -the basic instrument for the Action Plan (section 2.5.1), in particular the Campaign for Take-Off.

6.2.2. European Projects For Reducing Non-Technical Barriers

Since both Green paper and White paper recognize the need to reduce non-technical barriers for the development of renewable energy technologies, studies on

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[21] The strategic goal of the Specific Programme "Energy, Environment and Sustainable Development" under the Fifth Framework Programme is to promote environmental science and technology so as to improve quality of life and boost growth, competitiveness and employment, while meeting the need for sustainable management of resources and protection of the environment (EESD, 1998-2002). Targeted fields of research, under the key action 5 –Cleaner energy systems, including renewables- of the Energy, Environment and Sustainable Development programme are: (RTD info, 1999)

- Clean production of electricity and/or of heat from coal, biomass or other fuels - Combustion and thermochemical conversion with reduced CO_2 emissions; improved performance of gas turbines, diesel engines, etc; co-production of electricity and heat;
- Technologies for converting new and renewable forms of energy - Fuel-cells; biomass; wind energy; photovoltaic and thermic solar technologies; etc.;
- Integration of new and renewable forms of energy into energy systems - Hybrid systems combining renewable sources with conventional systems; elimination of technical impediments to their integration; etc;
- Reduction of damage to the environment caused by thermal electrical power stations - Technologies to abate polluting emissions (CO_2, SOx, NOx and other pollutants); purification of hot gases; etc.

Fostering collaboration, coordination and complementarity within and between key actions, promoting synergetic interactions and complementary activities, and coordination of relevant activities in the areas of marine research, urban issues, transport issues, global change, space and energy technologies are also underlined by the programme.

analyzing and evaluating the planning systems and procedures of the member states have been started just after the adoption of the White Paper, by the implementation of ALTENER II programme. ALTENER is the only Community Programme which focuses exclusively on the promotion of renewable energy resources, and ALTENER II, managed by DG XVII the European Commission's Directorate-General for Energy and run from January 1998 to December 2002, is an important tool both in implementing the Community strategy and action plan outlined in the White Paper, and in monitoring and evaluating its progress. The programme seeks to eliminate especially the non-technical barriers through finalizing the technical norms and standards that are already in preparation; developing and updating market strategies; completing and updating sectoral strategies; and proposing any necessary legislation (ALTENER II, 1998).

In the following sub-titles two projects are taken into consideration. ENER-IURE Project focuses mainly on the fulfillment of the targets established in the ALTENER Programme. The second one, PREDAC (Promotion of Renewable Energy and Development of Actions at a Community Level) is not a project of EU programme. However, initiated and coordinated by a non-profit organization of the Comité de Liaison Energies Renouvelables (CLER) and including 23 partners from 10 European countries is subsidized by the EU.

6.2.2.1. ENER-IURE Project - Phase III

The aim of the ENER-IURE project is the establishment of general legal principles and the specific legal instruments required to promote renewable energy resources in the EU. Breaking down the existing barriers to their dissemination and providing a well-defined legal framework would contribute to strengthening the position of RES. The tasks carried out in order to achieve that goal are:

- Synthesizing existing regulations affecting RES in Europe.
- Structuring the regulations according to the various administrative levels on which the EU currently operates.
- Analyzing and promoting regulations benefiting RES.
- If relevant, proposing the formulation of guidelines and directives to help the different European administrations to produce appropriate RES legal-administrative development.

In regard with these tasks, the analysis on the legislation of the different member states focuses on four sectors: financial as fiscal and subsidies measures, electricity, planning, and agriculture. The project includes sectoral reports submitted by 15 countries, and a final report prepared by the sectoral working groups, presenting the main conclusions of the national reports analysis. Planning report of each member country includes the institutional structure, main actors, legislation, planning system and the permission procedures. In the final report on planning, the planning systems and procedures of the member states are addressed under three main topics: a) Land Planning: Urban and rural planning, b) Environment protection, and c) Administrative proceedings.

In terms of land planning, referring to land-use and environmental planning, this project identifies that "in the majority of the cases there is no direct reference in the land planning laws to energy matters, in particular to renewable energy; this subject is dealt with in the framework of land planning of natural resources" (Working group on planning 2002, p. 8). Accordingly, recommendations included in the final report can be listed as below:

- Planning policies accompanied by an adequate coordination of sectoral and environmental planning,
- Coordinated and multi-sectoral action programmes that favor renewable energy at local/regional level, planning of natural resources;
- Setting clear criteria for land preservation,
- The minimum distances between installations or between installations and inhabited areas,
- Evaluation of the possibilities of the uses of renewable energy sources in special environmental protection areas,
- Elaboration of local energy plans.

For urban planning, referring to building norms and regulations, recommended ordinances for residential areas are:

- The obligation of including solar panels of low temperature in buildings or at least the pre-installation of solar energy in newly constructed buildings.
- The obligation of professional maintenance of solar energy facilities (small scale), the design of roofs of buildings, and the layout of plans all in coordination with local norms and ordinances.

- The promotion measures for introducing the use of renewable energy sources in buildings under restoration.
- The limitation of installing electricity heating in buildings with district heating, and specifically in new constructions.
- The consideration of bioclimatic criteria such as, promoting the passive solar energy in the building sector.

Lastly, it is recommended that clearly defined minimum standards of environmental protection levels for RES installations are necessary in terms of reducing environmental impacts and of reducing barriers during authorization.

6.2.2.2. PREDAC Project

The goal of PREDAC – Promotion of Renewable Energy and Development of Actions at a Community Level- project is to develop experience exchanges between European renewable energy and energy conservation actors and to promote development and actions at a local level. The project includes eleven themes: Local investment in renewable energy; development of emerging jobs; energy information center; bio-climatic and solar construction seal; promotion of thermal solar technical solutions; promotion of building-integrated PV; environmental impact of small hydraulic power stations; GIS to improve acceptance of wind energy; website services; and documentation center.

In accordance with the overall objective of the project, the Work Group on wind energy aims at providing a European framework of wind energy planning procedures through reviewing spatial planning procedures and experiences of different countries. This project recognizes that implementation of turbines on any territory is not neutral on its environment, and wind energy is subject to spatial planning procedures. Therefore, spatial planning or land use planning is considered as a crucial factor for successful integration of wind power in populated areas (PREDAC 2002, 2004).

Based on experiences with spatial planning in Belgium, Denmark, France and the Netherlands, and also Germany and Ireland, it is suggested that general objectives of a wind energy spatial planning should include:

- To take the maximum advantage of the wind energy potential, planning it in a coherent way for its correct development from territorial, energetic, environmental and socio-economic point of view.

- To both rationalize and accelerate the development of wind energy throughout the EU streamlining the current processes of project selection by developers and project judgment by planners.
- To optimize and facilitate the territorial integration of the projects, beyond energy concerns by holding account of local specificities.

In this project the issues considered within the planning framework are, integration of wind power in regional and local planning; environmental impact assessment requirements, other authorities involved, permits needed, involvement of stakeholders, period to obtain all permits, costs required for studies and permits; and relations with grid connection. It is concluded with guideline recommendations including 21 environmental and spatial criteria (PREDAC 2002, 2004).

6.2.3. EU Directive on Renewable Energy

Besides those programmes, campaigns and measures included in the Action Plan, the Commission states that it is "necessary to ensure that potential is better exploited within the framework of the internal electricity market" (EU Directive 2001, p. 33)

In that regard, Directive[22] 2001/77/EC addressed to the Member States on the promotion of electricity produced from renewable energy sources in the internal electricity market has entered into force on the day of its publication in the Official Journal of the European Communities. In order to ensure increased market penetration of electricity produced from renewable energy sources in the medium term, this EU Directive (Article 3, paragraph 2) obligates all Member States to set national indicative targets for the consumption of electricity produced from renewable sources.

Furthermore, this is an obligation, which concerns administrative procedures, and provides basis for member states to review and improve their procedures for planning and permitting processes through its provisions:

[22] *EU directives*, as one of the legal instruments available to the Community institutions to carry out their tasks under the Treaty establishing the European Community with due respect for the subsidiarity principle, are binding on the member states as regards the results to be achieved, but leave the choice of form and means of implementation to them (EU Glossary).

- Article 6 (1) of the Directive 2001/77/EC obligates the member states to evaluate the existing legislative and regulatory framework with regard to authorization procedures and with a view to:
  - Reducing the regulatory and non-regulatory barriers to the increase in electricity production from renewable energy sources,
  - Streamlining and expediting procedures at the appropriate administrative level,
  - Ensuring that the rules are objective, transparent and non-discriminatory, and take fully into account the particularities of the various renewable energy source technologies.
- Paragraph 2 of the same article (6) forces member states to publish a report on the relevant findings of that evaluation and on actions taken.

In accordance with that EU Directive and the response of member states, it becomes apparent that it is the obligations of reducing the regulatory and non-regulatory barriers to the increase in electricity production from renewable energy sources, and setting of national renewable energy targets, which constitutes basis for why planning should contribute to the renewable energy policies, and in a way directing how to contribute.

6.3. Authorization and Permission Procedures

With the aim of understanding the recognition of *spatial planning as a bottleneck* the emphasis here in this part is on authorization and permission procedures. As noticed during literature readings, these regulatory frameworks are recognized as major constraints for renewable energy developments. In this respect, it is attempted to explore general framework of authorization and permitting procedures apply to renewable energy projects, main problems associated with processes, and the actions taken or proposed to reduce these non-technical barriers.

In general, main types of authorization or permits required for renewable energy and co-generation technologies (Figure 6.1) are:

- An authorization or license to engage in the business of electricity generation and heat production which are normally required or exempted under procedures pursuant to the national energy legislation,

- Construction and/or building permits linked to spatial planning procedures and regulations,
- Environmental permits.

In some countries, renewable energy projects need only the second and third types of permits. However, the associated procedures vary strongly among technologies, member states, and also within a single member state among different regions, or municipalities.

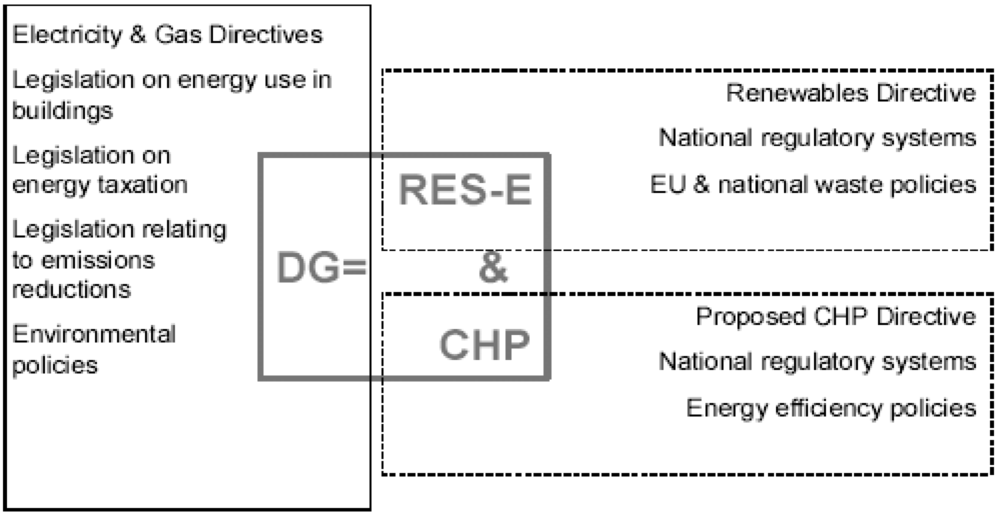

Figure 6.1. Legal and regulatory frame for decentralized generation
(Cross et al. 2002, p. 10)

As part of the project[23] "DECENT-Decentralized Generation Technologies: Potentials, Success Factors and Impacts in the Liberalized EU Energy Markets", the success factors and barriers of authorization and permitting procedures are investigated by comparison, based on analyses of cases studies in different countries. In accordance with that project, in which authorization and permitting is considered as the initial phase of project development and operation, main problems associated with permitting are given as the complexity of the procedure and the length of time period for approval.

[23] The aim of the project, which was carried out by ECN (Energy Research Center of the Netherlands) Policy Studies, and co-funded by the European Commission, DG TREN, under the Fifth Framework Programme, is given as to elaborate the key regulatory issues arising under EU and Member States' electricity policy and regulation relating to DG, and to make recommendations to the relevant decision-makers to enhance the feasibility of DG projects within the internal energy market. The abbreviation *DG*, or the term *Decentralized Generation* refers to the grid-connected or stand-alone generation of electricity using small, modular technologies close to the point of consumption, including not only electricity generated from renewables but also co-generation technologies.

Furthermore, four factors are identified as key issues of permission process that generate differences between and within member states, and result as bottleneck or success (Cross et al. 2002):

- Who takes the lead in identifying suitable sites for development,
- The government level on which the planning authority is placed, and the amount of experience or competence of local authorities,
- The criteria used for the environmental impact assessment and/or construction permit,
- The transparency of necessary procedures and the certainty/time of approval, are the key issues of permission process and that generate differences between Member States and/or regions, resulting as success or bottleneck.

- *Who takes the lead in identifying suitable sites*: The German spatial planning scheme encourages local authorities to identify priority sites for wind power development. Municipalities have to show in their spatial planning where it is feasible to build wind plants, and that scheme makes permitting procedure shorter and easier for investors (Cross et al. 2002, Reiche and Bechberger 2004). Similarly, municipal planning in Denmark should include the areas of wind power designated by regional planning. Developers can seek a site within the designated areas indicated in regional or municipal plans. If their preferred sit is outside of the designated are, they can propose to county. Designation of new areas requires an EIA. Together with the amendment of regional plan the time period is 1-2 years. For projects that are already in designated areas the period is about 3-6 months (Olesen 2002). In Spain, it is the wind farm developer who selects a site. However, in many cases the selected site concerns the public land, instead of private land. Large developers dominate the market, and they often involve regional governments, local industrial partners and local utilities in the organizational structure of the proposed project to ensure the required support (Cross et al. 2002). On the other hand, in the U.K and the Netherlands cases, the approval procedure is a lengthy process. Because existing land use plans are required to be revised to include permitted RES projects. If the developer is the one that identify possible sites, they have to appeal for such revisions, and this may cause significant delays associated with additional costs for the investor. As exemplified in the report, the wind farm Zwaagdijk in the Netherlands has been applying for planning permission for 6 years due to the planning permission procedure required the municipal zoning plan to be adjusted, and public appeal procedures and final approval from the provincial council.

- *Local authorities:* In most cases, it is the local level and sometimes regional on which planning authority is placed. Since the role of local governments is to balance potentially conflicting interests, the main issue that causes rejection or long delays in wind farm proposals is given as the balancing of local visual impact arguments against higher level benefits (Cross et al. 2002). Moreover, in the cases of strong local resistance for reasons such as noise impact and particularly bird endangerment, local authorities often give up their wind energy plans due to consensus-based decision making (Reiche and Bechberger, 2004). On the other hand, the Middelgrunden offshore wind farm and Lastour wind farm project are given as examples for planning procedures which has taken several years due to lack of knowledge and experience. In the case of the first private offshore wind farm in Denmark, the delay was caused since no planning rules had been established for this kind of plants, and in Southern France case, the delay was caused due to lack of experience during the necessary adaptation of spatial plan (Cross et al. 2002).
- *The criteria used for the environmental impact assessment and/or construction permit:* Depending on the technology, there are various licenses required, such as building permit, environmental permit, and depending on the size of the project environmental impact assessment. Most of the problems encountered during environmental permit are related to biomass plants. There are considerable licensing difficulties in biomass developments and a bad public reputation since most of the plants are considered as waste incineration/treatment installations instead of biomass power plants. As it is given, the permitting process for the Lelystad biomass project in the Netherlands had taken one year, and The Silbitz biomass project in Germany had its difficulties in obtaining the operation license. However, the processes were shorter and easier due to relatively clear definitions of waste categories in German legislation regarding the eligibility for RES support and on conditions for an operation permit. Clear definitions of waste categories, and the distinction between waste disposal and useful application of waste by co-incineration are essential. When the plant is classified as a type of residues/waste processing plant it enhances possible public opposition, and makes the licensing process more difficult. The plant needs an operation license covering possible emissions to air and water. The permit is to be granted if the emission

standards are met and the local pollution standards are not endangered (Cross et al. 2002).

In terms of construction permits, there might be problems for PV developments above 100 kW or in the MW size since most roofs built in the last two decades are not designed to carry high additional loads.

- *Transparency of necessary procedures and the certainty/time of approval:* It is given that the time period of approval is up to 6 months in Germany and Denmark, up to 3½ years in the UK, and up to 6 years in the Netherlands. It is also identified that in each country, the key problems occur at different stages of the planning process: it is the planning permission in the UK, the revision of the legally binding local plan in the Netherlands, and the construction permit in Germany (Cross et al. 2002, Reiche and Bechberger 2004). Another example where licensing procedures are very complicated is Greece. As it is expressed, RES developments require the agreement of more than 35 public sector entities at central, regional, and local level together with conforming to four national laws and seven ministerial decrees (Reiche and Bechberger 2004).

With reference to above factors, some recommendations provided by the DECENT project are:

- Permitting or licensing procedures should be transparent and efficient,
- Local authorities should take a lead with a pro-active planning strategy,
- Integration of renewables into spatial plans, and thus the pre-selection of potential sites helps to avoid conflicts,
- The work of planning authorities could be facilitated by improving the database or resources potential to better enable them to reach balanced decisions,
- If the competence of local authorities is a barrier, training programmes for personnel that issue the permit could be established.

In addition, it is also pointed out that the co-ordination of spatial planning and network planning is necessary. Beside the challenge of integrating wind energy development sites into spatial plans through appointing specific locations, grid connection issues to be considered are suggested, because:

> The sites that are appointed on this basis or that most eligible from a resource point of view are not always the most optimal sites from a network integration point of view… Vice versa, it would be commendable to take the designated wind/DG development areas into account in the grid planning by network operators. (p. 24)

This co-ordination is related mainly to minimize the cost of grid connection. The grid connection issues as pricing and regulation of connection to the grid and of transmission and distribution network services, and the technical aspects, such as capacity of grid, necessary upgrades, point of connection, interconnection voltage, line protection technology, substations, transformers are among the major factors for feasible RES installations.

6.4. Concluding Remarks

Renewable energy as a sectoral policy influences land use and spatial organization thus has impact on local planning policies, which is another sectoral policy field. The process of planning permission lies at the core of interaction between renewable energy and planning domains. The context and extent of legal and regulatory frameworks and especially the transparency of permitting procedures, clearly set criteria, time period of approval, the role and competence of local authorities and the actors responsible for site selection have impact on successful implementations.

However, it is European spatial planning, spatial development policy and integrated spatial development approaches that call for integration of renewable energy and planning policies. That planning, in European sense, refers to coordination and integration of sectoral policies and the spatial dimension of Community policies through a territory based strategy, and that integrated spatial development approach emphasizes the need for close cooperation amongst the authorities responsible for sectoral policies and with those responsible for spatial development (land use, regional planning, urban planning) at each respective level, and between actors at the Community level and the trans-national, regional and local levels. In the ESDP, an instrument to provide the coordination of Community policies through improved spatial coherence under the concept of sustainable development and with its three objectives, renewable energy-spatial development relations are considered within the policy aims of wise and resource saving management of the urban ecosystem; efficient use of resources; and contribution to the climate protection.

The measures included in the White Paper such as district heating and cooling networks based on co-generation with biomass, improving building regulations, supporting renewable energy projects in rural areas under Leader programme, etc. can be explained by the approaches of improvement of infrastructure, development of functional synergies and integrated spatial development defined in the ESDP in term of improving spatial coherence of energy policies. Both strategic policy frameworks suggest the use of renewable energy as urban, regional and rural policy, putting emphasis on strengthened cooperation, dissemination of knowledge and institutionalization.

While favoring bottom-up actions, the document having a top-down approach calls on strong national strategic policies and their hierarchically distribution to lower levels putting more emphasis on regional level. Accordingly, it can be suggested that there is a need for integration of renewable energy and spatial policies at the national level with a strategic policy framework so as to guide policy and actions at the regional and local level. Interreg IIC as implementation tool of the European perspective involves transnational cooperation in spatial development projects sharing common organizational, administrative and financial structures. Since renewable energy developments are part of these spatial development projects and spatial visions of regions, such as in Baltic Sea Region, member states of the regions are trying to establish a common language, and adjusting their planning systems and legislations to encourage successful development of renewable energy technologies.

Besides such adjustments, projects developed under European programmes focus on reducing non-technical barriers and increasing the use of renewable energy sources by providing general principles, guidance and common frameworks for legal, legislative and regulatory structures through analyzing and synthesizing member states' frameworks. These projects suggest planning policies accompanied by an adequate coordination of sectoral and environmental planning, by coordinated and multi-sectoral action programmes that favor renewable energy at local and regional level.

In the White Paper, the Community suggests aid opportunities for renewable energies, such as providing support to regional and local projects and planning in the framework of its promotional Altener Programme, and proposes the strengthening the weight given to renewable energy in Structural Funds. These funding opportunities could inevitably yield increase in the share of renewable energy sources. Basing on the rationale of European integration the funds are the main driving force for co-operation and co-ordination. Beside economic interdependency, member states participate programmes such as community initiative that are aid or action programmes set up to complement Structural Fund operation for regional developments, is to receive aid from the Community. In order to have funding for spatial development, member states should meet the requirements of the ESDP.

On the other hand, renewable energy policy of the Community is based on the objectives of security and diversity of supply, environmental protection and sustainable development, and of social and economic cohesion. Renewables are regarded as an important factor not only to combat global warming and to achieve carbon emission reduction targets, but also to attain energy policies of the Community. While the White Paper provides a comprehensive strategy and a comprehensive action plan for implementing renewable energy policies ensuring the co-ordination and consistency at Community, national and local levels, EU Directive ensures increased market penetration of electricity produced from renewable energy sources in the medium term. It can be argued that this Directive directly related to the completion of internal market triggers off the conflict of liberalization vs. environment. Together with this embodied contradiction, the provisions of the Directive explain the expression of planning systems' contribution to renewable energy policies, in particular to quantitative targets at national and Community levels through allowing penetration of large scale electricity generation projects into market.

Since the choice of measures and means of implementation are left to member states, the success or failure in achieving national targets and meeting European objectives depends mostly on the institutional framework of each country.

CHAPTER 7

INTERACTION BETWEEN RENEWABLE ENERGY AND PLANNING POLICIES: NATIONAL CONTEXTS

The contributions from different countries to cross/multi-disciplinary literature comprising analysis and evaluation of policy and practices indicate that there are substantial differences between and within countries in their experiences of renewable energy developments and the contribution of their planning systems. First of all, each territory has different climatic, geographic features together with the available natural sources. For that reason, each country has different understanding and definition of renewable energy. In accordance with the structure of national energy sectors, there are different set of policies and implementation tools, support mechanisms for exploiting renewable energy sources. Moreover, there are differences in planning authorities' approach to the question of renewable energy within their administrative and planning system, and in introducing renewable energy issues within planning policies and practices. There are also differences in terms of compatibility with and response to European context. In some cases, the European influence is main cause of conflict between national and local interests.

In accordance with the interpretations and identification given above and in line with the previous contexts, the aim here in this chapter is to explore national contexts and to understand both efficiency and deficiency of the national and local systems in responding to renewable energy and in integrating renewable energy, environmental and spatial policies within their institutional structures through the concept of contribution of planning systems to renewable energy policies. The research questions are: How planning systems contribute to European policies and legislation? What are the distinct features of national renewable energy policies and policy tools? What is the institutional framework for renewable energy developments? How local governments and planning authorities approach to the question of renewable energy? How planning authorities introduce renewable energy issues in their planning practices? and how they deal with the tensions and conflicts introduced newly by these unaccustomed developments?

7.1. Swedish Case

Sweden has long been an acknowledged leader in Europe in terms of its commitment to environmental protection. The main features of that commitment are; ecologically based technological innovation, high-quality environmental research and monitoring linked to indicators, environmental legislation and the creation of frameworks for administration, the commitment to the polluters-pay principle, the development of supports and fiscal mechanisms for linking environmental policy and practice, adoption of green taxation, and application of taxes to CO_2, NO_x and SO_x emissions, and landfill tax, and the inclusion of environmental considerations in spatial planning. Rather than zero-sum or negative-sum policy, proactive environmental management is characterized as positive-sum, which leads to gains environmentally and socio-economically. In addition to the decentralized and consensual style of governance, the government is committed to facilitative legislation and instruments, which promote continuing improvement rather than the command and control approach of preset environmental targets.

Despite these outstanding Swedish features, it is recognized that some tensions have arisen between local and national interests as a consequence of the integration of sustainable development agenda into central government programmes. It is argued that Local Agenda 21 is largely top-down and expert-led rather than embedded in the community, and increasingly finance driven rather ideology driven. Therefore, the emphasis is mostly given on infrastructure development rather than capacity building, and genuine public and community participation is not maintained though local actors come together through governmental programmes. As a consequence of these arguments, the authors Fudge and Rowe suggest that an "argumentative or deliberative ecological modernization may more effective in achieving its own goals than the techno-corporatist model implicitly favored by Swedish norms" (2001, p: 1542)

In Sweden, it is the green city concept, which is adopted, rather than compact city concept. Though compaction has been offered as a solution to urban growth, this approach has not been favored since compaction has a negative impact on existing green space in cities. On the other hand, there is an attempt to establish the general framework of planning for sustainable development. The recent project "Environmental objective and indicators in spatial planning and strategic environmental assessment" which was developed by National Board of Housing, Building, and Planning and the Environmental Protection Agency along with several municipalities and regional authorities in 2000, aims at integrating environmental issues into comprehensive planning, formulating the role of comprehensive planning in the path towards sustainable societal development, and enhancing collaboration in the planning process among different areas of disciplines, and among experts, decision-makers and the general public (Boverket and Naturvårdsverket 2000).

In this project, *building areas with sustainable energy supply* is one of the determined planning indicators. It refers to the proportion of built-up areas with sustainable energy supply and energy use distributed between renewable and non-renewable fuels, together with defining the type of sustainable energy supply. Using such a planning indicator means that the developed plan estimates future energy use, and specifies how proposed development areas are to be supplied with energy.

Within this framework of comprehensive planning, energy cultivation and biomass/biofuels are highly favored. The utilization of biomass is promoted not only for its advantages such as energy supply and reduction in net carbon emissions, but also for environmental gains. It is also emphasized that coordinating several functions and making use of synergy effects and systematic thinking in multi-functional solutions are important for sustainability. Therefore, it is necessary for municipalities to plan for eco-cycle solutions and general system solutions for waste, energy, and the water.

Accordingly, it is suggested the cultivation of energy forest (Salix) and energy grass could be exploited for the purification of wastewater, surface water, desalted water and sewage sludge; clones of Salix could reduce cadmium content in arable land and content of nitrate in groundwater, and erosion. However, it is also pointed out that estimating biomass potential is difficult due to the factors of land availability and productivity as well as demand for food production. Lastly, in terms of impact on landscape, only low-growing energy grass is suggested for preserved open landscapes.

7.1.1. Administrative and Planning System

With a unitary government structure and a policy of decentralization, the role of local authorities is strong in Sweden. Since planning was eradicated at national level in the early 70s, there are no comprehensive planning actors at national level, and almost non-existing regional level. Planning and Building Act, PBA (1987:10) states that the local authorities (*kommun*) are responsible for all planning in the community, and they are obliged to make a comprehensive plan (MCP) which co-ordinates the general interests regarding the use of water, soil and natural resources. The purpose of the PBA is to support a development of society with equal and good social conditions for living together with the liberty of the people, and support a sustainable environment for today's inhabitants as well as for future generations (Boverket 2003). According to the Act, local planning has to promote economical use of energy, and reserve those areas that are suitable for energy plants.

The MCP (*översiktsplan*), as an overall instrument of municipal planning, is not binding but has an important function as a guiding principle for public and private actors. Moreover, the MCP, within which national environmental guidelines are drawn, is a link between the general national policy expressed in the Environmental Code (see 6.1.2.1) and the local objectives. All new building projects need a building permit, and the projects having significant environmental impact require a Detailed Development Plan (DDP). The DDP (*detaljplan*) is legally binding and an important planning tool since it gives local authority the possibility of regulating in detail. However, often through the Building Office, it is the local authority that decides whether a DDP is required or not. The governmental impact on planning is implemented by the County Administrative Boards (*länsstyrelse*), which has consulting role. However, the state and county authorities can only override a municipal planning decision if a national interest has not been taken into account or if a project will threaten public health and security.

From the point of European perspective, Sweden -joined in the Union in 1995- which is not an entirely convinced member, shows low EU compatibility in terms of spatial planning and development, and its administrative system. As it is given, Sweden is the only country where the ESDP is discussed on local level. The document was transmitted from EU directly to the municipalities but not received much interest due to its top-down perspectives. There were difficulties in translating the term and the document since there was no such thing as spatial planning in Sweden in terms of European context. Physical planning and regional/economic development are traditionally two discrete policy fields, which are kept strictly separate. Therefore, the adopted translation is *Det regionala utvecklingsperspektivet inom Europeiska unionen* (The Regional Development Perspective in European Union). However, parallel to that translation, there has been changes towards restructuring and strengthening the regional level and policies as a consequence of Interreg projects and the experience of Structural Fund procedures (Böhme 2001).

7.1.2. Institutional Framework for Renewable Energy Developments

In Sweden, the Government and the National Energy Administration promote renewable energy through: The Government Bill 97/98:145, which consists of 15 qualitative environmental objectives, and National Decree 1998:22, which deals with grants for energy investments such as CHP based on biofuels, wind power and small-scale hydropower. The authorities that have responsibility are: The Ministry of Environment, Swedish Environmental Protection Agency, National Board of Housing, Building and Planning, Swedish National Energy Administration, Swedish Board of Agriculture, National Board of Forestry, County Government Boards, and Municipalities. The existing legislation relates to renewable energy projects:

- The Environmental Code (1998:808)
- Planning and Building Act, PAL (1987:10)
- The Forestry Act (1979:429)
- The Act on Municipal Energy Planning (1977:439)
- Act on technical requirements for construction works (1994:847)

In the documents of both ENER-IURE project (STEM 2001) and the report submitted as a requirement under Article 6 of Directive 2001/77/EC (Swedish report 2003), The Swedish legislation concerning planning is specified as a modern well-established system in which the authorization procedures are clearly defined and the overall purpose is to promote environmental concerns and extended use of RES. Therefore, a speed-up planning procedures are out of consideration in Sweden.

7.1.2.1. Environmental Objectives and the Environmental Code

Formulated through the aim of ecologically sustainable development, the Bill Swedish Environmental Quality Objectives – An Environmental Policy for a Sustainable Sweden (Gov. Bill 1997 / 98:145) includes 15 environmental quality objectives. These objectives define the state of the Swedish environment, which the environmental measures seek to achieve. Moreover, the overall strategy, defined by means of objectives, constitute the basis of the system of management, which is proposed as a new structure for the elaboration and implementation of environmental goals by the Government (Swedish Government 1997). Latter Bill 2000 / 01:130 The Swedish Environmental Objectives – Interim Targets and Action Strategies states the direction and timescale for the ongoing concrete environmental measures within which the interim targets relate to the situation in 2010, in most cases.

The Environmental Code (EC), which was adopted in 1998 and entered into force 1 January 1999, is considered as the first integrated body of environmental legislation enacted in Sweden. It is a framework law within which the environmental quality objectives serve as a guide to achieve objectives established by the Code, to assess the implications of sustainable development and thus to implement the Code's provisions.

In conjunction with the adopted concept of factor 10, which means that the use of resources including all energy resources and all materials must on average become ten times more efficient within one or two generations, the proposed strategies for action are: a strategy for more efficient energy use and transport; a strategy for non-toxic and resource-efficient cyclical systems, including an integrated product policy; and a strategy for management of land, water and the built environment (Regeringskansliet 2001).

These strategies are contributing to different sets of objectives. However, it is noticed that each of the three proposed strategies contributes to the objective of *A Good Built Environment,* and appointed by the Government it is The National Board of Housing, Building and Planning who is responsible for *A Good Built Environment* objective. Among the tasks of the Board are to develop and present spatial planning methods, procedures and measures for sustainable development, and coordinating spatial planning across sectoral boundaries local and central government agencies. Accordingly, municipalities and regional authorities should collaborate in defining and monitoring the national environmental quality goals in local and regional planning.

7.1.2.2. Authorization and Permitting Procedures

Wind power plants are subjected to two general laws. The PBA deals with the question of where to site turbines and how to make balance with conflicting interests, and the EC regulates how to assess the environmental and health impacts of wind power plants. In accordance with chapter 6 of the EC, the applicants have to produce an environmental impact assessment as to certain types of energy plants. The handling of the application is carried out on different administrative levels depending on the size of the project.

According to the Chapter 9 and the Ordinance (1998:899) concerning environmentally hazardous activities and the protection of public health, wind power plants and combustion plants are defined as environmentally hazardous activities that require permit. In Appendix "Environmentally hazardous activities that must be reported or require authorization in accordance with section 5 or 21 of Ordinance (1998:899)" activities are categorized into three for the consideration of permits in accordance with Chapter 9 (6) of the EC (Table 7.1).

Table 7.1: Categorization of activities for the consideration of permits (Swedish Environmental Protection Agency 2002)

Type of Activity	Level of Authority
Facility for gasification or incineration with a total installed supplied power of more than 200 MW	A
Facility for gasification or incineration with a total installed supplied power of between 10-200 MW	B
Incineration facility with a total installed supplied power of between 10 MW-500 Kw, using other than fuel oil or fuel gas as energy source	C
Wind farm of three or more wind generators with a combined output of at least 10 MW	A
Wind power plant with individual wind generators with a combined output of more 1 MW	B
Wind farm or wind power plant with individual wind generators, with a maximum combined power output of between 125 kW- 1MW	C
A: Application shall be made to the relevant environmental court B: Application shall be made to the relevant county administrative board C: Notification shall be made to the appropriate municipal board	

As indicated in Ener-Iure report, for installations on existing buildings and on-ground solar collector fields, permission from the local authority is needed, while no permission is required if solar panels are integrated on the roof during the construction of the building (STEM 2001).

Large-scale hydropower is no longer favored, but there is a potential for developing small-scale. As identified in Chapter 4, section 6 of the EC, four national and some other rives with their source rivers and tributaries are protected from hydroelectric power developments and the diversion of water bodies for the purposes of power generation is restricted (Regeringskansliet 2000). Instead of threshold capacities as applied to wind power and combustion plants, all hydropower installations are treated in the same way. However, this is considered as disadvantageous for small-scale developments (Swedish Report 2003).

Although the provisions for authorization and permits are clearly set, some deficiencies of the system, recognized through the evaluation of the existing legislation, regulation and administrative procedures and presented in the report submitted in accordance with the requirements of Article 6 of Directive 2001/77/EC, are:

- The problem of double regulation in terms of environmental impact assessment: Under the EC, an EIA is required if the activity is likely to have a *considerable effect* on the environment, and required to be carried out by the operator in connection with the permit application. Under the PBA, in connection with the DDP, an EIA is required to be carried out by the municipality if the project will have a considerable effect.
- Threshold capacities identified (125 kW - 1 MW, 1 MW – 10 MW and > 10 MW) for permit applications are considered as inappropriate due to the fact that capacity criterion is not relevant for deciding the effect of an installation on the surroundings.
- Applications for permit to establish off-shore wind power are subject to Chapter 11 (Water operations) of the EC, and in the condition that: “Water operations may only be undertaken if the benefits from the point of view of public and private interests are greater than the costs and damage associated with them” (Regeringskansliet, 2000, p: 60).
- The problem of municipal comprehensive plans neglecting the question of wind power, due to the fact that wind power is not in the status of natural interest.

At present, there is an attempt to designate areas of national interest for wind power and to distribute the planning target of 10 TWh, which is adopted by the

Parliament as a quantitative target to be produced by the year 2015, by regions. Gaining the status of national interest, the areas for wind power will become subjected to the rules of Chapter 3 (8):

> "Land and water areas that are particularly suitable as sites for facilities for industrial production, energy production, energy distribution, communications, water supply or waste treatment shall, to the extent possible, be protected against measures that may be prejudicial to the establishment or use of such sites.
> Areas that are of national interest on account of facilities mentioned in the first paragraph shall be protected against measures that may be prejudicial to the establishment or use of such sites".

Those attempts will reinforce the integration of wind power in municipal comprehensive plans, and facilitate weighing up different interests related to provisions on land and water management. Because, in the absence of a quantitative target for wind power development, it is hard to assert wind power interests in the kind of physical planning and permit procedure where those interests need to be balanced against other.

7.1.2.3. Criteria for Locating Wind Power Plants

While promoting the expansion of wind power in response to market demand for emission-free electricity production, the government recognizes that there should be good preparedness regarding wind power station locations, and questions of land and water use relating to wind power should be dealt with at the earliest possible opportunity in physical planning for areas with good wind conditions. In that regard, a commission was appointed to study on conditions of wind power developments. At the end of a two-phase study, the Commission on Wind Power has proposed basic criteria for locating wind power plants. The Commission's recommendations, presented in their final report "*The right place for wind power*" can be outlined as below (Ministry of Environment 1999):

- In balancing wind power developments against interests in the preservation of different natural and cultural qualities, Preservation concerns need to be concretized through value descriptions, and the type and extend of the impact of wind power on natural and cultural qualities need to be ascertained.

- Classification of different types of landscape throughout the country together with the principles regarding the positioning, height, number and grouping of wind turbines for each type of the landscape.
- An actual shadow time of ten hours per annum is proposed as a reasonable maximum shadow frequency to be tolerated. An annual limit value needs to be combined with a maximum permissible shadow time per 24 hours.
- Even though no substantial harm to bird life has been experienced, the siting of wind power stations in bird protection areas, along the main bird migration routes, in marine nature reserves, in the principal resting and feeding areas and in other areas with large concentrations of birds should be avoided for the time being. Power stations should not be erected and scheduled maintenance should be avoided during nesting and migration seasons.
- Due to possible effects, restraint should be exercised in areas of reindeer populations.
- Due to possible impact on seals, care should be given in rookeries and moulting areas. Construction and maintenance work should be done in the autumn and early winter. Wind power stations should not be permitted in areas designated as seal sanctuaries.
- When assessing the risk of impact on the fish fauna, it should be considered whether the wind turbines and the altered flow would affect spawning areas of certain fish species, have a potential impact on biotopes and disrupt the annual migrations of certain species such as herring, eel and salmon.

Further guidance on comprehensive planning issues, detailed plan processes, analysis of visual impact has been provided by the *handbook for wind power planning* published by Boverket in 2003. It is noticed that, the Danish cases are taken as reference in sitting issues.

7.1.3. Wind Energy Planning in Sweden

It is argued that there is a rather ambiguous national government policy towards wind power. Since there is no binding official target, the economic support is lower and less stable. The government is considered as reluctant to introduce measures that would ensure more substantial support. As a consequence of withdrawn central government, local governments are the key actors in wind energy planning in Sweden. However, the attitudes of local governments towards wind power are in a manner varying from willingness to support to being skeptical and turning down the applications. In accordance with the attitudes, planning strategies range from simple and quick procedures to postponed planning and strict control over sitting of turbines. These strategies determine the planning approach whether DDP is required or not for wind projects. In some municipalities, the developments are realized by farmers, through installing one or two turbines in their own land without any regulation on sitting of turbines. In the case of planning approach with MCP and DDP, local authorities identify suitable sites concentrating in a few geographical areas that are clearly separated from each other, and set criteria for the size and design of the projects. These identified sites generally favors big actors or large landowners, however local government can support partnership and local ownership of wind turbines. In order to present these varying processes of Swedish wind energy planning, Khan's comparative study (2003) on three municipalities is outlined in Table 7.2.

Though the Swedish system is regarded as satisfactory from the viewpoint of the energy sector, Khan claim that wind power poses a challenge to Swedish planning system, with increasing public opposition to wind power projects, lengthy and complicated application procedures and an inadequate planning at the municipal level which would likely increase in the case of a projected growth through official targets. Furthermore, it is argued the efforts given in particular to the methods on sitting of turbines and to public participation is insufficient to achieve best practices of developments without existence of stronger national policy measures, and the future of wind energy planning would be problematic unless the principle of local ownership is facilitated and supported by the state.

Table 7.2: Key characteristics of wind energy planning in three Swedish municipalities

<table>
<tr><th>Municipalities</th><th>Laholm</th><th>Halmstad</th><th>Falkenberg</th></tr>
<tr><td>Wind power projects</td><td>45 installed turbines, with total capacity of 22 MW</td><td>5 installed turbines</td><td>21 installed turbines, with total capacity of 10 MW</td></tr>
<tr><td>The attitude of local government</td><td>Strong political support</td><td>Was rather negative due to perceived negative impacts of turbines,
The belief was that technology could not contribute much to electricity production
Change in the attitude after 2000</td><td>Strong political support</td></tr>
<tr><td>Planning strategy</td><td>Simple and quick application procedures,
open policy to both single turbines and clusters</td><td>Approve as few applications as possible and to postpone overall planning before 2000,
The preparation of Municipal Comprehensive Plan (MCP) for wind power, in 2000.</td><td>An early and substantial support,
Conviction of the need to retain a strict control over sitting of turbines</td></tr>
<tr><td>Planning approach</td><td>A decision not to require DDPs for specific projects</td><td>Thorough planning approach with MCP, coupled with obligatory DDPs for all specific projects</td><td>Instead of a formal MCP, an informal study carried out in the northern part of the municipality</td></tr>
<tr><td>Planning and sitting of turbines</td><td>No regulation on sitting of turbines
Instead of being concentrated in few areas, single or pair of turbines are scattered all over the plains</td><td colspan="2">Suitable sites identified by the local authority,
Concentrating in a few geographical areas that are clearly separate from each other, and leaving the majority of the landscape free from turbines,
Through DDPs, local authorities put requirements on the size and shape of the project,
The authorities are restrictive about single turbines</td></tr>
</table>

(Cont. on next page)

Table 7.2 (cont.)

Local economic involvement	Developments dominated by farmers, installing one or two turbines in their own land, 5 turbines owned by the municipal energy company, and 5 of the rest co-operatively owned, Not the local government but the developers encourage farmers, Political strategy and planning approach facilitate small-scale projects and let farmers to install wind turbines	The sites identified as suitable for wind farms are the areas that are generally owned by large land owners, Therefore, the potential contributors to wind energy are those large land owners and energy companies, Large projects require DDP and environmental application which is difficult to small actors to afford the costs	Wind farms in identified sites favors big actors, However, local government supports local ownership of wind turbines, Local companies and citizens are offered to buy shares of wind farm developed and financed by the municipal energy company
Public participation	Not promoted actively by local government Since DDPs are not required the possibility of public participation is limited	Both planners and politicians recognize the importance of public participation as an input in wind energy planning, Extensive formal consultation process as well as a survey of people living in the areas identified for wind farms	The informal study instead of MCP implies a limited public participation, But the DDP process compensates the lack of participation in comprehensive planning
Evaluation of the overall process	***Tthe outcome of the adopted planning approach is a picture of scattered turbines, and lack of public participation,*** *So, there is a risk of local opposition against further development.*	*Local governments who are skeptical or hesitant delay the developments by postponing planning and allowing for long planning processes.*	*Together with strong political support, the planners recognize planning as a way of supporting wind power.*

7.2. Danish Case

In conjunction with the EU energy policies, the principal goal in Denmark is to achieve a reduction of CO2 emissions by 20 % compared to the 1988 level, before 2005. The main instrument to achieve this target is the utilization of renewable energy resources in both electricity and heat production. The priorities are: with the impression of *fewer but larger* promoting both on-shore wind power mainly by replacing old turbines and off-shore wind power with large capacities, and promoting the use of biomass (straw, wood chips and pellets) and biogas (animal manure and organic industrial waste) in district heating, with more emphasis on combined-heat power.

Though Denmark has been world leader in wind energy since 1980's, the most important success in Danish energy policy has been the fuel savings in residential space heating sector. This success depends mainly on two initiatives: energy conservation by insulation, and expansion of district heating based on cogeneration. For example, energy consumption in space heating has decreased by 30 % in the period from 1972 to 1996; heated areas have increased by 46 %, while the heat demand has decreased by 12 %; and district heating has been expanded by more than 50 %. Total decrease in fuel consumption for space heating is 53 %, in which 40 % is a result of energy conservation and the remaining is caused by the expansion of CHP. Combined heat power, which was expanded first in city areas where power stations already located, is now being built in towns and small villages. The expansion of district heating and conservation depend again on two reasons: energy price and tax policy, and the Danish tradition for consumer-owned heat supplies, which has been easy to adjust to CHP as well (Lund 2000).

Despite the fact that EU directive on electricity liberalization has created a struggle between liberalization approach and the democratization approach, or in other words, the conflict between market reorganization and competition, and climate change and sustainable development, Denmark seems to become again a leader in facing these conflicts and possible regulation problems.

On the other hand, in Danish case, those above energy policies have direct influence on planning, and urban and rural development, and more significantly, the planning system and practices have vital role in implementing energy policies and achieving adopted energy targets, in short in Danish success.

7.2.1. Administrative and Planning System

Denmark has a unitary government structure with a policy of decentralization, and a three-tier hierarchical administrative system. The planning approach is comprehensive integrated planning, that is described as "framework management" by the Danish, in which "spatial planning is conducted through a very systematic and formal hierarchy of plans from national to local level, which coordinate public sectors but focus more specifically on spatial co-ordination than economic development" (EC 1997, p: 36)

The Ministry of Environment and Energy[24] is the main actor, which is ultimately responsible for both environmental and physical planning, and national energy policy. It consists of three agencies, namely the Environmental Protection Agency (*Miljostyrelsen*), the Energy Agency (*Energistyrelsen*) and the Forest and Nature Agency (*Skov- og Naturstyrelsen*). The Spatial Planning Department (*Landsplanafdelingen)*, a branch of the Danish Forest and Nature Agency, is the national authority for planning.

The Planning Act -which has entered into force in 1992- its amendments and the Executive Orders on the planning act lays down the exact obligations. The purpose of the Act is stated as to ensure "that the overall planning synthesizes the interests of society with respect to land use and contributes to protecting the country's nature and environment, so that sustainable development of society with respect for people's living conditions and for the conservation of wildlife and vegetation is secured" (Ministry of Environment 2002a, 2002b). The Planning Act divides Denmark into urban zones, summer cottage areas and rural zones in order to protect countryside and to ensure the development of cities in areas where it is most convenient in relation to public services and transportation.

In accordance with the Act, counties are obliged to have a regional plan, which covers a period of 12 years, and to revise their plans every fourth year. Municipalities have the same kind of obligation to prepare municipal plans, and local plans for selected areas. Local plans are legally binding as they state what is permitted and what is not.

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[24] The Ministry of Environment and the Ministry of Energy was emerged in 1994. This integration is the result of response to environmental resource aspects of energy sector and since security of energy supply is no longer a great problem. The Ministry is also in charge of research tasks in the fields of environmental protection, energy and planning

In regard with its administrative system, in the e-paper of Spatial Planning in the Baltic Sea Region (2001) Denmark is considered as the (Scandinavian) country, which has the best preconditions for adapting to EU policies. Though the extent of planning does not reach the broader approach of European spatial planning context, the existing administrative system and institutional framework is seen as facilitative in transforming European goals.

It is also given that the Danish national plan of 1992 has been the first national planning document in Europe that made reference to the ESDP. With regard to the ESDP, national plans of both 1992 and 1996 have visualised Denmark in its European context. That might be due to the fact that Denmark has been involved in the ESDP process from its very beginning. There has been a linguistic challenge in translating the ESDP since there was no term comparable to 'spatial' as in Swedish case. Therefore it has been translated as *det europæiske fysiske og funktionelle udviklingsperspektiv* which is *The European Physical and Functional Development Perspective* (Böhme 2001). Though the adoption of the document and knowledge about the ESDP is mainly limited to national planning, visions and trans-national planning projects, there is a trend towards strategic planning approach at regional and municipal levels.

7.2.2. Institutional Framework for Renewable Energy Developments

The Ministry of Environment and Energy and its Agencies, the Ministry of Housing and Urban Affairs, counties and the municipalities are the authorities with shared responsibilities. Parallel to the administrative system, there is a hierarchy of regulations: Act of Parliament, Executive Orders, Circular and Guides.

Solar Energy Action Plan 1998-2000: Prepared by the solar energy advisory group of the Danish Energy Agency, this action plan suggests strengthening (Danish Energy Agency 1998b):

- The effort to design and develop solar energy units which can be fully integrated in buildings and architecture
- The creation of the basis for use of solar energy in district heating
- The development of experiences with larger solar heating units, including solar heating installations in public buildings, including units connected to heat producing plants

- The development of energy storage facilities
- The dissemination of information nationally and internationally.

Solar Heating Plan 2000, prepared by the Ministry of Housing and the Danish Energy Agency, focuses on the prospective for solar heating, and states that solar heating is preferable in areas without district heating and only in connection with new buildings and larger rebuilding. This plan has so far been followed up with Executive Order 337 (2001) Solar heating obligations in new buildings outside the district heating areas. These new buildings comprise public sector, large summerhouses, public dwellings, commercial buildings and institutions.

Act on Government Grant to switch over of electricity heated buildings: This Executive Order provides grants for households switch from electricity to collective and RES heat supply.

Executive Order 135 (2001) on Urban renewal: The use of renewables is among the activities to be considered in urban renewal projects (Lorenzen 2001).

The frameworks of heat supply planning and wind energy planning are given in the following subtitles in detail.

7.2.3. Danish Heat Planning

Adopted in 1979, the heat supply act (*Lov om varmeforsyning)* had initiated a heat planning (*Varmeforsyningsplanlægning*) process in the municipalities, with the aims of introducing a complete new infrastructure for domestic natural gas and raising the market share of district heating. Generally speaking, the Danish heat planning system was closely linked to the need for large investment project in the energy sector, and the system was very much inspired by the physical planning system (Danish Energy Agency 1998).

The government had issued guidelines, supervised the planning and approved the plans, and the municipalities had done the planning in collaboration with energy utilities and consultants. *Zoning* had been the main planning approach for heat supply. Cities were divided into heat supply districts (energy districts) in accordance with heat densities and the heat supply options. This zoning approach, regulated by a flexible least-cost national planning, has still been implemented, and regarded as an effective measure which provides better use of market forces in terms of a coordinated competition between district heating and gas companies (Dyrelund 2000).

In addition to least-cost zoning, monitoring the least-cost urban heat planning; monitoring of strict zoning of district heating and other sources for heating; implementation of legal measures that enforce building owners to connect and remain connected to district heating; ban on electricity heating in new buildings; high taxation of fossil fuels for heating; and investment subsidies to utilities and consumers are range of recent governmental measures to support district heating (Dyrelund and Steffensen 1999).

The existing legislation ensures the economic basis of district heating producers through allowing municipalities to point out areas where consumers are obliged to connect to district heating supply system. According to the Executive Order on Act on heat supply (2000:772), which lays down the price rules, the production should be carried out as non-profit. Only the private producers of heat based on RES and industrial surplus heat producers are allowed to make a profit. All district heating systems are owned by the consumers, either directly as consumer co-operatives or indirectly as municipally owned companies. Moreover, the operating costs and tariffs are kept at minimum to the benefit of consumers together with transparency in company accounts and public access to information of tariffs (Danish Energy Agency 1998).

In this Danish heat planning system great emphasis is given to CHP production based on biomass utilization. Although instructed by the national authority, the municipalities are also highly in favor of planning for and implementing these systems in order to improve quality of life and environment. According to the Executive Order 2000:582 on heat planning and approval of projects for collective heat production, municipalities are obliged to:

- Conduct a detailed planning for the heat supply within the municipality in cooperation with supply companies and other parties,
- Approve projects on distribution of natural gas and district heating and projects on production plants up to 25 MW electricity,
- Ensure that all plants above 1 MW are transformed to CHP production.

In planning for the heat supply by zoning approach, the system is divided into four different areas with respect to the fuel type (Table 7.3). As stated in Article 2 of Executive Order 2000:772, and together with together with the objective of promoting the most socio-economic and environmentally friendly utilization of energy for heating buildings, supplying them with hot water and reduce the dependency of the energy

Table 7.3: Zoning of heat supply by fuel type (OPET, 2001)

Zones	Measures
Area 1	➢ CHP plants has to be based on natural gas or biomass, ➢ The main priorities for RES are wind turbines and PV. ➢ Individual RES installations such as heat pumps, solar heating and biomass are excluded. They do not obtain grants in this area.
Area 2	➢ Natural gas supply ➢ The use of biomass on de-central CHP or heating plants is limited. ➢ Biomass is allowed if used as fuel on CHP plants. ➢ The main priorities for RES are wind turbines, solar heating and PV.
Area 3	➢ Collective heating supply ➢ Conditions for RES are the same as for area 1.
Area 4	➢ The open land area where natural gas or CHP is not suitable, ➢ All kinds of individual RES installations are provided with grants.

system on oil, the *collective heat supply* suggested in Area 3 involves any undertakings that operates below mentioned plants:

- Plants producing and transmitting other inflammable gases than natural gas;
- Plants for transmitting heated water or steam from CHP plants, waste incineration plants, industrial enterprises, geothermal installations, etc.;
- District heating supply plants, solar heating plants, waste incineration plants, etc., including combined heat and power plants with and electric effect not greater than 25 MW;
- Block heating stations with heat generating capacity exceeding 0.25 MW, including combined heat and power plants with an electricity output not greater than 25 MW."

7.2.3.1. Authorization and Permitting Procedures

For privately owned biomass plants building permit; approval of project proposals according to the act on heat supply; approval in relation to local planning requirements; and environmental permit are required. In terms of environmental permits, the energy production plants that require permit and at which administrative level is determined by a list of “particularly polluting enterprises” under the Executive Order (2001:753):

- Power and CHP plants with a fuel input of more than 50 MW/ County
- Power and CHP plants with a fuel input between 1 to 5 MW which are partly or completely based on solid biomass/ Municipality
- Power and heat producing plants, which is fully or partly based on biomass with a fuel input between 1 and 5 MW/ Municipality
- Power, heat and CHP plants and gas turbines and engines with a fuel input between 5 and 50 MW/ Municipality
- Installations for storage, treatment and processing of animal manure, including biogas plants with a daily capacity more than 50 tonnes of manure and/or vegetable waste/ Municipality

- *For biomass fired plants (0,12 -1 MW)* depending on the distance to the nearest dwelling:
  - Less than 100 m, the maximum allowed dust emission is 300 mg/Nm^3
  - More than 100 m, the maximum allowed dust emission is 600 mg/Nm^3
  - More than 1000 m, the maximum allowed dust emission is 1000 mg/Nm^3
  - The maximum allowed CO emission is 5000 ppm.
  - No limit values for SO_2 and NO_x.
- *For biomass fired plants (1 – 50 MW)* independent on distance to dwelling;
  - The maximum allowed dust emission is 40 mg/Nm^3
  - The limit value of CO emission is 500 ppm.
- For biomass fired plants larger than 50 MW:
  - The maximum allowed dust emission is 50 mg/Nm^3
  - The limit value of CO emission is 600 ppm
  - The limit value of NO_x is 200 mg/Nm^3
  - The limit value of SO_2 is 400-2000 mg/Nm^3

- *Noise limits for approval of biomass plants*:
  - In boundaries: 40 dB
  - In existing residential areas:
    - 45 dB (A) Monday-Friday from 7:00 – 18:00 hours and Saturdays from 7:00 – 14:00 hours
    - 40 dB (A) Monday-Friday from 18:00 – 22:00 hours and Saturdays from 14:00 – 22:00 hours, and Sundays and non-working days 7:00 – 22:00
    - 35 dB (A) all days from 22:00 – 7:0

7.2.4. Wind energy planning in Denmark

Similar to the heat supply, the cornerstones of the success in wind energy are the principle of local ownership, the tradition of partnership, and the systematic planning approach with clear criteria and guidance. Keeping out the big investors, the governmental provisions for local ownership necessitate residency for participation in a wind turbine cooperative. That means only citizens of the district where the turbines are located or those in the adjacent districts can invest in the cooperative with a limited amount that a participant can own. In that case, the governmental prerequisite of local ownership for subsidies has resulted about 48 % of wind turbines be owned by partnerships of between 20 and 50 families, depending on the size of the wind turbine.

Additionally, the spatial planning has a significant role in the success story of Danish wind power. Through the two decades, planning system has gradually been developed in connection with the ups and downs of the overall wind power development process. Below paragraphs include the historical development of Danish wind energy planning.

In the early 1980s, the small turbines, close to either houses or villages, were required to have permission from the municipality. During late 80s and early 90s, when the number and size of the turbines became larger (200-300 kW), some conflicts had begun to arise, and thus the need for spatial planning. Besides uncertainties in feed-in tariffs, there had been strong local resistance due to impacts on neighbors and landscape of badly placed turbines, especially in the areas where there were no local planning. Therefore, counties had begun to deal with sitting of wind turbines in their regional planning so as to guidance that municipalities and developers had to follow. However, the involvement of counties in the process had lengthened the time-period for planning permission leading to frustration of developers. Moreover, strong conflicts were experienced between developers and planners about where to place wind turbines, and several planners had found it was difficult to integrate wind turbines into spatial planning (Olesen 2002, PREDAC 2002).

Consequently, in 1994, the government had set up a demand for municipal wind planning. By the Circular (*Cirkulære om planlægning for vindmøller*), it was stated that all municipalities had to find areas where wind and grid connection conditions were favorable, and then to define areas, which would be designated for wind turbines. Though the municipalities were not given individual targets, the aim of the Order was to find sites for at least 1500 MW of wind turbines, which was the national target of the first Danish sustainable energy plan, Energy 2000, adopted in 1990 (Olesen 2002, PREDAC 2002).

Later, with the introduction of a new Circular (no. 100 from 10 June 1999, (*Cirkulære om planlægning for og landzonetilladelse til opstilling af vindmøller)* on planning and planning permissions for wind turbines in rural areas, the main responsibility for wind power planning has shifted from municipalities to counties, thus from municipal planning to regional planning. Instead of a former need for kick-starting the development, the focus of the new planning regime has been on reducing the environmental impacts while increasing the production. That environmental priority has been fortified by an additional regulation concerning environmental impact assessment (June 2, 1999, BEK no. 428). Further directive has been provided by the Guidance no:39 *Vejledning om planlægning for og landzonetilladelse til opstilling af vindmøller* accepted in 2001, which includes recommendations with respect to Circular no:100 in detail (Danmarks Vindmølleforening 2002, Olesen 2002).

As it is seen from above, the Ministry of Environment and Energy influences planning through regulation, national plan directives and the dissemination of information. In accordance with the task given by the national regulation (Cir. 100) on planning and land-zone permissions for wind turbines, counties issue zoning and installation permits in pursuance of the Planning Act (Danish Energy Agency, 1999). As part of their regional planning, counties should designate areas for wind turbines, indicating the size of the area and maximum height of wind turbines, and they should provide an evaluation of impacts on dwellings, nature, landscape, cultural heritage, etc. for each designated area. Moreover, they should consider the possibilities of renovating the existing old wind turbines areas. Since 1994, great importance has been given to the replacement of old smaller turbines by new large ones, and also on more suitable sites (Danish Energy Agency 1999).

Municipal planning should include the areas of wind power designated by regional planning. Municipalities often prepare a local wind turbine plan, for specific new developments. These plans indicate the exact number and places of turbines and their layout, together with the tower type, color and height of the turbines. If more than 3 turbines are installed or the total height of the turbines is above 80 m. (which applies to turbines above 1 MW) an EIA is required. The visual and other impacts on dwellings, nature, landscape, cultural heritage values, agricultural interests should be considered by the local plan even if EIA is not required. Therefore, it is the municipalities who have to weigh different and some conflicting interests. On the other hand, a single small turbine, below 25 m. total height can be placed without local plans and at the outside of the designated areas (Danmarks Vindmølleforening 2002, Olesen 2002).

Planning permission is given if only the turbines are placed within the designated areas indicated in regional or municipal plans. Developers (or co-operatives/farmers) can seek a site within the designated areas for wind power in regional plans. If their preferred site is outside of the designated area, they can propose to the county to designate the area for wind power. Designation of new areas requires an EIA, organization of public hearings, and data about environmental impacts provided by the developer. In that case, due to EIA process and the amendment of regional plans, the time-period for permission is given as 1-2 years. For projects that are already in designated areas the period of procedures is about 3-6 months in which the municipality issues the permission[25] once the local plan is approved.

The use of visualization is an essential part of both project design and approval process. Visualization is a means for projecting and assessing the consequence of the actual technical installations through drawings, photomontages, computer-generated displays and moving pictures from video or film. It is suggested that a visual assessment of the aesthetic expression of the installation should be completed prior to determining the exact placement of the wind turbines. For major projects, landscape architects draws up sketches with proposals for the number of turbines, the exact locations, their relative

[25] When the building permit is obtained, the power distribution company has to provide a 10 or 15 kV line to site while investor has to pay transformer from lower tension and cables from the individual turbines to the transformer. The distributor companies share the grid-connection costs. (PREDAC, 2002)

positions, height, etc. This is followed by visualization of the overall composition viewed from various distances and angles to provide a realistic picture (Nielsen 2002).

7.2.4.1. Criteria for Locating Wind Turbines

The installation of wind turbine does not presuppose permission in terms of building codes, however, the Danish approval scheme is based on a type approval of turbines and on a certified quality system. Certification and type approval are required under a set of rules included in Technical Criteria for Type Approval and Certification of Wind Turbines.

On the other hand, there are a number of criteria used for planning, permission and assessment of wind power developments. Some of the criteria are stated by the Circular no.100, some are given in the Guidance no.39, and the others are defined by the regional and the eventual local plan. These include:

- Wind turbines should preferably be placed in groups and ordered in an easily recognizable geometrical pattern,
- A harmonic relation between hub height and rotor diameter is recommended, e.g. that they are within 10 % from each other,
- Wind turbine plans must give thorough considerations to the influence on the landscape,
- New turbine groups must be clearly separated from existing groups,
- Considerations must include the character of the landscape together with the maximum height of the new and existing turbines,
- If a wind power development is closer than 2.5 km from another designated wind turbine area, the planning must include both sites,
- In coastal zones (up to 3 km from the coast), planning with special consideration of landscape and nature interests should be applied,
- New turbines must not be closer than 4 times their total height to dwellings,
- Plans for wind turbines closer than 500 m to dwellings must have a special analysis of impacts,
- Noise level at a height of 1.5 m at a wind-speed of 8 m/s at 10 m above ground level, shall not exceed 45 dB (A) at outdoor open spaces in the immediate vicinity of neighbouring properties in the open country (Ministry of Environment 1991),

- Noise level at a height of 1.5 m at a wind-speed of 8 m/s at 10 m above ground level, shall not exceed 40 dB (A) in the most noise-inflicted spot at outdoor open spaces in residential areas and other noise-sensitive land uses such as institutions, summer houses, allotment gardens or recreation areas (Ministry of Environment 1991),
- It is recommended that shadows from the turbines are not reaching neighbouring dwellings more than 10 hours/year with average cloud cover,
- Wind turbines should not be closer than:
  - 100 m to the coast, except in industrial areas, harbours.
  - 100 m to pre-historic sites
  - 150 m to lakes above 4 ha, and to rivers
  - 300 m to forests
- The aviation authority can demand that turbines with total height above 100 m should be marked[26]. Turbines above 150 m should always be marked, in accordance with the Act on aviation (June 13, 2001, LBK no 543)
- The use of white color turbines on rural landscape. Gray is also acceptable. Other colors, notably blue, is prohibited (Gipe 2002, p: 199)
- The hubs of all turbines in arrays to be at the same height. The use of pedestals on which the tower is erected (p: 207)

[26] Such as lights on top of nacelle, lights on wing-tips that only light up when the wing-tip is above a certain height. Some of the lights are only visible from the air, not from the ground.

7.3. Dutch Case

Spatial concepts of Dutch planning, the planning doctrine actually referring the concepts of Randstad and Green Heart have been dominating the planning literature for years. Throughout their development and implementations, these concepts have been associated with the basic principles of concentration of urbanization, spatial cohesion, spatial differentiation, spatial hierarchy, and spatial justice (Hajer and Zonneveld 2000). In terms of sustainable development, the primary goal of planning and growth management in the Netherlands is to enhance the quality of life, which is directly linked to sustainability, liveability and environmental quality. Common indicators used for quality of life, thus for sustainability are; employment, adequate housing, safety, healthy environment, clean air and water, and adequate level of servicing (van der Valk 2002).

In addition to the compact city concept, which has always been at the heart of Dutch planning through intensification in cities and corridors, a new concept used for dealing with the urban growth and sprawl, fragmentation and inefficient use of land is multiple land use. This concept, which aims to counterbalance inefficiencies in land use and preserving biodiversity, has four dimension: more efficient use of sole parcel of land; mixture of functions in one place; creating more floor space on a parcel by high-rise buildings; and extra living space by time management and smart physical design for multiple use in time (van der Valk 2002). Though such a commitment to improve quality of life, the problem is given as that consumers do not want to make substantial concessions in their lifestyles, moreover the trend in new lifestyles is using more space and spreading out of cities (Hajer and Zonneveld 2000, van der Valk 2002).

In conjunction with these spatial concepts and principles of Dutch planning, it can be said that integration of renewable energy technologies into Dutch cities has been successfully implemented in terms of passive and active solar energy, especially BIPV. For example, the project implemented in Nieuw Sloten comprising 71 houses (both single-family houses and apartment buildings) has been the first district in the world where building integrated photovoltaic demonstrated on such a large scale. Moreover, 1 MW Amersfoort experience has been the largest scale installation in a residential complex and been the best practice together with its overall planning and design, and organization and management processes. The orientation towards sun, and the considerations on roof designs for solar collectors, combisystems and PV have become an integral part of urban development plans.

On the other hand, it has been failed in wind energy developments. The sitting and visual intrusion of wind turbines on scarce land of the Netherlands, has become a conflicting issue. By the energy sector, planning procedure is seen as the major bottleneck for wind energy developments. However, the Dutch planners consider the challenge of wind energy as lack of institutional capacity.

7.3.1. Administrative and Planning System

The Netherlands is a decentralized unitary state with a three-tier system of government. The administrative system is based on constitution and implementing acts. The process of communication between the tiers of government comprises consensus building and mutual adjustment. All provinces and municipalities have the same statutory powers, and power flows from consensus, and political institutions are surrounded by advisory and participatory bodies consist of experts and stakeholders.

Accordingly, Dutch planning system is regarded as an institutional success story. With reference to the Dutch system and identified as comprehensive integrated approach, it is stated in the Compendium of European Commission that this tradition of planning, which is necessarily associated with mature systems as in the Netherlands, "requires responsive and sophisticated planning institutions and mechanisms and considerable political commitment to the planning process" (1997, p: 36)

Planning, or ruimtelijke ordening in Dutch, is closely tied to the traditions of managing scarce land resources, and the public sector activity in bring about the realization of the planning frameworks is the norm. With the priorities of growth management and land allocation, the system is consist of three levels of interrelated, indicative, strategic plans: the national spatial planning key decisions, the provincial regional plans, municipal structure plans (*structuurplannen*), and legally binding municipal zoning plans *(bestemmingsplannen).*

With its deep historical roots, the legal and institutional basis of the Dutch planning system was laid down in the Planning Act of 1965. Since that time, planning has been conceived of as a coordinative activity within which the planner has a discursive role such as listening to people, making an inventory of problems and demands, scanning preferences, developing concepts, assessing the possibilities of building coalition among actors, and thus providing to think about in the same language.

In relation to that role, the instruments of the planner are concepts, plans and vision documents (Hajer and Zonneveld 2000).

However, there have been shifts towards spatialization of economic policy, economization of spatial planning, project-based investment-oriented infrastructure approach, and centralization. Together with the societal changes, such as emerging network society it is argued that the existing system has fallen short to accommodate these changes. Moreover, new approaches with their new institutions have eroded the legitimacy and effectiveness of the famous Dutch planning system (Hajer and Zonneveld 2000, Wolsink 2003, Louw et al. 2003). Since planning is seen as unable to keep up with social changes and ineffective, there is an increasing interest on the concept of spatial development policy. The ESDP and Interreg initiatives are highly appreciated. The European perspective is apparently invoked in the Fifth National Policy Document on Spatial Planning 2000/2020. While advocating the European strategy on spatial policies, the government puts also emphasis on presenting a profile of Dutch qualities in Europe in a way strengthening competitive position of the Netherlands.

7.3.2. Institutional Framework for Renewable Energy Developments

In the Netherlands, the authorities that have responsibility are: Ministry of Economic Affairs; Ministry of Housing, Spatial Planning and Environment; Ministry of Agriculture and Fisheries; Ministry of Defense; Provincial authority; Local authority; and District Water Board and Department of Public Works.

The BLOW (*Bestuursovereenkomst Landelijke Ontwikkeling Windenergie)* Policy agreement national wind energy development, signed between the national government, provincial authorities and the union of municipalities in 2001, includes a target of 1500 MW on-shore wind energy in 2010, 6000 MW of off-shore wind energy in 2020, and 10 % of total energy production from renewables –wind energy and biomass in particular- in 2020. According to the BLOW, provincial authorities have to develop wind strategy plans (*plannen van aanpak*) in line with their provincial environmental plan (*provinciaal omgevings plan*) and/or regional plan (*het streekplan*). In these plans, each province has to indicate suitable locations and the strategies how to achieve their regional target (Table 7.4).

Laying down the vision on wind energy, the national strategic policy document *The Fifth National Policy Document on Spatial Planning 2000/2020* constitutes the main framework for provincial and municipal level planning. Through networks of infrastructure approach wind energy is promoted as a new developing infrastructure while existing infrastructure is conducted to solar energy. The conditions for wind energy developments are included in the Key Planning Decisions of the Fifth Policy Document. The guidelines stated in the sub-title of "c.23 *utilities in rural areas*" under the title "C *Quality* in city and country" can be outlined as below (VROM p: 54):

- The national government will conclude specific agreements on the location of wind turbines. The policy objective is to arrange wind turbines in rows and parks whenever possible and to place them on industrial estates and along waterways. The following criteria apply to the choice of sites:
  - Preferably they should be sited in young, large-scale landscapes,
  - Preferably they should be sited on the periphery of open spaces, while avoiding creating the visual effect that the open space is closed off,
  - New wind turbines are not permitted in open landscapes, unless they can be properly incorporated into the landscape and wind energy targets cannot otherwise be met,
  - Wind turbines may not be sited in green contour[27] areas, unless necessary in order to achieve wind energy targets and following a review based on applicable protection policy".

With little difference compared to the national guidelines, each province has its own criteria for wind energy developments. For example, some preconditions included in the regional plan of Province Overijssel are (Ecofys):

- Single turbines and only allowed on or near industrial sites
- Wind turbines are not allowed in the ecological protection area (EHS, Ecologische hoofdstructuur)

[27] *Green contour* areas include parts of the rural areas with outstanding visual landscape, nature conservation areas, cultural, historical or archaeological heritage areas, areas under the EU Bird Directive, areas under the EU Habitat Directive, and the National Ecological Infrastructure. The rural areas are the areas outside the red contours, and the red contours form the boundaries of the area already built up plus expansions required until the year 2015. The rural areas, which are not designated as green contours, are regarded as intermediate areas (VROM 2001).

- It is not allowed in meadow-bird and goose protecting areas, except nearby highways and/or railways through those areas
- The wind turbines have to fit properly into landscape by creating a link between the wind turbines and the built environment or rail/high-ways.

Additional restrictions in regional plans refer to mast height, and number of turbines in a cluster or a line.

Table 7.4: Regional wind energy targets (NOVEM 2004)

Province	BLOW Targets	Province	BLOW Targets
Flevoland	220 MW	Noord-Brabant	115 MW
Noord-Holland	205 MW	Gelderland	60 MW
Zuid-Holland	205 MW	Utrecht	50 MW
Zeeland	205 MW	Overwijssel	30 MW
Friesland	200 MW	Limburg	30 MW
Groningen	165 MW	Drenthe	15 MW
Total	**1500 MW**		

7.3.2.1. Authorization and Permitting Procedures

In connection with above policy frameworks, the planning and permitting processes proceed as below:

- For the specified locations in regional plans, the developer has to announce his initiative to the local government, convey about the possibilities of participation, prepare an EIA if necessary, and apply for the environmental and building permit. Subsequently, the local authority has to assess the application on existing zoning plan, and decide whether they cooperate. If the proposed project meets the requirements the alteration of the zoning plan is required on the condition of approval. The installation of turbines is allowed only after the revision of the plans.

- For projects larger than 15 MW or more than 10 turbines, the authorized government decides if an EIA is required, in terms of noise, shade, fauna, cultural monuments, and the landscape impact.
- Having an environmental permit is obligatory for operating any installation. It is the municipality that assesses the application on criteria such as landscape, noise and safety. In accordance with the policy decision AmvB (Algemene Maatregel von Bestuur) no environmental permit is required, if (Ecofys):
  - Turbines have a connection with ground through a mast,
  - Turbines have a horizantal axis of the rotor,
  - The distance between the turbine and the nearest house is at least 4 times the mast height,
  - The total capacity is less than 15 MW.
- Additional authorization is required on the condition of placing turbines on areas (such as highways and dikes) under the management of District Water Board and the department of Public Works.
- Authorization from the Ministry of Defense is required for wind turbines in low-fly zones and in military borders.
- Noise limit is 40 dB (A) on the nearest house. Due to the fact that the higher the wind speed, the louder the background noise, and since at certain wind speed the background noise exceeds the wind turbine noise, the Wind Norm Curve (Figure 7.1) is used as a corrective limit noise value of the maximum acceptable wind turbine noise.

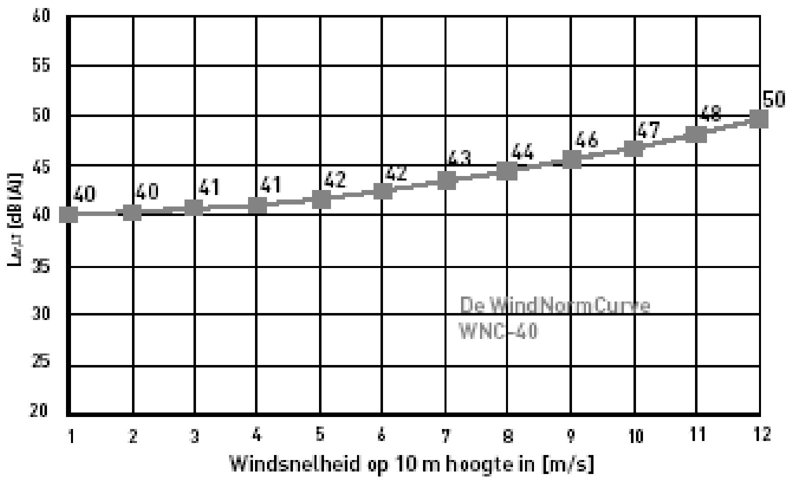

Figure 7.1. Wind Norm Curve

- For flickering shadows, 20 minutes per day, 17 days per hour at clear sky.
- Wind turbines near highways and / or railways have to be kept away from the edge of the infrastructure for at least 30 meters. When the rotor diameter exceeds 60 meters, the norm is half the diameter.
- Wind turbines near canals have to be kept away from the edge of the waterway for at least 50 meters.
- Roads and bridges might need to be enforced. As an indication roads and bridges need to be able to carry an axis load of a minimum 16 ton and have a minimum width of 4 m.
- For safety, wind turbines to conform NVN 11400-0 "Regulations for the type certification of wind turbines: technical criteria".

7.3.3. Wind Energy Planning in the Netherlands

Until the nineties energy policy had been primarily an economic and industrial policy in the Netherlands. The centrally organized large-scale production within which the department of Economic Affairs together with the energy generation companies was the key actors had been the framework of development in Dutch energy sector. Since 1990's there has been a shift from a monopolistic to a more liberalized regime together with a shift from a technocratic thinking to a market oriented and cost-effective culture, with also emphasis on energy efficiency policies. However, as it is argued such changes in the regime and culture have not provided impetus for the development of renewables, including wind energy and biomass, and also not resulted in a recast of dominant actors.

Within this frame of energy sector, planning is regarded as a bottleneck that planning procedures are main impediment for wind energy developments. Besides, decision-making process of making space for wind energy projects is under criticism. Addressing the problem of wind energy planning under the concept of institutional capacity Breukers and Wolsink state that "The situation with wind energy is one of multiple levels of governance as well as multiple actors. The capacity to deal with these in policy making and planning to a large extent determines whether actual implementation becomes feasible" (2003, p: 9). Accordingly, it is asserted that the institutions and the institutional changes both in planning and energy domain, and the relations between these sub-domains not provide much opportunity for better implementation of wind energy development in the Netherlands.

As mentioned in the previous subtitles, Ministries of Economic Affairs (EZ) and Housing, Spatial Planning and Environment (VROM) are the key national authorities. The argument is lacking of cooperation and fine-tuning between the horizontal levels of government that perspective about and commitment to wind energy varies substantially among different departments. Even though the two bodies consult each other regularly, the state of communication comprises the facts that wind energy is a goal in itself for EZ, and it is one of many aspects of planning that should not be pushed through the cost of other interests for VROM. However, the role of EZ as the main policy actor for wind energy is highly respected by VROM.

Further arguments focus particularly on the non-inclusive, top-down style of decision-making process of space making for wind energy developments. As it is stated in the Dutch report of PREDAC project (Ecofys), the limited national governmental level planning priority given by the agreement of Sitting Problems of Wind Energy (BPW), which was signed by EZ, VROM and coastal provinces without involving municipalities in 1991, was resulted with a capacity of less than 500 MW though the target by 2000 was set up as 1000 MW by the BPW. The BLOW, on the other hand, includes multiple levels of governments and more actors, together with a broader scope of planning than the former BPW. However, it is still the hierarchical top-down approach[28] constitutes the basis of the BLOW, since the targets and policy instruments are decided upon at a national level without involvement of lower levels of government. Accordingly, it is stated that the "ambiguity of involving various levels of government but keeping up the options for top-down decision-making does not reflect a move towards collaborative planning" (Breukers and Wolsink 2003, p: 11). In this respect, the decision-making process in Dutch system is defined as a communicative planning directed at consensus, and consensus building, however, merely between governmental agencies and authorities on various levels, comprising a shareholder approach rather than stakeholder[29] (Wolsink 2003).

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[28] An example of instrument for top-down approach is given as the NIMBY Bill. The NIMBY Bill gives the national and the provincial governments the authority to impose some land uses, such as waste facilities, manure processing installations and currently the wind farms, to be taken up by the municipalities in their zoning schemes.

[29] "As a metaphor, it emphasises that people have a 'stake' on what is going on, even though they may not quite know how to think about it and what to do it…. For example, there is 'global' stakeholder interest in the attempts by specific localities to reduce levels of CO_2 emissions. The

Therefore, the current system offers insufficient options for input from society (Hajer and Zonneveld 2000, Wolsink 2003, Breukers and Wolsink 2003), and the participation takes place only after consensus among the main players has been secured. It is only the Organization for Energy and Environment (NOVEM) –an agency of EZ- that works for increasing the involvement of local stakeholders while EZ itself adhering to decrease participation due to its view of hinder power. If that view of public participation as hindrance is to be clarified together with the fact of time period of approval (see in Chapter 6.3.1), it is necessary to consider planning process wholly. As mentioned in the previous subtitles, in the case of a wind project proposal the municipal zoning plan requires to be altered. Since most of the plans do not include areas for wind turbines the changing of the existing scheme together with the revision of regional plans has been an extensive process. That lengthy process of drawing up a plan and preparing the site for any building construction, taking up to 6-8 years considered also as bad reputation of the system by the Dutch planning scholars (Hajer and Zonneveld 2000, Louw et al. 2003). Public participation allowed right after the revision of plans through public hearings on ready-made plans unavoidably results with strong local opposition and protests (see chapter 5.2 and 5.3).

As a result, the problems experienced in Dutch wind energy planning are product of institutional practices including both energy and planning sectors. In this respect a more collaborative approach in which all relevant actors are recognized and included in the process is recommended for improved wind energy implementations: "…inclusive policy processes, where political participation on the various levels of government is apparent and where a variety of knowledge resources is granted access as well as an accordingly variety of actors, generate the best chances for actual implementation for wind energy, a renewable energy resource that is characterized by decentralized application and in local contexts" (Breukers and Wolsink 2003, p: 3).

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concept of stakeholder is in part a 'scoping' device, to encourage those at the core of defining and developing policy agendas to recognize the universe of people affected by what happens. But it can also be used more actively to encourage stakeholders to get involved in the policy process: people 'with stakes' may come together to discuss what they think about the issues affecting the place where their stake is. If such encounters are structured by the assumption of fixed interests, the discussions are likely to be characterized by adversarial conflict. If they are structured by the assumption that people may not know what they think about an issue, and may learn to think differently through discussion, such 'encounters' among stakeholders may generate both mutual learning and even consensus building before people come to 'fix' their positions" (Healey 1998, p: 1538)

7.4. The U.K Case

In the U.K the renewable energy developments and planning relations are taken into account as part of or in connection to the considerations on the concepts of sustainability and sustainable development. Regarding that, the main concern is on the contribution of planning system to sustainable development, or more precisely, to environmental sustainability. With the governmental commitment to sustainable development comprising the introduction of new environmental agenda, planning system is actually considered as a mechanism for pursuing environmental objectives, within which its plan making functions provide articulating spatial strategies interrelating environmental and economic development objectives, and its procedures provide an arena for conflict resolution.

However, this task of planning system is challenging. In applying the concept of sustainable development to land use policy, and considering the impacts of development and how to mitigate adverse impacts the initial debate over the content of new environmental agenda has been followed by a more fundamental debate between technical and radical conceptions of environmental sustainability and ecological modernization, together with the vocabulary of limits, capacity and demand management, and balancing and trade-off approaches.

In British planning, landscape quality, nature conversation, built heritage and conservation areas have always been the issues of treating environment through developments plans. Together with the emphasis shifted from amenity to ecology, the issues of global warming and the consumption of non-renewables are the newly introduced environmental concerns. However, the environmental discourse, within which multiple perspectives have co-existed and competed with each other since 1940s, has become more complex and contested with the introduction of new issues and the instrumental and non-instrumental/intrinsic values, and material and non-material dimensions of protection (Healey and Shaw 1994, Owens 1994). In such a conflicting field, the link between land-use and environment is a problematic issue, and while solving the development conflicts through land-use planning the critical question lies in defining what is critical? and why? and also who decides what critical is? Inevitably, the prior question is what we value? and why? Though scientific value of nature in terms of thresholds, carrying capacities, etc. is easy to adopt and apply however, there is still lack of consistent and defensible criteria for deciding critical capital (Owens 1994). On the other hand, as it is pointed out, "it is the modernist rationalist discourse of economic growth, instrumental rationality and the ability of the human species to control and manage nature, which has won out other conceptions" (Healey and Shaw 1994, p: 427).

On the other hand, if EU influences on British planning system are to be considered, it can be said that there has been a significant shift from Eurosceptic attitude. The attitude of prior government in a way ignoring the planning implications of European Commission's policy developments and keeping the EU at arms length from the statutory planning policy-making function within government has been changed into a commitment of the New Labor government into playing a lead role in EU policy-making (Bishop et al. 2000).

The statement *Modernizing Planning* issued by the Minister for Regions, Regeneration and Planning in 1998, acknowledges that the European context for planning has been missing from the planning system. Accordingly, the government has sought to enhance EU dimension of the UK planning system in relation to advice it has given to regional bodies on the way that they should prepare new Regional Planning Guidance (Shaw, and Sykes, 2001). As it is reflected in para 3.1 of the PPG 11: "…both the European Spatial Development Perspective (ESDP) and the Community Initiative on Transnational Co-operation on Spatial Planning - INTERREG II C and INTERREG III B - programmes will provide a European context for the preparation of RPG. So too, will other European funding regimes, in particular the EU Structural Funds" (DETR, 2000). Within this framework, the ESDP has been used as a reference point to inform strategic spatial thinking in developing regional policies.

Furthermore, all EC Directives have been transposed into planning system through revised guidance notes, however referring mainly to statutory instruments, regulations and circulars, rather than the Directives explicitly (Tewdwr-Jones et al. 2000). In practice, it is the local authorities that have progressed strong European links and utilized financial opportunities provided by the EU, leap-frogging central government on transnational planning (Bishop et al. 2000)

7.4.1. Administrative and Planning System

In the EU Compendium the planning approach in the UK is identified as the main example of land use management tradition, “where planning is more closely associated with the narrower task of controlling the change of use of land at the strategic and local levels” and “where regulation has been and is vigorously and effectively pursued with the objective of ensuring that development and growth are sustainable”(p:37).

Besides its distinctive planning tradition, the British case is substantially different from other European countries in terms of its administrative and planning systems. Though local governments have the responsibility for local plan making and determining development decisions, the system is highly centralized. Central government has influence on local policy through planning policy guidelines, which provide tighter framework within which local authorities have to operate.

The system includes three broad functions: development control, development plans and central government supervision. Development control decisions are made by local politicians but based upon advice from local planners. Development plans, that contain local policies and proposals for the development and use of land, are at two levels; structure plans prepared by counties and local plans by district authorities. These two levels are combined into a Unitary Development Plan in metropolitan areas.

The adopted plan-led system emphasizes rational and consistent decision-making, however, there is considerable amount of discretion in making decisions on planning application. Moreover, planning policy guidance approach allows central government to change planning policies very quickly, and currently, there are 25 planning policy guides. Though the focus is on regulating the use and development of land –in the public interest-the policy criteria are not specified in legislation, and development plans are not legally binding. In relation to these, the system is considered as very flexible and open for interpretation (Newman and Thornley 1996, Healey and Shaw 1994).

This interpretive flexibility contrasts with the legalistic form of other planning systems in Europe. Furthermore, in many countries the elements of all three functions mentioned above are included in the local legally binding plans however they are treated separately, and often carried out in different departments of the planning office, in Britain. In contrast to the partnership approach oriented around the detailed plan in other European countries, the British approach, as pointed out by the authors, embodies a conflicting style of administration in which the actors –local authority and the applicant- are competing to win in an appeal system (Newman and Thornley 1996).

On the other hand, Scotland, with its own legal and administrative arrangements, has distinctive features in terms of having a stronger strategic approach with more comprehensive and clear statements of national planning policies.

7.4.2. Institutional Framework for Renewable Energy Developments

Environment and the concept of sustainable developments are the main drivers for renewable energy developments. The environmental policy framework for renewable energy development includes below instruments:

1990	This Common Inheritance: Britain's Environmental Strategy: Government's White Paper, UK Government
1998	Sustainable Development: Opportunities for Change Consultation Paper on a Revised UK Strategy, DETR
1999	A Better Quality of Life: A Strategy for Sustainable Development for the UK, DETR
2000	Climate Change: The UK Programme, DETR, National Assembly for Wales and the Department of Environment, Northern Ireland.

The policy instruments for renewables included within energy policy framework are:

1988	Renewable Energy in the UK: The Way Forward, Energy Paper 55, Department of Energy
1992	First round of the Non-Fossil Fuel Obligation, DTI
1994	New and Renewable Energy: Future Prospects in the UK: Energy Paper 62, Department of Energy
1998	Review of Energy Sources for Power Generation, DTI
1999	New and Renewable Energy, Prospects for the 21st Century, DTI
2000	Introduction of Renewables Obligation, DTI
2003	Our Energy Future-creating a low energy economy: Energy White Paper, DTI.

Within above frameworks, in accordance with the Climate Change Programme the government's legally binding target –set under the Kyoto Protocol is to reduce the emission of pollutants causing global warming by 12.5 % below 1990 levels by 2008-2012. Another domestic goal is 20 % reduction of CO2 emissions below 1990 levels by 2010, and the recent White Paper sets a target of 60 % reduction by 2050.

In relation to tackling climate change, renewable energy, which was defined as *sources of energy rather than fossil fuel or nuclear fuel* by the Utility Act 2000, is acknowledged as the primary component of the sustainable energy policy. In line with the EU policies, the government is committed to generating 10 % of its electricity from renewable sources by 2010. Moreover, 2003 White Paper has an ambition of doubling the share of electricity from renewables by 2020 from the existing 2010 target of 10 %.

The Renewables Obligation, introduced as a new support mechanism replacing NFFO system, requires all electricity suppliers to source an increasing proportion of their electricity from renewable energy and sets incremental targets for designated electricity suppliers in relation to the sources, which are listed as eligible.

The Department of Trade and Industry (DTI) and the Office of Deputy Prime Minister (ODPM) are the main governmental bodies[30] that are responsible for renewable energy developments. In accordance with the Electricity Act 1989, planning permissions for renewable energy schemes over 50 MW are given by the DTI, and schemes under 50 MW are assessed by local planning authorities that the primary planning legislation is under the responsibility of the ODPM. The DTI targets are devolved to the Regional Development Agencies (RDAs) through the regional Government Offices, who will determine how they will meet them (Stevenson and Richardson, 2003).

7.4.2.1. Planning Policy Guidance Notes and Renewable Energy

Planning Policy Guidance notes (PPG) set out the Government's policies on different aspects of planning, and local authorities are required to take their contents into account in preparing their developments. Since 1992, energy has been a land-use topic to be covered in developments plants (see Appendix B.1).

[30] DTI is mainly responsible for economic development and UK competitiveness. Established in 2002, ODPM is responsible for policy on housing, planning, devolution, regional and local government, fire service, the Social Exclusion Unit, the Neighbourhood Renewal Unit and the Government Offices for the Regions.

Planning policy guidance 22: Renewable Energy

Published in 1993, with an informative annex on harnessing energy, PPG 22 explains the government's policy on renewable energy. It is initially stated that the general aims in planning for the use of land by energy generating installations are (DoE, 1993, para. 20):

- to ensure that society's needs for the energy are satisfied, consistent with protecting the local and global environment;
- to ensure that any environmental damage or loss of amenity caused by energy supply and ancillary activities is minimized; and
- to prevent unnecessary sterilization of energy resources.

Further, the guidance advises local planning authorities to consider the contribution that renewable energy technology could make in their area to meeting local, regional, and national needs, and to bear in mind that investment in renewable energy developments can make an important contribution to national economy and can help to meet international commitments to reducing greenhouse gas emissions. LPSs are suggested to survey the nature and extent of resources in their area, as well as assessing the immediate impact of projects on the local environment.

Accordingly, structure plans and UDPs Part I should include general policies and proposals on providing renewable energy in their areas, including the general location of any individual project likely to have a significant effect; and local plans and UDPs Part II should include detailed policies for developing renewable energy sources and identify broad locations or specific sites, suitable for the various types of renewable energy installations.

It is also advised that authorities should take account the Government's policy for renewable energy sources along with the other policies for protecting the environment. Policies on planning issues relevant to the siting of renewable energy installations are: PPG 2 Green Belts, PPG 4 Industrial and Commercial Development and Small Firms, PPG 7 The Countryside and the Rural Economy, PPG 9 Nature Conservation, PPG 11 Regional Planning, PPG 12 Development Plans, PPG 16 Archaeology and Planning, PPG 20 Coastal Planning, PPG 23 Planning and Pollution Control, PPG 24 Planning and Noise. Though these are advisory documents, they can be a material consideration in both the assessment of planning applications, and the approval of development plans.

The annex on wind energy, including considerable information about the technology in order to help in framing policies within development plans, advises that LPAs must always weigh the desirability of exploiting a clean, renewable energy resource against the visual impact of the turbines on the landscape. More advice about the siting and landscape issue include (DoE, 1993, p: 15 para.60).:

> The local planning authority and the applicant for planning permission should attempt to agree at an early stage the likely positioning of the wind turbine generators…. should agree from which points the turbine development will be seen, both close to a site and at some distance from it, and to what degree and from which location photo-montages may be made.

More sophisticated landscape assessment, including electronic mapping todetermine zones of visual influence and computer graphics to generate landscape images are suggested for larger developments or sensitive areas.

As it is given in the annex, land form and characteristics; number and size of machines; design and color; layout of machines; and the existing skyline of the area are the five principal factor that influence the visual impact of the turbines. In terms of turbine siting, it is indicated that "the most desirable layout in any given case will be a compromise between the quality of the wind resource, the characteristics of the land form and existing features of the landscape" (para.69)

7.4.2.2. Environmental Impact Assessment

As it is also indicated in PPG 22, local planning authorities are required to consider, at an early stage, whether environmental assessment should be undertaken in accordance with the relevant environment assessment regulation. At present, the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 implement Council Directive No. 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (the EIA Directive), as amended by Council Directive No. 97/11/EC, in so far as it applies to development under the Town and Country Planning Act 1990. Therefore, the Directive sets out a procedure that must be followed for certain types of project before they can be given development consent, and the Regulations integrate the EIA procedures into this existing framework of local authority control through the guidance provided by DETR Circular 02/99.

Regulations apply to two separate lists of projects: Schedule 1 projects for which EIA is required in every case, and Schedule 2 projects for which EIA is required only if particular project in question is likely to have significant effects on the environments by virtue of factors such as its size, nature or location. If a development of a type listed in Schedule 2 meets one of the relevant criteria or exceeds one of the relevant thresholds listed in the second column of the table in Schedule 2; or is located in a *sensitive area*[31] EIA is required. Accordingly, for installations for harnessing wind power for energy production (wind farm) –listed under Schedule 2- an EIA may be required if the development involves the installation of more than 2 turbines; or the hub height of any turbine or height of any other structure exceeds 15 metres (Statutory Instrument, 1999 No. 293). In Annex A of Circular 02/99, further suggestions include:

> The likelihood of significant effects will generally depend upon the scale of the development, and its visual impact, as well as potential noise impacts. EIA is more likely to be required for commercial developments of five or more turbines, or more than 5 MW of new generating capacity (para A.15).
>
> EIA is unlikely to be required for smaller new conventional power stations. Small stations using novel forms of generation should be considered carefully in line with the guidance in PPG 22 (Renewable Energy). The main considerations are likely to be the level of emissions to air, arrangements for the transport of fuel and any visual impact (para. A.11).

In terms of location of projects, it is also stated that "for any given development proposal, the more environmentally sensitive the location, the more likely it is that the effects will be significant and will require EIA" (DETR 1999b, para. 36).

In practice the effect of Schedule 2 development on an SSSI will often be such as to require EIA. Whilst each case should be judged on its merits, EIA would normally be required where a Ramsar site or a potential or classified SPA, or a candidate, agreed or designated SAC could be affected. Where a local planning authority is uncertain about the significance of a project's likely effects on the environment, it should consult English Nature (DoE 1994, para 39).

In the document of a statutory agency/NGO workshop on wind farms and nature conservation, includes further guidance on assessing wind farm proposals in sensitive areas. As it is advised, where wind farms are proposed, their development should not cause adverse effects on the integrity of statutory international sites, including indirect effects from outside the site; and on conservation objectives, reasons for identification

[31] See Appendix B.2 for sensitive area definitions.

and notification or designation of sites of national wildlife importance. On a site of regional or local nature conservation importance, wind farm proposals should only be permitted if it can be clearly demonstrated that there are reasons for the proposal which outweigh the need to safeguard the nature conservation value of the site, and keeping the damage to minimum. Moreover, wind farms developments should not cause significant disturbance to, or deterioration or destruction of, key habitats of species listed in Annex IX of the Habitats Directive; should not contravene the protective measures that apply to Schedule 1 birds, Schedule 5 animals and Schedule 8 plants identified by the Act; and should respect the objectives and targets identified for priority habitats and species listed in the UK Biodiversity Action Plan (Harley et al. 2001).

7.4.3. Renewable Energy and Land Use Planning in the UK

The institutional structure within which renewable energy policies are made and implemented in the UK includes many actors, different values, controversial issues, contested fields and fragmented policies. Both energy sector and planning system are in a time of flux, and both of them are struggling for finding ways to achieve national targets.

Though Great Britain has substantial potentials of renewable energy resources, and especially the best wind resource in Europe, it is lagging behind Denmark and Germany. Similar to the Dutch case, the Government acknowledges the planning system as a significant obstacle to the development of renewable energy technologies. Therefore, the planning system is under immense pressure to deliver renewable energy developments.

On the other hand, with critical views on energy policies, the contributors from the planning domain see the problem as an absence of a strategic framework integrating national energy policy with the mainstream of planning policy (Hedger 1995, Stevenson and Richardson, Beddoe and Chamberlin 2003).

While aiming at reducing carbon emissions, the core energy policy is to ensure secure, diverse and sustainable supplies of energy at *competitive prices.* It is characterized as supply-side led, short-time, flexible, rapidly changing, innovative, influenced by external circumstances, having a culture of uncertainty, and increased reliance on the market mechanism which provides the certainties in the sector. Hedger further argues that: "major decisions are not determined in geographical and locational contexts. Energy policy works on national statistics, graphs and tables, not maps. Only macro-economic aspects are considered, not local or even regional dimension" (1995, p: 19).

It is that given context of strategic energy planning within which renewable energy policy has arisen as a new policy issue. Therefore, it is not surprising that the market is dominated by larger, corporate companies, which has enabled projects to be developed cheaply through economies of scale, and provided renewable energy technologies to compete effectively with the conventional fuels. However, it is again that large-scale development which put burden on social and local requirements of sustainable development.

Accordingly, it is that Non-Fossil Fuel Obligation (NFFO) –the governmental support mechanism[32], which is largely blamed for stimulating the contested nature of RES development. Through the competitive nature, with the focus on the cheapest generation of RES, of the NFFO developers were encouraged to target sites with the highest resource that led to inappropriate site selection in environmentally sensitive areas with inappropriate scale (Stevenson and Richardson, 2003). Since the procedure was highly competitive within which the bidders had to specify the location of the plant and winning bids were tied to that location, it was also secretive that the developers were keeping their applications secret until the outcome of the bidding round (Upreti and van der Horst 2004). Therefore, it was a top-down decision-making process providing no opportunity for public participation and consideration of alternative sites.

As a result of those implementations of 90's were strong landscape conservation lobbies, and a high profile, vocal public opposition towards RES developments. "Why compromise the beauty of rural landscapes just for a tiny proportion of energy, of which ten times more can be saved by energy conservation measures?" (cited in Hull 1995b, p: 301). As it is apparent in that quotation the conservation bodies argue that policies on renewable energy must be considered in conjunction with other aspects of energy policy, including demand management and energy efficiency.

On the other hand, despite worries over visual impact, the schemes are highly welcomed by the community in the case of local benefit. As it is seen in Hull's studies,

[32] This support mechanism of NFFO has a bad reputation in Energy literature. Reiche and Bechberger state that "for a long time followed a failed promotion and now risks making the same mistake again, despite a change in the promotion to quota obligation" (2004, p: 848)

among several actors involved in assessing the suitability of proposed wind farm locations in Montgomeryshire District, the farmers and the politicians of District Council recognize wind farms as a diversification of rural economy. Since Mid-Wales has been designated as an Objective 5b region[33] by the European Union, because of agricultural decline and a low wage economy, wind farms are viewed as windfall for the farmers, and a means to stall decline.

British academics acknowledge that renewable energy is not exclusively the concern of energy policy. Stevenson and Richardson (2003) describe renewable energy considerations as a policy discourse, which is “constructed across a complex field comprising environment, planning, economic and rural policy, all underpinned by a discourse of sustainable development”, and adding that “each of these policy fields spans the scalar levels of the political system, from global agreements to local agendas. In each policy field and at each level of governance different devices can be identified that combine to create a ‘need’ for RE development” (p: 99)

Since renewable energy controversies are a consequence of inadequate integration of both the two bodies of public policy (Hedger 1995), the main concern is on how to build an integrated policy discourse across a complex and contested field (Stevenson and Richardson 2003). Hull (1995b) contemplates the British context of renewable energy policies as providing an *interesting policy field* within which new models of policy process “which acknowledge the recursive relationship between policy and action, and the multiorganizational clusters of public and private actors now involved in policy and programme implementation” (p: 286). In accordance with that she emphasizes the need for striking a *negotiated consensus* between all stakeholders on multiple and conflicting objectives, and the importance of socio-political context for understanding the dynamics of policy making.

Beside the suggestions for institutional change (Owens 1992), more dialogue and spatial planning at the national level address, addressing the arguments on renewable energy as a classical institutional challenge of implementing sustainable development and examining the new arenas for deliberative policy making in the devolved Welsh Assembly Government Stevenson and Richardson (2003) admit that

[33] Objective 5b region comprises the development and structural adjustment of rural areas, in terms of modernising and diversifying rural areas, developing new forms of income outside agriculture and upgrading the tourism sector. Under the Single Programming Documents for Structural Funds of the EU, the aim is to sustain local communities and protect them against rural depopulation, by providing skills and training in non-farming activities.

the vertical and horizontal changes provided by the devolution has created new potentials for an integrated approach to renewable energy policy making. However, they state that "institutional redesign does not provide quick wins in resolving deep-seated political and cultural struggles" (p: 115) and "at the very heart of renewable energy policy debates are unresolved conflicts over core environmental values, which are being played out in the new institutional arrangements" (p: 95)

In terms of environmental values in the context of nature conservation policies that renewable energy applications are subject to Owens argues that designation of nationally and internationally important sites, which are based on established scientific criteria and accepted as a prior determinant of environmental capacity is a "hierarchy of scale, not of value" (p: 449) that at the same time, fails to tell how weight different kinds of interests against each other. Therefore, reappraisal of the relationship between value and scale is suggested. Not only the potential cumulative and indirect impacts, and the role of local nature in people's quality of life but also the clear definition of what constitutes environmentally acceptable form of renewable energy development, and conservation values to be widely shared are required for reducing conflicts. In accordance with their statement "the making of difficult, risky decisions needs to be widely shared among the diverse interests of a community" Healey and Shaw (1995) suggest "assessing and mitigating the adverse impacts of development projects within a framework of precautionary limits informed by an argumentative approach to planning debate allowing both technical and moral/aesthetic issues to be discussed in open democratic way" (p: 436)

In relation to national targets, it is given that the tendency in local authorities is the use of emission targets in place of renewable energy targets. However, as Owens recognizes the spatially disagregation of well-defined targets as a means of relating specific policies to land use policies, Beddoe and Chamberlin (2003) suggest setting of targets through the planning process as a means of reducing confrontation and uncertainty, and providing local authorities with a clear mandate to take positive approach to renewable energy provision.

Including all above arguments, the other issue included in the agenda of British case is the criticism on PPG 22. This guidance is widely criticized as being too generalized and concentrated on predominantly on wind energy; failing to address both the range of technologies and the wider issues of resource management; having a strong rural focus and providing little guidance on the development of renewable energy technologies in an urban context; offering insufficient protection to designated areas and underestimating the significance of amenity issues (Hedger 1995, Hull 1995a and 1995b). In brief, as defined by Hull, the guidance leaves three key methodological questions unclear to local planning authorities: a) what are the procedures and techniques for assessing the resource potential of an area? b) how do they assess the local amenity or impact of a scheme? c) how do they balance the local amenity impacts of a scheme with its contribution to national renewable energy policy?

7.4.3.1. Recent Changes in Planning for Renewable Energy

In the context of above arguments of renewable energy debate, a very limited number of renewable energy power plants have received planning permission and been built compared to those that are needed to meet Government targets or compared to the majority of other European countries. Wind energy, representing the most immediate opportunity for the short-term deployment of significant renewable energy capacity, has become one of the least acceptable forms of technology, regarded as unsustainable form of development.

At present, not only the energy system but also the planning system is in a time of change. In the new framework of the planning system in England and Wales, Regional Planning Guidance (RPG) is replaced by Regional Spatial Strategies, which is Statutory Documents and prepared by Regional Assemblies; instead of structure planning councils are expected to co-operate in preparing Sub Regional Spatial Strategies, covering areas with common interests and spanning existing local authority boundaries; local plans is replaced with Local Development Documents; Inspectors' recommendations following local plan inquiries is become binding on local planning authorities in order to speed up and make the development plan preparation process more certain; and the system is replaced on a PPG by PPG basis with Planning Policy Statements (PPSs) which are regarded as more concise and leaving detailed information to be covered in accompanying Best Practice Notes.

In conjunction with these changes in the planning system, there is a requisite to strengthen the renewable energy deployment interactions with planning policies with clarified and simplified procedures. In order to achieve targets of Renewables Obligation, in line with and as a requirement of European Union Renewable Energy Directive, the Government in its recent Energy White Paper states that "planning [for renewable energy] needs to be streamlined and simplified' (Para 4.30)… the Office of the Deputy Prime Minister, in partnership with other government departments, will be examining how to bring consideration of the use of renewables and energy efficiency in developments more within the scope of the planning system, in context of the review of PPG 22 and the Government's wider planning reforms, and in a way that does not impose undue burdens on developers (Para 4.31)" .

In regard with the Government's requirement, in 2003, a group of stakeholders involved in renewable energy and spatial planning –the Renewable Energy Planning Panel (REPP) was set up to analyze planning policy issues for renewable energy in order to lead policy change and better informed decision-making. The aims of that group were to discuss key issues and make recommendations to Government (ODPM, and DTI, DEFRA, MoD), regional assemblies, local authorities and planners. The key issues included in the report of REPP, which is also a product of serial meetings and seeks to be a balanced and authoritative report representing all views and differences of opinions, are:

- *Positive, clear language in planning documents and clarity of hierarchy between them:* Due to the legalistic nature of planning applications, it is vital that the wording and phrases used within the national, regional and local documents are clearly defined with explanations for definitions and exceptions. The Note of Planning Policy Guidance 6 for Scotland is regarded as a good example, and the new PPS 22 is considered as positive in the manner of NPPG 6.
- *Achieving consistency of judgments:* Lack of consistency in outcomes is the key difficulty for developers. A clearly defined planning system in relation to renewable energy development is needed for consistency of judgements.
- *Clarifying the purpose and role of the planning system and material consideration:* Though sustainable development is a major aspect of planning, the role of energy in achieving sustainable development is not clarified in PPG 1. Therefore, it is expected that new PPS 1 makes material consideration for land use explicit, including the origin and use of energy within a context of sustainable development.
- *How energy is treated compared to other issues within the planning system:* Planning policy is mainly concentrated on renewable energy from the perspective of individual applications for new energy plants, however the planning system can also influence how other developments such as housing, new buildings, etc. interact with renewables or energy use. It is recommended that the treatment of energy within the

planning system should be consistent with other important societal issues, and should be considered both from the perspective of individual applications and the perspective of how it can influence the way new developments use energy.

- *Maximize positive planning:* In order to influence the energy use of new developments, local authorities should develop policies that require both energy efficiency measures to be adopted and proportion of energy to be supplied from renewable energy sources.
- *Areas of search versus criteria-based policies*: Areas of Search approach comprise identifying potentially suitable areas for renewable energy development in Development Plans, providing greater certainty regarding the outcome of the planning applications. However, the majority of REPP members agree on criteria-based approach, including different interpretations of 'criteria for approval' and 'criteria for selection". The former puts burden of proof on the developer and the latter which is largely supported involves that it is up to the LPA to clarify its criteria, and provided the developer meets them, the development would be approved.
- *Using today's technologies*: Wind energy is expected to dominate renewable energy development in the UK, since it is the cheapest form of development, and economics is the key determinant of technology choice. Moreover, since development can only occur with available technology, today's technology must be used instead of non-economic and therefore unlikely to be developed technologies. Accordingly, it is recommended that planning authorities should not produce planning policy for technologies, which are unlikely to be seen on a large scale before 2010 or later.
- *Targets for renewable energy*: The preferred approach is criteria-based targets. Though disaggregation of targets down to local level is among suggestions, as a balance of opinions it is considered that the targets at a regional or sub-regional level can best influence delivery.
- *Landscape concerns and environmental sensitivities:* Though most discussion is around wind energy, the other technologies such bio-fuels or energy crops are likely to have an increasing impact on the landscape and character of the countryside. Accordingly, it is agreed that the National Parks and Areas of Outstanding Natural Beauty require protection; any proposed development should pass the test of "national need" and "no alternative site", and large scale potentially intrusive developments should generally be not located in them. Exceptions to this rule are

given as very small scale projects, smaller community proposals, and small scale hydro projects. Criteria-based site selection is suggested for buffer areas outside of the designated area[34].

- *Local authority resources and expertise:* the lack of resources within local authorities to deal with renewable energy issues is seen as a constant problem. Since renewable energy is technically demanding and controversial topic area for planners to handle, a substantial increase of resources fundamentally financial which can be translated into more personnel and access to expertise is recommended.
- *Independent and easy access to information:* The need for easy access to independent information by planners and the public about renewables, their costs and benefits is emphasized. Since each power plant is making a contribution to meeting national targets, access to information enabling an understanding of this benefit should be easily available, and PPS 22 should explicitly.
- *Involve society:* main routes defined for involving society are i) education and ii) businesses, individuals and communities have to gain from this sustainable energy system through the ability to invest in renewable energy projects, employment and new sources of income, iii) democratic and institutional changes which encourage society to become more involved in decision-making.
- *Implementing an energy policy for diversity of technologies as a key tool in minimizing planning concerns:* Combining demand and supply side policies; promoting urban as well as rural technologies; promoting micro as well as macro developments; promoting diverse set of technologies. Further recommendations include; more capital grants to bring a larger mix of technologies into the RO; a renewable heat obligation; redraft building regulations.
- *Join-up Government's sustainable development policies and inter-departmental policies:* The joining-up of complementary policies to do with climate change, energy production and use, transport, land use, agriculture and food, and waste strategy. Existing policies are broadly separate, though there is an increasing overlap between above sectors.

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[34] In terms of opinions on whether landscape has inherent value deserving of conservation or preservation or whether the living, changing nature of landscape should allow for changes in human activity having impact on the landscape, the majority of members support the latter interpretation with the view that valued landscape can be conserved while developing renewables achieved by criteria-based policies.

7.5. Turkish Case

In recent years, there has been a progress in the field of renewable energy utilization but renewable energy concept is still a novel concept in Turkey. The developments taking place in the market involve utilization of hydropower, wind and geothermal energy, and energy from waste (EPDK 2004b) though the utilization of solar energy[35] is also included in demand and supply estimations (DPT 2001).

The contribution of planning system to renewable energy is not a question since there is no strategic national renewable energy policy, and neither a renewable energy nor an indicative carbon emission reduction target exists. Due to very few numbers of schemes also developed in small-scale, renewable energy developments are not experienced as yet a challenge to land use decisions and planning. Energy concerns, which have always been a central policy, have never been an issue to be considered in planning and never been included in planning legislation and plans.

However, experiencing structural changes Turkey is in a transition period presently. This restructuring process involves paradigm shifts, improvements and radical changes in all sectors of the country.

Therefore, the attempt of exploring Turkish case within the frame of the study on national contexts is oriented to investigate the context based on current institutional frameworks drawn by recent legal arrangements.

7.5.1. Administrative and Planning System

In this time of transformation, one of major changes, so-called reforms, has been realized in the field of public administration. In order to solve problems caused by the inadequacy of the existing system a series of Laws, aiming at changing the traditional structure of distribution of authority and sources among the central and local

[35] In fact, solar energy is the most promising alternative in Turkey though the advance technology foe electricity production is expensive yet. The contribution of solar water heating to the energy demand is excessive however, the statistics focus primarily on electricity and solar collectors are products that consumers buy and install by their own preferences. In the world market by the year 2001, Turkey is at the third rank in terms of total installed collector area, and at the forth in terms of installed collector area per 1000 inhabitants (Weiss et al., 2004). According to the study on energy consumption in housing sector done by the EIE and State Institute of Statistics, 10 % of total number of households in Turkey uses solar collector for hot water. By geographical distribution, solar water heating is extensive mostly in Mediterranean and Southeastern Anatolia Regions. By provinces, Antalya is leading (57 % of total residences in the province) followed by Gaziantep (21.4 %), Konya (12.3 %) and Izmir (6.1 %) (DIE 1998).

governments in a way providing flexible and horizontal organizational structure, and considering the principles of strategic management foreseeing the future, democracy, autonomy, participation and efficiency, have been put into effect. These are: Public Administration Law, Provincial Administration Law, Law of Municipalities, Law of Greater City Municipalities.

On the other hand, problems caused by the implementation of Development Act No: 3194 which has been valid since 1985, and inadequacy of the existing law with respect to the ongoing changes in socio-economic structures and the new planning approaches adopted in the world were necessitated the redefinition of planning and radical changes in Turkish planning system. Accordingly, the efforts of restructuring planning system, introducing new concepts and planning approaches, and developing a framework law have been conducted contemporaneously.

Within the scope of research, the contents of the mentioned laws and the latest outline of Draft Law on Development are examined from the viewpoint of "energy" and also "environment" in order to discuss and evaluate whether the new legal arrangements involve "energy-environment-spatial structure/planning" relations, and/or the level and scope of the interactions and integration.

7.5.1.1. Laws on Local Governments

Among the series of Laws, so-called reforms, first of all, it is the Public Administration Law, which distributes the duties of public services between central and local governments. Introducing a regulatory role to the State, the Law enhances the duties, responsibilities and the power of local governments. As it is noticed, there is a tendency towards a three-tier administrative system; in other words, an attempt of creating an administrative unit at regional level.

In Turkey, local governments comprise Provincial Authority (*İl Özel İdare*), Greater City Municipality (*Büyükşehir Belediyesi*), and Municipalities (*Belediyeler*). These administrative units are public juristic people having administrative and financial autonomy and their decision-making bodies formed by voting. According to the new legal arrangements, in order to establish a greater city municipality at the central city of a province the population of the city should be at least 1.000.000 as indicated by the last population census; this population size should cover the number of people inhabiting within 10.000 m of radius from the boundary of the central municipality; and should consist of, at least, three town municipalities or first level municipalities[36]. The population limit of 2.000, which was stated in Municipality Law No.1580 in 1930, is raised to 5.000 for establishing a municipality. A further measure is that a newly founded municipality should not be closer than 5.000 m. to the inhabited area of another municipality.

In compliance with the strategic plan approach adopted in Public Administration Law, and as asserted by the Laws on Local Governments, the authorities should prepare their strategic plans and working programmes within six months following the local government selections. According to Article 31 of Law of Provincial Authorities No. 5197, and Article 42 of Municipality Law No. 5215), complying with spatial plans:

> The Governor… prepares the medium or long-term strategic plan and its annual program concerning infrastructure, transportation, environment, agriculture and forestry, health, education, industry and commerce, *energy*, public works and settlements, village affairs, drinking and irrigation water, development, solid wastes, natural disasters, protection of cultural inheritance, and other services…
>
> Mayor… prepares the medium or long-term strategic plan and its annual program concerning infrastructure, transportation, environment, development, solid wastes, natural disasters, protection of cultural inheritance, and other services...

It is asserted that these plans should be prepared through consulting with the universities, professional chambers, and relevant non-governmental organizations. It is not obligatory for the municipalities with population size less than 30.000 to make a strategic plan. Greater City Municipalities should consult with the town and first level municipalities for the preparation of the plan.

In addition to the strategic management approach, the Law No: 5216 assigns new duties, jurisdictions and responsibilities to Greater City Municipalities. As it is asserted in paragraph (y) of the Article 7[37], one of these new charges is *to establish/let be established and to operate/let be operated district heating systems*.

7.5.1.2. Draft Law on Development

In Article 6 of the Draft Law Outline, the planning hierarchy concerning the scale and purpose of the plans is formulated as “Spatial Strategic Plans” (*Mekansal Strateji Planları*), “Development Plans” (*İmar Planları*) and “Rural Settlement Plans”

[36] Municipalities that take place within the boundaries of the greater city municipality without forming a town municipality.

[37] In order to prevent probable authority conflicts, this article includes the distribution of duties and responsibilities among greater city municipality and the other municipalities.

(*Kırsal Yerleşme Planları*). Providing a radical change in the existing hierarchy and context, the newly introduced Spatial Strategic Plans, which determine general long-term principles and targets and main spatial steering decisions, comprise "National Spatial Strategic Plan" (*Ülke Mekansal Strateji Planı*), "Regional Strategic Plan" (*Bölge Strateji Planı*) and "Settlement Key Strategic Plan" (*Yerleşme Ana Strateji Planı*). Accordingly, the Outline changes the tradition of Development Plans –including both the Structure Plans and Implementation Plans in terms of their context and planning approach.

National Spatial Strategic Plan is to be prepared by the *National Plan Commission*, in which the relevant Ministries, public institutions and organizations, chambers of profession, and universities are the participants under the co-ordination of State Planning Organization (SPO) Secretary, and approved by the decision of Council of Ministers. Regional Strategic Plans to be prepared by *Regional Development Agencies*, inspected by the *regional planning commission*, and approved by the Secretary of SPO. Settlement Key Strategic Plans to be prepared under the *co-ordination of governors* at the region by consulting the relevant institutions and organizations, public juristic people, universities, and professional chambers, and approved by the Ministry. In the Greater Municipalities, the authority for the preparation of Settlement Key Strategic Plans belongs to the Greater City Municipalities. Development plans within the boundaries of Greater City Municipality to be prepared under the co-ordination of Greater City Municipality. Implementation plans to be prepared and approved by the town municipalities go into effect with the decision of Greater City Municipality Council. The provincial authorities are responsible for the preparation of the Rural Settlement Plans.

In accordance with the systematic hierarchy, every plan to be in consistency and compliance with the higher level plan decisions, unified with its report, and directing the plans at lower level. Within the planning principles introduced in Article 8, the initial concern is on the definition of the term plan:

> The plan is a document that solves the social problems, considers the changing conditions, and is continuous, reflects the existing and probable spatial-institutional relations, formulates decisions for the future and present, aims to meet the needs of future generations, sets relations between the space and social, cultural, natural values, selects the best alternative, also involves the implementation, requires participation, and determines the development process with long-term targets based on research and investigation.

An emphasis is also given to environmental and energy concerns: "Plans develop methods and take precautions in preventing environmental problems, and providing *energy efficiency* and *rational use of resources*". It is also noticed that the definitions (see Appendix C) given for Development Plans include such phrases as "*the principles of increasing energy efficiency"*, "*aiming at increasing energy efficiency"* that are worthy regarding inclusion of energy concept and energy-environment relations in plans and planning.

The concept of energy is also considered in terms of energy efficiency in housing sector within the subject of building permission. As stated in Article 36, it is obligatory to ask building permission from the municipality or the provincial authority for all the buildings included in the Law and the ones[38] that are defined in Article 5. For building permission, the projects should be prepared in accordance with the law, relevant regulations, scientific and technical rules, Turkish standards, agreed international standards and technical contracts. In this frame, some stipulations during the project process are demanded such as; natural illumination, air-conditioning, energy efficiency, noise control, etc.

7.5.2. Energy Sector

Turkish energy policy is primarily focused on meeting the national energy demand in a reliable, sufficient, timely, economically sound manner. Accordingly, the main objectives are: diversifying energy sources by fuel type; reducing dependency on imports; increasing domestic production and optimum use of indigenous resources; promoting energy efficiency and decreasing energy intensity. With respect to these objectives, providing the participation of private and foreign investors into market; enduring transparency and creating competition in the energy market through liberalization; pursuing the functional role of "energy corridor" in transmitting the rich energy resources of the East to European and world markets; and promoting R&D

[38] Building: the establishments that take place on land and water, permanent or temporary, directly or indirectly connected to the ground, that are; private or public buildings and alike, and the roads, bridges, tunnels, airports, dams, fillings, piers, harbors, towers, retaining, embracing and garden walls, water supply, waste water, gas, electricity, telecommunication centers and stations, transmission and distribution lines, infrastructure for energy and communication and their associated on-ground and underground systems, and the stationary or immobile establishments required for construction, production, mounting, replacing, supporting and maintenance of these systems.

activities on alternative energy technologies are the main instruments (DPT 2000, Pala et al. 1997).

At present, harmonization with the EU legislation and implementation, and transposition of EU Directives into Turkish legislation constitute the main framework of actions in energy sector. Moreover, under the EU TEN Programme, Turkey has signed two projects: Turkey-Greece Natural Gas Pipeline Interconnection, which is among both the common interest[39] and priority projects identified by the European Commission, and Turkey-Greece Electricity Interconnection and the Connection of the Turkish Electricity Network to the Union for the Co-ordination of Transmission of Electricity (UCTE) system. This project is among the projects of common interest, which aims at realizing electricity connections with third countries, especially candidate countries and the reciprocal and secure functioning of the systems. According to the agreement signed in 2002, a 400 kV capacity line will be constructed between Babaeski and Philippi, which is to be completed by the end of 2006 (ABGS 2003).

In compliance with the EU Directives and objectives above, the market is restructured by the introduction of Electricity and Natural Gas Market Laws. The Electricity Market Law No.4628, put into force in March 3, 2001, ensures the establishment of a competitive internal energy market, and provides the legal framework for private investors. Comprising specific provisions for the privatization of state-owned enterprises it separates the activities of generation, transmission, distribution, trading and import. Moreover, the Law introduces the eligible consumer concept that the consumers are free to choose their suppliers, and ensures the implementation of measures for protecting consumers and the environment.

Within the framework of the Market Laws, it is the Energy Market Regulatory Authority (EMRA), which is responsible for monitoring, regulating and supervising activities in the market (established on 19 November 2001). The authority grants licenses (transmission, distribution, generation, auto-production, wholesale and retail), approves tariffs, ensures non-discriminatory access to grids, ensures fair and effective competition, determines eligibility thresholds, and issues secondary legislation. The Ministry of Energy and Natural Resources (MENR) is solely responsible for formulating macro policies, and coordinating and supervising their implementation. The

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[39] Identified by the Commission, projects of common interest are the projects, which have impact on both EU member states and other relevant countries for the completion of the internal market and attainment of security of supply. In addition, priority areas are identified for common activities in order to realize cooperation between the parties in a wide range of areas.

SPO is responsible to approve and allocate funding for investment proposals of public institutions, to prepare 5-year and annual socio-economic development/implementation plans and programs as well as to conduct the related coordination and supervision in pursuit of the activities, and to assign priorities to the budgetary allocations.

In the field of energy efficiency and renewable energy, Electric Power Resources Survey and Development Administration (EIE) within the MENR is the main organization. Within EIE, the Department of Energy Resources Survey carried out studies on energy efficiency and new and renewable energy resources. In 1992, that department was entrusted by MENR with the responsibility to act as National Energy Conservation Center (NECC) in order to enhance the activities on improving energy efficiency in all end-users and promoting the use of solar and wind energies.

At present, there is no framework law in Turkey comprising a general basis for neither energy efficiency, nor renewable energy. However, a Draft Law on Energy Efficiency is under preparation by NECC/EIE, and a Draft Law on Utilization of Renewable Energy Sources for the Purpose of Generating Electrical Energy is issued in summer 2004.

Energy efficiency activities in industry is carried out by the EIE/NECC in terms of energy auditing in energy intensive industrial establishments for determining potential energy saving measures as well as training, providing public awareness, and policy studies. EIE/NECC is also responsible for the implementation of the Regulation on "the measures to be taken to increase energy efficiency in industrial establishments" which was issued on 20 November 1995 and requires industrial establishments with annual energy consumption of 2000 tons of oil equivalents or more to set up an energy management system in their plants. Since 2002, the Ministry of Industry and Trade has issued a number of regulations on energy efficiency labeling standards for appliances (such as refrigerators, washing machines, dryers, dishwashers and lamps).

Energy efficiency in building sector is provided by the implementation of the Regulation on Heat Insulation at Buildings. Mandatory standards for heat insulation in new buildings were first adopted in 1985. However, in accordance with the study on household energy consumption characteristics, done by EIE and State Institute of Statistics in 1998, it was estimated that the heat losses were over 200 kWh/m^2 which was very high compared to average losses in Europe. With the aim of reducing heat losses, the standards were revised, and *The Obligatory Standard Notice on Rules of*

Heating Insulation at Buildings- TS 825 was issued by the Turkish Standards Institute in 1999.

In conformity with TS 825, the Regulation on Heating Insulation at Buildings (Official Gazette No. 24043, dated May 8, 2000) was introduced by the Ministry of Public Works and Settlements. Within the context of the regulation Turkey is separated into four heating regions. In order to minimize the energy needed and maintain the desired comfort level, the construction and insulation materials are to be chosen with respect to these regions. Accordingly, this Regulation makes it mandatory to reduce heating requirements by 100-150 kWh/m^2. In compliance with the Regulations, monitoring and controlling of the implementations on insulation of public buildings are carried out by the provincial directorates of the Ministry under the supervision of Governors. Controlling and monitoring of private buildings are carried out by the Building Inspection Agencies, which function under the control and inspection of the municipalities.

7.5.2.1. Legislation for Renewable Energy

As a policy, the utilization of renewable energy is promoted primarily to reduce energy import dependency and ensuring energy supply security and diversity. Paragraph 1436 of the Eight Five Year Development Plan indicates that:

> Measures shall be taken for the development of new and renewable energy resources, providing their prevalence and increasing their proportion in total energy consumption, by considering the purpose of protecting nature. So that the use of energy potential of the country in maximum will be provided by adding the renewable energy resources into energy balance in addition to domestic fossil fuels.

- *Draft Law on utilization of renewable energy sources for the purpose of generating electrical energy*. As given in Article 1 the purpose of the Law is:

> To expand the utilization of renewable energy sources for generating electrical energy, to benefit from these resources in secure, economic and qualified manner, to increase the diversification of energy resources, to reduce greenhouse gas emissions, to assess waste products, to protect the environment and to develop the related manufacturing industries for realizing these objectives.

- As used in the Law, *renewable energy sources refer* to wind, solar, geothermal, biomass energy sources, and electricity generation sources suitable for establishing run of river/canal type hydraulic generation plants with a reservoir area of less than 15 square kilometers. Accordingly, the Law comprises the procedures and principles for conservation of the renewable energy resource areas, for certification and utilization of the energy generated from these sources

- In article 4 on identification, conservation and utilization of the resource areas, it is stated that:

  > Following the entry into force of this Law, for the purpose of benefiting from the national economic potential of renewable energy resources identified on public lands or on the lands owned by the Treasury, no development plan which affects the utilization and efficiency of these lands shall be made. The procedures and principles for identification and utilization of geothermal resource areas for electrical energy generation shall be laid down in the regulation to be issued.

- As asserted in the second paragraph of the same article: "Before granting a generation license for utilization of renewable energy sources, EMRA shall consult with DSİ, EİE, MTA, TEIAŞ, related regional distribution company, and the Ministry of Environment and Forestry on the basis of their expertise and fields of specialization."
- In accordance with Article 6 on projection for utilization of the renewable energy sources, the MENR will prepare minimum ten years of utilization projection of electricity to be generated from renewable energy resources. The projections are to be made for each type of resource and in every year. The first projection shall be issued within three months following the enactment of this Law.

▪ *The EMRA legislation* promotes the use of renewable energy through provisions below:

- In Article 5 of the Energy Market Law, it is stated that:

  > In addition to the duties set out in other provisions of this Law, the Board shall also have the following duties:….. paragraph (p): with regard to the environmental impacts of the electricity generation operations, to take necessary measures for encouraging the utilization of renewable and domestic energy resources and to initiate actions with relevant agencies for provision and implementation of incentives in this field.

- In Electricity Market Licensing Regulation, electricity generation units depending on *renewable energy resources* are defined as; units generating electricity from wind, solar, geothermal, wave, tide, biomass, biogas, and hydrogen energy; and river/canal type hydro-electricity units with installed capacity of 50 MW and below and hydro-electricity units with a reservoir volume of hundred million cubic meter or a reservoir area of less than 15 square kilometers.

- Article 12 and 38 of Electricity Market Licensing Regulation:

  The legal entities applying for licenses for construction of facilities based on domestic natural resources and renewable energy resources shall only pay one percent of the total licensing fee. The generation facilities based on renewable energy resources shall not pay annual license fees for the first eight year following the facility completion date inserted in their respective licenses.

  TEIAS and/or distribution licensees shall assign priority for system connection of generation facilities based on domestic natural resources and renewable resources.

- *The procedures of granting and applying for licenses*: In order to be granted by a relevant license to operate in the market the legal entities should apply to the EMRA. In accordance with the provisions related to applying for generation and auto-production licenses, the applicants shall document that; (Article 7 of Electricity Market Licensing Regulation)
  - They have signed the fuel supply agreement regarding the energy resource to be used or have acquired the right of use for the energy resource or other real rights (real property rights) or that such rights have been guaranteed by the authorized real persons or legal entities, for geothermal and wave energy,
  - They have obtained the ownership or other real rights (real property rights) on the land or that such rights have been guaranteed by the authorized real persons or legal entities, if the land on which the generation facility based on solar energy is to be established is private property and the expropriation is not demanded.
  - If the land proposed for generation facility based on wind and solar energy is publicly-owned and has not already been allocated for any other activity or if the ownership on the referred land has not been established or if such rights have not been guaranteed the other legal entities, that wish to set up generation facilities in the same area and based on the same resources, are required to apply to the Authority within ten working days following the announcement of the first application**.**
  - The applicants for solar and wind energy based generation should also submit the measurement data, site plan for turbine sitting, the location of the generation site applied on the map at the scale of 1/25.000.
- As given in Article 9, the basic criteria used by the EMRA in reviewing and evaluating applications for all types of licenses are as in below order:
  - Conformity with the objectives set forth in the related legislation,

- □ The opinions on the written objections regarding the publicized applications within the pre-determined period
- □ The impact on the protection of consumer rights, the promotion of competition, and the development of market,
- □ The financial strength of the legal entity and its financial resources,
- □ If any, the experience and performance of the applicants in the domestic and international markets.
- □ In addition to these criteria, it is indicated that the fuel type and the selection and efficient use of the site with respect to fuel type shall be taken into consideration in evaluating the applications for generation and auto-producer license.
- □ Complying with the basic evaluation criteria, if there is more than one applicant for electricity generation in the same area and based on the same resources, the selection is done with regards to the highest offer in the sealed envelopes given by the applicants (Communique dated 23-07-2004).

▪ Apart from EMRA legislation and Draft Law on Renewable energy, in the Regulation on principles of granting authorization for private developers, dated 16.8.1985, it is stated in paragraph (g) of Article 4 on principles for establishing and operating generating plants, that:

> In industrial establishments and satellite settlements involving more than 1.000 residential units (for generation plants based on wind and/or solar energy, the measure of residential units is not compulsory), hospitals, 4 star hotels and holiday resorts (for generation plants based on wind and/or solar energy, the measure of four star is not compulsory), organized industrial areas, campus areas, municipalities (urban waste, biomass and biogas, wind and/or solar energy), auto-producers/auto-producer groups can generate electricity in a reliable and economically sound manner to meet their electricity demand totally or partially by their own production plants.
>
> The establishments of fishery, poultry, breeding and agricultural irrigation can meet their electricity demand totally or partially by their own wind and/or solar based generation plants.

7.5.3. Environment Sector

In this section, it is aimed at addressing the energy-environment, environment-spatial structure relationships included in the domain of Turkish environment sector. In this respect, initially the contents of all the existing policy documents were scanned and the appropriate documents were selected for further studies of analysis, comparison and evaluation. The documents taken into account are: Eighth Five Year Development Plan, National Environmental Action Plan, EIA Regulation, Air Quality Control Regulation, and Circular on Air Quality Control.

The Ministry of Environment and Forestry (MoEF) is the main actor in the environment sector, thus in the field of energy related environmental policies, and in the harmonization of the Turkish environmental legislation with the EU acquis. It is given that the screening process of more than 60 % of the legislation was already concluded towards EU legislation harmonization (EU Del, 2004). Turkey has recently (on May 24, 2004) signed the UN Framework Convention on Climate Change. Up to now, the country had no commitment under Kyoto Protocol such as to cut carbon emissions[40] through developing mandatory greenhouse abatement strategies, carbon taxation or emission trading schemes.

By the Law on Organization and Duties of the Ministry of Environment and Forest No. 4856 (Official Gazette No. 25102, dated 08.05.2003), it is the General Directorate of Environmental Management assigned to the duty of;

> Promoting the use of clean energy, especially the renewable energy resources, taking all the necessary precautions in preventing air pollution caused by the use of fossil fuels, determining the environmental-friendly technologies and fixing the properties of the foundations to be established for this purpose.

Among the environmental policies in the Eighth Five Year Development Plan the measure specified in para. 1823 , “with a view to control and reduce the greenhouse gas emissions originating from transport, energy, industry and settlements, arrangements shall be made towards increasing energy efficiency and ensuring energy saving”, considers energy related environmental problems and recognizes energy efficiency as a means of reduction and control.

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[40] Though per capita CO_2 emissions, CO_2 intensity of energy, CO_2 intensity of GDP, and per capita emissions of sulphur oxides (SO_x), nitrogen oxides (NO_x) and total suspended particular (TSP) which are all associated with energy use, are lower than OECD average, the emissions have grown significantly due to increasing energy use. Moreover, air quality standards are less stringent than the standards recommended by the World Health Organization, and there is a lack of regular monitoring of pollutants (IEA, 2001). With the introduction of natural gas into residential use SO_2 and TSP levels have decreased in the cities of Ankara, Istanbul and Bursa, however many cities remain exposed to high levels of pollutants which causes considerable health problems. As the country continues to develop its economy, the air pollution problem likely will be exacerbated unless further preventive actions are undertaken.

On the other hand, it is the National Environmental Action Plan[41] (NEAP) which considers energy generation and consumption as one of the major problem areas, and identifies both energy efficiency and the use of renewable energy resources as actions areas.

7.5.3.1. National Environmental Action Plan

The NEAP, intends to be implemented over a 20 years period, includes only short and medium-term projects initially. The actions proposed in the NEAP are organized in three topics (DPT 1998, p. 60):

i) Actions to develop a more effective system of environmental management
ii) Actions for enhancing information and public awareness
iii) Actions investing in environment

In the action program for i) enhancing environmental management system, *planning* is considered as one of the action categories. The proposed actions related to the field of planning are;

- Incorporation of environmental concerns in the national, regional and local plans. Identification of local environmental problems, eco-basin activities, and priority actions in the plans.
- Arranging the scope and method of the urban development and environmental plans in a way integrating the environmental variables.

The project of *encouraging clean technologies and energy sources* is considered under the topic of iii) investing in environment. In that respect, the activity of promoting clean technologies and energy sources is planned as a medium-term project in which the Ministries of Industry and Trade, and Energy and Natural Resources are assigned as the main actors, and the Ministry of Environment, DSI, Privatization Administration, TUBITAK, local governments, private sector, universities and NGO's are the related stakeholders.

[41] Published in 1998, the NEAP process was guided by an Executive Committee consisting of representatives from the State Planning Organization, the Ministry of Environment and the World Bank. Since there is no tradition of preparing and implementing an *action plan* for a specific problem area in Turkey, this NEAP is regarded as a document for the implementation of a national environment strategy.

For each defined problem area, the document includes a set of action categories and a list of activities to be done. Among the proposed sectoral options for the problem of *energy generation and consumption*, the activities comprising the *clean technologies and energy sources* are outlined in the table 9.1.

Since developing relevant indicators are vital for monitoring, evaluating and determining the successes and failures of implemented policies, programs, and investments, the NEAP –a policy document- includes a proposal of a set of policy-based indicators. Among those proposed indicators, which are grouped with respect to five strategic objectives[42], one of three energy related indicators comprise the use of renewable energy: relating to the objective of promoting sustainable resource use, renewable energy use as % of the total energy consumption is proposed for indicating sustainability of energy consumption (Annex 8 of the NEAP, 1998, p: 3)

Table 7.5: Action options for energy generation and consumption

Action categories	Options
Policies	▸ Measures to encourage wider use of natural gas; ▸ Substitution of alternative energy sources for wood as a source of energy and spread of the practice of forest management for energy; ▸ Support the utilization of clean and renewable energy sources as well as passive solar energy applications;
Economic & Financial Measures	▸ Encouraging R&D on cleaner technologies; ▸ Encouraging wider use of co-generation and central heating
Techniques	▸ Promoting the diffusion and efficiency of central heating systems; ▸ Wider use of process energy (e.g. co-generation); ▸ Introducing renewable energy sources for energy supply in rural areas

[42] The five strategic objectives of the NEAP are: reduce or prevent pollution, improve access to basic environmental infrastructure and services, encourage sustainable resource use, encourage sustainable environmental policies, and minimize vulnerability to environmental hazards.

7.5.3.2. Air Quality Control Regulation and Circular on Air Pollution Control

Prepared by the MoE on the behalf of aims and principles stated in Environment Law[43] No. 2872 (dated 09.08.1983) and that is valid since 1986, the Air Quality Control Regulation (Official Gazette No. 19269, dated 02.11.1986) involves facts like; controlling the emissions that spread into the atmosphere as a result of every kind of activities, protecting the well-being of human-beings and their living environment from all the dangers of pollution, eliminating all the harmful effects of air pollution and providing these negative effects not to emerge[44]. Therefore, on the behalf of these facts the Regulation comprises the establishment and management of the foundations, and the production, utilization, storage, transport and import of fuels, raw material and products.

In this Regulation, the scope of the established relationship between air pollution and spatial structure/planning is as in Article 54: "In preparing regional, environmental and development plans, the settlement areas should be planned in a way so that the negative effects of air pollution on settlement areas and other protection areas are minimized and appropriate preventive decisions are taken".

In recently issued Circular on Air Pollution Control (dated 27.04.2004), provinces are grouped[45] according to their air pollution ranks through considering the average pollution values of 2003-2004 winter season within the frame of the value limits defined in Air Quality Control Regulation. In this respect, the Circular involves a set of precautions and measures related to the fuel type selection in accordance with the level of air pollution, reducing air pollution and providing a healthy environment for the society.

- In terms of fuel type selection, the use of natural gas is highly promoted by the measures:
    - Conveyance of natural gas, which is recognized as clean fuel because of releasing less emission to the atmosphere when compared to the other fossil fuels, to the most polluted, first rank provinces,
    - Governors of provinces and mayors making their best in bringing natural gas to their provinces and in developing required infrastructure systems,

[43] This Environment Law is under revision during the time period study.
[44] It is emphasized in the NEAP that this regulation should be simplified and upgraded.
[45] According to this grouping the province of Izmir takes place within Group II of the first rank provinces in which air pollution is densest.

- Encouraging[46] the use of natural gas in houses, offices and industrial foundations where the pipeline is transmitted and distributed.

- The measures about the utilization of alternative energy resources are;
  - Investigating the usability of alternative clean energy resources (solar, geothermal, wind, etc.) for heating, and mobilizing all the possibilities for the utilization of these resources,
  - Encouraging the use of other alternative fuels (LPG, diesel fuel, kerosene and electricity) for heating.

7.5.3.3. Environmental Impact Assessment Regulation

Lastly, it is the Environmental Impact Assessment Regulation, which is considered from the point of renewable energy development projects. In Turkey, the EIA Regulation has been implemented since 1993. However, for complying with the EU legislation it was subject to revision several times.

The revised Regulation (Official Gazette No. 25318, dated 16.12.2003) applies to two separate lists of projects. EIA is required in every case if the project is listed in Annex I. The projects listed in Annex II are subjected to scrutiny and selection criteria. After the analysis and evaluation of the project, the decision of "EIA is required" or "EIA is not required" is given. In the Regulation, the projects of energy generation based on renewable energy resources are taken place in Annex II. The projects listed are:

- River type hydropower plants with the installed capacity of 10 MW and above (up to 50 MW),
- Wind energy plants (wind farms)
- Installations for the use of geothermal energy (with the heat capacity of 5 MW_t and above)

[46] Before the amendment, the statement in the Circular was "making the use of natural gas obligatory in… " instead of "encouraging".

CHAPTER 8

RENEWABLE ENERGY INTEGRATED PLANNING PROCESS

Seeking to meet research objectives, this chapter includes the results of efforts to define renewable energy integrated planning process. Basing on the outcomes and findings of contextual studies, it is attempted to explain process through technical and procedural aspects and to introduce the procedural dimension into Turkish context by evaluating the legal and institutional structure examined in the previous chapter.

While focusing on the concept of renewable energy, it is necessary to underline that this concept be addressed within a wider frame of energy concept, thus of energy integrated planning comprehensively. If planning should contribute to reduce the rate of global warming and to move towards sustainability, then both strategies of energy efficiency and the use of renewable energy sources are to be considered within the field of planning. Comprehensiveness is necessary because renewables are site-specific and it cannot be practical and feasible applying in every location. Moreover, the policies and techniques of energy efficiency and use of renewable energy can compensate or fortify each other.

8.1. Technical Aspects of Renewable Energy Integrated Planning

As indicated in the literature, urban areas can be planned to accommodate the most efficient combination of energy supply systems and conservation measures by considering the relationships between renewable energy technologies and spatial structure; environmental impacts of energy developments can be reduced and their compatibility with other land uses can be provided through land-use planning, or in other words through planners' traditional task of promoting orderly development within spatial framework; and deciding on the most proper policies require not only the availability of local resources and the mature technology, but also considering the economics, demographical, social, environmental, geographical, physical and climatic conditions of the region. At that point, it should be kept in mind that it is the local characteristics, which are fundamental in determining the appropriate energy-environment related planning policies, and it is not the planners who can decide on the exact type of renewable energy technologies or energy supply systems.

Besides, if the findings of studies conducted are to be outlined:

- The exploitation of carbon-free, replenishable and site-specific sources has direct impact on physical and social environments,
- Utilizing renewables through advance technologies takes place within a short time period. That means, both positive and negative, consequences of developments become apparent rapidly,
- Contrary to this promptness, there is inertia –institutional, organizational, social, spatial, infrastructural inertia- in the receptor side. Therefore, the adaptability of environments and society to the rapid developments is critical,
- Depending on the source type, technologies used for conversion and utilization are in some cases manufactured plants rather than constructed ones, or small-scale industrial plants rather than the large-scale centralized conventional plants, and all are associated with networks or system components,
- Environmental impacts, which can be encountered, are not actually the result of that renewable energy sources are inherently bad and hazardous, but rather of the way the technologies are used. In other words, it is the compatibility of the systems with the basis on which they are installed and the compatibility of the basis occupied with its surroundings comprising natural, spatial and social environments,
- In that case, the size of renewable energy developments is also a factor that influences the level of impact.

8.1.1. Translating Renewable Energy Concept into Operational Terms of Planning

Before explaining technical aspects by taking above considerations account, it is necessary to translate the concept of renewable energy into operational terms and issues. In this respect, it is decided to categorize renewable energy technologies by utilization type that the attempt is likely based on renewable energy and land-use/spatial structure relationships. As it is clear, each type of renewable energy resource and/or alternative technology has different characteristics, which causes differences in the context of relationships. Organizing the manner of interaction between each renewable energy resources and land-use issues can indicate the context and extent of contribution, the techniques and the tools, the scale and type of plan, and moreover the state of action, the content of policies, and the nature of institutional intervention. Therefore, it is thought that distinguishing the types of renewable energy utilization is crucial, and that categorizing their utilization into two would be appropriate: the utilization of renewable energy technologies for the purpose of meeting electricity demand, and of space conditioning.

As seen in Figure 8.1 there is considerable difference between land-use/spatial structure relations of the use of renewable energy for the purpose of electricity generation and for space heating. In the case of electricity generation, due to their land requirements for power plants renewable energy developments can be regarded as a type of land use, thus as a land allocation or land use compatibility problem. Spatial structure relations are becoming important when renewable energy technologies are used for space heating. Apart from the use of renewables by individual building heating systems, collective usage comprises feeding district heating systems by renewable energy sources or benefiting from co-generation systems-CHP/DH systems that use the heat discharged during conversion of renewable energy sources into electricity.

Generally, CHP/DH systems require spatial concentration while passive and active solar systems require spatial dispersion. That means medium-to-high urban densities are appropriate for district heating systems fed by cogeneration plants, and medium-to-low urban densities for solar energy utilization. However, it is not reasonable to determine exact thresholds for densities since technologies are dynamic. In view of that urban design is the key planning consideration and urban planning and building regulations are the key tools for integrating renewable energy technologies into cities through planning. For example, incorporation of measures for solar access comprising orientation, building heights, plot ratios, space between buildings, roof types, etc. into plans and building permission procedures are vital for promoting solar energy technologies. For cogeneration plants feeding heating networks proximity to heating areas is required to reduce heat loss and infrastructure costs. In that regard, power plants can locate in urban areas by taking measures for preventing environmental impacts. In the case of electricity generation, proximity to the grid is crucial for locating power plants (Table 8.1).

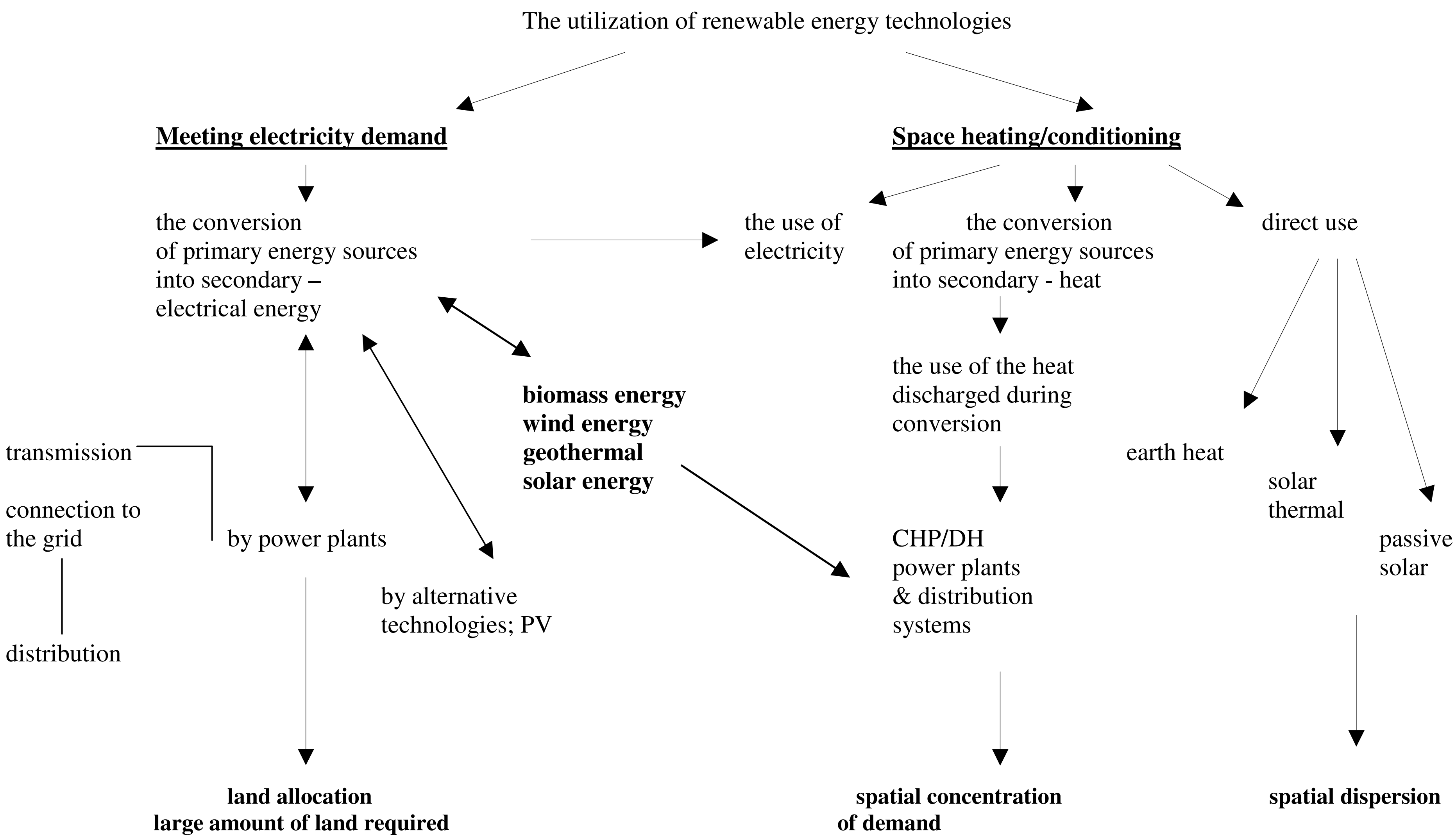

Figure 8.1. Land-use/spatial structure relationships by type of renewable energy demand

Table 8.1: Spatial requirements of renewable energy sources by utilization type

<table>
<tr><th>RES</th><th colspan="3">RES for electricity generation</th><th colspan="2">RES for space conditioning</th></tr>
<tr><td rowspan="3">Solar</td><td rowspan="2">Photovoltaics</td><td>Building integrated systems</td><td>Roof area and façades →</td><td rowspan="3">Orientation of plots, buildings, streets
Space between buildings
Building heights
Plot ratio
Medium-to-low urban densities
Roof area
Land is required for ground mounded collectors and storage</td><td>Passive solar</td></tr>
<tr><td>Large-scale ground mounded systems</td><td>Land is required for tilted modules</td><td rowspan="2">Solar thermal block or district heating systems</td></tr>
<tr><td colspan="2">High temperature solar systems</td><td>Hectares of flat land
High annual solar radiation</td></tr>
<tr><td>Biomass</td><td colspan="2">Energy crops, energy forests</td><td>Large amounts of land for cultivation
Accessibility</td><td>Medium-to-high urban densities
Mixed land-uses
Spatial concentration of heat demand
Proximity to heating areas
Accessibility and traffic control</td><td>CHP/DH systems (landfill gas, sewage gas, energy from waste, animal-agricultural-forestry residues, energy crops)</td></tr>
<tr><td rowspan="2">Wind</td><td colspan="2">Small-scale and/or stand-alone systems</td><td>A wind turbine or turbine groups installed on rural areas, on private property</td><td>Medium-to-high urban densities
Mixed land-uses
Spatial concentration of heat demand
Proximity to heating areas</td><td>Geothermal district heating systems</td></tr>
<tr><td colspan="2">Wind farms</td><td>Windy sites; open rural areas, remote sites, hilltops and coastal areas,
Dual use of land,
Large amounts of land,
Accessibility</td><td colspan="2"></td></tr>
</table>

In regard with suggested classification and related considerations about spatial requirements, incorporation of energy/renewable energy concept into planning process can be explained as in Table 8.2.

Table 8.2: Integrating energy efficiency and renewable energy into planning

Goal formulation: identification of objectives

- Accessing existing conditions and problems
- Energy demand and supply, Air quality values; carbon emissions

Goals

Conservation of non-renewable sources	Promoting The use of renewable energy sources

Objectives

• Reducing inelasticity of energy demand in the built environment • Making land-use and transportation patterns as energy efficient as possible and compatible with other planning objectives	• Providing the viability and competitiveness in energy supply and conservation options through planning, spatial structure arrangements • Planning for new developments structurally compatible with a desired energy supply and conservation strategy	• Providing rational use of land • Providing compatibility between energy development areas and the other land uses

If it is to be emphasized that the overall objective is to plan for achieving local sustainable development through the policies of improving quality of life and environmental quality, contributing global environmental gains, providing rational use of local resources, preserving natural resources and assets.

While speaking of renewable energy integrated planning, it is decided to use a pair of expressions with respect to utilization classification. Henceforth, the expression of *planning with renewable energy sources* is used to refer addressing renewable energy developments as a land-use decision, land allocation and compatibility problem, and *planning for renewable energy utilization* is used to refer considering heat supply systems and spatial structure interactions. In view of that planning with renewable energy calls rather for regional planning while the scale of planning for renewable energy utilization is urban planning and design. These two distinct expressions are also useful for explaining relationship between the sectors of energy and planning to be considered within procedural aspects in the following sections.

8.1.1.1. Data Collection, Analyses and Estimations

Since planning begins with data collection, planning with renewable energy sources necessitates additional new data to be gathered and used.

- *Data related to renewable energy potentials:* If we are to plan with renewable energy the data to be gathered should comprise technical source capacity of a region. As planners, we do not have the knowledge and skill of how to estimate regional potentials and do not understand very much about energy statistics and such units of watt, kilowatt-hours, etc. What planners need is geographical application, spatial distribution of energy capacities, and locational/spatial features of resources. In brief, we need maps; map of solar radiation, map of wind energy capacities, map of geothermal reservoirs, and have to be familiar with renewable energy technologies and have to know or learn how to read and use energy maps. However, the availability of such kind of data at regional scale is crucial. On the other hand, most of the gains can be achieved through the use of climatic data. Though planners are familiar with collecting sheets of climatic data, they often neglect this data while arranging land-use patterns and spatial structures and formulating macroform and development decisions, especially in Turkey.
- *Site selection*: Threshold analysis and sieve maps are our basic tools for deciding on future development and conservation, for land use allocation and nature-environmental protection. Theoretically speaking, while overlapping number of maps what planners can newly add to this process is maps of available renewable energy sources together with related information. In this respect, it can be expected that macroform and land-use decisions be influenced with spatial distribution of renewable energy source capacities. Further elaborations about site selection and also about the use of data are explained in chapter 9.
- *Energy Demand:* In the case of planning for renewable energy utilization, the interaction between the spatial structure and the energy demand/supply is significant. Accordingly, energy demand and/or energy densities are the key instruments in dealing with the interactions and spatial modifications. However, urban energy consumption, urban energy demand analyses and estimations are again unfamiliar themes to urban planners, especially in Turkey. There are

various techniques and methods included in the literature in terms of spatial energy analysis. Instead of focusing on these analysis and estimation methods, it is decided, here in this part, to introduce basic energy indicators that can be used in calculating energy densities. Energy demand indicators for residential and service sector are given in table 8.3. The scheme in figure 8.2 illustrates analysis of exact profile of urban energy demand. Actually, data related to energy demand can be gathered if there is urban energy database based on surveys and monitoring.

Table 8.3: Energy demand indicators for residential and service sector

Demand	**Structure**	**Energy intensity**
Residential Sector		
Space heating	floor area/capita	heat/floor area
Hot water	person/household	energy/capita
Lighting	floor area/capita	electricity/floor area
Appliances	ownership/capita	energy/appliance
Cooking	person/household	energy/capita
Service Sector		
Space heating Lighting Appliances/information	floor area/capita	energy/floor area energy/GDP energy/employee

8.2. Procedural Aspects of Renewable Energy Integrated Planning

The technical frame explained theoretically requires to be considered within the context of planning, including the norms and values of the society and planning system. Moreover, the role of planner in putting renewable energy considerations into practice very much depends on the political and decision-making system, the position of planning system in that governmental and administrative system and prevailing or espoused planning approach. Accordingly, it is aimed at explaining procedural aspects within the scope of organizational and institutional frameworks, and that suggestions are based on the outcomes and findings of conducted contextual studies.

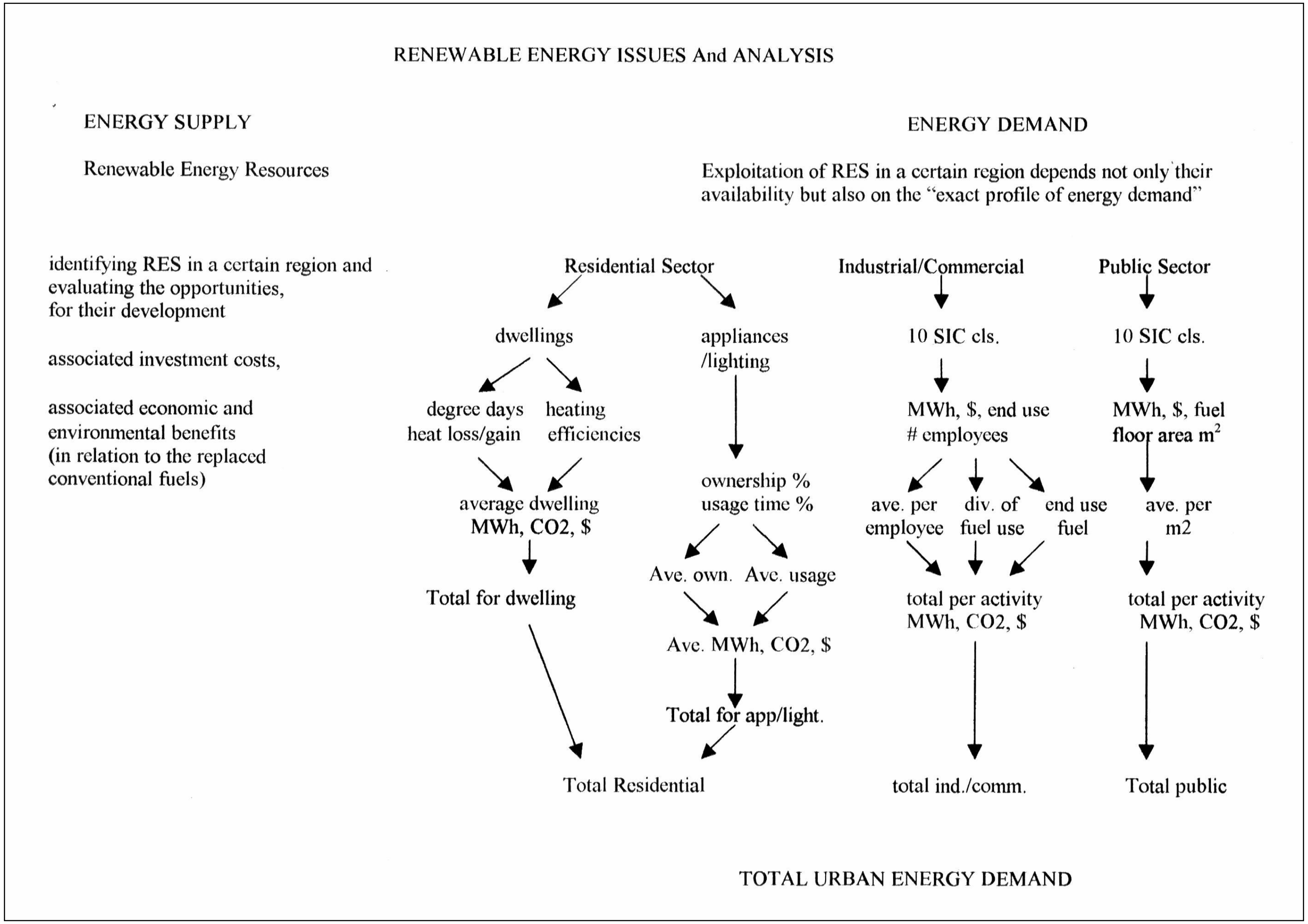

Figure 8.2. Energy demand analysis for renewable energy utilization

- *Explaining renewable energy as a policy field*
  - Due to political and strategic importance energy has always been a national policy, and till 1990's energy production and consumption were issues of energy sector,
  - In today's agenda, renewable energy is not exclusively the concern of energy policy,
  - Underpinned by the concept of sustainable development, the use of renewable energy sources is promoted in each field of energy, environment, planning, economic and rural policy,
  - In the absence of linkage, each sector has different understanding and definition of renewable energy and different policy tools, and varying also at each level of governance,
  - In this respect, renewable energy is a complex and contested field involving multiple public and private actors having conflicting interests.

- *Explaining renewable energy with energy sector*: In view of sustainable energy supply, the existing schemes range form integrated-regulated approaches and market-based approaches. In market mechanism, the main of objective of liberalization is to reduce price of electricity through competition. In this case, it is cheapest power that wins rather than the ones providing highest environmental benefits. As a solution to global problems, the market mechanism seeks to converge energy and environment by means of translating environment into language of market through the use of tradable economic instruments.
  - The current situation about European renewable energy policy is the conflict of liberalization versus environment,
  - This mentioned conflict is more bitter and divisive in the U.K case where energy market is fully competitive,
  - From a standpoint of market-based approaches planning system is a bottleneck, a non-technical barrier for achieving national and European renewable energy targets.

The structure of energy sector range from centralized to decentralized systems:

- In semi-to-centralized structures, the decision making process for renewable energy developments is rather exclusive and in top-down style (British and Dutch cases),

- These structures do not provide a capacity for renewable energy integrated planning approach. Actually, planning should contribute to renewable energy regarding national interest of renewable energy targets rather than the targets of carbon emission reductions,
- Central, exclusive policies and their implementation often result in the conflict of national and local interests, rejection of projects at the stage of planning permission because of strong public opposition, in short failure in attaining targets.
- It is the decentralized structures which provide a capacity for renewable energy integrated planning, which allows making space for renewable energy developments through finding and designating suitable areas at the local level.
- In addition, decentralized systems allow local ownership; opportunities for partnership in a cooperative that enhance public acceptability and increase local benefits while contribute to global environmental gains.
- Supported by local ownership opportunities decentralized systems favor small-to-medium size developments. Moreover, developments are regulated through clearly set sitting and design criteria, and well-defined environmental measures.
- On the contrary, centralized systems driven by market principles favor medium-to-large scale projects due to ambition of high generation capacities and that developers seek benefiting from economies of scale. Associated with deregulation, large-scale developments often result as a challenge to land use decisions and planning objectives, and negative environmental and social impacts are substantial, respectively.

- ***In accordance with above statements, it can be suggested that***:
  - A strategic approach is indispensable because of the scale and nature of environmental problems, the inertia in existing physical, social, institutional and organizational structures, and the dynamics of renewable energy technologies and the market
  - National policies are to be comprehensive and inclusive about diverse aspects of renewable energy utilization

- This inclusiveness necessitates an integrated policy approach. In other words, an integrative strategic policy framework comprising incorporated energy/renewable energy-environment-spatial development policies at the national level is a requisite not only for renewable energy integrated planning but also for successful renewable energy developments and substantial achievements in terms of environmental gains.
- The formulation of this policy framework and the actions related to integrated strategies necessitate a collaborative work and coordination and cooperation both vertically and horizontally, in which all policies, policy instruments and actions are to be coordinated and be conducted at the same direction through mutual trust and shared views covered by common frames of reference.
- Keeping in mind that neither governments have all the answers, not markets have all the solutions. Governmental intervention is needed for technological innovations since markets do not support expensive technologies, and regulation is required as competitive market undermines environmental and social objectives, and local benefits.
- A change from centralized to decentralized systems together with strengthened role of local authorities and guided by government
- Within this frame, planning can respond to energy efficiency and renewable energy policies through making space for renewable energy developments and promoting their utilization by spatial arrangements.
- Guided by an integrative national policy framework, renewable energy integrated planning approach can be put into practice within the frame of hierarchy of plans in three-tier administrative structure with distributed responsibilities that decision-making process comprise involvement of all stakeholder and based on negotiated consensus-building.
- Finally, the planner, having knowledge and skills related to renewable energy, should perform not only his traditional task of promoting orderly development, but also develop strategies to link diverse interests of multiple actors.

8.3. Evaluating the Capacity for Renewable Energy Integrated Planning in Turkey

- *Renewable energy considerations in Turkey*: The common expression used is "new and renewable energy sources" and that the term "new" can be explained as alternative technologies for utilization of domestic sources and natural gas. That articulated phrase also elucidates political understanding of renewable energy. That is, within the frame of energy policies renewables are promoted as a strategy for reducing dependency on imports and providing security of energy supply through diversifying fuel types by increasing the use of domestic sources.

On the other side, the Draft Law on Renewable Energy does not provide a strategic policy framework as it is mainly a response and adjustment to EU Directive 2001/77/EC concerning penetration of renewables into market in terms of electricity generation. In the absence of a national renewable energy policy, the use of renewable energy sources regarding environmental benefits is promoted within the frame of energy efficiency concerns by the environment sector.

- *The level of integration between environmental and energy policies*: First of all, if environmental policy is to be addressed, it can be said that the legal frame and the related institutions, responsible for the protection of environment and bringing solutions to existing problems, were already constituted in Turkey. However, it is obvious that integration of environmental objectives into national policies requires more than institutionalization of environmental policy and/or internalization of the environmental effects of an individual policy sector. Unfortunately, as it is also indicated in 8FYDP about the previous plan period that "no progress has been achieved towards sustainable development, and integration of environmental policies with economic and social policies has not been provided" is still valid. Accordingly, though the concept of sustainable development is accepted as a reference point in the formulation of all legal frames neither the path to be followed nor the tools are defined. Moreover, while studies on harmonization with European environmental legislation is still continuing and being a party most of the international conventions and agreements on environmental protection and preservation of natural resources, rather than the priority given to environmental concerns the reason behind is to meet European requirements and necessities of participating global and international platforms politically. In that case the problem can be explained as absence of political willingness and awareness about environment, and absence of political commitment to sustainable development.

While sustainable development requires moving in cooperation and coordination, until present what characterizes Turkish institutional context is centralized administrative system with a fragmented and disjointed structure in which actors move independently and in a business-as-usual manner. Strong bureaucratic relations, top-down and exclusionary style of decision-making not only exclude public participation but also the local governments and non-governmental organizations. The progress towards governance by recent restructuring activities can inevitably be slow due to institutional inertia.

If *energy sector* is considered, the picture is that environmental objectives are not an integral part of energy policy. Energy efficiency regarded as a means of reducing and controlling GHG emissions in environmental measures of Development Plan is not a measure included in energy supply and demand balance. Actually, with the goal of progressive economic development the principal energy policy in Turkey is meeting the growing energy demand in a secure and continuous way with lower costs. Due to scarce financial resources, it has been aimed at meeting energy demand through private and foreign investments. When the bureaucratic obstacles and the political and economic instability of the 1990's were unattractive and insecure for investors, and after the trials of BOT and BO models implementations, the main strategy has been formulated as creating a competitive energy market in which the private and foreign investors can operate in obstacle free, reliable, stable and transparent market conditions. That restructuring of energy sector through rapid liberalization and extensive privatization is well coincided or reinforced by the priority of harmonization with EU policies and adjustment to European energy market principles. Accordingly, the use of renewable energy sources is mainly an issue of market, and the link to environmental concern is provided just by the expression of "environment-friendly electricity".

- *The level of integration between energy-environment and planning considerations*: In an integrative framework of the NEAP, planning is identified as one of action fields for environmental management, and suggested that the scope and methods of planning be organized in a way integrating environmental variables and incorporating environmental topics into national, regional and local plans. However, the extent of established relations and proposals included is fallen short to accommodate a comprehensive frame in terms of contribution of planning to energy-environmental concerns, integration of energy-environmental objectives into planning. "Energy management" is considered on the basis of sectors that based on the studies, policies and implementations of EIE/NECC comprising end-user approach. Within this perspective, planning is not recognized as an action field to deal with problems related to energy production and consumption in urban environments.

If it is to be emphasized the city is a sector involving most of the energy consuming sectors. Cities are the main energy consumers with their urban form and land-use and spatial structure arrangements in which within-place and between-place activities are realized by the use of energy. In today's competing European cities strategies for improving quality of life and global-local environmental quality, in short for urban sustainability are formulated through the concepts of energy generating cities and energy efficiency at urban scale.

In this respect, it can be argued that the techniques suggested as increasing widespread and efficient use of central/district heating systems, supporting mass transportation systems, etc. cannot be thought independently from spatial patterns, urban from and spatial structure arrangements. In accordance with the policy proposal about benefiting from passive solar energy as emphasized in the NEAP within the extent of clean and renewable energy resources, it is the spatial organization that affects the efficiency of utilization. The spatial structure may permit or obstruct benefiting from both active and passive solar systems. Accordingly, building regulations comprising orientation of buildings, lots, and streets, site layout, distance between buildings, building heights, etc. are means to provide benefiting from passive solar energy, thus achieving energy efficiency.

At that point, the institutional frame of Turkish energy sector can be given as a reason for absence of an understanding of urban energy perspective that the sector does not provide a capacity for balancing energy demand and supply at urban scale, for managing urban energy and associated environmental impacts.

With respect to recent reforms on public administration, it can be said that the institutional restructuring towards governance with issued legal frameworks provide a capacity fro integrating renewable energy technologies into cities through urban management. Within the context of new roles defined for local governments comprising action in cooperation and businesslike manner, provision of local services by public - private partnership with market mechanisms, Laws on Local Governments that are inclusive about energy-environment concerns involving energy efficiency strategies on the basis of promotion of district heating systems constitute a legal basis for actions that can be taken in the field of urban heat supply.

In compliance with the changes in administration system together with the tendency of creating an administration unit at regional scale, the efforts of redefining planning and restructuring planning system introduces strategic planning as an approach to be adopted for developing spatial plans in the hierarchy of national, regional and local scales, and recognizes energy concerns as a matter to be considered in the context of planning.

As indicated in the proposal of Draft Law on Development, energy and energy related environmental objectives are incorporated into planning through the principles of prevention of environmental problems, providing energy efficiency and rational use of resources. Conditional to the enactment of the Law, it is the relevant regulations be issued that will translate the meaning of energy efficiency and its principles into operational terms for preparing development plans.

In accordance with the plan preparation process defined in the Draft Law, site selection decisions for energy (and environmental) developments, which are regarded as having special importance and requiring advance technology, be made by central government, and spatial plans be prepared in conformity with the decisions of national interests. That space-making process for energy developments also applies to renewable energy developments as indicated in Draft Law on Renewable Energy. That is, the suitable sites on public lands and on lands in the ownership of Treasury to be reserved for renewable energy developments, and be included in plans as potential renewable energy development areas for electricity generation with regard to national energy balance. In brief, this inclusion of energy developments in plans corresponds to recognition of spatial dimension or impacts of energy developments so as to provide spatial coherence of sectoral policies through strategic planning approach.

CHAPTER 9

RENEWABLE ENERGY INTEGRATED PLANNING APPROACH: IN THE CASE OF GEOTHERMAL AND WIND ENERGY POTENTIALS OF IZMIR

Focusing on the local level, this part of the study on Turkish context aims at proposing geothermal and wind energy integrated planning approach through examining and evaluating the existing practices in the province of Izmir.

9.1. Geothermal Energy Case

Considering the characteristics of geothermal sources and exploration and exploitation activities given in chapter 3.2 and in the below sub-titles, the case of geothermal energy is addressed as a special designated area and its utilization for heating purposes as urban heat supply infrastructure. Based on the study of identifying existing problems through examining and evaluating Balçova-Narlıdere geothermal field and Balçova-Narlıdere geothermal district heating developments, the proposal of geothermal energy integrated planning within a frame of process comprises the approaches of planning with geothermal sources/fields and planning for their utilization by district heating systems.

9.1.1. Izmir Balçova-Narlıdere Geothermal Field and District Heating

According to the quantity and quality of the geothermal energy sources, Izmir is one of the most prosperous provinces in Turkey. Within its borders, there are 11 geothermal fields; Seferihisar (*Karakoç, Doğanbey, Cumalı ve Tuzla*); Balçova-Narlıdere; Dikili (*Kaynarca, Bademli, Çamur Ilıcaları, Nebiler, Kocaoba*); Bergama (*Güzellik Ilıcası, Dübek, Paşa Ilıcası*), Çeşme (*Ilıca, Alaçatı, Şifne*); Aliağa (*Ilıcaburnu, Samurlu, Güzelhisar, Biçer, Helvacı*); Çiğli-Menemen (*Ulukent*); Urla (*Gülbahçe*); Bayındır (*Vardar Ilıcaları*), Menderes and Kemalpaşa. During the last two decades, those fields have been investigated through the studies of geology, geophysics and geochemistry. Beside the nature of the geothermal source, unfortunately, the investigations on characterizing the sources have not provided yet the definition of geothermal fields above as geothermal reservoirs because of the discontinuity on studies, organizational and technical shortcomings, and institutional deficiencies in terms of organizing and monitoring studies and combining and storing the results of investigations. Apart from these problems, Seferihisar region and the line of Karşıyaka-Çiğli-Menemen-Aliağa are considered as potential source areas for district heating. At present, the activities on Seferihisar region are at the second stage of development, while the work is geothermal reconnaissance at the north line (Toksoy et al., 2003b).

9.1.1.1. Balçova-Narlıdere Geothermal Field

The exploration of geothermal energy in Balçova-Narlıdere field, located between Balçova and Narlıdere region, approximately 10 km west of Izmir city center, and covering a total area of about 3.5 km^2 with an average thickness of the aquifer horizon of 150m, was started with drilling of the first geothermal well in 1963. Twenty years later, in 1983, the first geothermal heating application (of the country) was applied to Balçova thermal facilities (Thermal Balneologie Cure Center) and then to Izmir Dokuz Eylül University campus, by using a downhole heat exchanger system. Afterward the BD-I and BD-2 deep wells were encouraged the local government on these waters' usage in district heating. In that manner, the feasibility and engineering works of geothermal district heating system was started in October 1995 (Hepbaşlı and Çanakçı 2003, Mertoğlu 2001).

Since the continuity of the geothermal development is directly related to the sustainability and renewability of the source capacity, geothermal fields are required to be preserved. Balçova-Narlıdere field was designated as preservation area in 1989. However, the main concern in that time-period was about curative activities and benefiting from thermal springs and hot waters of drilled wells continuously and in a healthy manner through keeping thermal waters from chemical and biological pollution and keeping characteristics of hot waters from change that can be caused by artificial, mechanical effects (MTA 1989). Therefore, with the demand of Provincial Authority and by the work of MTA the boundaries of the preservation area were drawn by Zone I, II and III (Figure 9.1), and the measures to be taken in each zone were defined by a report.

That preservation decision has provided feasibility for today's geothermal energy developments. However, it is argued that the existing boundaries are not enough for further developments and future progress, and redefinition of preservation area is recommended (Toksoy et al. 2003b). Accordingly, the problems related to the field and the necessity of new drilling locations are defined as;

- That the potential well locations now remain in built-up areas (Figure 9.2),
- Building on the area hinders geophysical surveys for reservoirs studies,
- The field has limited development potential since built-up areas impede new drilling locations,
- Corrosion in geothermal energy systems, or changing of well performances or becoming unserviceable due to other reasons necessitate drilling of new wells in order to meet energy demand of the system,
- The risk of earthquake necessitates reserved areas for new drillings. Since the field is locating on an active fault line, the possible movements at the earth crust can cause deflects on the wells, change the source of crack ways feeding the wells and damage the components of the energy system. In that case new wells near or far locations are to be drilled.

9.1.1.2. Balçova-Narlıdere Geothermal District Heating System

Izmir Balçova-Narlıdere geothermal field includes two district heating systems: Izmir-Balçova district heating system (IBGDHS) and Izmir-Narlıdere geothermal district heating. The first stage of *15.000 Residences District Heating* project including both Balçova and Narlıdere settlements and having a designed capacity of 100 MW_t, was planned to serve 2.500 residences and started to operate in October 1996. At the second stage, the design heating capacity of the IBGDHS is equivalent to 7500 residences. The INGDHS is designed for 1500 residence equivalence but has a sufficient infrastructure to allow a capacity growth to 5000 residence equivalence.

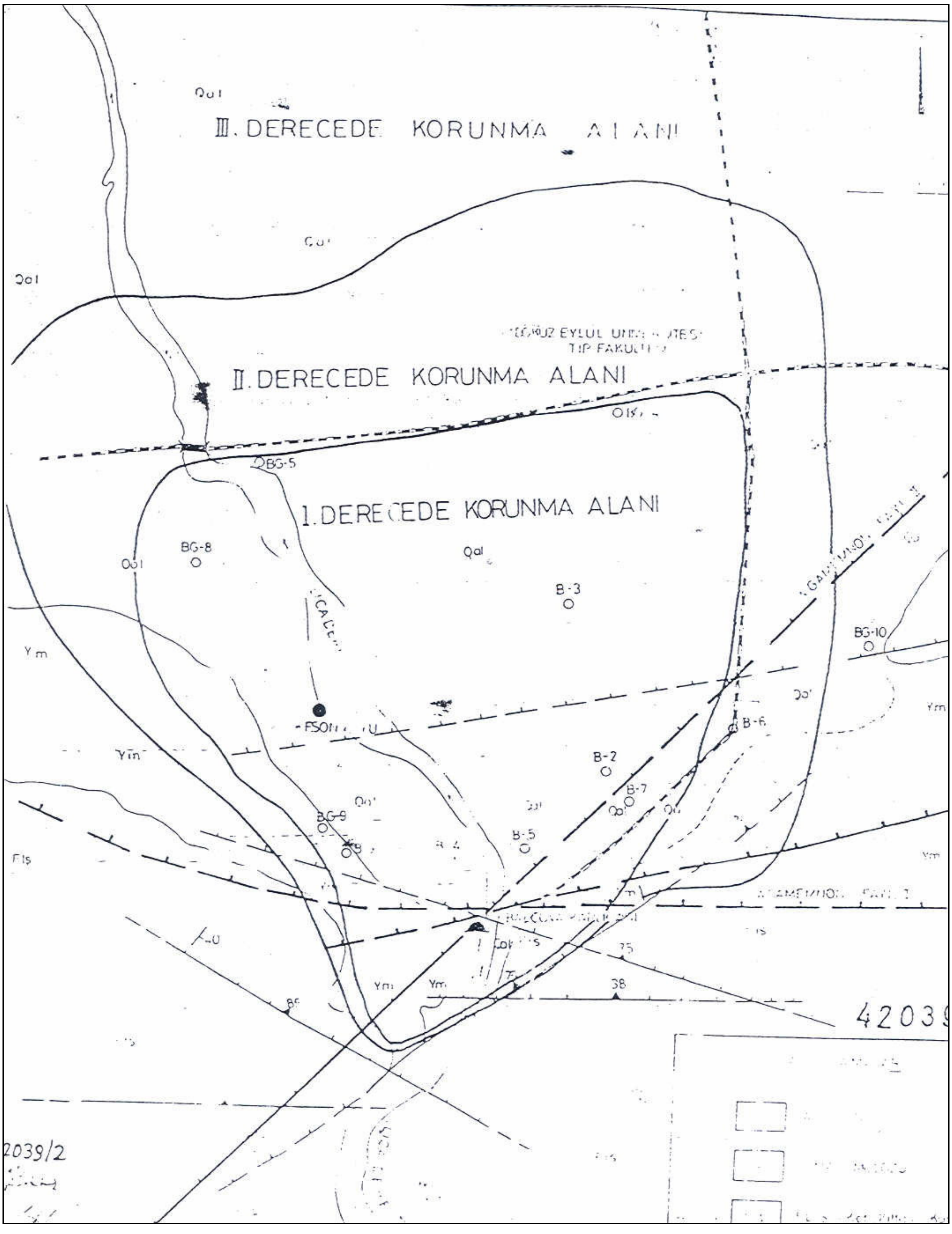

Figure 9.1. Map of Balçova thermal springs preservation area (MTA 1989)

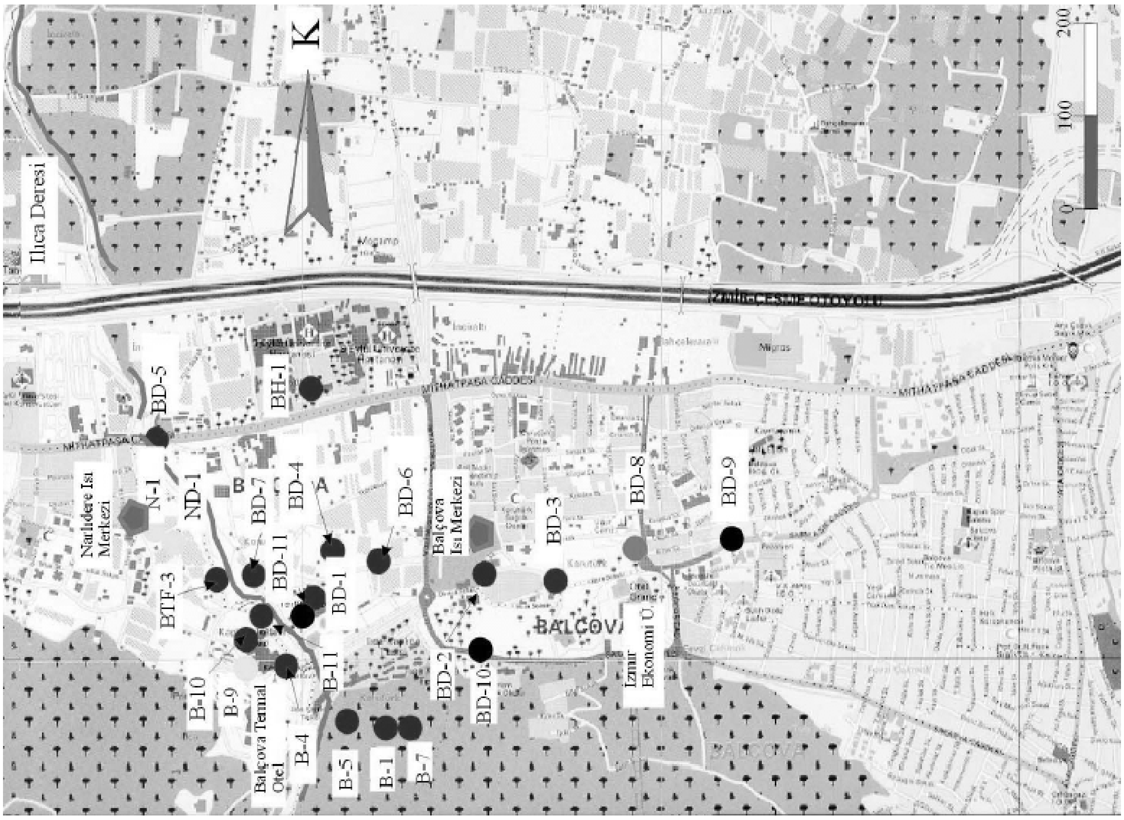

Figure 9.2. Heating centers, potential and operating wells in Balçova-Narlıdere geothermal field (Aksoy 2003)

The schematic illustration of the IBGF, including the IBGDHS, the INGDHS, and hotels and official buildings heated by geothermal energy is given in Figure 9.3. As it is seen in the figure, the district heating system consists mainly of three cycles: energy production cycle (geothermal well loop and heating center lop), energy distribution cycle (distribution network), and energy consumption cycle (building substations). There are 14 wells (7 production wells, and 7 reinjection wells) in the field; ranging in depth from 48m to 1100m, well heat temperatures of the production wells vary from 95° to 140 °C, with an average value of 118 °C, and volumetric flow rates range from 30 to 150 m3/h.[47] The heat load of the IBGDHS, based on the parameters of heating degree-

[47] In the operation of the system, geothermal fluid, collected from the seven production wells at an average well head temperature of 118° C, is pumped to a mixing chamber, where it is mixed with the reinjection fluid at an average temperature of 60–62° C, cooling the mixture to 98–99°C. This geothermal fluid is then sent to two primary plate type heat exchangers and is cooled to about 60–62° C, as its heat is transferred to the secondary fluid. The geothermal fluid whose heat is taken at the geothermal center is reinjected into the reinjection wells, while the secondary fluid (clean hot water) is transferred to the heating circulation water of the building by the heat exchangers of the substations. The average conversion temperatures obtained during the operation of the IBGDHS are, on average, 80/57°C for the district heating distribution network and 65/45° C for the building circuit. By using the control valves for flow rate and temperature at the building substations, the

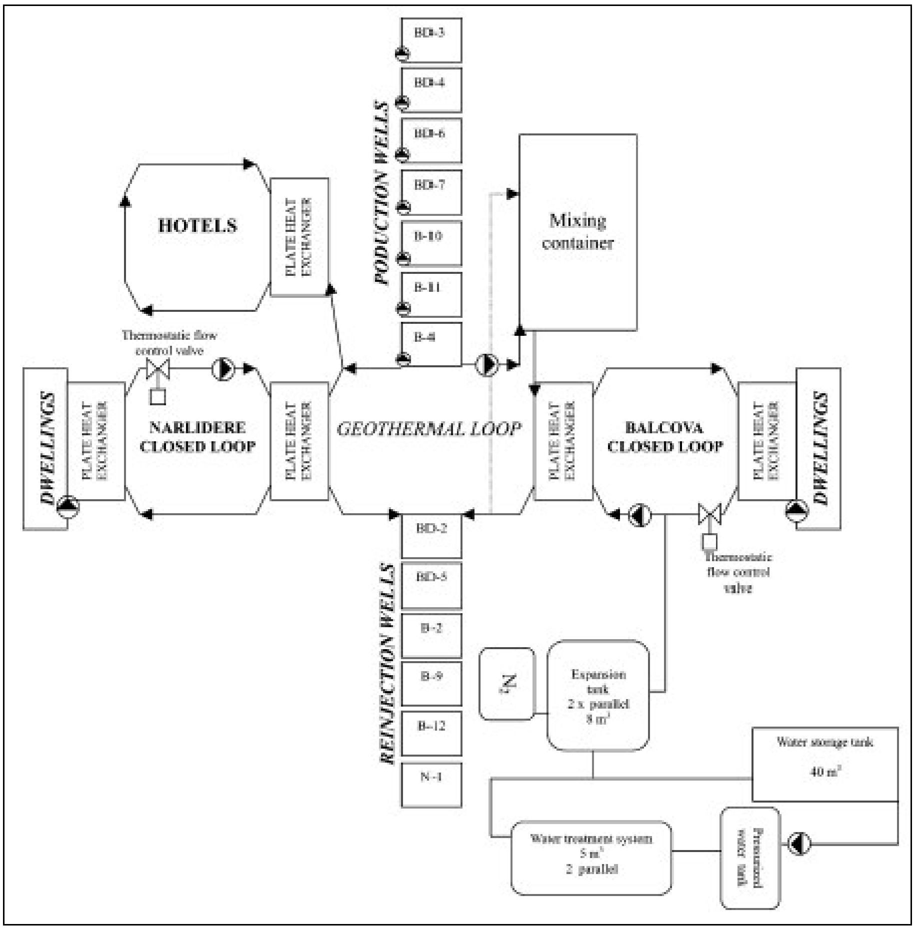

Figure 9.3. Balçova-Narlıdere geothermal district heating system (Hepbaşlı and Çanakçı 2003 p: 1291)

days for Izmir and heat loss in buildings[48], is 22.985 kJ/h (6.384 kW) for a residence equivalent. For a typical dwelling of 100m^2 area, peak heat load per unit area at 22°C design temperature is 54.9 kcal/h.m^2.

In the piping system, pre-insulated fiberglass reinforced polyester and welded steel pipes are used for transportation of the geothermal fluids and energy distribution network in the city. All pipes are buried directly underground, and the longest

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needed amount of water is sent to each housing unit and the heat balance of the system is achieved (Hepbaşlı and Çanakçı, 2003).

[48] The annual number of heating degree-days for Izmir at zero-based temperature of 18 °C is 1223, that is the average of two different values calculated as 1264 and 1182 for Izmir (Hepbaşlı and Çanakçı, 2003). In terms of heat loss calculations, TS 825 and TS 2164, and the Regulation on Heating Insulation in Buildings are the norms for designing heating systems. As determined by the Regulation among four main climate regions, the city of Izmir is in the first heating degree-days region. For this region, the limit values of annual heating energy demand are: Q' = 46, 62 A/V + 17,38 (kWh/m^2) Q' = 14,92 A/V + 5,56 (kWh/m^3) (Appendix 1-A of Heating Insulation Regulation, 2000)

geothermal fluid transportation distance is 929 m (Mertoglu 2001). Except raw material, fiberglass reinforced pipes are produced domestically.

If the growth of the system and the increase in production capacity are to be considered, it is reported that by the year 2001 capacity of the system was increased by 117 % (from 620 m^3/h to 1350 m^3/h) through improving existing wells without drilling any new wells. The system, started operation in 1996, was enlarged to 6.589 KE[49] in 2000, 9.388 KE in 2001, and 11.502 KE in 2002 (Table 9.1) (Aksoy 2003, Toksoy et al. 2003b). According to the data taken from geothermal energy company (Table 9.2), the capacity is 14.400 KE by September 2003, and depending on the planned projects the target value is 46.250 KE.

As given in chapter 3.4.1 and also in chapter 4.3, the *user participation* is the most critical parameter not only for conceptual planning of the system, but also for realization of the project. The factors that influence user participation are the initial participation costs and the savings and benefits of being connected to the system. However, there is an inverse relationship between investment costs and participation level; higher the level of participation, lower the participation costs.

According to the results of questionnaire carried out for conceptual planning of System-2 expansion project, the level of participation in the project area is 89 %. In the questionnaire, the given participation fee is between 1.000 – 1.500 $, and an extra fee of 1.000 $ is indicated for the buildings that has no central heating installations. Since the 33 % of dwelling do not have any installations, the level of participation decreases to 79 % that people are not willing to pay additional fee. With respect to that cost values, 5 % of the respondents (85 % of the total number of dwellings in project area), being tenants, do not submit an opinion on behalf of landlord about connecting to the system. 6 % of the respondents reject participation. In particular it is the owners of low value rented dwellings who refuse paying connection costs. On the other hand, the rent values are higher in system-connected houses. Moreover, the tendency about landlords' behavior is investing in the system and increasing rent value of its property respectively, which often causes dispute over rent contracts (Toksoy et al. 2003a).

[49] 1 KE is the heat energy demand equivalent of a typical dwelling of 100 m^2 in climatic conditions of Izmir.

Table 9.1: The growth of geothermal district heating system by heated area (m^2) (Toksoy et al. 2003c p: 3)

Yük Cinsi	Isıtma Sezonları					
	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
Konut	454.500	688.449	711.370	715.132	815.132[d]	815.132
Resmi daire	17.600	19.400	19.600	19.600	19.600	19.600
Princess Otel	25.000	25.000	25.000	25.000	25.000	25.000
Termal Tedavi Mer.	13.000	13.000	13.000	13.000	13.000	13.000
Otel Havuzları[e]	5611	5611	5611	5611	5611	5611
Termal Otel			9543	9543	9543	9543
DEÜ Hastahane[f]			143.600	143.600	143.600	143.600
Ekonomi Üniversitesi			18.800	18.800	18.800	18.800
Özdilek Otel					27.000	27.000
Özdilek Alış Veriş M.					20.000	20.000
Özdilek (-6 kot)					14.000	14.000
DEÜ Güzel San.fak.					20.000	20.000
DEÜ Konservatuar					12.000	12.000
Balçova Sistem-2						302.000[g]
TOPLAM	515.711	751.460	946.524	950.286	1.050.286	1.445.286
BÜYÜME[h] (%)		45.7	25.9	39.7	20.3	26.6

On the other side, the user contribution to the half of the initial investment cost by 1250 $/dwelling is amortized in 5 years through 8 % interest rate and 40 % discount in heating price. Under these circumstances, the payback period of the system is 20 years (Gürses 2003). At present, the selling price of geothermal heat is held constant for the whole year, and the cost of geothermal heating includes also the cost of domestic hot water supply. In order to make a comparison and give an idea about the relative cost attractiveness of geothermal district heating, or in other words the consumer benefits, the costs of heating with conventional fuels is given in the table 9.4. As it is seen, the cost of heating with electricity followed by gas oil, LPG and diesel oil are expensive.

Besides implementation of the constant low price policy, the inhabitants of the region have also benefited from environmental gains, such as reduced air pollution during winter season. The air is comparably cleaner and the sky is clearer than the other parts of the city. The quantitative presentation of environmental benefits is as in table 9.5. Provided by the geothermal district heating, the average reduction values per dwelling correspond to 18.5 kg of SO2 and 2710 kg of CO2.

Table 9.2. The system capacity by usage and future projects

Residential Use	**# of subscribers**	**heating area (m^2)**	**KE**	**MW_t**	**m^3/h**	**70%**
Balçova 7500	5.324	669.658	6697	43	565,6	395,9
Narlıdere 5000	801	104.821	1048	7	88,5	62
Narlıdere 1720	354	49.088	491	3	41,5	29
Total	*6.479*	*823.567*	***8.236***	*53*	*695,6*	*486,9*
Other Users						
Public buildings	heating		211	1	17,8	12,5
Princess Hotel	heating+hot water+thermal use		571	4	48,2	33,8
Balçova Thermal Hotel	heating+hot water+pools+cure center		653	4	55,2	38,6
DEU Hospital	heating+hot water		2.459	16	207,7	145,4
University of Economy	heating+hot water		273	2	23,1	16,1
Çağlayan	heating+hot water		200	1	16,9	11,8
Özdilek Shopping Center and Hotel	heating+hot water+thermal use		729	5	61,6	43,1
Fac. of Fine Arts, DEU	heating		365	2	30,8	21,6
Conservatory, DEU	heating		175	1	14,8	10,3
Dormitory	heating		528	3	44,6	31,2
TOTAL			***14.400***	*39*	*520,7*	*364,4*
Future Projects						
Narlıdere 1720			1.229			
Sahilevleri			600/980	4	50,7	35,5
System-2 3900			3.900	0	0	0
System-2 6100			6100	0	0	0
System-3			5.000	0	0	0
Military area			2.000/3.442	13	168,9	118,2
Olympics village			2.500	0	0	0
Oyak mass housing site			5.200	0	0	0
Narlıdere extension			3.500	0	0	0
TOTAL			***17.000/46.251***	*109*	*1435,8*	*1005*

Table 9.4: Cost comparisons of different fuels for residential heating, based on prices of December 2001 (Hepbaşlı and Çanakçı 2003 p: 1295)

Fuel type used for space heating	Heating value (a)	Unit price[a,b] (b)	Average efficiency (%) (c)	Increase in annual cost (%)[c] (d)	Fuel cost (cents/kW h) ($e = [100b/ac]$)	Amount of fuel used over the heating season (f from Eq. (1))	Annual cost of fuel (US$/yr) ($g = bf/100$)	Average monthly cost of fuel (US$/month) ($h = g/12$)
Domestic Soma coal	6.40 kW h/kg	10.33 cents/kg	60	122	2.69	1774.4 kg	183.30	15.27
Natural gas (Istanbul City)	9.59 kW h/m^3	26.63 cents/m^3	90	166	3.09	789.5 m^3	210.24	17.52
Wood	2.91 kW h/kg	6.00 cents/kg	60	88	3.44	4234.9 kg	254.09	21.17
Furnace oil	11.28 kW h/kg	35.47 cents/kg	80	143	3.93	745.6 kg	264.46	22.04
Diesel oil	11.86 kW h/kg	71.65 cents/kg	84	110	7.19	675.4 kg	483.92	40.33
LPG of 12 kg (in a container)	12.79 kW h/kg	83.39 cents/kg	88	219	7.41	594.2 kg	495.50	41.29
Gas oil	12.09 kW h/kg	79.46 cents/kg	84	109	7.82	671.0 kg	533.18	44.43
Electric resistance	3600 kJ/kW h	9.20 cents/kW h	99	127	9.29	7400.6 kW h	680.85	56.74
Electric heat pump								
Air source	3600 kJ/kW h	9.20 cents/kW h	2.8[d]		3.29	2418.4 kW h	224.49	18.54
Ground source (Geothermal)	3600 kJ/kW h	9.20 cents/kW h	3.8[d]		2.42	1928.9 kW h	177.45	14.78
Geothermal energy	Constant fee for dwelling equivalent						176.04	14.67

[a] 1 US$ = 1,500,000 TL.

Table 9.5: Environmental benefits of geothermal district heating (Hepbaşlı and Çanakçı 2003 p: 1297)

Type of heating system	Number of dwelling equivalence (a)	Amount of fuel used over the heating season (b)	Total amount of fuel used over the heating season (kg/yr) ($c = ab$)	Content of S in fuel (in percent by mass) (d)	kg SO_2/kg S (e)	kg SO_2/yr or kg SO_2/heating season ($f = cde/100$)	Content of C in fuel (in percent by mass (g))	kg CO_2/kg C (h)	kg CO_2/yr or kg CO_2/heating season ($i = cgh/100$)
Diesel-oil fired systems	3423 (45%)	675.4	2,311,894.2	0.7		32,334.15	85.9		7,276,400.32
Coal-fired heating systems (incl. boilers and stoves)	1902 (25%)	1774.4	3,374,908.8	1.1	1.998	74,173.75	65.0	3.664	8,037,682.8
Furnace-oil fired systems	2282 (30%)	745.6	1,701,459.2	1.0		33,995.15	85.0		5,299,024.53
Total	7607					140,503.05			20,613,107.65
Average (per dwelling)						140,503.05/7607 = 18.47			20,613,107.65/7607 = 2709.76

9.1.2. Institutional Framework for Geothermal Energy Utilization

The resource potential is high and the technology is mature enough in Turkey. However, the utilization of geothermal energy is quite below the expected level of development, and the source fields are poorly managed and preserved. The common view is that the deficiencies and insufficiency of the legal and institutional structure is the main cause of failure in Turkey.

Since geothermal resources are natural and underground sources, the State has the possession and control over these resources in accordance with the article 168 of the Constitution Law. The right of exploration and exploitation of geothermal resources belongs to State. The authority is the MENR, and the General Directorate of Mineral Research and Exploration (MTA) is responsible for studies of exploration and exploitation.

Principally, the utilization of geothermal sources is subjected to Law on The usage of cold and hot mineral waters and thermal springs foundation No. 927, put into effect in 1926. With this Law, the right of profiting and charging (*temettü ve rusüm hakkı*) of the use of the hot and curative waters has been given to Provincial Authority. Later in 1957, by the Law No. 6977 it was issued that Provincial Authority could transfer their right to municipalities and villages. The exploitation and hygienic inspection of the waters are subjected to the provisions of Law No. 1593. Besides, the authority of managing thermal sources on the lands designated as tourism area or tourism center was given to the Ministry of Tourism by the Law No. 3487.

Apparently, all these legal arrangements are directly related to curative usage of thermal waters, and there are number of authorities responsible for the management of the thermal waters, which seems quite confused. Under these circumstances and within the frame of the right given by the Law No.927, each provincial authority has their own practices and procedures about the utilization of geothermal sources and the management of the geothermal fields, quite different than each other. That absence of standards defined within a legal framework and the absence of regulation defining the authority and duties of provincial authorities is given as a major problem (Koç 2003).

In 1983, due to the problems caused by the absence of a specific legislation, geothermal resources were included in the Mineral Law No. 6309, for a short time period. Later in 1985, it was suggested to include again in the new Mineral Law No. 3213, but not realized. After those attempts, it has been recognized that geothermal energy has different characteristics than minerals which necessitates an independent, special law that considers its specialties, its state of existence in nature, its being renewable, and the possibilities of integrated utilization (Demirel 1997). After series of draft works aiming at meeting the requirements and reducing the legal and institutional deficiencies related to geothermal energy, the recent Draft *Law of Geothermal Sources and Mineral Waters*, prepared in 2003 is now on agenda for its enactment.

In this Draft Law, the definitions of geothermal sources and mineral water are given individually, and it is aimed at regulating the procedures and principles of continuous and effective exploration and exploitation of sources, their preservation, and the rights of activities; their transfer, abandonment and termination. Accordingly, for any activities of exploration and exploitation the authorization is required to be obtained separately. If a new source is found, *the right of discovery* is granted to the finder, and in the condition of approval of the project proposed for operation *the right of usage* is granted. General Directorate of Mineral Works within MENR is the authority for granting licenses. In authorization process, the projects are to be investigated by a Technical Committee composed of agents from General Directorate, MTA, local governments, and the agents of related Ministries, universities and professional chambers. The technical Committee is also responsible for designation of preservation areas, protection of reservoirs, inspection of activities and solving technical conflicts between the holders of right (Article 10).

It is stated that the exploitation projects have to be prepared (Article 7);

- Appropriate to the characteristics of the source,
- By considering the utilization priorities in the order of electricity generation, district heating, thermal tourism and curing,
- Through the principles of maximum utilization, integrated usage, preservation of reservoir and prevention of environmental pollution.

The holders of right and authorization have to meet directives of Environmental Law (Article 18). If it is to be added, the projects of geothermal source extraction and power plants with the heat capacity of 5 MW_t or more are listed in Annex II of EIA regulation (see chapter 7.5.3.3).

About expropriation and easement; the holder of exploration license can request for easement and/or share (*irtifak ve/veya intifa hakkı*), and the holder of exploitation license can ask expropriation in the condition of disagreement with the property owner. If accepted, the procedures will be carried out with the decision of public benefit and in accordance with the Law No. 2942 (Article 15).

According to the provision for payment, the right and license owners have to pay 1 % of their profit to Treasury as *state share,* 1 % to the municipalities or provincial authorities as *local government share,* and 0.5 % to defined bank as *finder share* and *fund participation.* Local governments should spend this income only for public benefit initially in urban areas nearest to the source.

9.1.3. Planning with Geothermal Sources and for District Heating

- *Definition of existing problems related to Balçova-Narlıdere geothermal field:*
  - Geothermal energy scholars claim that the built-up areas threaten the sustainability and renewability of the geothermal sources and restrict further exploration and exploitation activities in the field. In this respect, the necessity of *redefinition of preservation area* by new borders, covering undeveloped areas, elongated to the coast on the north is emphasized. Accordingly, it is suggested that no development be permitted except large-scale health, sports and curing establishments basing on the use of thermal waters.
  - However, even the existing designated area is poorly managed. In the interview with the agent from Izmir Provincial Authority, *illegal developments*[50] along Izmir-Çeşme Road and *unlicensed drilling and usage activities* within Zone I are claimed as major problems. Actually, the *confusion of authorities* and the *undefined responsibilities* seem to be the main question in dealing with the given problems. From the viewpoint of municipalities, provincial authority is the main actor due to the authority given by Law No. 927. As accentuated by the provincial agent, their responsibilities coming from the Law involve granting licenses for exploration and exploitation, inspecting usages and stopping unlicensed and inconvenient well drilling and usage.
  - An additional crucial factor that triggers illegal developments, impedes the use of property rights and hinders preservation of geothermal field is the *absence of implementation plan*. As told by Koç, the expropriation request, following the preparation of the preservation area map, was resulted with a limited amount of area due to scarce financial resources. Later, Zone I of the preservation area was designated and applied to the Structure Plan as tourism area by the decision of Ministry of Tourism (Figure 9.4). However, the Implementation Plan of the area

[50] As studied in a recent dissertation (Senol 2005) in detail, about unauthorized developments taking place in Zone I and Zone II, there are *demolition decisions* given by the Municipality of Balçova, and lots of *objection cases* to these demolition decisions. However, the fact is that these decisions are not implemented, and the litigants claim that the land is not expropriated and availing of property rights inaccessible.

has not been developed yet. Though its preparation is on agenda, no action is taken. As perceived through observing the communications, there are disagreements and conflicting views between the Greater Municipality, Balçova Municipality and the Provincial Authority over the development of the area.

- *Relationship between geothermal source/district heating and land-use/spatial structure:*
  - Geothermal field is as a special designated area, a *preservation area*: for the purpose of attaining sustainability and renewability of geothermal source, the area determined as on-ground physical boundaries of the source or the reservoir, is –or is to be a preservation area within which the use of land and the utilization of source be subjected to protective, preventive and precautionary measures depending on the characteristics of the source and reservoir,
  - Geothermal field as *a land-use*: due to integrated usage potentials of geothermal source and since thermal waters are used for curative purposes, the sites on geothermal fields can be used for health and recreation activities.
  - The interaction between the use of geothermal sources for heating and the spatial structure, as *spatial economics* of geothermal energy: The spatial structure (also involving the social structure) has direct impact on the feasibility and efficiency of the geothermal district heating systems, and a project of district heating necessitates medium-to-high urban densities, mixed land-uses including large-scale energy consumers such as schools, hospitals, offices, public buildings, shopping centers, hotels, etc.

In accordance with items above, it is decided to use two different expressions: the expression of *planning for geothermal energy* is used to refer planning approach for promoting and providing the utilization of geothermal energy based heating through district heating systems, and the expression of *planning with geothermal sources* refers to incorporating geothermal fields into the process of land-use decisions so as to provide rational use of land and natural sources through seeking a balance between conservation and development.

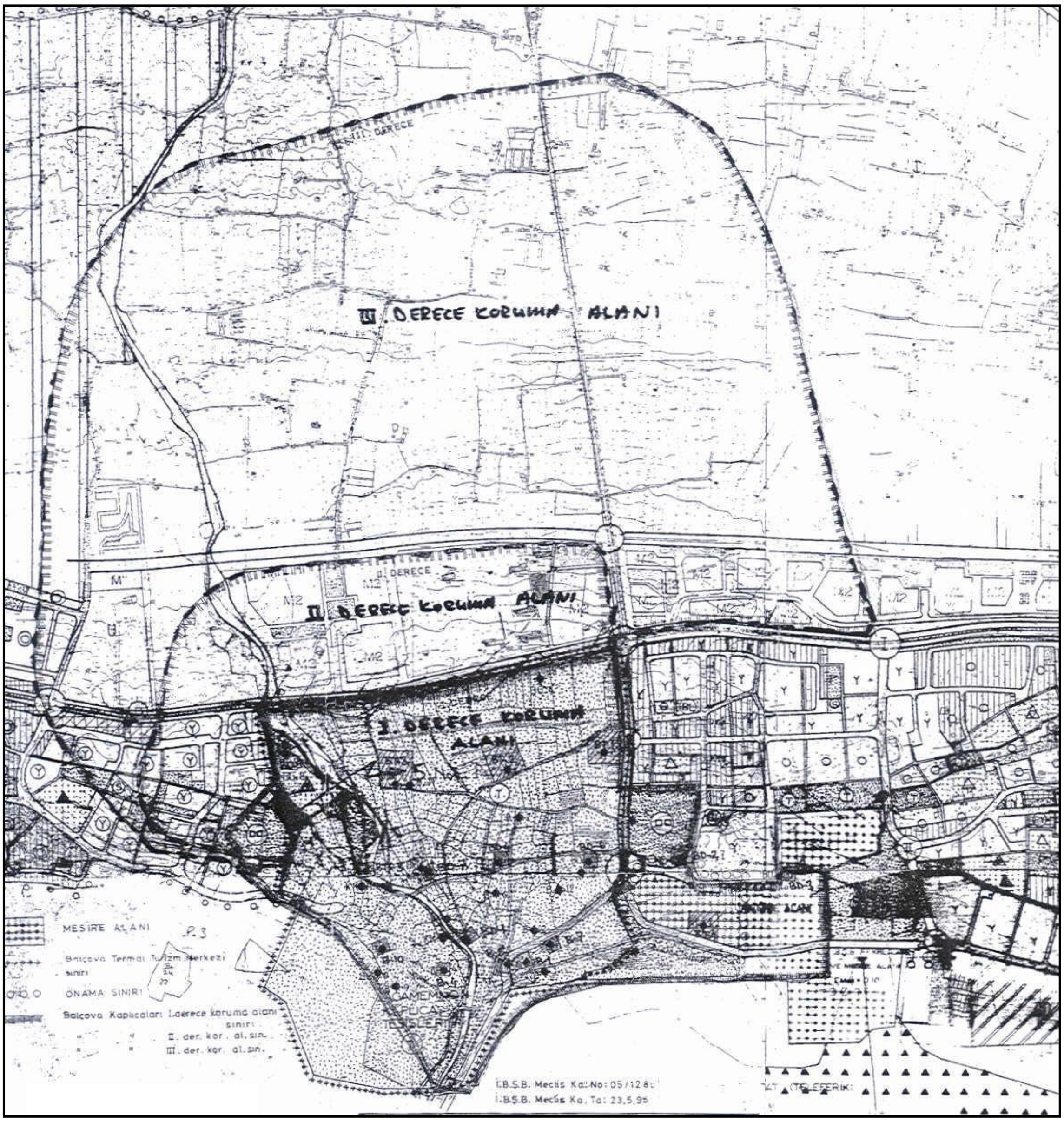

Figure 9.4. Balçova-Narlıdere Structure Plan (1/5.000)

9.1.4. Geothermal Energy Integrated Planning: Evaluations and Recommendations

As an alternative, clean and renewable energy source for heating, the geothermal energy developments seem promising in Izmir. The source potential of the province, willingness of the local governments, low price policy, the level of user participation, improved air quality, gained knowledge and skills through long-term experiences and supported by scientific and technical researches are all beneficiary to future geothermal energy developments.

It is apparent that the achievement of the city of Izmir is an example of local initiative driven by bottom-up approach, and the failures of development process and the problems encountered are the result of existing institutional framework, in other words, the lacking of legal framework and implementation tools, unclear and contested institutional structure together with undefined, confused and conflicting responsibilities. The question in mind is about the near future consequences when this geothermal initiative would be carried out within newly introduced legal and institutional frameworks.

➤ *Institutional, Organizational Structure:*

- With regard to geothermal energy sector, the nature of energy source and related activities necessitate an implementation of *strategic approach*. Accordingly, the formulation of policies, strategies and actions concerning regional distribution of source potentials, their characteristics and capacities is a prerequisite for geothermal energy integrated planning.
- Provincial Authority as a *main actor*: In addition to the power and assigned duties of defining preservation areas, preservation of reservoirs, inspection of activities and solving conflicts, the duties and responsibilities of the Authority is extended and its power is strengthened also by Law No. 5197 and the Draft Law of Development. Accordingly, geothermal energy can be expected to be a topic of Provincial Strategic Plan and an element and a policy of Settlement Key Strategic Plan.
- To some extent, these assignments can reduce the confusion of authorities in the field of geothermal energy, and be a proper body for an integrated, coordinated approach. In relation to that, the fulfillment of responsibilities, realization of duties considering national and local interests necessitate an organizational restructuring within the authority.
- Following the entry of Law on Local Governments into force, a joint company of geothermal energy has been established. The idea behind this establishment is sharing responsibilities between the municipalities and the provincial authority; the activities related to exploration to be carried out by governorship and municipalities to be responsible for exploitation of sources by operating district heating systems.
- However, to achieve a balance between protection, development and utilization such attempts require to be taken in compliance with a main strategic policy framework which has not been put forward yet.

- Rather than a consultation approach as stated in legislative documents, adoption of a negotiated consensus-building between all relevant stakeholders in formulating objectives, strategies and actions, in the process of decision-making can provide a capacity to deal with conflicting interests related to utilization of geothermal energy and to achieve successful developments.

➤ *Integrating Geothermal Energy into Physical Plans:*

- *Planning with geothermal sources:*
  - Wise management of natural sources: Within the perspective of this policy, geothermal field/reservoir requires to be a special designated area.
    - It is necessary to make a distinction between mineral waters and geothermal sources. As seen in Balçova case, the existing preservation area, which was designated for the purpose of preserving curative hot waters, is now insufficient in the occasion of geothermal energy. Using thermal waters for energy generation depends on the thermal capacity and temperature of fluids, while curative usage depends on chemical characteristics, contents of the hot water. Keeping land from building, providing undeveloped area is required for allowing exploration and exploitation activities to meet energy demand.
    - Therefore, it is necessary to use such expressions of "geothermal field protection area" "geothermal reservoir" while defining preservation borders and zoning.
  - Completion of reservoir definitions and protection area designations is a prerequisite for both planning with and for geothermal energy:
    - In this respect, priority should be given to the sites on the north line of Karşıyaka-Çiğli-Menemen-Aliağa and in Seferihisar at the southwest, which are featured as having characteristics favorable for district heating. These mentioned sites are locating on development axis of the city of Izmir. So, the boundaries of the fields are to be defined primarily through supporting and accelerating the continuous survey and feasibility works.
- *Planning for geothermal energy utilization:*
  - Rational use of local resources, increasing energy efficiency and improving quality of life and environmental quality. Within the scope of these policies;

- Land-use and spatial structure decisions on areas surrounding geothermal fields with defined boundaries, capacities and development potentials, are required to be given with a view of maximizing the applicability of geothermal district heating system but optimizing with other planning policies at the same time.

➤ *Towards Local Energy Planning:*

▪ *Introducing "urban energy management" and "heat supply planning":*

- The condition of alternative energy source potentials on north development axis of the city of Izmir;
  - Besides indicated geothermal sites, north axis involves some other energy source alternatives comprising various renewable energy source (urban waste energy, solar energy, biomass and biofuels related to rural activities, and urban waste)[51] potentials and natural gas. Depending on national natural gas policies[52], and being listed in Group II of first-degree polluted provinces, the studies of natural gas distribution network for district heating has already been started.
  - The situation is that heating with natural gas -driven by national interest versus locally driven, heating with geothermal energy. In regard with the high initial costs of network investments and the fact of rational use of resources, geothermal energy developments on the north require to be considered in accordance with the natural gas distribution network.
- Development of Izmir Energy Plan;
  - It is necessary to conduct studies and programmes on investigating regional alternative resources and technologies comprehensively and comparatively, and establishing and energy database. Formulating medium to long-term

[51] Few years ago, a feasibility study for sewage gas was prepared. However, the project was canceled due to its high investment costs.

[52] Basing on national energy policy, natural gas transmission lines and regional distribution networks, the regions to be heated by natural gas and the system development strategies, to be included in National and Regional Spatial Strategic Plans, and these higher level decisions related to transmission and distribution infrastructure will constitute basis for Settlement Key Strategic Plans. At present, planning authorities of municipalities, in which the transmission line passes, have been working on the required alterations in plan and application of the line. This study is carried out in accordance with the technical safety criteria, called "planning principles and safety criteria to be conformed in planning and development implementation studies around natural gas pipeline and establishments" and decided by BOTAŞ Board of Directors.

strategies for their development and utilization through developing a local energy plan.

- Instead of theoretical source capacities[53] the plan should include technical capacities determined by scientific research and feasibility studies for each fuel type and technology. The consideration of technical capacities together with environmental and spatial variables constitute usable capacitates. In this respect, there should be consistency between energy and spatial plans, and planning should be carried out through cooperation and coordination between sectors.

- Developing district heating systems based on heat supply planning;
    - As noticed in the policy documents examined in chapter 7.5, the political tendency is encouraging district heating systems (based mainly on natural gas) and making them widespread regarding global and local environmental concerns and in the name of energy efficiency policy.
    - While aiming at increased energy efficiency and improving air quality, rational use of local resources can better be attained through heat supply planning based on the energy plan. Zoning approach implemented in Denmark (see details in chapter 7.2.3) can be an example for efficient and effective district heating operation.
    - Since district heating and heat supply cannot be realized without considering the aspects of spatial structure, that the level of heat planning can provide the means to establish spatial relationships, thus for integrating heating and spatial policies.

- Objective of developing district heating systems based on local renewable energy sources: integration of energy efficiency and renewable energy policy;
    - Together with the other possibilities of solar energy based block or district heating, biomass based CHP systems, the local initiative of geothermal based district heating system development in Izmir can be encouraged and expanded within a frame of “developing district heating systems based on local, renewable energy sources” objective.

[53] There is a tendency of using theoretical capacities or speculative potentials for encouraging developments through taking attention to high quantitative values. However, the actions on purpose cannot be based on these speculative, theoretical quantities.

  - This objective can be an integral part of spatial development scenarios of Izmir, comprising a vision of “clean, efficient and generating city” and goals of local sustainable development, in particular, protection of global and local environment, wise management of natural sources, rational use of local resources, increasing energy efficiency, and improving quality of life.
  - In relation to local heat energy targets to be formulated in energy plan, the amount of area or the number of units heated by renewable energy based systems can be used as an indicator in spatial plans.

- Energy efficiency and urban energy management;

  - As it is known that energy efficiency in urban areas necessitate more actions than implementation of the Regulation on Heat Insulation in Buildings. Commitment to increase energy efficiency requires formulation of a set of policies and implementation tools, within which energy efficient urban planning and design and building regulations allowing benefiting from and/or modifying local climatic conditions, including measures for passive solar energy utilization can be such means to increase energy efficiency.

  - Since the policies of energy efficiency and the use of renewable energy have different implications, it is necessary to consider strategies in conjunction with each other, while developing energy plan and during heat supply planning.
  - Measuring achievements, evaluating policies and implementations require an application of monitoring.
  - Actions towards energy efficiency at the urban scale, integrating renewable energy and energy efficiency policies within an urban energy concept, and the integration of this energy concept into spatial planning together with the environmental objectives can best be realized through adopting an urban energy management approach and by institutionalizing at provincial and municipal levels.

9.2. Wind Energy Case

With respect to centralized structure of electricity sector in Turkey and in accordance with the electiricity market, it is the developers and investors who selects the wind energy development sites, and it is the EMRA that determines the exact scheme of development in relation to its licence granting principles. Iın accordance with this current institutonal framework for wind energy developments, the study on wind energy case aims at drawing recent profile of wind energy sector through examining licences granted by EMRA, Outlining key features of Alaçatı wind farm as a successful implementation and examining existing planning permission procedures applied to wind farm projects for the purpose of clarifying why planning with wind energy is necessary, in other words sheding light upon problems that can be encountered, even within two years.

9.2.1. Wind Energy Developments in Izmir

The province of Izmir, in which the first wind energy investments were taken place, has high wind source potentials that attract private developers to invest. As it can be seen from the Wind Atlas of Turkey (see in Chapter 3.1.3), the wind speeds and power potentials in Izmir range as 5.5-6.5 m/s and 200-300 W/m^2 in open areas, 6.0-7.0 m/s and 250-400 W/m^2 at seashore, 7.8-8.0 m/s and 400-600 W/m^2 at sea surface, and 8.5-10.0 m/s and 700-1200 W/m^2 at hills and slopes.

If the investment potentials in the province are to be examined, it is seen that 40 of 156[54] wind energy based generation license applications submitted to EMRA during October 2002-October 2004 cover the sites locating in Izmir (EMRA 2003, EMRA 2004a). The regional distribution of these 40 wind energy projects within province by number is; 9 in Çeşme Peninsula, 8 in Karaburun Peninsula, 7 in Aliağa, 4 in Seferihisar, 3 in Urla, 3 in Bergama, 3 in Foça, 2 in Menemen and one project in Dikili.

However, it cannot be assumed that all these applications would be licensed for energy generation. As it is noticed, there is more than one application for the same location. For example, for the site of Yayladağ-Kargılık Hills-Değirmentepe-Bozköy at

[54] About license applications data, two lists dated June 2003 and October 2004 were used. There were some differences about few projects. Those differences were neglected while counting the total number of wind energy projects. License applications cover 22 provinces. 25.6 % of total projects are proposed for sites in Izmir. The other provinces having proposals with higher proportions are: Hatay (10.8 %), Balıkesir (10.2 %), Çanakkale (7.6 %) and İstanbul (7.6 %).

Karaburun Peninsula there are three independent project proposals with 15 MW, 47.4 MW and 249.3 MW of installed capacities. For the time being, it is not possible to guess which projects would be realized but the sites and the sizes of the applications give idea about the exploitation potential of Karaburun region.

On the other hand, according to the updated list of applications granted generation license (EMRA 2004b) announced[55] on EMRA web page, 36 of all wind energy based project proposals were licensed for generation, and 22 projects were rejected (EMRA 2004c). These 36 licensed projects, with totally 1406.92 MW of installed capacity, would be installed and operating on lands of 16 provinces by mid of the year 2006.

If the wind projects granted are to be disturbed by province, there would be 5 wind farms in Hatay, 4 in Balıkesir, and 3 wind farms in each province of Istanbul, Izmir, Manisa and Osmaniye (Figure 9.5a). In terms of installed capacities by province, the highest capacity would be realized in Osmaniye as 190.8 MW, followed by, 165 MW in Balıkesir, 163.71 MW in İzmir, 157.4 MW in Hatay, and 119.7 MW in Kocaeli (Figure 9.5b).

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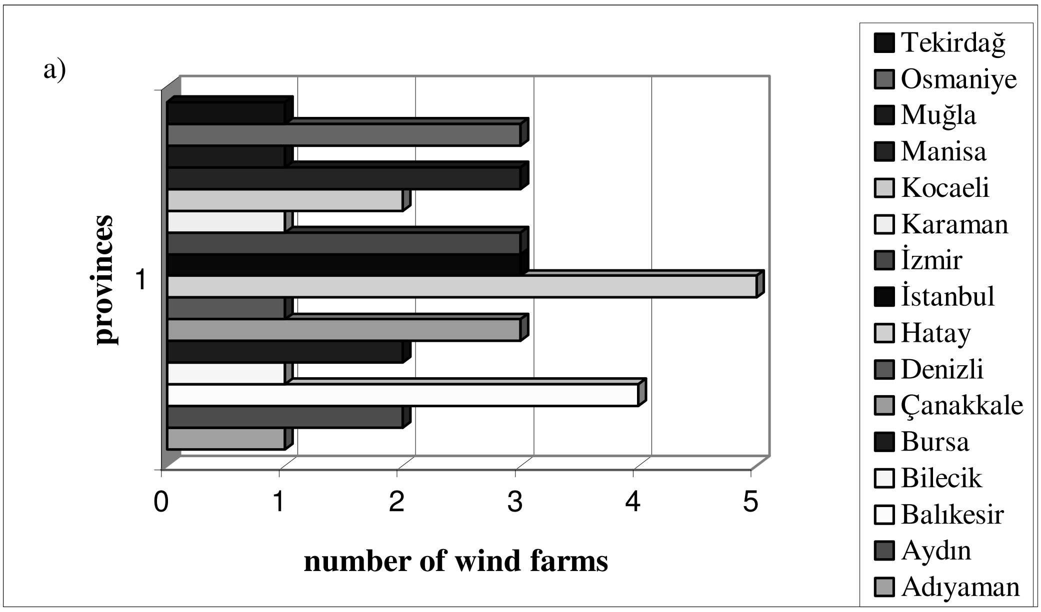
[55] Announcement related to license process is compulsory.



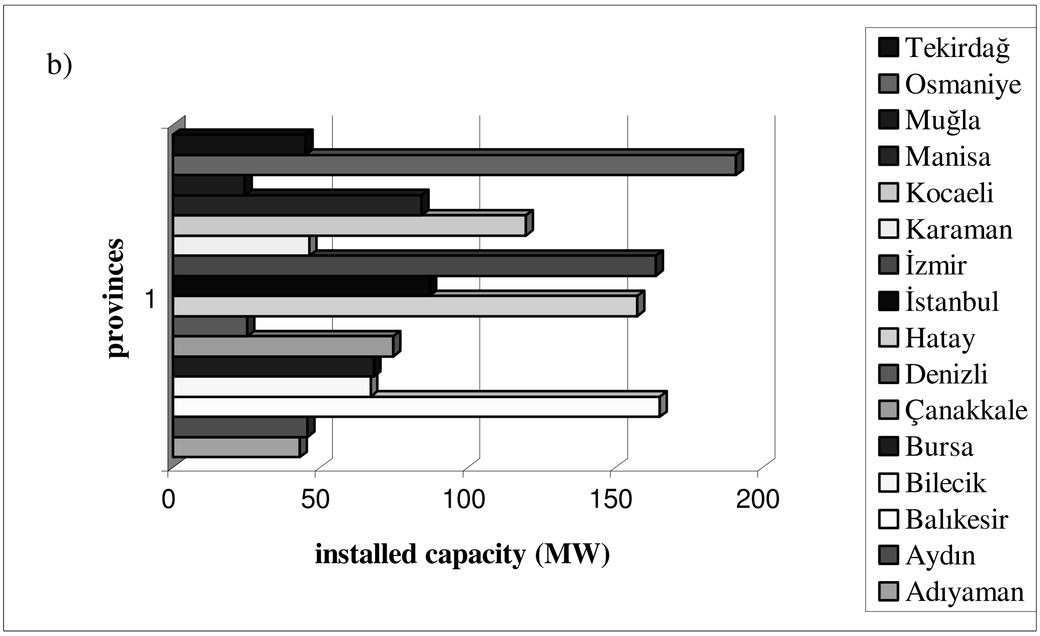


Figure 9.5. a) Distribution of wind farms by province
b) Distribution of installed capacities by province

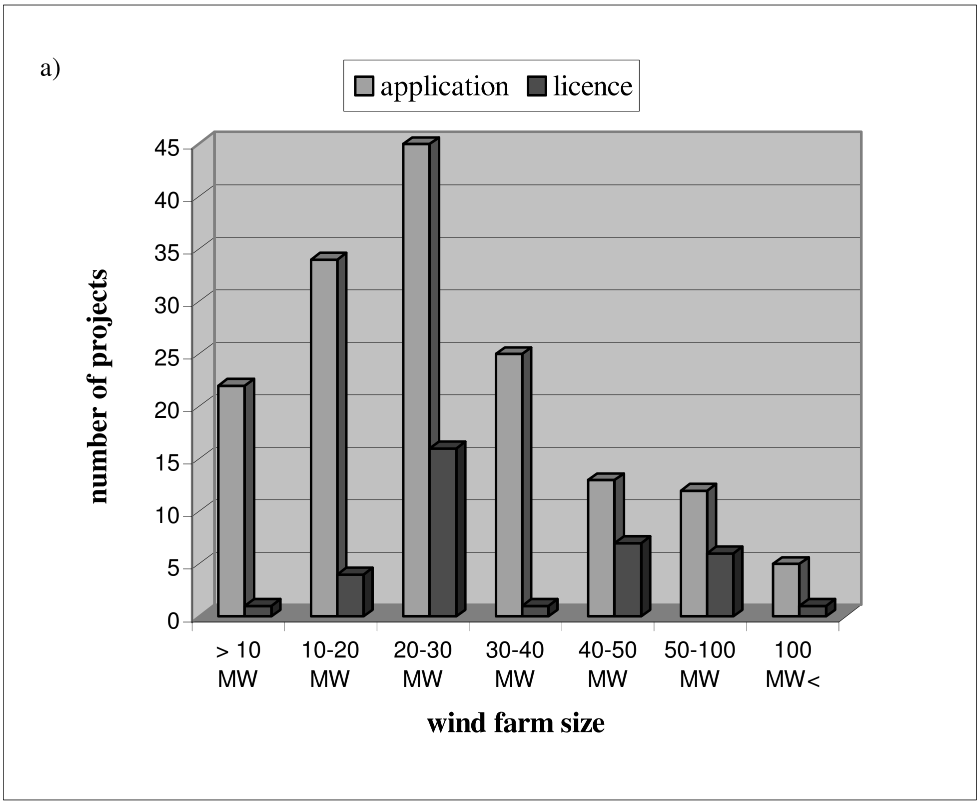
If the applications and licensed projects are to be examined according to the installed capacities as project size, it is seen that the wind farm projects are mostly 20 – 30 MW in size. As examined, 29 % of the applications and 44 % of the licensed projects have 20 – 30 MW installed capacity, and 24 % of the total applications and 22 % of the licensed projects have 30 -50 MW capacity. As it can be seen in Figure 9.6, the share of large-scale projects is higher in licensed projects though they are less in total projects included in application list. In contrast with the higher share of small-scale applications, few of them were licensed. In brief, it can be said that developing in medium scale is preferable.

It is also identified that there are 22 different companies for 36 licensed projects (EMRA 2004b). It seems that some of the licencees are local companies investing in their own region, but some are big companies having more than one approved projects covering different provinces. In general, the licencees present variety in a province, however there are regions dominated by only one company for example, Osmaniye.

In the above paragraphs, it is attempted to present the recent profile of country developments by wind energy sector. If it is to be focused on Izmir case again by considering the licensed projects, it can be given that the total installed capacity in the province will be 172.65 MW by mid-2006; involving 3 new projects with 163.71 MW, 1 auto-producer with 1.74 MW in Germiyan/Çeşme and ARES with 7.2 MW in Alaçatı/Çeşme. New development sites are Aliağa, Bergama and Kemalpaşa.

The wind farm in Kemalpaşa (Üçkuyular tepe-Bozburuntepe-Beşpınar-Çatalkaya-Çırpıcıdededağı) with installed capacity of 66.66 MW consists of 101 turbines of Vestas/660 kW. The decision given for this project is "EIA is not required" (Ak-El, 2004; Durak, 2004). With respect to the installed capacity of 55.8 MW[56] in Bergama (Madradağı-Yaylacık-Tekkeköy)[57] a wind farm of 93 turbines can be envisaged if the project is supposed to be consisted of the state-of-art turbines of 600 kW. The size of the third wind farm to be installed in Aliağa (Yuntdağı-Balaban-Koyuneli-Korutepe) is 41.25 MW. It is apparently seen that these projects are rather in large-scale.

[56] It is noticed in the application list that the initial capacity of Bergama project was 64.8 MW.
[57] A 30 MW project proposed for the same location is one of the rejected applications.



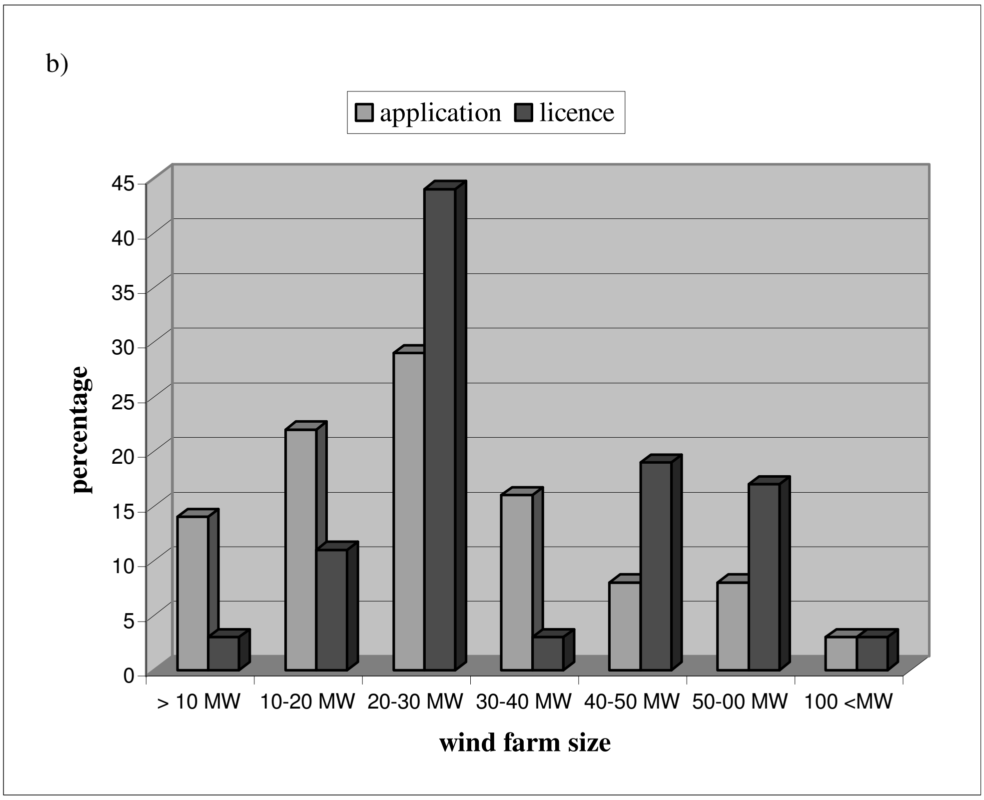


Figure 9.6. a) Distribution of wind farm sizes by number of projects
b) Wind farm sizes by percentage

9.2.2. ARES Alaçatı Wind Farm

Being the first commercial development in Turkey, 12 turbines of the wind farm in Alaçatı have been rotating and generating electricity since 1998. When the site was first visited[58] at the sixth month of power plant's operation, the planning studies were at the stage of application of the project to the Structure (1/5.000) and Implementation (1/1.000) Plans in compliance with the approved alteration in Master Plan at the scale of 1/25.000. In the legend of the plan, the wind farm was presented with a new notation (▣) and an expression of "wind energy". As it can be seen in the plan (Figure 9.7 and 9.8), the project site is overlapping with the designation of natural conservation area (D1). Though permitted by the Conservation Board, the question of developing on natural conservation area became a matter of concern during the establishment of Bozcaada wind farm. Consequently, by the Council of Conservation of Cultural and Natural Assets (*Kültür ve Tabiat Varlıklarını Koruma Yüksek Kurulu*), a principle decision (dated 20.07.2001, No. 688) was issued concerning that the Conservation Boards can assess wind energy projects on natural conservation areas through the policy of promoting wind energy due to its global environmental benefits.

ARES is located on a hilltop at the entrance of the Alaçatı settlement. Although adjacent to the built-up area, the locational aspects of the project site provide advantages of being in harmony and compatible with the surrounding environment, and also enhance the feasibility of the project. The highway and its Alaçatı junction are drawing a border between the project site and the settlement, and the designated area of agricultural land constitutes a buffer zone. On the east of the wind farm, Alaçatı Dam and a treatment plant are taking place. The existing transportation system at the region have provided convenience in terms of accessibility to the field, development costs and controlling of the additional traffic created by the project. The access to the site is from Izmir-Çeşme road. It was benefited from the Çeşme highway while conveying the pieces of turbine components from the harbor.

The turbines that are located on a hill, inevitably, have high visibility and contrasts, dominating the landscape due to geographical features of the region and the height of the turbines. However the turbines, delineated clearly from a distance, are

[58] The site survey was done in April, 1999 for seminar study. Later this study was revised to present in 4th International Thermal Energy Congress (Peker, 2001). These studies constitute basis for the assessment of Alaçatı wind farm.

Figure 9.7. ARES wind farm application on Master Plan of Alaçatı (1/25.000)

located in harmony with the topography, that they are following the contours without disturbing the shape and structure of the hill drastically. The number of turbines included and the spacing between them are providing compatibility with the carrying capacity of the landscape. Since the slope of the site is moderate and turbines are installed parallel to the slope the amount of earth moving for service and installation is not excessive.

The twelve turbines, welcoming the visitors and the inhabitants at the entrance to the wind paradise, are now the landmarks of the region; while modern turbines are rotating on one hill, the old windmills as the cultural symbol of the settlement, taking

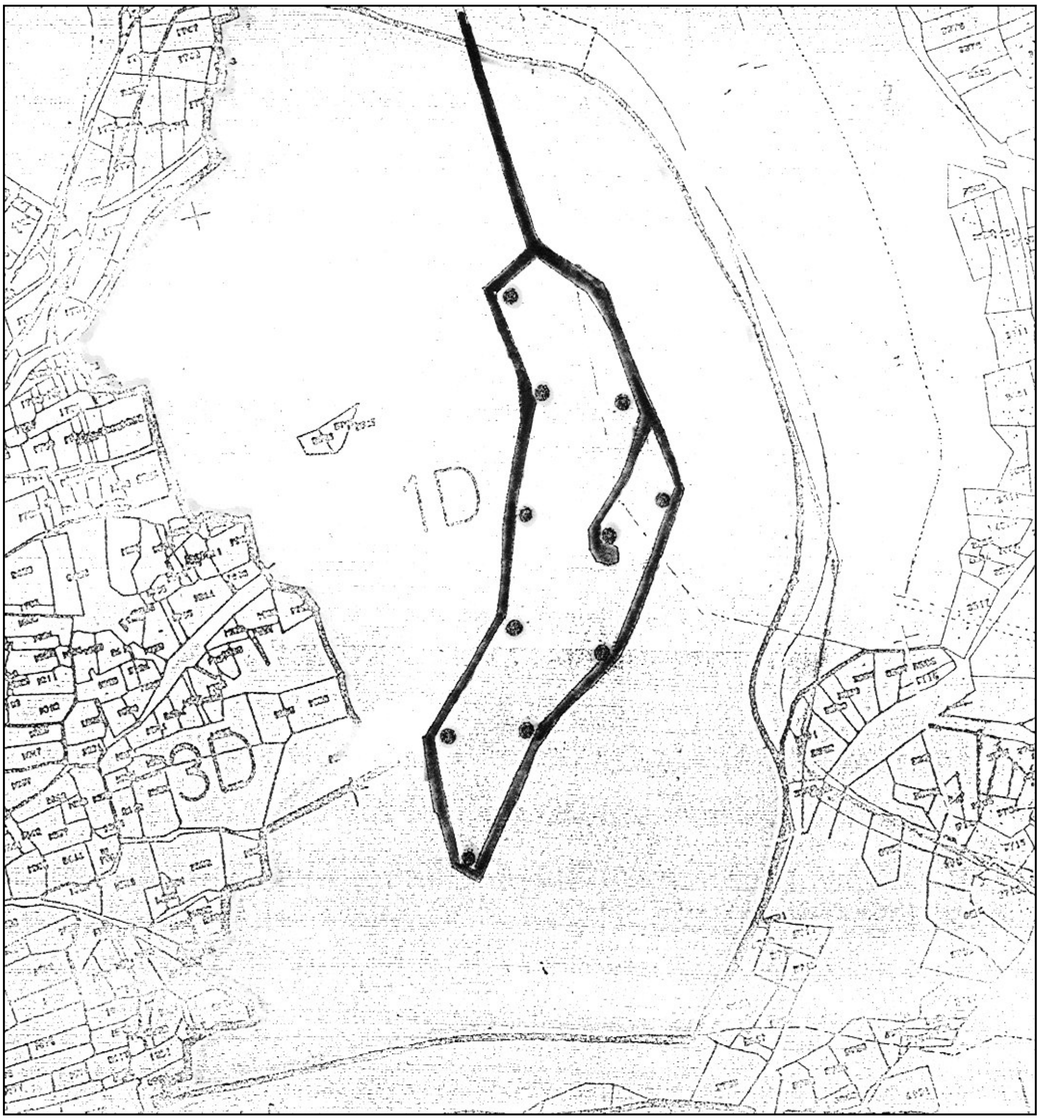


Figure 9.8. Wind turbine locations on cadastral map (1/10.000)

place on the opposite hill. This combination is recognized as an asset and used as an image and symbol in presenting and advertising the region. Therefore, the turbines are input for settlement's economy, which depends mainly on tourism, recreation and entertainment activities. Moreover, realized by the corporation the Municipality has a share in this wind energy investment.

On account of these benefits, the wind energy development is highly welcomed by the local people. Some examples of the expressions uttered by the people about their opinions related to wind farm, are: "these mills are very advantageous, good for Alaçatı because tourists like them very much", "they are so huge and strange, but I get sad when they do not spin", and "they print money, when they spin". The planner working in the municipality made an explanation as, "indeed, we had some worries before the construction, such as how the turbines would be carried to the site, how they would be constructed and whether any damage would be given to the surroundings. However, no problem was encountered. Pieces brought by trucks and surprisingly, constructed in a very short time". As a conclusion, it can be said that ARES is a good example of socially and environmentally acceptable wind energy development.

9.2.3. Planning Procedures in Practice

The process of planning permission for wind energy developments has been realized in accordance with Development Act No. 3194 and its related regulations. In general, the installations are considered as industrial plants. In the below paragraphs, Germiyan, Mazı and Datça projects are taken into account in order to explain the process in practice.

- The site for *auto-producer* turbine group is located at the south of Germiyan village, and outside of the borders of both the village settlement area and municipality, that no plan exists. The process of planning includes below stages:
  - Positioning the project area on base map of 1/25.000 scale,
  - Applying for preliminary permissions. According to the Development Regulation to be implemented in areas inside or outside of the municipality borders where no plan exist, the governorship grants preliminary permission for any kind of industrial establishments to be constructed on unplanned areas,
  - In this project, permission is requested also from Regional Directorate of Forestry, since the project site is overlapping with the area designated as forestry.
  - Next stage is the preparation of the Piecemeal Development Plan (*Mevzi İmar Planı*) at the scale of 1/1.000, and its approval by the governorship.
  - For permission, the developer should submit their feasibility report[59]

  A cadastral road provides the access to the area, and the report includes such stipulation as; 15 m. of setback from the main road, compliance with the Environmental Law and the relevant regulations during both installation and operation, and regarding tower height, no *h* limit value is given (h=serbest).

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[59] The content of the report is determined by the Regulation on principles of granting authorization for private developers.

- The second project taken from the Provincial Directorate of the Ministry, is the plan report of the *Mazı I, MARE* project which is one of the 16 projects planned to be build under BOT model. If it has not been cancelled, 70 turbines of Enercon E 40 with installed capacity of 39.2 MW, covering 17.53 ha. of land, would be operating in Alaçatı Region, at Mazıdağı-Manastır site, locating at the south of Izmir-Çeşme road and facing the 3 turbines at the north.
  - As it can be seen in the map (Figure 9.9) the micro-sitting of 70 turbines involves four linear groupings perpendicular to the slope direction on mountain top, and another line consists of groupings and elongated towards west on the ridge. As given in the report, the roads, with 10 m. width, providing service for each turbine totally constitute 75,87 % of the whole project area. Besides foundations for each turbine, a transformer with 2.50*3.50*3.00 m. and 250 m^2 of staging and crane pads are planned.
  - It is apparent that the project would have resulted in serious environmental impacts, such as removal of mountain top, erosion caused by too much earth moving for road construction, impact on fauna and flora. There would have been even visual intrusion due to number of turbines and their unclear layout.
  - In general, the plan report includes issues such as the description of the project, its technical properties and benefits of wind energy globally. The laws, regulations and stipulations brought by relevant institutions to be taken as compulsory are listed as plan notes. The measure for height of the turbines are set as free, and for buildings h=6.50 and 250 m^2 of building area.
  - For this project, EIA decision was not given.
  - In the visit to Izmir Provincial Directorate of the Ministry, the information given about the Mazı I project was, “The Local Development Plan of this project is approved and all the procedures are completed. They just have to apply for building permission to begin installation and operation. But nobody from the company have come to apply yet” (Çelik 2004).
- The third sample taken into consideration is another cancelled project that was planned for Datça/Muğla under the BOT Model. The project site of Datça wind farm, consists of 48 Enercon E-40/600 turbines with total installed capacity of 28.8 MW, is located within Special Environmental Protection Area (*Özel Çevre Koruma*

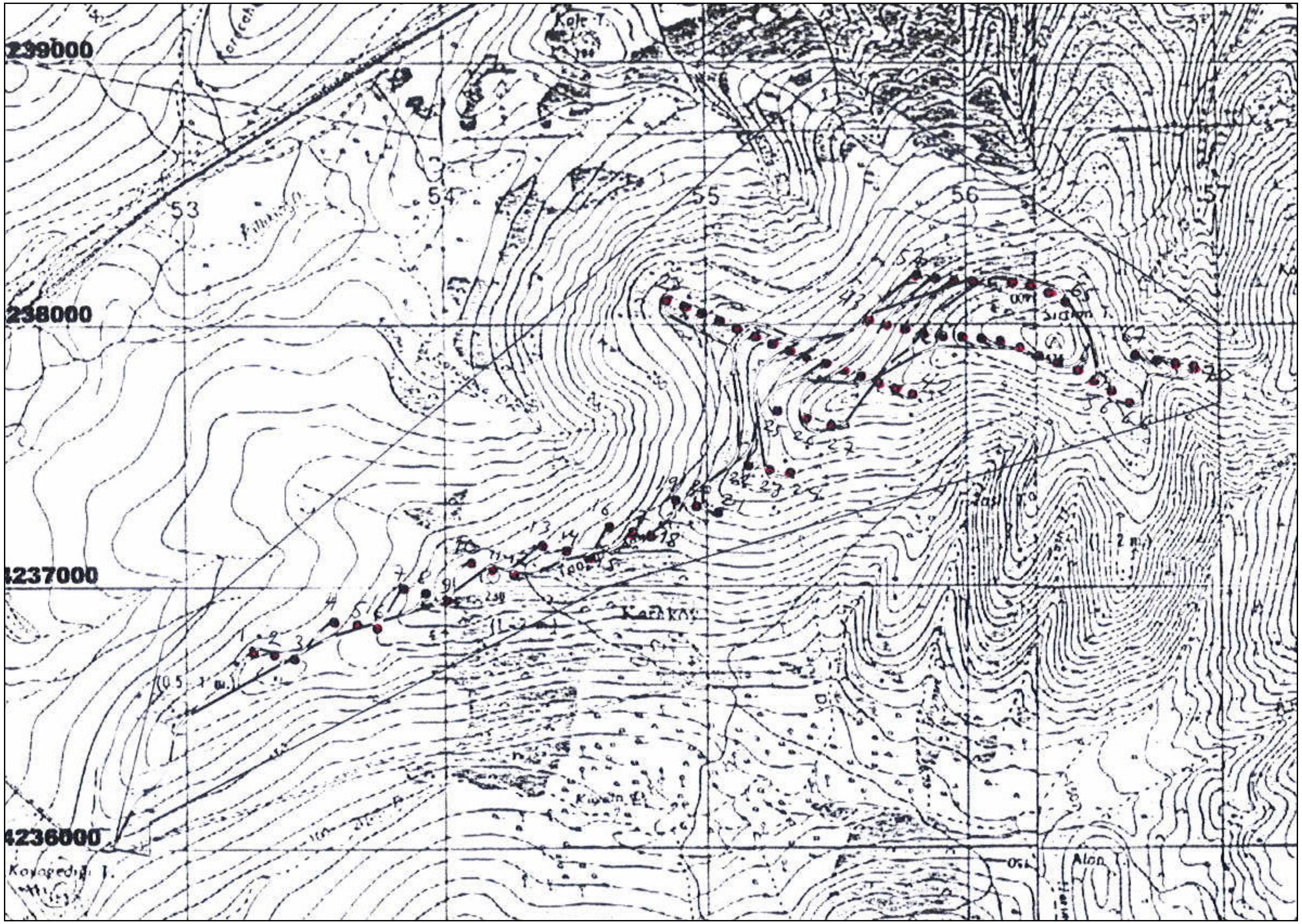

Figure 9.9. Mazı I wind farm application on base map (1/25.000)

Alanı) and on the natural conservation area. In this case, the approval process includes below actors and the stages:

- The plan alteration at the scale of 1/25.000 is approved by the Authority of Protection of Special Areas (*Özel Çevre Koruma Kurulu*) (approval date: 20.08.2003),
- At the early stage of the process, the Authority invites an agent from the company in order to be informed about wind energy installations and the proposed project. As articulated by the planner;

  > When the plans came into agenda, nothing was known about wind energy by nobody. We had no knowledge about how power plant operates, how generation would be realized, what kind of buildings would be constructed by how much closed area, what kind of activities would taken place in the area. Later, when the agent gave information we learnt that the project do not need much closed area and do not have significant impact.

- During approval process, the Authority asks opinions of related institutions about the project,
- According to the opinion of the Provincial Directorate of Environment "EIA is required"
- Approved by the Muğla Conservation Board (dated 19.09.2000 No. 2703), with the measures of restoration of the old windmills at the region and the design of buildings through vernacular architecture and local materials,
- Since the alteration at the scale of 1/25.000 is approved, the process is now at the stage of the fulfillment of EIA, applying for building permission and application of plan alteration to plans of 1/5.000 and 1/1.000, and their approval,
- However, similar to the case given before the planner at Muğla Provincial Directorate expressed that "the procedures are completed for this project, they are now required to apply for building permission, but they have not applied yet" (Özbey 2004).

9.2.4. Evaluating Wind Energy Developments and Planning Practices

As it is seen, wind energy industry is driven by the actors of private developers and the EMRA through licensing procedures indicated by Electricity Market Licensing Regulation. Obviously, the market shapes wind energy landscapes of Turkey, and technically, it is the electricity infrastructure or the capacity of grid that determines wind energy developments.

Since licenses granted have been announced lately during the completion of dissertation, the information gathered related to wind farm projects in Bergama, Aliağa and Kemalpaşa is limited. However, the consequences –failures and successes of these projects, which will also represent the initial developments realized under the Act on Electricity Market, will become apparent within two years. While examining the procedures and interviewing with the licensees[60] and applicants, it is perceived that there are uncertainties and ambiguity about the process, and also secrecy.

In the field of planning, it is natural that there is a lack of knowledge and experience related to wind energy[61]. In the case of facing a new type of land-use or development, the attempt is, practically, to address the question through existing knowledge and within existing frame of practice and legislation. It is seen that wind energy projects are considered as industrial establishments. There are not any criteria set for wind energy developments. Moreover, there is a lack of communication and coordination between governmental bodies that provincial planning authorities do not have the information that wind farm projects at the stage of applying for building permission are the ones cancelled in 2001. Furthermore, since wind energy is not an element of plans, not considered in planning policies and building regulations, and especially developing through Piecemeal Development Plan approach can cause the problem of cumulative effects of wind farms, deterioration of nature and landscape substantially. If it is to be emphasized that the tendency of medium-to-large scale wind farm developments especially on hills and sloped areas[62] due to high wind energy capacities can cause removal of hills, disturbance on contours and surface thus accelerating erosion, and also loss of habitats.

[60] In order to gather information about approved projects proposed for sites locating within the boundaries of the province of Izmir, it is attempted to interview with licencees, which are not local companies, by phone call. One of them is unreachable during trials of call. The other one though showed willingness for interviewing, no reply was received for the questions of "the type and number of turbines, the size of project area, whether EIA decision is given or not, and whether application for planning permission is done or not."

[61] As expressed by a planner (Öztulu, 2001), another problem related to developing a plan for wind energy projects is difficulties in application of coordinates. Since micro-siting is done by specific software, turbine and road coordinates do not fit with plan coordinates. The same problem was experienced during a study on wind farm project proposal for campus area of Izmir Institute of Technology (Peker and Özerdem, 2003).

[62] Except Bozcaada wind farm, the examined wind farm projects are all locating on hilly areas.

As a result, it can be said that the future of wind energy would be problematic if developments are not regulated and integrated into planning.

9.2.5. Explaining Wind Energy Integrated Planning

In order to promote wind energy utilization in a way providing their compatibility with other land uses and planning decisions, their harmony with nature and social areas;

- *Identification of suitable sites for wind energy developments:* In accordance with knowledge gained through examining practices and considerations in different countries, the approaches for identifying potential wind farm areas can be explained by,
    - Area-based approaches
    - Criteria-based approaches

Area-based approaches comprise designating areas having favorable wind source capacities for wind turbines or farm developments. This zoning approach involving set of criteria for sitting of wind turbines concentrates developments within few defined areas and leaves the rest of the land free from wind turbines. In that case, developers are directed to find sites within designated areas. The level of designating areas for wind energy is mostly regional scale, and the sites to be included in plans hierarchically.

In *criteria-based approaches,* instead of designating wind farm areas, site selection is left to developers however projects shall meet specific criteria on site selection and sitting of turbines.

- *Wind source data:* For both approaches of wind energy integrated planning, regional wind source data is required. That means regional wind energy maps (Figure 9.10) are prerequisite. Wind Energy Atlas developed usually at national scale includes global distribution of wind energy potentials through territory of country. The global estimations presented in map, tables and graphics are useful for wind energy economics, investments and technology developments. On the other side, regional maps provide

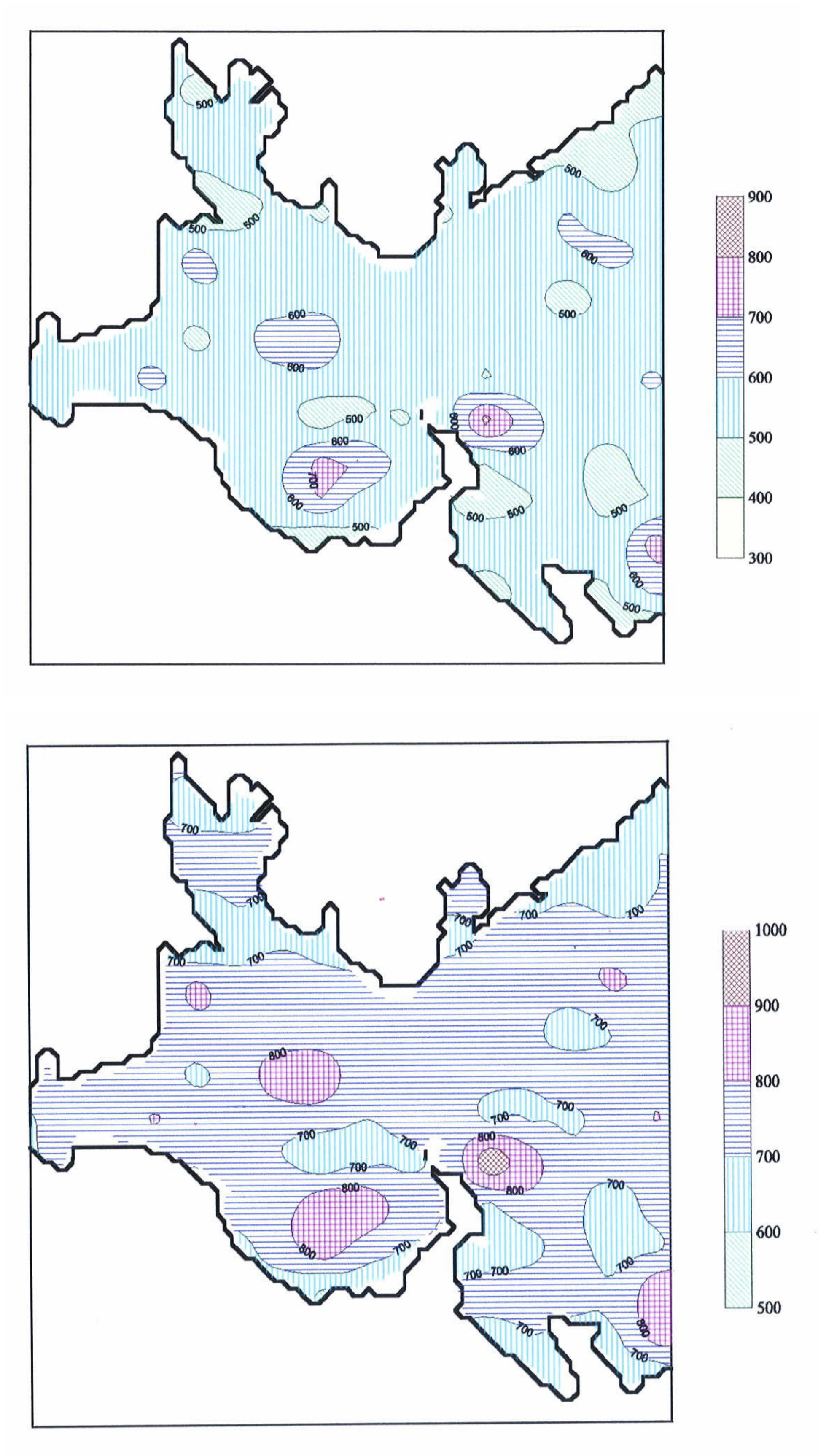

Figure 9.10. Energy densities at 50 m. and 100 m. above ground level in Çeşme Region (Dündar 1997)

precise information about geographical distribution of source potentials that can be used during threshold analysis and in sieve maps for zoning and/or formulating criteria for wind energy developments.

The approaches for using wind source data in wind energy integrated planning range between quick scanning of regional potentials and using of regional wind energy plans. It is identified that in the cases of semi-to-centralized structures, local governments and planning authorities are assisted by regional renewable energy assessment studies or wind strategy plans indicating technical capacities, targets and strategies.

Although there is research and surveys related to wind energy capacities, such kind of regional data is not available in Turkey yet. As advised by Dündar (2003), who is one of the participants in the development of Wind Energy Atlas of Turkey, since the data taken from meteorological stations that are locating in urban areas and surrounded by buildings do not present the exact profile of wind conditions of the territory, regional data can practically be developed through gathering site-specific measurements done by developers[63].

- *<u>Formulating criteria for site selection and sitting of wind turbines</u>*: Criteria for wind energy developments generally include such measures related to positioning of wind turbines and layout of wind farm, height of wind turbines, number of turbines or the size/capacity of wind farm, distance between two wind farms or turbine groups, etc. Theoretically, the required criteria can be grouped into two:
  - Measures for preventing direct impacts such as noise, shadow flickering, electromagnetic interference, traffic security (air, sea, railways and roads) and other safety measures related to possible technical hazards,
  - Measures related to visual impact, impact on landscape, compatibility with designated areas, impacts on flora and fauna.

In the first group, measures are and can be determined in accordance with technical measurements. For second group, the formulation of criteria is directly related to understanding of landscape and environment, to definition of landscape aesthetic and environmental values. In relation, the key concern is whether wind energy developments can take place in nature conservation areas, in cultural, historical and

[63] However, the problem is that developers are secretive about their measurements due to competitive market and bidding procedures.

archeological heritage areas, and in areas of outstanding visual landscape; if yes, what is acceptable?

Accordingly, the common approach is classification of rural areas or different types of landscape throughout the country or region, and definition of values for designated areas. Therefore, measures are set for each type of landscape and for each type of designations through defined values.

Depending on planning system and administrative structure, criteria for wind energy developments are set and implemented by regulations, or by spatial planning policies at the national scale assisted by additional measures formulated at regional and zoning planning, or by local governments and planning authorities. In order to clarify the given explanations and to present as a sample, the approaches, strategies and measures implemented in four examined countries are outlined in table 9.5.

Setting targets: It is necessary to consider quantitative targets as a means of formulating, managing and assessing the strategies and actions for achieving the goals. Accordingly, setting of wind energy targets through planning process can provide a clear frame for actions in promoting wind energy. However, instead of a top-down style of distributing national targets to be met, quantities be set by assessing technical and practical potentials at regional scale can result in achievable targets, thus acceptable developments.

Table 9.5: Examples of criteria for wind energy developments by country

	Danish Case	Dutch Case	Swedish Case	British Case
Energy sector	Decentralized	Semi-centralized	Decentralized	Centralized
Who leads site selection	Counties	Provincial authorities + developers	Municipalities	Developers
Planning approach	Zoning / area-based Areas for wind energy developments are designated by regional plans and included in municipal plans	Area-based / zoning Regional plans indicate suitable locations in line with provincial wind strategy plans	Area-based Suitable sites for wind energy are identified by local authorities with or without municipal comprehensive plan	Criteria-based
Regulatory frame	National plan directives + regulation on wind energy developments in rural areas	Guidelines included in key planning decisions of national plan + regional plans + zoning plans	(environmental code) + guidance provided by Boverket through a handbook for planning of wind energy	Regional planning guidance + planning policy guidance + criteria set by local planning authorities
Environmental Impact Assessment (EIA)	EIA is required, if: Project > 3 turbines, or total height of turbines above 80 m. (applies to turbines above 1 MW) EIA is required for designation if the site preferred by developer is outside of the area indicated in regional plan	If project capacity > 15 MW, or project > 10 turbines, the authorized government decides if EIA is required. Assessed by the municipality, environmental permit is required, if: project capacity > 15 MW, if distance to nearest house < 4 times the hub height	EIA is required, if: Project capacity > 1 MW Application to environmental court, if project ≥ 3 turbines, or ≥10 MW Application to relevant county board, if project or turbine capacity > 1 MW Application to municipal environmental committee, if project ≤ 1 MW	EIA is required, if: project is located in a sensitive area An EIA *may* be required, if project > 2 turbines, or hub height or height of any other structures > 15 m. EIA is *more likely* to be required if project > 5 turbines, or > 5 MW

(Cont. on next page)

Table 9.5 (cont.)

Criteria for site selection and sitting of wind turbines			
Criteria	**Danish Case**	**Dutch Case**	**Swedish Case**[64]
Noise limit	Noise level at a height of 1.5 m. at a wind speed of 8 m/s at 10 m. above ground level, shall not exceed: 45 dB(A) at outdoor open spaces in the immediate vicinity of neighboring properties in rural areas, 40 dB(A) at outdoor open spaces in residential areas and other noise sensitive land-uses such as summer houses, allotment gardens or recreation areas	40 dB(A) on the nearest house. Wind Norm Curve is used as a corrective limit noise value of max. acceptable wind turbine noise	
Shadow time and frequency	Shadows from turbines shall not reach neighbor dwelling more than 10 hours/year with average cloud cover	For flickering shadows, max. 20 min. per day, 17 days per year at clear sky	10 hours/year
Distance from housing	4 times total height of turbine For turbines closer than 500 m. to dwelling, special analysis of impact is required.		
Distance from roads, railways and waterways	Up to 4 times total height of turbine for major roads	At least 30 m. away from the edge of highways/railways. The norm is half the diameter if rotor diameter exceeds 60 m. At least 50 m. away from waterways edge	

(Cont. on next page)

[64] In general, Danish norms are adopted

Table 9.5 (cont.)

Criteria	Danish Case	Dutch Case	Swedish Case
Distance from sensitive areas	Turbines should not be closer than; 300 m. to forests 150 m. to rivers and lakes above 4 ha. 100 m. to pre-historic sites 100 m. to coast, except in industrial areas, harbours 500-800 m. to RAMSAR areas		
Safety measures	Turbines with total height above 100 m. should be marked Certification and type approval of wind turbines	Distance for high-voltage lines is half the rotor diameter Roads and bridges be able to carry axis load of a min. 16 ton and have a min. width of 4 m. Wind turbines have to conform technical criteria of regulation for type approval	
Flora and fauna	EIA includes a fauna study and analysis of impacts	Wind turbines are not allowed: in areas under the EU Bird Directive, EU Habitat Directive, in ecological protection areas, in meadow bird and goose protecting areas	Wind turbines are not allowed: in bird protection areas, along main bird migration routes, in marine nature reserves, in principal nesting and feeding areas and in other areas of large bird concentrations Erection and maintenance should be avoided during nesting and migration seasons

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Table 9.5 (cont.)

Criteria	**Danish Case**	**Dutch Case**	**Swedish Case**
Positioning of turbines and wind farm layout	Since land is flat and open; Turbines be placed in groups and ordered in recognizable patterns New turbine groups must be clearly separated from existing groups If a wind power development is closer than 2.5 km from another designated wind turbine area both sited must be included in landscape planning	Since land is scarce; Turbines be placed in rows alond crossing of the landscapes; along highways, railways, waterways and dikes, or industrial estates On the periphery of open spaces In young, large-scale landscapes Not be sited in green contour areas	Local authorities decide developing whether by single turbine, turbine groups or wind farms
• Further measures in Dutch case are indicated in regional and zoning plans • For criteria implemented in Belgium, France and Germany, see PREDAC reports • For American measures, see Energy Aware Planning Guide II: Energy Facilities, CEC • For further planning procedures in other European countries, see ENER-IURE reports			

CHAPTER 10

CONCLUSION

For integrating energy considerations into planning practice, there should be a change in the way, we, the planners perceive *energy*, and we should become aware that our traditional task of allocating functions, arranging urban pattern and spatial structure have substantial influence on energy demand, on viability of energy efficiency technologies and on energy budgets of consumers. Therefore, it is necessary to consider energy as a resource like we consider financial resources throughout the whole planning process. The attempt of providing rational use of energy means attaining reduction in environmental costs of energy consumption. That means the planners can improve local air quality through energy efficient urban design and planning approaches.

For integrating renewable energy considerations into planning practice, we, the planners should have substantial knowledge about nature of renewable energy sources and characteristics of technologies, and should learn as much as possible from the impacts of renewable energy developments which have already taken place. Moreover, the planners should become familiar with the implications of national energy policies and the trends in adopting renewable energy. Having the required knowledge, understanding the planning implications of new technologies and gaining experience, we can promote the use of renewable energy sources through indicating suitable sites for harmonious developments and through spatial structure arrangements that enhance feasibility of energy supply systems based on renewable energy sources. If it is to be underlined this does not mean that planners should or can decide on the most appropriate renewable energy technologies. However, we should develop skills and strategies to link and to involve diverse interests and objectives of the public, the investors and developers, utilities, environmentalists, and the decision-makers.

On the other hand, we should understand renewable energy integrated planning as incorporation of renewable energy policies into planning policies. In that case, there must be a defined national and/or local renewable energy policy. Moreover, if the utilization of renewable energy sources is a crucial strategy to combat with the reality of climate change and to reduce the rate of global warming, and to improve quality of life and local environmental quality, and to reduce the level of dependency on limited non-renewable sources, there must be a strong political commitment to move towards sustainability, a radical change towards a new pattern of energy production based on smaller scale generation systems operated on a more decentralized base in a liberalized market, and an adoption of a radical approach for the technological and institutional innovations.

What characterizes the current political attitude towards renewable energy in Turkey is a fairly leisurely incremental approach. Much of the effort given by the EIE comprises innovations in the field of energy efficiency improvements. Reasonably, new renewable energy technologies are introduced into existing pattern of energy supply through already existing support systems.

On the other hand, this study argues that the current institutional and organizational framework for wind energy developments together with the enactment of Draft Law on Renewable Energy which is a response to EC/77/2001 that calls for deregulation may significant environmental and social impacts, conflicts in sitting of wind farms and therefore conflicts between national needs and local interests. Among for national contexts examined in this study, the British context is critical for explaining given argument. In the U.K. case, the electricity generation has a centralized structure, the energy market is fully competitive and the former support mechanism (Non-Fossil Fuel Obligation) is based on bidding approach. The result is strong public opposition and failure in achieving targets and from the viewpoint of energy sector, planning system is the main barrier.

However, in Danish case where energy sector is vertically integrated the role of planning in integrating renewable energy sources and especially the wind energy is indispensable. Accordingly, Danish case can be taken into account as a successful example for distribution of responsibilities with three-tier administrative system, and how they deal with the conflicts and tensions between European directive of liberalization and democratization in energy sector. The Swedish case is valuable in terms of its high level of legislative integration, and is an example of how sustainability objectives can be incorporated into environmental management and into overall development strategies through national integrated strategic policy framework. The success of Dutch case involves integration of environmental objectives, sustainable energy supply and energy efficiency measures with urban planning and design. Especially the Danish case is a good example of the combination of market-based approaches and regulatory approach. That means ambitious targets and environmentally sound, socially acceptable developments can be achieved by attaining balance of liberalization and regulation.

In that case, in accordance with the contextual studies carried out for the purpose of defining renewable energy integrated planning process it can be suggested for Turkey that:

- There is a need for a strategic national policy framework for the utilization of renewable energy sources
- There is a need for incorporation of environmental objectives into national energy policy
- National policies are to be comprehensive and inclusive
- This inclusiveness necessitates an integrated policy approach. In other words, an integrative strategic policy framework comprising incorporated energy/renewable energy-environment-spatial development policies at the national level is a requisite not only for renewable energy integrated planning but also for successful renewable energy developments and substantial achievements in terms of environmental gains
- The formulation of this policy framework and the actions related to integrated strategies necessitate a collaborative work and coordination and cooperation both vertically and horizontally, in which all policies, policy instruments and actions are to be coordinated and be conducted at the same direction through mutual trust and shared views covered by common frames of reference.
- Governmental intervention is needed for technological innovations since markets do not support expensive technologies, and regulation is required as competitive market undermines environmental and social objectives, and local interests.

In addition to above suggestion related to national policies, as it is addressed in the study of geothermal case in Chapter 9.1 and discussed in Chapter 9.1.4 considering alternative source potentials of Izmir and the existence of natural gas distribution project, this study proposes urban energy managemenet and local energy planning for integrating renewable energy technologies into cities (see Chapter 4). In this respect, it can be suggested that:

- For the purpose of achieving urban sustainability objectives, there is a need for decentralization of energy and environmental policy in Turkey.
- This necessitates the involvement of one identifiable decision-making agency at the local level for institutional effectiveness.

<u>Recommendations for integrating renewables into plans</u>:

- At the very beginning, it can be suggested that widespread use of renewable energy sources be included among planning principles and fundamentals. In that case, paragraph 4 in article 8 of Draft Law of Development can be stated as: “Plans develop methods and take measures for preventing environmental problems, providing energy efficiency, providing effective and efficient use of resources and providing widespread use of renewable energy sources".

- Accordingly, plan definitions indicated in the Draft Law can include the expression of "aiming at increasing energy efficiency and the use of renewable energy sources", and "meeting energy demand from renewable energy sources" can be included in definition of Rural Settlement Plans.
- Development of "local energy plans", indicating local energy and environmental strategies and technical and financial feasibility of potential sources and utilization technologies, should be compulsory especially for I. and II. group provinces where air pollution is densest.
- This energy plan should constitute basis for formulation of energy related planning strategies in preparing Settlement Key Strategy Plan.
- Development of energy demand map/zoning of energy demand: During the preparation of Structure Plans, zoning should be done for both existing and new development areas in accordance with energy densities or in other words, energy demand.
- Formulation of set of energy supply measures for each identified zone in reference to available renewable energy sources and energy efficiency technologies indicated in local energy plans and Settlement Key Strategy Plan. Such zoning provides options for integrating energy conservation measures with renewable energy utilization. For example, in the zone of passive solar and solar thermal block or district heating involving new development areas with lower densities, the efficiency of solar energy utilization can be fortified with more strict standards for thermal insulation of new buildings.
- Development plans should indicate suitable sites for DH/CHP power plants (see p. 164 for Danish environmental measures for biomass fired power plants).
- In terms of benefiting from solar energy in maximum throughout the whole country, EIE and MPWS can initiate and coordinate pilot solar energy projects in different cities representing common features of four heating regions identified in the Regulation of Heat Insulation at buildings. These pilot projects to be conducted at urban scale comprising passive solar and solar thermal district and block heating can serve for setting of standards related to orientation, installation of solar collectors, roof area and design, and for solar energy related building regulations. Such large-scale demonstration projects should also include financing and development schemes. For

cities such as Antalya, Adana, Izmir, etc, which have lower degree-days (1. heating region) consideration of cooling measures are also necessary.

- At least, all new buildings should be oriented with their main longitudinal axis along the direction of east-west for south orientation with options of south-southwest and south-southeast. The distance between adjacent buildings should be such to guarantee that the degree of shadowing by surrounding buildings must not exceed a given value in the worst winter conditions, calculated for 21st December.
- Much of the gains from solar energy utilization can inevitably be achieved in new development areas. However, energy efficiency measures and maximum utilization of renewable energy sources should be compulsory for renewal and regeneration projects.
- In accordance with the Regulation (dated 16.8.1985) that allows auto-producer/auto-producer groups to generate electricity in order to meet their electricity demand totally or partially, the developers of mass housing projects involving more than 1.000 units, campus areas, hospitals, organized industrial areas can be encouraged to meet their own energy demand from renewables through excluding the area needed for installations from permitted total building construction area or through bonus construction area. If such kind of electricity generation is to be promoted by local energy policy, then the area needed should be specified in total building construction area. In each case, each type of installation should be regulated through specific measures. For example, min. distance from building in parcel and from buildings in neighbor parcels, max. height and number of turbines for wind energy installations in urban areas.

REFERENCES

Books:

Breheny, M. (1992) "The Contradictions of the Compact City: A Review", *Sustainable Development and Urban Form*, ed. by M. J. Breheny (Pion Limited, London).

Brittan, G. G. (2002) „The Wind in One's Sails: A Philosophy"in *Wind Power in View: Energy Landscapes in a Crowded World*, ed. by Martin J. Pasqualetti et al., (Academic Press, California, San Diego).

Capello, R., Nijkamp, P. and Pepping, G. (1999) *Sustainable Cities and Energy Policies*, (Springer-Verlag, Berlin, Heidelberg).

Creswell, J. W. (1998) *Qualitative Inquiry and Research Design: Choosing Among Five Traditions*, (Sage Publications, USA).

Cullingworth, B. and Nadin, V. (2002) *Town & Country Planning in the UK*, 13th Edition, (Routledge, London).

Eden, R. and Bending, R. (1989) "Economic Change and Energy Markets, Spatial Energy Analysis", in *Spatial Energy Analysis*, ed. by Lars Lundqvist et al. (Avebury, Aldershot).

Energie-Cités (1994) *Urban Energy Planning Guide,* (Energie-Cités, Besançon) .

Erbaş, E. (2000) "Enerji Kaynak Çeşitliliğine Dayalı Konut Alanları Planlaması İçin Temel İlkeler ve Ölçütlerin Belirlenmesi Üzerine Bir Çalışma", Yayınlanmamış Doktora Tezi, MSÜ, İstanbul

Gipe, P. (2002) "Design as if People Matter: Aesthetic Guidelines for a Wind Power Future" in *Wind Power in View: Energy Landscapes in a Crowded World*, ed. by Martin J. Pasqualetti et al., (Academic Press, California, San Diego).

Göksu, Ç. (1993) *Güneş ve Kent*, (ODTÜ Mimarlık Fakültesi Yayını, Ankara).

Göksu, Ç. (2000) *Anadolu Güneş Uygarlığı*, (İmaj Yayınevi, Ankara).

Gürses, A. Ç. (2003) "Jeotermal Bölgesel Isıtma Sistemleri Tasarım Kriterleri", in *Jeotermal Enerji Doğrudan Isıtma Sistemleri: Temelleri ve Tasarımı Seminer Kitabı*, ed.by Macit Toksoy, MMO/2003/328-4, İzmir.

Hammarlund, K. (2002) "Society and Wind Power in Sweden" in *Wind Power in View:Energy Landscapes in a Crowded World*, ed. by Martin J. Pasqualetti et al., (Academic Press, California, San Diego).

Kleinpeter, M. (1995) *Energy Planning and Policy*, (John Wiley & Sons, Chichester).

Lundqvist, L. (1989) "A Model System for Strategic Metropolitan Energy Studies", in *Spatial Energy Analysis*, ed. by Lars Lundqvist et al., (Avebury, Aldershot).

Newman, P. and Thornley, A. (1996) *Urban Planning in Europe. International Competition, National Systems and Planning Projects*, (Routledge, London).

Nielsen, F. B. (2002) "A Formula for Success in Denmark" in *Wind Power in View:Energy Landscapes in a Crowded World*, ed. by Martin J. Pasqualetti et al., (Academic Press, California, San Diego).

Nijkamp, P. and Perrels, A. (1994) *Sustainable Cities in Europe*, (Earthscan, London).

OECD (1995) *Urban Energy Handbook: Good Local Practice*, (OECD, Paris).

Owens, S. (1986) *Energy, Planning and Urban Form,* (Pion Limited, London).

Owens, S. (1987) "The Urban Future: Does Energy Really Matter", in *Energy and Urban Built Form*, ed. by Dean Hawkes et al., (Butterworths, London).

Owens, S. (1989) "Models and Urban Energy Policy: A Review and Critique", in *Spatial Energy Analysis*, ed. by Lars Lundqvist et al., (Avebury, Aldershot).

Owens, S. (1990) "Land Use Planning for Energy Efficiency", in *Energy Land and Public Policy,* ed. by J. Barry Cullingworth, (Transaction Publishers, New Jersey).

Owens, S. (1992) "Energy, Environmental Sustainability and Land-use Sustainability", in *Sustainable Development and Urban Form*, ed. by M. J. Breheny, (Pion, London).

Pasqualetti, M. J. (1990) "The Land Use Focus of Energy Impacts", in *Energy Land and Public Policy*, ed. by J. Barry Cullingworth, (Transaction Publishers, New Jersey).

Pasqualetti, M. J. (2002) "Living with Wind Power in a Hostile Landscape" in *Wind Power in View: Energy Landscapes in a Crowded World*, ed. by Martin J.

Pasqualetti et al., (Academic Press, California, San Diego).

Rickaby, P. A. (1987) "An Approach to the Assessment of the Energy Efficiency of Urban Built Form", in *Energy and Urban Built Form*, ed. by Dean Hawkes et al., (Butterworths, London).

Rickaby, P. A. and de la Barra, T. (1989) "A Theoretical Comparison of Strategic Spatial Options for City-Regional Development, Using the TRANUS Model" in *Spatial Energy Analysis*, ed. by Lars Lundqvist et al., (Avebury, Aldershot).

Righter, R. W. (2002) "Exoskeletal Outer-Space Creations" in *Wind Power in View:Energy Landscapes in a Crowded World*, ed. by Martin J. Pasqualetti et al., (Academic Press, California, San Diego).

Schipper, L. (1989) "Approaching Long-term Uncertainties in Energy Demand", in *Spatial Energy Analysis*, ed. by Lars Lundqvist et al., (Avebury, Aldershot).

Schwahn, C. (2002) "Landscape and Policy in the North Sea Marshes" in *Wind Power in View: Energy Landscapes in a Crowded World*, ed. by Martin J. Pasqualetti et al., (Academic Press, California, San Diego).

Senol, P. (2005) "A Critical Evolution on the Concept of Justice in Planning Process – Judicial Oversight: The Balçova and Narlıdere Cases" Unpublished dissertation, Izmir Institute of Technology, Izmir.

Sfligiotti, G. M. (1997) "Past Issues and New Problems: A Plea for Action", in *Environment Energy and Economy: Strategies for Sustainability,* ed. by Yoichi Kaya and Keiichi Yokobori, (United Nations University Press, Tokyo).

Short, L. (2002) "Wind Power and English Landscape Identity" in *Wind Power in View:Energy Landscapes in a Crowded World*, ed. by Martin J. Pasqualetti et al., (Academic Press, California, San Diego).

Walker, F. J. and Nicholas, J. (1997) *Wind Energy Technology,* (J. Wiley & Sons, England)

Periodical Articles:

Abbate, C. (2001) "Power of Design: The Future of Building Integrated PV", *Renewable Energy World*, Vol. 4, No. 2, March-April, pp. 59-65.

Agioutantis, Z. And Bekas, A. (2000) "The Potential of District Heating Using Geothermal Energy. A Case Study, Greece" *Geothermics*, 29, pp. 51-64.

Barbier, E. (2002) "Geothermal Energy Technology and Current Status: An Overview" *Renewable and Sustainable Energy Reviews*, 6, pp. 3-65

Beddoe, M. and Chamberlin, A. (2003) "Avoiding Confrontation: Securing Planning Permission for On-Shore Wind Energy Developments in England" *Planning Practise & Research*, Vol. 18, No. 1, pp. 3-17.

Bishop, K., Tewdwr-Jones, M. and Wilkinson, D. (2000) "From Spatial to Local: The Impact of the European Union on Local Authority Planning in the UK", *Journal of Environmental Planning and Mangement*, Vol. 43, No. 3, pp. 309-334.

Bosselaar, L. (2001) "Solar Heating - a Major Source of Renewable Energy" *Renewable Energy World*, Vol. 4, No. 4, pp. 219-229.

Breheny, M. (1995) "The Compact City and Transport Energy Consumption", *Transactions of the Institute of British Geographers*, Vol. 20, No.1, pp. 81-101.

BTM Consult (2001) "A Towering Performance: Latest BTM Report on the Wind Industry *Renewable Energy World*, Vol. 4, No. 4, pp. 68-87.

Butera, F. M. (1998) “Moving Towards Municipal Energy Planning – The case of Palermo: The Importance of Non-Technical Issues”, *Renewable Energy*, Vol. 15, pp. 349-355.

Byrne, J., Glover, L., Alleng, G., Inniss, V., Mun, Yu-Mi and Young-Doo Wang, (2001) “The Postmodern Greenhouse: Creating Virtual Carbon Reductions From Business-as-Usual Energy Politics”, *Bulletin of Science, Technology & Society*, Vol. 21, No. 6, pp. 443-455.

Christensen, P. and Lund, H. (1998) “Conflicting Views of Sustainability: The Case of Wind Power and Nature Conservation in Denmark”, *European Environment*, Vol. 8, pp. 1-6.

Crookall-Fallon, C. and Crozier-Cole, T. (2000) “Green Certificates: New Currency for Trading the Environmental Benefits of Renewable Energy” *Renewable Energy World*, Vol. 3, No. 4, pp. 42-51.

Dinçer, I. (2000) “Renewable Energy and Sustainable Development: A Crucial Review” *Renewable and Sustainable Energy Reviews*, Vol. 4, pp.157-175.

Droege, P. (2002) “Renewable Energy and the City: Urban Life in an Age of Fossil Fuel Depletion and Climate Change”, *Bulletin of Science, Technology & Society*, Vol. 22, No. 2, pp. 87-99.

Elliott, D. (2000) “Renewable Energy and Sustainable Futures” *Futures,* 32, pp. 261-274.

Eser, T.W. and Konstadakopulos, D. (2000) “Power Shifts in the European Union? The Case of Spatial Planning”, *European Planning Studies*, Vol. 8, No. 6, pp. 783-798.

Faludi, A. (2000) “The European Spatial Development Perspective – What Next?”, *European Planning Studies*, Vol. 8, No. 2, pp. 237-250.

Faludi, A. (2002), “Positioning European Spatial Planning” *European Planning Studies*, Vol. 10, No. 7, pp. 899-911.

Fudge, C. and Rowe, J. (2001) “Ecological Modernization As a Framework For Sustainable Development: A Case Study in Sweden”, *Environment and Planning A*, Vol. 33, pp. 1527-1546.

Gordon, P. and Richardson, H. W. (1989) “Gasoline Consumption and Cities: A Reply” *Journal of the American Planning Association*, Vol. 55, Winter, pp. 342-345.

Gordon, P. and Richardson, H. W. (1997) “Are Compact Cities a Desirable Planning Goal?”, *Journal of the American Planning Association*, Vol. 63, No. 1, pp. 95-106.

Hajer, M. and Zonneveld, W. (2000) “Spatial Planning in the Network Society- Rethinking the Principles of Planning in the Netherlands”, *European Planning Studies*, Vol. 8, No. 3, pp.338-355.

Healey, P. and Shaw, T. (1994) "Changing Meanings of 'Environment' in the British Planning System", *Transactions of the Institute of British Geographers*, Vol. 19, pp. 425-438.

Healey, P. (1998) "Building Institutional Capacity Through Collaborative Approaches to Urban Planning", *Environment and Planning A*, Vol. 30, pp.1531-1546.

Healey, P., Khakee, A., Motte, A. and Needham, B. (1999) "European Developments in Strategic Spatial Planning", *European Planning Studies*, Vol. 7, No. 3, pp. 339-355.

Hedger, M. M. (1995) "Wind Power: Challenges to Planning Policy in the UK", *Land Use Policy,* Vol. 12, No. 1, pp. 17-28.

Hepbaşlı, A. and Çanakçı, C. (2003) "Geothermal District Heating Applications in Turkey: A Case Study of Izmir –Balçova", *Energy Conversion and Management,* 44, pp. 1285-1301.

Hull, A. (1995) "Local Strategies For Renewable Energy: Policy Approaches in England and Wales", *Land Use Policy,* Vol. 12, No. 1, pp. 7-16.

Hull, A. (1995b), "New Models for Implementation Theory: Striking a Consensus on Windfarms", *Journal of Environmental Planning and Management*, Vol. 38, No.3.

Hull, A. (1997) "Windfarms in the U.K: The Arguments For and Against", *Ekistics*, Jan/Feb-May/June, 64, 382-384, pp. 112-116.

Khan, J. (2003) "Wind Power Planning in Three Swedish Municipalities", *Journal of Environmental Planning and Management*, Vol. 46, No. 4, pp. 563-581.

Krause, C. L. (2001) "Our Visual Landscape: Managing the Landscape Under Special Consideration of Visual Aspects", *Landscape and Urban Planning*, Vol. 54, pp. 239-254.

Louw, E., van der Krabben, E. and Priemus, H. (2003) "Spatial Development Policy: Changing Roles For Local and Regional Authorities in the Netherlands" *Land Use Policy*, Vol. 20, pp. 357-366.

Lund, H. (2000) "Choice Awareness: The Development of Technological and Institutional Choice in the Public Debate of Danish Energy Planning", *Journal of Environmental Policy and Planning*, Vol. 2, pp. 249-259.

Lund, J. W. and Derek H. F. (2001) "Worldwide Direct Uses of Geothermal Energy 2000", *Geothermics* 30, pp. 29-68.

Mahler, B. (2002), "Sharing the Sun: Solar District Heating in Europe", *Renewable Energy World*, Vol. 5, No. 6.

Marvin, S., Graham, S. and Guy, S. (1999) "Cities, Regions, and Privatized Utilities", *Progress in Planning*, Vol. 51, Issue 2, pp. 91-165.

Mega, V. (2002) "Cities and Energy: The Sustainability (R)evolution", *Ekistics,* Jan-Jun, 69, 412-414, pp. 31-40.

Mertoğlu, O. (2001) "Geothermal district heating experience in Turkey", *GHC Bulletin*, June, pp. 14-18.

Mertoğlu, O., Bakır, N. and Kaya, T. (2003) "Geothermal Applications in Turkey", *Geothermics,* 32, pp. 419-428.

Mitchell, C. and Connor, P. (2004) "Renewable Energy Policy in the U.K 1990-2003", *Energy Policy,* Vol. 32, pp. 1935-1947.

Nadin, V. and Shaw, D. (1998) "Transnational Planning in Europe: The Role of Interreg IIC in the UK" *Regional Studies,* Vol. 32, No. 3, pp. 281-299.

Newman, P. W. G., and Kenworthy, J. R. (1989) "Gasoline Consumption and Cities: A Comparison of U.S Cities with a Global Survey", *Journal of the American Planning Association*, Vol. 55, pp. 24-37.

Owens, S. (1981) "Energy: Why Planners Must Be Involved", *International Journal of Environmental Studies*, Vol. 16, pp. 197-206.

Owens, S. (1985) "Energy Demand: Links to Land-Use and Forward Planning" *Built Environment*, Vol. 11, No. 1.

Owens, S. (1994) "Lands, Limits and Sustainability: A Conceptual Framework and Some Dilemmas for the Planning System", *Transactions of the Institute of British Geographers*, Vol. 19, pp. 439-456.

Paul, N. (2004) "Pastures New-Germany's PV Market Moves into New Territory", *Renewable Energy World*, Vol. 7, No. 3, May-June.

Pimentel, D., Rodrigues, G., Wane, T., Abrams, R., Goldberg, K., Staecker, H., Ma, E., Brueckner, L., Trovato, L., Chow, C., Govindarajulu, U. and Boerke, S. (1994) "Renewable Energy: Economic and Environmental Issues" *Bioscience*, Vol. 44, No. 8.

Quaschning, V. (2004) "Technology Fundamentals: Photovoltaic Systems" *Renewable Energy World*, Vol. 7, No.1, January-February.

Reiche, D. and Bechberger, M. (2004) "Policy Differences in the Promotion of Renewable Energies in the EU Member States", *Energy Policy*, Vol. 32, pp. 843-849.

Roseland, M. (2000) "Sustainable Community Development: Integrating Environmental, Economic, and Social Objectives", *Progress in Planning*, 54, pp. 73-132.

Sommer, C. R., Kuby, M. J. and Bloomquist, G. (2003) "The Spatial Economics of Geothermal District Energy in a Small, Low-density Town: A Case Study of Mammoth Lakes, California", *Geothermics,* 32, pp. 3-19.

Stevenson, R. and Richardson, T. (2003) "Policy Integration for Sustainable Development: Exploring Barriers to Renewable Energy Development in Post-Devolution Wales", *Journal of Environmental Policy & Planning*, Vol. 5, No. 1, pp. 95-118.

Tewdwr-Jones, M., Bishop, K. and Wilkinson, D. (2000) "Euroscepticism, Political Agendas and Spatial Planning: British National and Regional Planning Policy in Uncertain Times", *European Planning Studies*, Vol. 8, No. 5, pp. 652-668.

Throgmorton, J. A. (1987) "Community Energy Planning: Winds of Change from the San Gorgonio Pass", *Journal of the American Planning Association*, Vol: 53, Issue: 3, Summer, pp. 358-367.

Throgmorton, J. A. (1993) "Planning as a Rhetorical Activity: Survey Research as a Trope in Arguments About Electric Power Planning in Chicago", *Journal of the American Planning Association*, Vol. 59, No. 3, Summer, pp. 334-346.

Throgmorton, J. A. (2003) "Planning as Persuasive Storytelling in a Global-Scale Web of Relationships", *Planning Theory*, Vol. 2, No. 2, pp.125-151.

Upreti, B. R., and van der Horst, D. (2004) "National Renewable Energy Policy and Local Opposition in the U.K: The Failed Development of a Biomass Electricity Plant", *Biomass and Bioenergy*, Vol. 26, pp. 61-69.

Upreti, B. R. (2004) "Conflict Over Biomass Energy Development in the United Kingdom: Some Observations and Lessons From England and Wales", *Energy Policy*, Vol. 32, pp. 785-800.

van der Valk, A. (2002) "The Dutch Planning Experience" *Landscape and Urban Planning*, Vol. 58, pp. 201-210.

Walker, G. (1995) "Energy, Land Use, and Renewables: A Changing Agenda", *Land Use Policy,* Vol. 12, No. 1, pp. 3-6.

Weinberg, C. J. (2001) "Keeping the lights on: Sustainable Scenarios for the Future" *Renewable Energy World*, Vol. 4, No. 4, pp. 31-51.

Weiss, W. (2000) "Solar Combisystems: Thinking Big For a Sustainable Energy Future", *Renewable Energy World*, Vol. 3, No. 2, March-April, pp. 84-91.

Williams, R. H. (2000) "Constructing the European Spatial Development Perspective – For Whom?" *European Planning Studies*, Vol. 8, No. 3, pp. 357-365.

Wolsink, M. (2000) "Wind Power and the NIMBY-Myth: Institutional Capacity and the Limited Significance of Public Support", *Renewable Energy*, Vol. 21, pp. 49-64.

Wolsink, M. (2003) "Reshaping the Dutch Planning System: A Learning Process?" *Environment and Planning A,* Vol. 35, pp. 705-723.

Electronic papers:

Andersen, P. D. (1999) "Review of historical and modern utilization of wind power", Available in HTML at: http://www.risoe.dk/rispubl/VEA/dannemand.htm

Andersen, P. D. And Jensen, P. H. (2000) "Wind Energy Today and in the 21st Century", *Int. J. Global Energy Issues*, Vol. 13, Nos. 1-3, pp. 145-158.

Blechschmidt, K. (2000) "Spatial and Energy Planning in the Baltic Sea Region" *Baltic Chain News-letter*, No. 1, August 2000, p: 4. Available in PDF at: http://www.kape.gov.pl/PL/Programy/Programy_Bilateralne/BALTIC_CHAIN/nl1.pdf (last visited in 25 June 2004)

Blechschmidt, K. (2001) "Spatial Planning in Poland and Estonia for Promoting Energy Efficiency and Renewable Energy Sources", *eceee summer study proceedings 2001*, european council for an energy efficient economy. Available in PDF at: http://www.eceee.org/library_links/proceedings/2001/pdf2001/panel1/01p1_1_060st.pdf (last visited in 25 June 2004)

Böhme, K. (2001) "The Scandinavian Countries and European Spatial Development Perspectives", *Spatial Planning in the Baltic Sea Region: Implications of European Spatial Development Perspectives*, ed. by M. Hansen and K. Böhme, Nordic Centre for Spatial Development, Nordregio Electronic Paper 2001:1, Stockholm, Sweden. Available in PDF at: http://www.nordregio.se/Files/ep0101.pdf (last visited on 26 June 2004)

Böhme, K. (2002) "Nordic Echoes of European Spatial Planning: Discursive Integration in Practice", Nordregio Report 2002:8, Stockholm. Available in PDF at: http://www.nordregio.se/ (last visited on 25 June 2004)

Cross, E. D, Uyterlinde, M. A., van Sambeck, E. J. W., Jörβ, W., Löffler, P., Morthorst, P.E. and Jorgensen, B. H. (2002) "Decentralized Generation: Development of EU Policy", Report in the framework of the DECENT project, October 2002, ECN BS: ECN-C- -02-075, Petten, The Netherlands. Available in PDF at: http://www.ecn.nl/docs/library/report/2002/c02075.pdf (last visited on 25 June 2004)

CSD/BSR – The Committee for Spatial Development in the Baltic Sea Region (1998) "Spatial Planning for Sustainable Development in the Baltic Sea Region: A VASAB 2010 Contribution to Baltic 21", Baltic 21 Series No. 9/98, April.

Available in PDF at: http://www.vasab.org.pl/Public/baltic/baltic21.pdf (last visited in 25 June 2004)

CEC – California Energy Commission (1996) "Energy Aware Planning Guide II: Energy Facilities", available in PDF at (last visited in 25 June 2004): http://www.energy.ca.gov/reports/70096006.pdf

Dalenbäck, J-O. (1997) "State of the Art – Solar District Heating (Solarthermische Grossanlagen)", available at: http://main.hvac.chalmers.se/cshp/Status.htm (last visited 24 June 2004).

DOE - Department of Energy (2001) "Concentrating Solar Power: Energy From Mirrors", available in PDF at: http://www.nrel.gov/docs/fy01osti/28751.pdf (last visited 24 June 2004).

Dutch National Team (1998) "Sustainable Building: Enhancing the Energy Performance Coefficient" CADDET Energy Efficiency: Low Energy Housing & Life-Cycle Assessment, Newsletter No.1. Available in PDF at (last visited on 29 June 2004): http://www.caddet.org/public/uploads/pdfs/newsletter/981_01.pdf

Dutch National Team (2001) "Sustainable Energy Infrastructure Within Reach: the Dutch Approach" CADDET Energy Efficiency: Optimisation of District Heating and Cooling Systems, Newsletter No. 1. Available in PDF at (last visited on 29 June 2004): http://www.caddet.org/public/uploads/pdfs/newsletter/011_07.pdf

Dyrelund, A. and Steffensen, H. (1999) "Best Practice in Danish District Heating", News from DBDH 3/1999, Danish Board of District Heating. Available in PDF at: www.dbdh.dk/pdf/key-articles-pdf/ best-practice-in-danish-district-heating.pdf

Dyrelund, A. (2000) "Why Zoning? Why Not Just Leave It All to Market Forces?" News from DBDH 2/2000, Danish Board of District Heating. Available in PDF at: http://www.dbdh.dk/pdf/key-articles-pdf/Why-zoning.pdf

Ecofys, report for the PREDAC project (publication date and title is not included). Available in PDF at: http://www.cler.org/predac/IMG/pdf/reviewNetherlands.pdf (last visited on 26 June 2004)

EESD - Energy, Environment and Sustainable Development Programme (1999) "Cleaner Energy Systems Including Renewables" *RTD info*, No. 21, Supplement February 99. Available in HTML at (last visited on 26 June 2004): http://europa.eu.int/comm/research/rtdinf21/en/key/19.html

Energie-Cités (1999) "50 interesting case-studies on renewable energy projects carried out by committed European municipalities", *Into a Renewable Millennium*, CD Rom, prepared by Energie-Cités in co-operation with 50 municipalities, funded by the ALTENER Programme.

ETSU (1997) "Energy Technology -The Next Steps: Summary findings from the ATLAS project", available in PDF at: http://europa.eu.int/comm/energy/library/atlas.pdf (last visited 24 June 2004).

EU Del. (2004) "Needs Assessment Study: Improvement of Energy Efficiency in Turkey", Delegation of the European Community in Turkey. Available in PDF at: http://www.eie.gov.tr/english/energy_resources/necc/Needs%20Assessments_revised_04 06_2004.pdf

European Large-Scale Solar Heating Network (1999) *Information Brochure on Large-Scale Solar Heating*, Göteborg. Available in PDF at (last visited 24 June 2004): http://main.hvac.chalmers.se/cshp/ELSSHN.pdf

EWEA – European Wind Energy Association (2003a) "Wind Energy - The Facts: An Analysis of Wind Energy in the EU-25", available in PDF at (last visited 30 January 2005): http://www.ewea.org/06projects_events/proj_WEfacts.htm

EWEA (2003 b) "European Installed Wind Capacity –End 2003", available in PDF at:http://www.ewea.org/documents/europe_windata_jan20041.pdf

Greenpeace (GP) and the European Solar Thermal Power Industry Association (ESTIA)(2003) "Solar Thermal Power 2020: Exploiting the Heat From the Sun to Combat Climate Change", available in PDF at: http://solarpaces.org/GreenpeaceSolTherm.pdf or http://www.greenpeace.nl/ multimedia/download/1/331711/0/SolarThermalPower.pdf (last visited 24 June 2004).

Harley, M., Drewitt, A., Gilliland, P., Cleary, B., Langston, R., Southgate, M., Marsh, R., Burges, D., Marais, M. and Shears, C. (2001) "Wind Farm Development and Nature Conservation", English Nature, RSPB, WWF-UK, BWEA. Available in PDF at: www.bwea.com/pdf/wfd.pdf

IEA – International Energy Agency (1998) "Benign Energy? The Environmental Implications of Renewables", IEA/OCDE, Paris. Available at (last visited on 30 January 2005): http://spider.iea.org/pubs/studies/files/benign/full/00-bene.htm

IEA – International Energy Agency (2001) *Energy Policies of IEA Countries: Turkey 2001 Review,* IEA/OCDE, Paris. Available in PDF at: www.iea.org/dbtw-wpd/textbase/ nppdf/free/2000/turkey2001.pdf

Khan, J. (2001) "The Local Politics of Renewable Energy", paper presented for the workshop Environmental Politics at the Local Level, ECPR Joint Sessions, Grenoble, April 6-11, 2001. Available in PDF at (last visited 24 June 2004): http://www.essex.ac.uk/ECPR/events/jointsessions/paperarchive/grenoble/ws10/khan.pdf

Lorenzen, K. H. (2001) "Report Concerning Planning in Denmark", Ener-Iure Project Phase III Analysis of the Legislation Regarding Renewable Energy Sources In the E.U Member States. Available in PDF at: http://www.cler.org/predac/IMG/pdf/reviewDenmark.pdf

Moll, M. (2002) "Interreg IIC North Sea Programme –Successful Transnational Planning?" Diploma Thesis, University of Dortmund, Dortmund. Available in PDF at: http://www.eurography.de/interreg/ (last visited in 25 june 2004)

Murphy, J. and Gouldson, A. (1998) "Integrating Environment and Economy Through Ecological Modernization: An Assessment of the Impact of Environmental Policy on Industrial Innovation", OCEES Research Paper No. 16, Oxford Centre for the Environment, Ethics & Society, Oxford, UK.

Murphy, J. (2001) "Ecological Modernization: The Environment and the Transformation of Society", OCEES Research Paper No. 20, Oxford Centre for the Environment, Ethics & Society, Oxford, UK.

Olesen, G. B. (2002) "Danish Experience in Spatial Planning of Windturbines", Draft report for the PREDAC project, WP8, Danish Organization for Renewable Energy. Available in PDF at: http://www.cler.org/predac/IMG/pdf/reviewDenmark.pdf

O'Rourke, T. (1996) "Land-use Planning and Renewable Energy in Cornwall", Energy Technology Support Unit (ETSU) for the DTI, ETSU PR 004, March 1996. www.dti.gov.uk/energy/renewables/publications/pdfs/cornwallrep.pdf

O'Rourke, T. and ETSU (1998) "Lancashire and Yorkshire Renewable Energy Planning Study", Energy Technology Support Unit (ETSU) for the DTI, ETSU PR 006.

Available in PDF at (last visited on 30 January 2005): http://www.dti.gov.uk/ energy/renewables/publications/pdfs/006rep.pdf

Oxera & Arup (2002) "Regional Renewable Energy Assessments", A Report to the DTI and the DTLR, Final Report February 6th 2002, Oxera Environmental, Oxford, UK. Available in PDF at (last visited on 30 January 2005): http://www.dti.gov.uk/ energy/renewables/publications/pdfs/oxera_renew.pdf

Pandit, N. R. (1996) "The Creation of Theory: A Recent Application of the Grounded Theory Method", *The Qualitative Report,* Vol. 2, No. 4. Available in HTML at: http://www.nova.edu/ssss/QR/QR2-4/pandit.html

PREDAC (2002) "Wind Energy and Spatial Planning Procedures: Synthesis of the PREDAC European Seminar", The Comité de Liaison Energies Renouvelables (CLER), 6 December 2002, Brest, France. Available in PDF at (last visited on 25 June 2004): http://www.cler.org/predac/IMG/pdf/Guide_English_WP_8.pdf

PREDAC (2004) "Spatial Planning of Windturbines: Guidelines & Comparison of European Experiences", The Comité de Liaison Energies Renouvelables (CLER), France. Available in PDF at: http://www.cler.org/predac/IMG/pdf/doc-100.pdf (last visited on 25 June 2004)

Reddy, A. K. N., Williams, R. H. and Johansson, T. B. (1997) "Energy After Rio: Prospects and Challenges", United Nations Development Programme, United Nations Publications, New York. Available at (last visited on 30 January 2005): http://www.undp.org/seed/energy/contents.html

REPP – Renewable Energy Planning Panel (2003) "The Renewable Energy Planning Panel Report 2003: Adressing local, regional, national and global needs in the UK renewable energy planning policy". Available in PDF at (last visited on 29 June 2004) http://www.pgen.com/about/policy_regulation/pdfs/Renewable_energy_ planning_2003.pdf

Schoen, T. J. N. (2000) "Building with Photovoltaics - the Challenge for Task 7 of the PV Power Systems Program" PVPS 1996 Annual Report Feature Article Revised 4. December 2000, available in HTML at: http://www.task7.org/hm.html (last visited 24 June 2004).

Schoen, T. J. N., Prasad, D., Ruoss, D., Eiffert, P. and Sorensen, H. (2000) "Status Report of Task 7 of the IEA PV Power Systems Program", available in PDF at:

http://www.task7.org/Public/further_reading/status_of_iea_pvps_task7_(eupvsec2000).pdf (last visited 24 June 2004).

Shaw, D. and Skyes, O. (2001) "Delivering the European Spatial Development Perspective" Planning Officers Society Report, University of Liverpool. Available in PDF at: www.liv.ac.uk/civdes/POSReport.pdf (last visited on 29 June 2004)

STEM – Swedish Energy Agency (2001) "Report Concerning Planning in Sweden", Ener-Iure Project Phase III Analysis of the Legislation Regarding Renewable Energy Sources In the E.U Member States. Available in PDF at (last visited on 26 June 2004): http://www.jrc.es/cfapp/eneriure/Reports/SWE%20.pla.pdf

Toksoy, M., Çanakçı, C., İmamoğlu, F., Başeğmez, D. and Gülşen, E. (2003a) "Jeotermal Bölge Isıtma Sistemlerinin Kavramsal Planlaması Açısından Bölge Veri Tabanının Oluşturulmasına Yönelik Bir Anket Çalışması: Balçova Sistem-2 Örneği", GEOCEN, Report 6, İzmir Institute of Technology. Available in PDF at: http://geocen.iyte.edu.tr/turkish/geocenReportsTurkish.htm

Toksoy, M., Aksoy, N. and Serpen, U. (2003b) "İzmir İli Jeotermal Enerji Politikası ve Bölgesel Jeotermal Enerji Planı İçin Öneriler", GEOCEN, Report 3, İzmir Institute of Technology. Available in PDF at: http://geocen.iyte.edu.tr/turkish/geocenReportsTurkish.htm

Toksoy, M., Şener, C., Aksoy, N. and Çanakçı, C. (2003c) "Balçova-Narlıdere Jeotermal Bölge Isıtma Sisteminin Genişlemesi Üzerine Görüşler" GEOCEN, Report 4, İzmir Institute of Technology. Available in PDF at: http://geocen.iyte.edu.tr/turkish/geocenReportsTurkish.htm

Weiss, W., Bergmann, I. and Faninger, G. (2004) "Solar Heating Worldwide: Markets and Contribution to the Energy Supply 2001", International Energy Agency Solar Heating & Cooling Programme, available in PDF at (last visited on 26 June 2004): http://www.iea-shc.org/outputs/activities/iea_shc_solar_heating_worldwide_2002.pdf

Wolsink, M. (1999) "Impediments for Renewables: An Environmental Organization and Wind Power", eceee summer study proceedings 2001, european council for an energy efficient economy. Available in PDF at: (last visited on 26 June 2004) http://www.eceee.org/library_links/proceedings/1999/pdf99/Panel4/4-12.pdf

Working Group on Planning (2002) “Planning: Technical Recommendations” The ENER-IURE Project Phase III Final Report, Altener Programme Contract No. 4.1030/C/00-025/2000 PRISM: “Integral Programme of Research and Promotion of Renewable Energy Sources, the ENERIURE Project-Phase III”. Available in PDF at: http://www.jrc.es/cfapp/eneriure/Reports/Final%20reports-Planning-TR-EIII.pdf (last visited on 26 June 2004)

Symposium, Conferences and Congress:

Atagündüz, G. (2001) “Kentlerde ve Köykentlerde Yenilenebilir Enerji Kaynaklarının Etkin Kullanımında Yerel Yönetim Politikaları Ne Olmalıdır”, Yenilenebilir Enerji Kaynakları Sempozyumu (18-20 Ocak 2001), İzmir, TMMOB Elektrik Mühendisleri Odası İzmir Şubesi

Aringhoff, R., Geyer, M., Herrmann, U., Kistner, R., Nova, P. and Osuna, R. (2002) “AndaSol-50MW Solar Plants with 9 Hour Storage for Southern Spain” paper presented in *11th Solarpaces International Symposium on Concentrated Solar Power and Chemical Energy Technologies*, September 4-6, 2002, Zurich, Switzerland. Available in PDF at (last visited 24 June 2004): http://www.solarpaces.org/AndaSolPaperZurich2002-04-01.pdf

Bloomquist, G. R. and Boyd, T. (2000) “Models – Can They Really be Trusted in Determining the Feasibility of a Geothermal District Energy System?” Proceedings World Geothermal Congress, Kyushu-Tohuku, Japan, (May 28-June 10, 2000), pp. 4009-4015.

Breukers, S. and Wolsink, M. (2003) “Institutional Capacity in Policy Processes for Wind Energy in the Netherlands”, ECPR Conference Marburg, section 8, panel 5 (September 20, 2003). Available in PDF at (last visited on 26 June 2004): http://www.essex.ac.uk/ECPR/events/generalconference/marburg/papers/8/5/Breukers.pdf

Demirel, Z. (1997) “Jeotermal Suların Arama-Araştırma ve Kullanımları ile İlgili Mevcut Yasalar, Hazırlanmakta Olan Yasa ile İlgili Kişisel Görüşler ve Öneriler”, Türkiye 7. Enerji Kongresi, (3-8 Kasım 1997), *Yeni ve Yenilenebilir Enerji Kaynakları* Cilt III, Dünya Enerji Konseyi Türk Milli Komitesi, Ankara.

Dündar, C. and İnan, D. (1997) "Çeşme Rüzgar Enerjisi Potansiyelinin Belirlenmesi", Türkiye 7. Enerji Kongresi, (3-8 Kasım 1997), *Yeni ve Yenilenebilir Enerji Kaynakları* Cilt III, Dünya Enerji Konseyi Türk Milli Komitesi, Ankara.

Pala, C., Çağlayan, İ. and Gönül, G. (1997) "Türkiye Avrupa Topluluğu Entegrasyonunun Enerji Boyutu" Türkiye 7. Enerji Kongresi, (3-8 Kasım 1997), *Enerji Politikaları ve Planlama,* Cilt I, Dünya Enerji Konseyi Türk Milli Komitesi, Ankara.

Uyar, T. S. (2001) "Ulusal Güneş Pilleri Stratejisi", II. Çevre ve Enerji Kongresi Bildiriler Kitabı (15-17 Kasım 2001), İstanbul, MMO Yayın No. E/2001/289.

Policy and Legislation Documents:

Boverket and Naturvårdsverket (2000) "Planning with Environmental Objectives! A Guide", Available in PDF at (last visited on 26 June 2004): http://www.internat. naturvardsverket.se/documents/issues/planning/5124.pdf

Danish Energy Agency (1998) "Combined Heat and Power in Denmark", downloaded from http://www.ens.dk/pub/chp (not available)

Danish Energy Agency (1998b) *Solar Energy: Plan of Action 1998-2000*, (The Solar Energy Committee, Taastrup, Denmark).

Danish Energy Agency (1999) "Wind Power in Denmark: Technology, Policies and Results" available in PDF at: http://www.ens.dk/graphics/Publikationer/ Forsyning_UK/Wind_Power99.pdf

Denmark Energy Center (1997) *Solar District Heating System's*, DTI, Taastrup.

Danish Ministry of Energy (1993) *Solar Heating in Denmark*, Denmark.

Danish Ministry of Environment and Energy (2000) "The Heat Supply Act",

Consolidated Act No. 772 of 24 July 2000. Available in PDF at: http://www.ens.dk/graphics/Publikationer/Laws/Danish_Heat_Law_2000EN.pdf

Danish Ministry of Environment (1991) "Statutory Order From the Ministry of Environment No. 304 of May 14, 1991, on Noise From Windmills", available in Word doc. at: http://www.mst.dk/rules/Ministerial%20Orders%20in%20force/ Transport,%20air% 20and%20noise%20in%20force/02060200.doc

Danish Ministry of Environment (2002a) "The Planning Act in Denmark Consolidated Act No. 763 of 11 September 2002", Spatial Planning Department, Copenhagen, Denmark. Available in PDF at: www.lpa.dk/Topmenuen/Publikationer/Andre_sprog/2002/planning-act-2002.pdf

Danish Ministry of Environment (2002b) "Spatial Planning in Denmark", Spatial Planning Department, Copenhagen, Denmark. Available in PDF at: http://www.lpa.dk/Topmenuen/Publikationer/Andre_sprog/2002/spatial-planning.pdf

Danmarks Vindmølleforening (2002) "Planlægnig for Vindmøller", Fakta om Vindenergie, P2. Available in PDF at: http://www.dkvind.dk/fakta/fakta_pdf/P2.pdf (in Danish)

DETR – Department of Environment, Transport and the Regions, "Planning Policy Guidance 11: Regional Planning", HMSO. Available in PDF at: http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/pdf/odpm_plan_pdf_606926.pdf

DETR – Department of Environment, Transport and the Regions (1999) "Planning Policy Guidance 12: Development Plans". Available in PDF at: http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/pdf/odpm_plan_pdf_606929.pdf

DETR – Department of Environment, Transport and the Regions (1999b), "Environmental Impact Assessment Circular 02/99" Available in PDF at: http://www.sheilapantry.com/fulltext/samples/evpd/cc199902.asp

DoE – Department of the Environment (1993) "Planning Policy Guidance 22: Renewable Energy", Welsh Office, HMSO, London. Available in PDF at: http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_606910.pdf

DoE – Department of the Environment (1994) "Planning Policy Guidance 9: Nature Conservation", HMSO, London. Available in PDF at: http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/pdf/odpm_plan_pdf_606919.pdf

EC - European Commission (1997a) "The EU Compendium of Spatial Planning Systems and Policies", Luxembourg: Office for Official Publications of the European Communities.

EC – European Commission (1997b) “Energy For the Future: Renewable Sources of Energy. White Paper for a Community Strategy and Action Plan”, COM (97) 599 final (26/11/1997) Brussels, Belgium

EC – European Commission (1999) “ESDP – European Spatial Development Perspective”, Luxembourg: Office for Official Publications of the European Communities.

EU Directive (2001) “Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market”, Official Journal of the European Communities, L 283/33-38, Brussels, Belgium.

Leicester City Council (2002) “Supplementary Planning Guidance: Energy Efficiency & Renewable Energy In New Developments City Wide Guidance”. Available in PDF at: http://www.leicester.gov.uk/endev/spg/EnergyEfficiency.pdf

Regeringskansliet (2000) “Environmental Code”, Ministry of Environment (Miljö Departementet). Available: http://miljö.regeringen.se/pressinfo/pdf/ds2000_61.pdf

Regeringskansliet (2001) “The Swedish Environmental Objectives-Interim Targets and Action Strategies: Summary of Government Bill 2000/01:130”, Ministry of Environment (Miljö Departementet) Article No. M 2001.11, Stockholm, Sweden. Available in PDF at: http://www.regeringen.se/content/1/c4/11/97/2aa978ad.pdf

Statutory Instrument (1999) “Statutory Instrument 1999 No. 293 The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999”. Available in HTML at (last visited on 29 June 2004): http://www.legislation.hmso.gov.uk/si/si1999/19990293.htm

Swedish Environmental Protection Agency (2002) “Ordinance (1998:899) concerning Environmentally Hazardous Activities and the Protection of Public Health”, Latest revision: 2002:557. Available in PDF at (last visited on 26 June 2004): www.internat.environ.se/documents/leagl/hazard/ordinanc.pdf

Swedish Government (1997) “Swedish Environmental Quality Objectives: Summary of the Swedish Government Bill 1997/98:145”, Stockholm.

Swedish Government (1999) “The Right Place for Wind Power”, The Swedish Commission on Wind Power, Summary of Final Report, (SOU 1999:75), Stockholm. Available in HTML at (last visited on 26 June 2004):

http://www.svensk-vindkraft.org/WindPowerReportSOU1999-75SummaryJune99.htm

Swedish Report (2003) “Evaluation of existing legislation, regulations and administrative procedures to identify obstacles to establishing productio plants for electricity produced from renewable energy sources”, Report under the provisions of Article 6 (2) of EC Directive 2001/77/EC on the promotion of electricity produced from renewable energy in the internal electricity market. Available in PDF at (last visited on 26 June 2004):
http://europa.eu.int/comm/energy/res/legislation/doc/electricity/member_states/sv_2003_report_art6_en.pdf

VROM – Ministry of Housing, Spatial Planning and Environment (2001) “Summary: Making Space, Sharing Space: Fifth National Policy Document on Spatial Planning 2000/2020”. Available in PDF at (last visited on 26 June 2004): http://www2.vrom.nl/docs/internationaal/vijfdenota_engels.pdf

Laws, Regulations and Policy Documents of Turkey

ABGS (2003) “Avrupa Birliği Müktesebatının Üstlenilmesine İlişkin Türkiye Ulusal Programı”, (24 Temmuz 2003 tarih ve 25178 sayılı Resmi Gazete) Avrupa Birliği Genel Sekreterliği, available at: http://www.abgs.gov.tr/up2003/up.htm

DPT (1998) “National Environmental Action Plan / Türkiye Ulusal Çevre Stratejisi ve Eylem Planı”, Devlet Planlama Teşkilatı (SPO), Ankara. Available at: http://ekutup.dpt.gov.tr/cevre/eylempla/ucep.html

DPT (2000) “Eight Five Year Development Plan / Sekizinci Beş Yıllık Kalkınma Planı” Devlet Planlama Teşkilatı, Ankara. Available at: http://plan8.dpt.gov.tr/

DPT (2001) *Enerji*, Sekizinci Beş yıllık Kalkınma Planı, Özel İhtisas Komisyon Raporu, Ankara.

EMRA (2003) “List of applications / İnceleme ve Değerlendirmeye Alınan Üretim Lisansı Başvuruları ve İtiraz Süreleri listesi”, Enerji Piyasası Düzenleme Kurulu, http://www.epdk.gov.tr/lisans/elektrik/

EMRA (2004a) “List of applications / 22.10.2004 tarihinde güncellenmiş İnceleme ve Değerlendirmeye Alınan Üretim Lisansı Başvuruları ve İtiraz Süreleri Listesi”, Enerji Piyasası Düzenleme Kurulu, http://www.epdk.gov.tr/lisans/elektrik/

EMRA (2004b) “List of granted generation license / 22.11.2004 tarihli Üretim Lisansı Verilen Tüzel Kişiler Listesi, Enerji Piyasası Düzenleme Kurulu, http://www.epdk.gov.tr/lisans/elektrik/

EMRA (2004c) “List of rejected applications / 5.11.2004 tarihli Reddedilen RES Başvuruları Listesi, Enerji Piyasası Düzenleme Kurulu, http://www.epdk.gov.tr/lisans/elektrik/

MTA (1989) “Balçova Kaplıcalarının Hidrojeolojisi ve Koruma Alanları Raporu”. Air Quality Control Regulation / Hava Kalitesinin Korunması Yönetmeliği, (2 Kasım 1986 tarih ve 19269 sayılı Resmi Gazete)

Circular on Air Pollution Control / Hava Kirliliği Kontrolü Genelgesi, Çevre Yönetimi Genel Müdürlüğü, 27 Nisan 2004.

Communique dated 23.07.2004 / Elektrik Enerjisi Üretmek Amacıyla Aynı Bölge ve Aynı Kaynak İçin Yapılmış Birden Fazla Lisans Başvurusu Olması Halinde Seçim Yapılmasına İlişkin Usul ve Esaslar Hakkında Tebliğ, Enerji Piyasası Düzenleme Kurumu

Draft Law on Development/ İmar Kanunu Tasarısı Taslağı, Bayındırlık ve İskan Bakanlığı, Teknik Araştırma ve Uygulama Genel Müdürlüğü, Ankara 2004.

Draft Law on Geothermal Sources and Mineral Waters / Jeotermal Kaynaklar ve Mineralli Sular Kanunu Tasarısı, Enerji ve Tabii Kaynaklar Bakanlığı, 2003.

Draft Law on utilization of renewable energy sources for the purpose of generating electrical energy / Yenilenebilir Enerji Kaynaklarının Elektrik Enerjisi Üretimi Amaçlı Kullanımına İlişkin Kanun Tasarısı Taslağı, Enerji ve Tabii Kaynaklar Bakanlığı, 2004.

Electricity Market Law / Elektrik Piyasası Kanunu, (3 Mart 2001 tarih ve 24335 sayılı Resmi Gazete) Kanun No: 4628.

Electricity Market Licensing Regulation / Elektrik Piyasası Lisans Yönetmeliği (12 Temmuz 2004 tarih ve 25520 sayılı Resmi Gazete), Enerji Piyasası Düzenleme Kurumu

Environmental Impact Assessment Regulation / Çevresel Etki Değerlendirmesi Yönetmeliği, (16 Aralık 2003 tarih ve 25318 sayılı Resmi Gazete)

Law of Greater City Munipalities / Büyükşehir Belediyeleri Kanunu, Kanun No. 5216.

Law of Municipality / Belediye Kanunu, Kanun No. 5215

Law of Provincial Authorities / İl Özel İdareleri Kanunu, Kanun No. 5197.

Law on Organization and Duties of the Ministry of Environment and Forestry / 4856 sayılı Çevre ve Orman Bakanlığı'nın Teşkilat ve Görevleri Hakkındaki Kanun.

Plan of Alaçatı / Alaçatı Çevre Düzeni Planı

Plan report of Germiyan auto-producer wind energy project

Plan report of Mazı I wind farm project

Principle Decision of Council of Conservation of Cultural and Natural Assests / 20.07.2001 tarihli ve 688 sayılı Kültür ve Tabiat Varlıklarını Koruma Yüksek Kurulu İlke Kararı

Regulation on Heat insulation at buildings / Binalarda Isı Yalıtımı Yönetmeliği, (8 Mayıs 2000 tarih ve 24043 sayılı Resmi Gazete).

Regulation on Principles of granting authorization for electricity generation activities by private developers / Türkiye Elektrik Üretim İletim Anonim Şirketi ve Türkiye

Elektrik Dağıtım Anonim Şirketi dışındaki kuruluşlara elektrik enerjisi üretim tesisi kurma ve işletme izni verilmesi esaslarını belirleyen yönetmelik, (4 Eylül 1985 tarih ve 18858 sayılı Resmi Gazete).

Web Sources:

Altener II (1998) http://europe.eu.int/comm/energy/en/altener2.htm

Baltic Chain (2001) "Executive Summary", at (last visited in 25 June 2004):

http://www.kape.gov.pl/EN/Programmes/Programmes_Bilateral/BALTIC_CHAIN/index.phtml

B. C. Energy Aware Committee, http://www.energyaware.bc.ca/

Borgatti, S., "Introduction to Grounded Theory", (last visited in 22 November 2004), http://www.analytictech.com/mb870/introtoGT.htm

Boverket (2003) "Two main planning laws from 1987", National Board of Housing, Building and Planning, http://boverket.se

EESD – Energy, Environment and Sustainable Development Programme (1998-2002), available at: http://www.cordis.lu/eesd/src/overview.htm#3

Energie-Cités, http://www.energie-cites.org/

ENER-IURE Project, www.jrc.es/cfapp/eneriure/welcome.html

EU Glossary, "EU Directive", http://europa.eu.int/scadplus/leg/en/cig/g4000c.htm#c19

EU Glossary, "Green Paper", http://europa.eu.int/scadplus/leg/en/cig/g4000g.htm

EU Glossary, "White Paper", http://europa.eu.int/scadplus/leg/en/cig/g4000w.htm#w6

Hall, P. (1997) "World Cities and Global Cities", The First Megacities Lecture.

Available: http://www.megacities.nl (19 July 2004)

IEA-PVPS -International Energy Agency Photovoltaic Power Systems Programme (2002) "Basics of PV", online source available at: http://www.oja-services.nl/iea-pvps/pv/index.htm (last visited 24 June 2004)

IEA-Solar City programme, http://www.solarcity.org/

Lenardic, D. (2001-2004) "Photovoltaic Technologies and Applications", at:

http://www.pvresources.com, and "Top 50 Photovoltaic Power Plants", at:

http://www.pvresources.com/en/top50pv.php (last visited 24 June 2004).

Plataforma Solar de Almería (PSA), "General Description of the PSA", available at: http://www.psa.es/webeng/instalaciones/index.html (last visited in 24 June 2004)

Todd, N. J. (1997) "E. F. Schumacher, An Appreciation", at (last visited in 24 June 2004): http://www.schumachersociety.org/fritzbio.html

Interviews:

Ak-El (2004), Akhisar Elektrik Üretim A.Ş., İstanbul, in December.

Balçova Jeotermal Enerji Ltd. Şt., Balçova-İzmir, in November 2003.

Çelik, Z. (2004) The planner, Provincial Directorate of Ministry of Public Works and Settlements, İzmir, in June.

Durak, M. (2004) The engineer, Kemalpaşa wind farm project, in December.

Dündar, C. (2003) Research Branch Office, Turkish State Meteorological Service, Ankara, in June.

Koç, H. (2003) Directorate of Provincial Authority, İzmir, in November.

Özbey, G. (2004) The planner, Provincial Directorate of Ministry of Public Works and Settlements, Muğla, in November.

Öztulu, D. (2001) The planner, İzmir, in November.

APPENDIX A

RENEWABLE ENERGY TECHNOLOGIES

A.1. Biomass Energy Systems

Bio-energy or biomass energy is the energy recovered from the chemical bonds formed via photosynthesis in living (or once-living) matter. Traditionally, the main source of biomass fuels has been wood and the main conversion technology has been simple combustion in open fires, kilns, or ovens. Today, a variety of other biomass fuels are recognised, and new conversion technologies have been, or are being developed. In addition to wood fuels, sources of biomass include: agricultural residues, animal residues, urban refuse, industrial waste, sewage sludge, and energy crops.

Some types of biomass are used directly. Others are converted first to intermediate fuels which are later used to produce heat or electricity production. Intermediate fuels include charcoal (still used for smelting for example), bio-ethanol (from the distillation of sugar cane), sewage gas (from the digestion of sewage and animal residues), landfill gas (a by-product of landfill waste disposal), and other forms of biogas (for instance from the gasification of energy crops).

The principal biomass conversion technology remains direct combustion. Biomass resources of various types are burnt in stoves, furnaces and boilers either to provide energy directly to end-users. The other technologies involve thermochemical and biochemical conversion processes. The basic thermochemical process is pyrolysis which uses heat to break down solid biomass into a gas mixture, an oil-like liquid and an almost pure carbon char. Gasification is a pyrolytic technology which has been used since 1830 to produce biogas – a mixture of methane and carbon dioxide – from organic matter. The main biochemical conversion process is fermentation, the breaking down of organic matter through the metabolic action of microbial organisms. Anaerobic fermentation is a simple, reliable, and versatile method of producing biogas from organic matter. Ethanol fermentation is another well-known and relatively simple biomass conversion process in which micro-organisms (usually yeasts) are used to convert carbohydrates into alcohol. Distilled ethanol can then be used, for example, as a transport fuel (Jackson and Löfstedt 1998)

In the US assessment, *forest biomass* is given as the most abundant biomass resource and the most concentrated form of biomass. It is estimated that a city of 100,000 people using the biomass from a sustainable forest (3 tons/ha) for fuel would require approximately 220,000 ha of forest area, based on an electrical demand of 1 billion kWh per year. Nearly 70 % of the heat energy produced from burning biomass is lost in the conversion into electricity, similar to losses experienced in coal fire plants. The energy input/output ratio of the system is 1:3. Approximately 3 kcal of thermal energy is required to produce 1 kcal of electricity. The cost of producing a kilowatt of electricity from woody biomass ranges from 7 cents to 10 cents, which seems competitive. (Pimentel et al. 1994)

Culturing fast-growing trees might increase yields of woody biomass. However, prime land is first of all essential for food production. It is pointed out that energy is not the highest priority use of trees. Moreover, such intense systems require additional fossil fuel inputs for heavy machinery, fertilizers, and pesticides, thereby diminishing the net energy available. On the other side, loss of biodiversity can be expected, if forests are managed for maximal energy production. Soil erosion and water runoff can increase due to the conversion of natural forests into plantations. In addition to the serious degradation of valuable agricultural land, the practice of burning crop residues as a fuel removes essential nutrients from the land. The burning of biomass is environmentally more polluting than gas but less polluting than coal. It is emphasized that biomass combustion releases more than 100 different chemical pollutants into the atmosphere. It is also reported that wood smoke contains pollutants known to cause bronchitis, emphysema and other illnesses.

Energy crops are agricultural crops grown specifically for their energy content. A wide variety of different crops have been suggested for this purpose including short-rotation, fast-growing trees (such as willow or eucalyptus), herbaceous crops (like miscanthus, sorghum, sugar cane, or maize), and vegetable oil-bearing plants (such as soya, sunflower, rapeseed, and palm).

The burdens associated with energy crops will vary according to the type of crop and the former use of the land given over to energy plantations. The use of agrochemicals (herbicides, fertilizer, pesticides, insecticides and fungicides) is generally less than with arable crops. Good farming practice can minimize the impacts of these chemicals. Establishing an energy crops plantation in an area formerly under intensive agriculture should increase wildlife diversity. However, if it displaces permanent woodlands or other environmentally sensitive habitats, the impacts are likely to be negative. Guidelines for those setting up plantations can help to ensure that they are located in appropriate areas and that they are designed to maximize, as far as possible, habitat diversity (IEA 1998).

Their visual impact may be mitigated even further by appropriate design of the plantation (e.g. avoiding straight edges to the plantation and using the natural topography) and by using different species or clones within plantations to provide variety. Guidelines for developers on such matters are already available in some countries. Barns or silos for energy crop storage are likely to be large and similar to existing farm silos. The most intrusive aspect of the combustion plant is likely to be the stack or chimney, whose visual impact can be minimized (but not negated) by appropriate sitting. Emissions are lower from the newer technology gasification plant, which would allow lower stack heights.

The other environmental burdens of energy crops are likely to be temporary (e.g. disturbance from construction of the combustion plant) or small (e.g. spore release from stored wood chips or fire). Noise, traffic congestion, etc. from crop harvesting and transportation would also be a burden.

A wide variety of starch and sugar crops, food processing wastes, and woody materials are raw materials for *ethanol* production. The Brazilian Proalcool programme is the most extensive ethanol fermentation programme in the world, currently producing 12 billion litres of ethanol a year, equivalent to around 60% of the country's automotive fuel requirements.

The major energy input in ethanol production, approximately 40% overall, is fuel needed to run the distillation process. This fossil energy input contributes to a negative energy balance and atmospheric pollution. Another environmental problem is caused by the large quantity of stillage or effluent produced. During the fermentation process approximately 13 liters of sewage effluent is produced and placed in the sewage system for each liter of ethanol produced. Due to problem of the disposal of the stillage produced during the distillation process the wastes are now subject to further treatment.

Methanol is another potential fuel for internal combustion engines. Various raw materials can be used for methanol production, including natural gas, coal, wood, and municipal solid wastes. At present, the primary source of methanol is natural gas. The major limitation in using biomass for methanol production is the enormous quantities needed for a plant with suitable economies of scale. A suitably large methanol plant would require at least 1250 tons of dry biomass per day for processing. More than 150,000 ha of forest would be needed to supply one plant.

Compared to gasoline and diesel fuel, both methanol and ethanol reduce the amount of carbon monoxide and sulfur oxide pollutants produced, however both contribute other major air pollutants such as aldehydes and alcohol. Air pollutants from these fuels worsen the tropospheric ozone problem because of the emissions of nitrogen oxides from the richer mixtures used in the combustion engines (Pimentel et al. 1994).

A.2. Solar Energy Systems

There are a number of different kinds of techniques and technologies for using direct solar radiation. These are:

- Passive solar design: which has been used since time immemorial to provide space heating and cooling in dwellings.
- Active solar systems: which concentrate the sun's radiation so as to provide heat of sufficiently high quality for space heating, and sometimes electricity generation.
- Photovoltaics: which convert sunlight directly to electricity through the so-called photoelectric effect.

A.2.1. Passive Solar Design

The idea behind passive solar design is to maximize the free *solar gain* from incident sunlight to reduce the need for additional heating and cooling energy requirements within buildings. The main principles of passive solar heating are to orientate glazed surfaces towards the sun, to site buildings in such a way as to provide protection from prevailing winds, and to avoid the heat loss that comes from windows which are in the shade. For passive solar cooling, the basic idea is to use solar heat to induce convection currents that cool living spaces. Passive solar lighting consists of increasing the availability of natural light – again through the appropriate use of glazing – and reducing the need for artificial lighting. More complex passive solar designs include the installation of glass atria, conservatories, and solar walls, and the use of roof space collectors.

Both new and established homes can be fitted with solar heating and cooling systems. Passive solar is most effective when it is incorporated into the buildings at the design stage, in conjunction with a range of energy conservation measures. Nevertheless, it can also be cost-effective to retrofit certain passive solar design features, such as glass conservatories. Recent developments in passive solar design include the use of high performance glazing, which transmits light but has good insulation properties. This allows for a kind of enhanced greenhouse effect, trapping solar heat within the building.

A.2.2. Active Solar Thermal

Active solar technologies generate heat, usually in the form of hot water or steam, which can be used for space heating, domestic hot water requirements, or electricity generation. There are low and high temperature systems. *Low temperature systems* generally fall into two types: flat plate collectors and evacuated tube collectors. The flat plate collector has a blackened surface to absorb heat. Beneath this surface, pipes carry a fluid that is used to transfer the heat, usually via a heat exchanger, to the space heating or hot water system. *High temperature systems* (parabolic trough, parabolic dish and power tower) comprise solar thermal technologies that concentrate solar radiation for large-scale energy production and include distributed and central receivers.

High Temperature Systems: Distributed receiver technologies use rows of parabolic troughs to focus sunlight on a central-pipe receiver that runs above the troughs. Pressurized water and other fluids are heated in the pipe and are used to generate steam to drive a turbo-generator for electricity production or provide industry with heat energy. Central receiver plants use computer-controlled, sun-tracking mirrors, or heliostats, to collect and concentrate the sunlight and redirect it toward a receiver located atop a centrally placed tower. In the receiver, the solar energy is captured as heat energy by circulating fluids, such as water or molten salts that are heated under pressure. These fluids either directly or indirectly generate steam, which is then driven through a conventional turbo-generator to yield electricity. The receiver system may also be designed to generate heat for industry (Pimentel et al. 1994), (See Figure A.1).

Distributed receivers have entered the commercial market before central receivers, because central receivers are more expensive to operate. But, compared to distributed receivers, central receivers have the potential for greater efficiency in electricity production because they are able to achieve higher energy concentrations and higher turbine inlet temperatures. Nine trough systems, built in the mid to late 1980's by Luz International set up electricity-generating plants in the southern California desert with a total installed capacity of 354 MW, making parabolic troughs the largest solar thermal electric generating producers to date. Today, utilities in the U.S. have installed more than 400 megawatts of solar thermal generating capacity, providing electricity to 350,000 people and displace the equivalent of 2,3 million barrels of oil annually.

The dish systems use an array of parabolic dish-shaped mirrors (similar in shape to a satellite dish) to focus solar energy onto a receiver located at the focal point of the dish. Fluid in the receiver is heated up to 1000°C and is utilized directly to generate electricity in a small engine attached to the receiver. Engines currently under consideration include Stirling and Brayton cycle engines. Several prototype dish/engine systems, ranging in size from 7 to 25 kW have been deployed in various locations in the USA the modular design of dish/engine systems make them a good match for both remote power needs in the kilowatt range as well as hybrid end-of-the-line grid-connected utility applications in the megawatt range. A 250-kW plant composed of ten 25-kW dish/engine systems requires less than an acre of land (DOE 2001).

The first power tower Solar One was built near Barstow in Southern California This facility operated in the mid-1980's, used a water/steam system to generate power. Later an upgrade of Solar One was planned — Solar Two. Solar Two operated, with molten-salt receiver and thermal storage system, from 1996 to 1999. Both systems had the capacity to produce 10 MW of power. By Solar Two, the stored energy in molten salt allowed the plant to generate power day and night, rain or shine. It demonstrated how solar energy can be stored efficiently and economically, and therefore, fostered commercial interest in power towers (DOE 2001).

At present, The Spanish project, called Solar Tres or Solar Three, will use all the proven molten-salt technology of Solar Two, scaled up by a factor of three. Solar Two was a demonstration project, but Solar Tres will be operated by industry as a long-term power production project. It will be the first commercial central receiver plant with the help of EU and Spanish grants. This proposed 15 MWe Solar Tres plant in Cordoba, Spain will utilise a 16-hour molten salt storage system to run on a 24-hour basis, and with its 240.000 m^2 heliostat field the Solar Tres plant will feed an estimated annual 80 GWh of electricity into the Spanish grid. (GP and ESTIA 2003)

Another project under development is PS-10. In this project, Spanish and German companies are involved in commercializing the solar tower with air receiver technology. With a 90.000 m^2 heliostat field, the Planta Solar (PS-10) 10 MWe project near Seville will feed an annual 19.2 GWh of solar electricity into the grid and will achieve a 10.5 % annual net efficiency. (GP and ESTIA 2003)

Due to its commercial maturity, parabolic trough technology is the preferred choice of industrial bidders and investors in utility scale projects in Europe and the South-western United States. There are two significant projects, which are supported by the 5th Framework Programme of the European Union. One of them is the THESEUS project, which consists of a nominal 50 MWe net solar power plant with an advanced parabolic trough collector field, on the southern coast of the Greek island Crete. With 300.000 m² of parabolic trough solar field, the plant will supply solar only electricity to Crete's island grid (Quaschning and Geyer 2000). Moreover, with this project it is intended to demonstrate the maturity of large-scale parabolic trough power plants under European energy economic and operating conditions.

The other one is the AndaSol I – II projects in Andalusia, Spain. Each of the projects can provide a capacity of 50 MWe by combining solar concentrating parabolic trough collectors as the power source with a 9 full-load hours storage system. The prime technological objective of AndaSol is to demonstrate and qualify a 549.360m² parabolic trough field[65] with the innovative EuroTrough design, which is a new parabolic collector technology developed at the Plataforma Solar Research Center[66] (Figure A.2), (Aringhoff et al. 2002, GP and ESTIA 2003).

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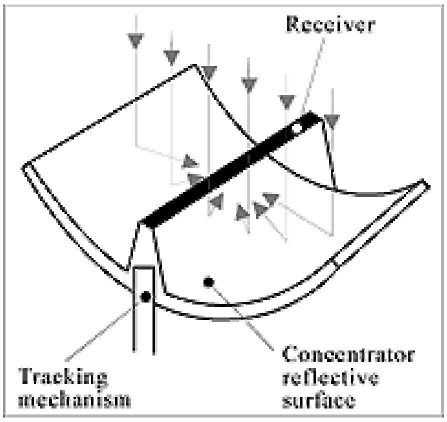
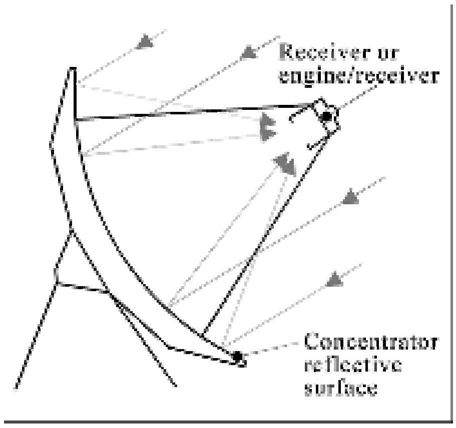
[65] **Site selection criteria**: a) The site must have an annual direct normal insulation of at least 2000kWh/m²a; site locations with higher insulation will receive bonus points in the evaluation, b) A minimum land area of 400 hectars of flat land must be available for industrial land use, c) Sufficient cooling water per year must be available at reasonable cost, d) A 220 kV substation that can accommodate 100 MVA must be available in the vicinity of the site, e) Access and service roads are required for equipment and spare part delivery and for supply of auxiliary backup fuel, train and/or port access will receive bonus points for evaluation.
With respect to these criteria, an extensive site selection effort includes screening over 100 sites in Southern Spain, analyzing the meteo data of over 25 localities in this area and identification of Aldeire in the Marquesado valley, Province of Granada in Spain as the most promising site. Together with the technical experts of the Aldeire municipality, a 1.300 m x 1.500 m site has been identified. With the full support of the municipality, long-term land leasing agreements have already been signed (Aringhoff et al. 2002).

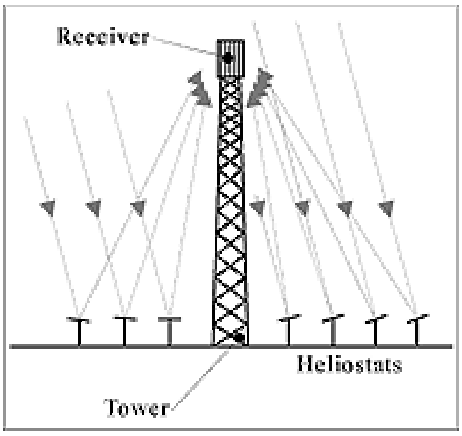
[66] The Plataforma Solar de Almería (PSA), a dependency of the Center for Energy, Environment and Technological Research (CIEMAT), is the largest center for research, development and testing of concentrating solar technologies in Europe.



a) parabolic trough



b) parabolic dish



c) power tower

Figure A.1. Illustration of a) parabolic trough b) parabolic dish c) power tower

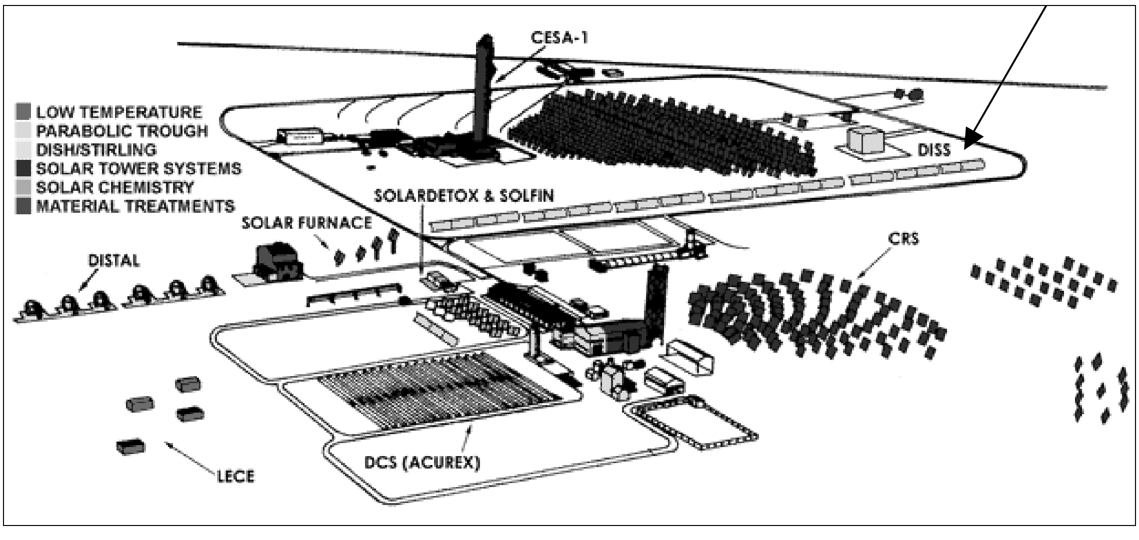


Figure A.2. The Plataforma Solar de Almería, Spain (PSA)

Solar Ponds made up of layers of salt-concentration gradient prevent natural convection and enable heat collected from solar radiation to be trapped in the bottom brine (Figure A.3). Then, the hot brine from the bottom of the pond is piped out for direct use or generating electricity. It is given that, approximately 4000 ha of solar ponds (40 ponds of 100 ha) and a set of evaporation ponds that cover a combined 1200 ha are needed for the production of 1 billion kWh of electricity needed by 100,000 people in one year. Therefore, a family of three would require approximately 0.2 ha of solar ponds for its electricity needs. The efficiency of solar ponds in converting solar radiation into heat is estimated to be approximately 1:5 (Pimentel et al. 1994).

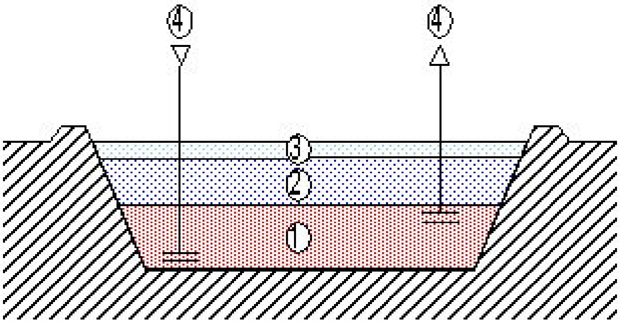
Israel leads the world in salt-gradient solar pond technology. Among several systems installed in the Dead Sea, the largest is a 5 MW electric system (20 hectare). The largest solar pond in the USA is a 0,3 hectare pond in El Paso, Texas, which has operated reliably since its start in 1986. The pond runs a 70 kW (electric) organic Rankine-cycle turbine generator, and a 20 000 litres per day desalting unit, while also providing process heat to an adjacent food processing company. Another pond in the USA (Miamisburg, Ohio) heats a municipal swimming pool and a recreational building.

Since these systems, or in exact term solar thermal power, uses direct sunlight, it must be sited in regions with direct solar radiation. Suitable sites should offer at least 2.000 kWh of electricity per m^2 of sunlight annually, while the best sites offer more than 2.500 kWh/m^2. Therefore, typical locations where the climate and vegetation do not offer high levels of atmospheric humidity, include steppes, bush, savannahs, semi-deserts and deserts are ideally located within ± 40 degrees of latitude. In many of the regions of the world, one square kilometre of land is enough to generate as much as 100-200 GWh of solar electricity per year solar thermal technology, which is equivalent to the annual production of a 50 MW conventional coal or gas-fired power plant. Due to its site features, solar thermal power is regarded as *the offshore wind farms of the desert* (GP and ESTIA 2003).

Low Temperature Systems: At present, the contribution of low temperature systems, so-called *solar* (thermal) *heating system,* to the energy demand is larger[67] than

[67] In terms of total installed flat-plate and evacuated tube collector area by the year 2001, China (32.000.000 m^2) is the leading country, followed by Japan (12.066.489 m^2) and Turkey (8.130.000 m^2), Israel (3.920.000 m^2), Germany (4.396.000 m^2), Greece (2.990.000 m^2). Total installed collector area in Europe is 11.200.000 m^2 (Turkey is not included). In terms of installed collector area per 1000 inhabitants, Israel, Greece, and Austria are leading with 608 m^2, 298 m^2, and 220 m^2 per 1000 inhabitants. They are followed by Turkey, Japan, Australia, Denmark and Germany with collector areas between 118 and 45 m^2 per 1000 inhabitants (Weiss et al. 2004).

is accounted for in statistics since the statistics focus primarily on electricity. It is mentioned that solar heating would come out as one of the major renewable energy sources if the total heat demand were included in the energy balance (Bosselaar 2001).



1. High salt concentration
2. Middle layer.
3. Low salt concentration.
4. Cold water in and hot water out

Figure A.3: A solar pond section

The main technologies are solar water heating, solar heating/cooling – combisystems and district heating, and also solar crop drying. Moreover, it is the solar building that passive and active solar systems and daylighting is combined into new and existing building, which can reduce energy requirements by a factor of four compared with traditional building. Though solar collectors and also solar buildings are consumer products, it is important that the technologies are to be considered as an integral part from the beginning of the design and construction process, and even at the site design and planning process in terms of orientation of streets, building lots, distance between buildings, etc.

Solar Water Heating is the well established, best known solar energy technology throughout the world. The system includes solar collectors, which converts solar radiation into heat, and a boiler to store heat for later use. The potential for domestic hot water use is given as about 1 m^2 of collector area per person (Bosselaar 2001).

The mature and reliable technology of solar collectors used for domestic hot water demonstrates also a viable option of space heating. In order to meet heating requirement of a building, the solar hot water system is combined with short-term heat storage. This combined system is called *solar combisystem*. The term solar combisystems is used only for detached one-family houses, groups of one-family houses, or multifamily buildings with their own heating installations.

For combisystems, the installed collector area is larger, and additionally the collectors are supported by at least one auxiliary energy source –biomass, gas, oil or electricity. The system design differs in different countries due to local climate and local practice. Depending on the size of the solar collector surface, the storage volume, hot water consumption, heat load of the building and the local climate, the solar contribution to heating demand varies from 10 % up to 100 %. Current applications ensure that solar space heating is possible at a wide range of latitudes. However, on a horizontal plane at particular latitude, there can be not only strong seasonal variations in solar radiation, but also daily, or even hourly fluctuations (Weiss 2000). The methods used to balance out the variations and the shortfall in solar radiation, constitute the design concept of the system.

Large-Scale Solar Heating: A precondition is the use of central heating plants, i.e. heating plants supplying heat to blocks of buildings, a village or a city, via hot water distribution systems. The most feasible large-scale applications at present are domestic hot water preheating in multifamily apartment blocks, institutions, hospitals, block and district heating systems at the urban scale (Dalenbäck 1997).

There are two kinds of applications: short-term storage systems and seasonal storage systems. Short-term storage systems are used mainly for the preparation of hot water and able to store heat for one or two days. The seasonal storage systems balances the seasonal difference between solar heat supply in summertime and heat demand in wintertime (Mahler 2002). In these systems heat is stored via water storages as tanks, pits, rock caverns, and ground storages. Heating plants with short-term stores require 0.03-0.05 m^2 collector area per m^2 heated floor area and water storage volumes of the order of 50 l/m^2 of collector area. Plants with seasonal heat stores require 0.20-0.30 m^2 heated floor area and about 2 m^3 of storage per m^2 of collector area in order to cover 50-80 % of the total load (Dalenbäck 1997).

The most common application is *roof-integrated collectors*. The other applications are *large module flat plate collectors*, and *large ground mounded collectors.* An essential prerequisite is to find suitable places for collectors and storage, and roof area.

Today, Sweden and Denmark, and Germany are the leading countries in the field of large-scale solar heating implementation[68]. Sweden and Denmark have a fairly long tradition of district heating where most of the buildings in cities and bigger villages are supplied with heat from hot water district heating systems. Moreover, high thermal insulation standards limit heat demand in building, and consequently keep the water temperature requirements quite low[69]. In table A.1, some largest applications of European solar heating projects are included.

A.2.3. Photovoltaics

Photovoltaic (PV) power generation uses solar cells to convert light directly into electricity. PV cells are made of a semi-conducter material, which is treated chemically to create a positive and a negative charge layer. When sunlight strikes a PV cell, an electron is dislodged. These loose electrons gathered by wires attached to the cell form an electrical current.

A PV module is composed of interconnected cells that are encapsulated between a glass cover and weatherproof backing within an aluminium frame. Most commercial modules consist of 36 or 72 cells. Modules are then connected together as arrays -either in series or in parallel- to provide the voltage and current levels required to meet a particular load. An inverter converts DC voltage to AC and feeds the solar power into the grid. Being modular systems they provide for easy transportation and rapid installations, and installation, and enable easy expansion if power requirements increase. PV modules sold commercially range in power output from about 5 watts to 300 watts. The smallest systems power calculators and wristwatches. The other uses of PV systems are stand-

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[68] Currently, there are 65 plants, more than 10 million m^2 of solar collectors in Europe, corresponding to about 5.000 MW thermal power which is of the same order of magnitude as for European wind power. The work on developing large-scale systems were firstly initiated by IEA Solar Heating & Cooling Programme, and then most of the projects were carried out under the EU-APAS project *Large Scale Solar Heating Systems* followed by EU-THERMIE B project *European Large-Scale Solar Heating Systems for Housing Developments* during 1998-2001. In cooperation with EU projects, it is the European Large-Scale Solar Heating Network, a non-profit network of European institutes and companies that provide the knowledge transfer and the technology dissemination.

[69] For example, annual solar radiations in Sweden, Denmark, Germany and Austria are 900-1000 kWh/m^2, 900-1100 kWh/ m^2, 900-1200 kWh/ m^2 and 1000-1400 kWh/ m^2, annual space heating demands (and system costs per year) are 60-100 kWh/ m^2 (0.90-1.90 ECU/kWh) in Sweden, 100 kWh/ m^2 (0.60-1.50 ECU/kWh) in Denmark, 100-150 kWh/ m^2 (1.00-3.00 ECU/kWh) in Germany, and 100-150 kWh/ m^2 (1.00-2.80 ECU/kWh) in Austria. The annual collector output depending on type, design and operation of the system for all countries is 350-450 kWh/ m^2 (Energy Center Denmark 1997)

alone or off-grid applications, building-integrated and grid-connected systems, and large scale, grid-connected power generation (IEA-PVPS 2002, Quaschning 2004).

Stand-alone systems contribute to the provision of electricity in remote rural dwellings, and to the rural development in developing countries providing electricity for homes, schools, health centers, communications, and battery charging stations, water

Table A.1: European large-scale solar heating plants

Block Heating Plants	
Hammarkullen, Göteburg, SE 1986-	1.500 m^2 of roof integrated collectors, 4 units of 20 m^3 water in insulated steel tank, existing two multifamily apartment blocks, 400 flats
Sarö, Göteburg, SE 1989-	740 m^2 of roof integrated collectors, with 640 m^3 of water in insulated steel tank placed in a rock pit, small new residential area, 48 apartments in 20 block
Friedrichshafen, Wiggenhausen, DE 1996-	5.600 m^2 of roof integrated collectors with 12.000 m^3 seasonal storage, new residential area 380 flats in 10 blocks of multifamily houses + 50 terraced houses
Neckarsulm, DE 1993	700 m^2 roof integrated collectors, new residential area multifamily building blocks
District Heating Plants	
Kungälv, SE 2000-	Installed in 2001, it is the largest solar heating plant in Europe with 10.000 m^2 large module collectors, 800 module each 12.5 m^2 in size mounted in rows. It is estimated to gain close to 4 GMh, which is about 4 % of the annual load.
Marstal, on the island of Aeroe, DK 1996-	8.000 m^2 of ground mounted, large module collectors connected to existing small district heating network (30 GWh/a), 2000 m^3 of water in an insulated steel tank above ground. The system extended with 1000 m^2 in 1999. Consists of 640 modules (now 720), each 12.5 m^2 in size, arranged into two parallel blocks, comprising 36 rows in a 20.000 m2, facing 5° east of south, tilted 40° from horizontal. Supplies 13-15 % of 1260 household's hot water and heating requirements, with 3.250 MWh annually.
Nykvarn, Stockholm, SE 1985-	7.500 m2 of ground mounted, large module collectors connected to an existing small district heating network (20 GWh/a) in combination with 1.500 m3 water in an insulated steel tank above ground. The system is designed to cover about 10 % of the annual load.
Falkenberg, SE 1989	5.500 m^2 of ground mounted, large module collectors connected to an existing small district heating network (25 GWh/a) in combination with 1.100 m^3 of water in an insulated steel tank above ground. The system is designed to cover about 6 % of the annual load. It comprises 440 modules, each 12.5 m^2 in size, arranged into two parallel blocks of 22 rows facing 5° east of south, tilted 38° from horizontal. The solar collector loop consists of arrays, a 720 m underground pipe, circulation pump, and a flat-plate heat exchanger.
Ry, on Jutland, DK 1989	3.000 m^2 of ground mounted, large module collectors connected to existing small district heating network (32 GWh/a), serving 3000 people, 1300 households. The system is designed to produce 1.270 MWh annually, which is about 4 % of Ry's total heating requirement.

Sources: Danish Ministery of Energy, 1993; Energy Center Denmark, 1997; Dalenbäck, 1997; European Large-Scale Solar Heating Network, 1999; Mahler, 2002.

pumping and purification. Off-grid systems telecommunication applications range from remote repeaters and amplifiers for all modes of communication, including fiber-optics, satellite links and cable links, to small data link stations via phone, TV, etc. Remote systems serve as sensor power sources and data communication power for applications such as weather and storm warning, seismic and radiation monitors, pollution monitors, security phones on highways and parking lots, and traffic monitors. Lighting and signals powered by stand-alone systems are expanding with applications of bus stops, shelters, parking lots, billboards, highway information signs, etc (ETSU 1997).

Like solar thermal plants, large-scale photovoltaic power plants have also proven their feasibility in terms of grid-connected systems. But they are still expensive. Although small photovoltaic systems and photovoltaic stand-alone systems today are already competitive with conventional electricity supply systems, however large grid-connected photovoltaic systems depend mostly on governmental support[70]. One argument often used against photovoltaics is the huge amount of energy needed to produce PV systems, with the idea that more energy is used to produce systems than they can generate in their lifetime, which is expected to be 25-30 years (IEA-PVPS 2002, Quaschning 2004).

Table (A.2) includes a list of world's largest grid-connected photovoltaic power plants with power capacities > 1 MW. Since the systems are mounted on ground, these MW range power plants occupy large amount of land. For example, of the 33.000- module Hemau solar park covers 18 hectares (Paul 2004); Tudela power plant covers 6 ha and modules, having an automatic east-west tracking system, are tilted at 30 degrees; and Delphos plant (680 kW) in Foggia, Italy has two parts: The module area of 5,760 modules in the first part measures 3,800 m^2, where the modules are mounted into a single row with fixed tilt angle of 20° on land area surface of 4,400 m^2 and the second part consists of 2,700 modules with total module area of 2,700 m^2 on land area of 8,500 m^2 (Lenardic, 2001-2004).

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[70] Reliable general conditions given by fed-in laws in Germany and Spain support the erection of new large systems. Rooftop programs in Japan (70.000+), in Germany (100.000), in USA (1.000.000) and in Europe (1.000.000) are fruther incentives to increase the use of PV. At present, Japan has the highest installed capacity, followed by Germany and the US. These countries represent about two thirds of worldwide PV capacity, which is more than 1900 MW by the year 2002 (Quaschning, 2004).

Table A.2: Large-scale photovoltaic power plants (Lenardic, 2001-2004)

Power Plant, Location	**Built date**	**Peak Power**
Solarpark, *Hemau*, Germany	2003	4 MW
Rancho Seco power plant, CA, USA	1984-2000	3,9 MW
Serre power plant, Italy	1995	3,3 MW
Prescott Solar, AZ, USA	2001-2003	2 MW
Solarpark *Neustadt*, Germany	2003	2 MW
Solarpark *Sonnen*, Passau, Germany	2002	1,75 MW
Solarpark *Oberötzdorf-Untergriesbach*, Germany	2003	1,7 MW
Solarpark *Markstetten*, Germany	2001	1,6 MW
Solarpark *Saarbrücken*, Germany	2004	1,4 MW
Tudela power plant, Spain	2002	1,18 MW
Toledo power plant, Spain	1994	1,1 MW

Building Integrated Photovoltaic Systems: (BIPV) is the system in which the PV materials form the part of the skin of the building. BIPV systems are composed of PV modules and balance of system (BOS) components, which include inverters, an electricity storage system, and/or a grid-metered connection, fault protection, cabling, and wiring. In terms of their applications, the systems are: facade or roof systems added after the building was built; facade integrated photovoltaic systems built along with an object; roof-integrated photovoltaic systems built along with an object; *Shadow-Voltaic* - PV systems also used as shadowing systems, built along with an object or added later. Accordingly, building-integrated PV systems are designed to serve more than one function. As a construction material, such as a BIPV glass facade, it is an integral component of the building envelope and generates electricity. Hence, a BIPV system is defined as a multi-functional building material.

On the other hand, the acceptance of PV in most cases depend on the aesthetic quality of the material, rather than the mature environmental awareness, and the efficiency of the system depends on design and construction quality of the PV buildings. For PV buildings, the orientation of the structure, possible shadows, the correct inclination of the panels, the morphology of the volume of structure, the sum of available surface, and the amount of electrical energy that needs to be generated are important features to be taken into account (Abbate 2001). In meeting these requirements, appropriate design of the site is also essential. In that regard, large-scale solar residential developments require urban planning skills to coordinate such undertakings. For example, for the case of Mississauga House, Canada it is pointed out that the application was resulted 25 % loss of estimated total annual electricity production, since the building and thus the roof integrated photovoltaic panel face 45 degrees east of south as a result of conforming street orientation and local building by-laws production (IEA-PVPS). On the other hand, Amersfoort project in Utrecht, Holland, which is the most extensive integration of photovoltaic technology into a residential complex, is regarded as one of the best example of how these requirements can be met through design and urban planning. Meanwhile, worldwide applications have already created new architectural styles. The attempt is to develop best integration techniques. For example, Sol 300 project, which is largest BIPV demonstration project in Denmark, including installation of totally 300 systems on detached or semi-detached houses in 8 different small cities, aims to develop new mounting techniques suited for Danish tradition of construction. As a result of this project, most of the systems are now installed on the roof instead of in the roof (IEA-PVPS). Furthermore, PV roof tiles have already replaced the conventional tiles even in pagoda-like roofs of traditional Japanese architecture. The Olympic Solar Village, Sydney has provided the showcase for a green Olympics and a sustainable inner suburb residential development.

All these efforts are for integrating solar power into cities. There is an increasing attention for large-scale photovoltaic systems in the built environment and urban-scale application (Task 7 and Task 10 of IEA-PVPS)[71]. Since no land is available for the installation of ground-based system in dense urban areas, the trend is large-scale realization through distributed PV systems integrated with residential developments, commercial and large office buildings, institutions, administrative buildings, schools, sports and leisure facilities and tourism. Besides photovoltaics installed on surfaces of buildings, the systems can be installed along roads or railways (such as noise barriers),

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[71] Focusing on the building integrated systems, the objective of Task 7 of the Photovoltaic Power Systems Programme (PVPS) of International Energy Agency (IEA) –which is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD) and carries out a comprehensive programme of energy cooperation amongst its 23 member countries, including the European Commission as a participant- is to enhance the architectural quality, technical quality and economic viability of PV systems, and to assess and remove non-technical barriers. The main concern is on the integration of PV into architectural design of roofs and façades for all types of building and other structures in the built environment. Task 7 motivates the collaboration between urban planners, architects, building engineers, PV system specialists, utility specialists, the PV and building industry and other professionals involved in photovoltaics, and linking PV developments of Europe, the US, Japan and Australia to each other (Schoen et al. 2000).

or on streets as canopies, street furnitures and other elements. No high-value land is required, and no separate support structure is necessary (Schoen 2000). Examples of largest photovoltaic systems in the built environment are, Floriade exhibition hall PV system, Vijfhuizen, Holland (2.3 MW); Munich Fair PV system (2 MW); Santa Rita Jail Power Plant, CA (1.18 MW); Logistic center roof mounted system, Relzow, DE (1.5 MW); Akademie du Mont Cenis, Herne, DE (1 MW); Amersfoort residential development, Holland (1 MW); and an example of, noise barriers along A92, Munich (499 kW) (Lenardic, 2001-2004).

Amersfoort Experience (Energie-Cités 1999)

In the planning of new district of Nieuwland, in the city of Amersfoort it is decided that new development should serve as an experiment for both new environmental techniques and a high grade of sustainable living. In that regard, started in 1994 and finished by 2000, and consists of 5000 houses and 70 ha. for industrial purposes, Nieuwland comprises four different district, each of them having its own characteristics. another objective of this development project is to investigate how to develop projects like these with a complex organisational structure in which many parties are involved, such as architects, planners, builders, developers, pv-suppliers, etc. Co-operation must be straightforward and standardised, in order to reduce costs and increase acceptance of the builders.

As part of new development, it is decided to aim for an installed capacity of 1 MW with solar panels. Accordingly, urban development is structured to allow optimum installations on as many houses as possible through reorienting the streets and the waterways providing sufficient southern exposures, which is quite different than typical Dutch streets. This photovoltaic project includes 500 houses based on an average of twenty square meters of solar panels per house and a peak capacity of 100 W per m^2. The solar panels produce 1.3 MW, which is 54 % of the electrical energy required.

While selling these PV integrated houses, two different methods are applied by the Utrecht Electricity Company-REMU: One half of the solar panels remain in the property of REMU with similar conditions for using the roof space, but the house owners are remunerated by REMU for the use of their roofs. For 20 % of the electricity generated on their roof, they receive a sum equal to the normal domestic consumer tariff. The other half of the installations is sold to the residents. The current generated is fed into the grid with the residents receiving normal domestic user tariff for the whole of the electricity produced.

Another project, carried out by the Amerfoort housing corporation-SCW, comprises 114 rented houses with 50 of them using combined solar power. This project is an experience of implementing and managing solar power in social housing. Each house has 5.6 m2 of solar collector and 22.5 m2 solar cells on their roofs, and a solar/gas combination unit with a capacity of 15 kW. A row of windows below energy roof provides direct solar radiation into the house. With an agreement, the solar panel roof is in the property of REMU, the solar collector and the solar/gas combination unit are the property of Gasrent Stegas B. V. and rented by SCW.

In one of the districts, the aim of the project is investigating the possibilities of solar energy in private housing. This case includes integration of solar panels on roof of 19 luxury owner occupied houses. While solar panels belong to REMU, they act as waterproof roof covering for house owners. They pay nothing for construction and maintenance but have to prevent the panels from being shadowed and should not make any changes to the roof.

As a result, The Nieuwland project, a joint effort of REMU, Ecofys and the Italian utility ENEL, and financially supported by the Netherlands Agency for Energy and the Environment (Novem) and the Thermie programme, is one of the success stories of large-scale realization of grid connected building integrated photovoltaic system, not only as being integrated into residential complex but also its cooperation and coordination of actors involved.

APPENDIX B

THE U.K. CASE

B.1. Planning Policy Guidance Notes and Energy

Planning Policy Guidance notes (PPG) set out the Government's policies on different aspects of planning, and local authorities are required to take their contents into account in preparing their developments. Since 1992, energy has been a land-use topic to be covered in developments plants. Below are the relevant policy guidance notes:

Planning Policy Guidance 11: Regional Planning

This PPG includes advice on the preparation, scope and content of Regional Planning Guidance (RPG), and replaces the advice on RPG contained in the February 1992 version of PPG 12. While advising on the main policy areas to be covered by RPG, it places greater responsibility on regional planning bodies, and strengthens the role and effectiveness of RPG on strategic issues. Among these issues, in chapter 14 of the PPG 11, reducing demand for energy and facilitating the provision of renewable energy are introduced as two main energy dimensions to RPG. In terms of regional dimension to energy efficiency, para 14.3 and 14.4 include advices on CHP and input fuel used (DETR, 2000, p: 41):

14.3. RPG should also encourage development plans and other regional partners in their investment programmes to promote more local energy-efficient development through such measures as Combined Heat and Power (CHP) and Community Heating schemes. These need to be considered at the earliest stage of development because of the infrastructure required. CHP along with a Community Heating scheme can offer optimum energy efficiency and contribute towards urban regeneration and a sustainable environment. CHP/Community Heating schemes are particularly relevant to assisting an urban renaissance since they work most efficiently when they are supplying a mix of nearby residential and commercial buildings, particularly in high density city areas, because of the diverse heating and electricity requirements throughout the day.

14.4. RPG can also encourage development plans to take account of the planning dimension of the input fuel used. In rural areas, there may be facilities to access bio-gas or other biofuels.

In terms of renewable energy and in relation to the guidance on Preparing Regional Sustainable Development Frameworks, it is suggested that a regional approach should include regional renewable energy generation targets flowing from the assessments of each region's capacity together with environmental considerations and advice from Energy Technology Support Unit (ETSU). As outlined in para 14.5 :

"RPG should then assist in the delivery of these targets by defining broad locations for renewable energy development and setting criteria to help local planning authorities select suitable sites in their plans. RPBs should also set targets in draft RPG, where sensible to do so, for the structure plan and unitary development plan areas within the region consistent with the regional targets provided by the frameworks. More positive planning at regional and local levels will contribute to greater public familiarity with, and acceptance of, prospective renewable energy developments".

Planning Policy Guidance 12: Development Plans

In accordance with the Town and Country Planning Act 1990, structure, local and unitary development plans should include policies in respect of the conservation of the natural beauty and amenity of the land, the improvement of the physical environment, and the management of traffic. Other PPGs provide guidance on the planning policies on specific topics, and local authorities must have regard to those policies set out in PPGs in preparing plans.

The revised PPG 12, providing a more strategic overview of the role and importance of development plans within the planning system and introducing new arrangements for the preparation of plans, outlines key issues on plan content and procedures. Within its framework, the subject of "energy generation, including renewable energy" is one of nine land-use policy topics asserted in the box titled as "Subjects for Inclusion in Structure Plans and Part I of UDPs". As stated in paragraph 3.9, structure plans and part I of UDPs should include this topic where it is relevant to the particular are covered, considering both urban and rural dimensions. (DETR, 1999, p: 13)

B.2. Sensitive areas

In terms of locational sensitivities, there are different (international/national) statutory and (national/local) non-statutory designations (Harley et al. 2001). These areas are regarded as prior determinant of environmental capacity especially when assessing wind farm applications:

Special Areas of Conservation (SACs) arise from the Habitats Directive (Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora) which requires Member States to set up a series of sites whose purpose is to contribute to the maintenance or restoration of favourable conservation status of habitats or species listed in Annexes I and II of the Directive.

Special Protection Areas (SPAs) arise from the Birds Directive (Council Directive 79/409/EEC on the Conservation of Wild Birds) which requires Member States to take special measures to conserve habitats for certain rare or vulnerable species and for regularly occurring migratory species of birds.

It is Government policy that any such site is first notified as a Site of Special Scientific Interest (SSSI). SACs and SPAs are collectively referred to as *Natura 2000* sites. Under the Convention on Wetlands of International Importance, the UK Government is committed to the conservation and wise use of wetlands, partly through the notification of wetlands of international importance as *Ramsar* sites. It is Government policy that any such site is first designated as an SSSI.

Sites of Special Scientific Interest (SSSIs) are areas of land notified under the Wildlife and Countryside Act 1981 as being of national nature conservation interest. SSSIs receive greater protection through the Countryside and Rights of Way Act 2000, which introduces new procedures for landowners and public bodies in relation to activities that may affect SSSIs.

National Nature Reserves (NNRs) are areas of national nature conservation importance designated under Section 19 of the National Parks and Access to the Countryside Act 1949, or Sections 34 or 35 of the Wildlife and Countryside Act 1981. NNRs are either managed by English Nature or by others, including RSPB and the National Trust.

Marine Nature Reserves (MNRs) are areas below mean water mark and up to 3 miles offshore designated under Section 36 of the Wildlife & Countryside Act 1981. Their purpose is to conserve marine flora, fauna, geological and geomorphological features of special interest, or to provide opportunities for study or research of such features.

Areas of Special Protection are a statutory protection mechanism aiming to prevent the disturbance and destruction of the birds for which the area is identified by making it unlawful to damage or destroy either the birds or their nests and, in some cases, by prohibiting or restricting access to the site.

Sensitive Marine Areas (SMAs) are non-statutory sites identified by English Nature as being nationally important for their marine plant and animal communities or because they provide ecological support to adjacent statutory sites such as SSSIs or MNRs.

Local Nature Reserves (LNRs) are designated by local authorities because of their local rather than national interest. Moreover, *the UK Biodiversity Action Plan* is to conserve and enhance biological diversity within the UK and to contribute to the conservation of global diversity.

B.3. Examples of Renewable Energy Planning Documents

It is given that, at present, 75 % of adopted development plans contain general renewable energy policies and some are associated with supplementary planning guides or regional planning studies. This sub-title includes examples of practice documents presenting the developed local renewable energy policies under the guidance of PPG 22.

Initially, it is the report of regional renewable energy assessments, which is taken into consideration. Since the English regions and the devolved administrations were asked to undertake detailed analyses of the potential for their areas and to propose a reasonable target, this study carried out by the DTI and the DTLR, aims an overview of the UK's potentials through examining whether the targets proposed by the different regions in their regional renewable energy assessments would together be sufficient to achieve the national target for renewable electricity generation.

Providing the distribution of targets together with mix of technology by regions (Figure B.1) it is pointed out that only the high targets proposed satisfy the RO, while the low targets proposed fall short in meeting the national targets. The condition of uncertainties is also mentioned in the report: "the likelihood of hitting the target depends on whether economic, technological and planning assumptions turn out to be reasonable by 2010" (Oxera and Arup 2002, p: 34). It is also considered that the technology mix envisaged in the assessment might not be identical to the mix offered by the market even the national target is met. In addition, the study recognizes offshore wind and biomass energy having more uncertainties and accordingly, underlines that a massive deployment of onshore wind energy would be needed to meet the target if offshore wind and biomass energy prove uncompetitive. With respect to improvements in the planning system, the greater use of supplementary planning guidance on renewable energy, and the sub-regional targets are among the recommendations included in the report.

In terms of an earlier regional study, *Lancashire and Yorkshire Renewable Energy Planning Study* covering the counties of Lancashire, North, South and West Yorkshire and the metropolitan boroughs of Rochdale and Oldham, and coordinated by town planning consultants and ALTENER contractors in partnership by ETSU aims at identifying renewable energy resources in the region and evaluate the opportunities for their deployment; promoting a local level development plan policy framework fully integrated with established land-use and economic development strategies in the region; identifying the role and contribution of local plans in facilitating the pre-feasibility evaluation process for renewable energy projects; and reporting the results of the study so that the lessons can be applied in other regions (ETSU 1998).

The report of the study includes resource estimations, physical implications and principal planning considerations of each resource, comparisons between technologies and areas, and the further estimations assisted by the use of measures such as equivalent number of homes supplied, and the reduction in carbon emissions. Besides resource estimations, further analysis on energy demand densities, the general capacity of the grid to accept new generation, and the costs of connecting into the grid are also included as part of the study, and coordinated planning approach to connection of renewable energy generation is suggested for maximizing the potential benefits.

A study taken at county level *Land-Use Planning and Renewable Energy in Cornwall,* which was conducted under the guidance of a steering group comprising representative offices of Cornwall County Council, the local planning authorities and ETSU, on behalf of the DTI during 1992-1994, examines the available resources together with the technical, planning and environmental factors. The aims of the study are to draw up a model policy framework through looking at each major renewable energy resources and at the relevant environmental and planning constraints; to amplify the draft Structure Plan policy for renewable energy in accordance with outlined framework; and to draw up draft guidance and model policies covering renewable energy for local plans (ETSU, 1996).

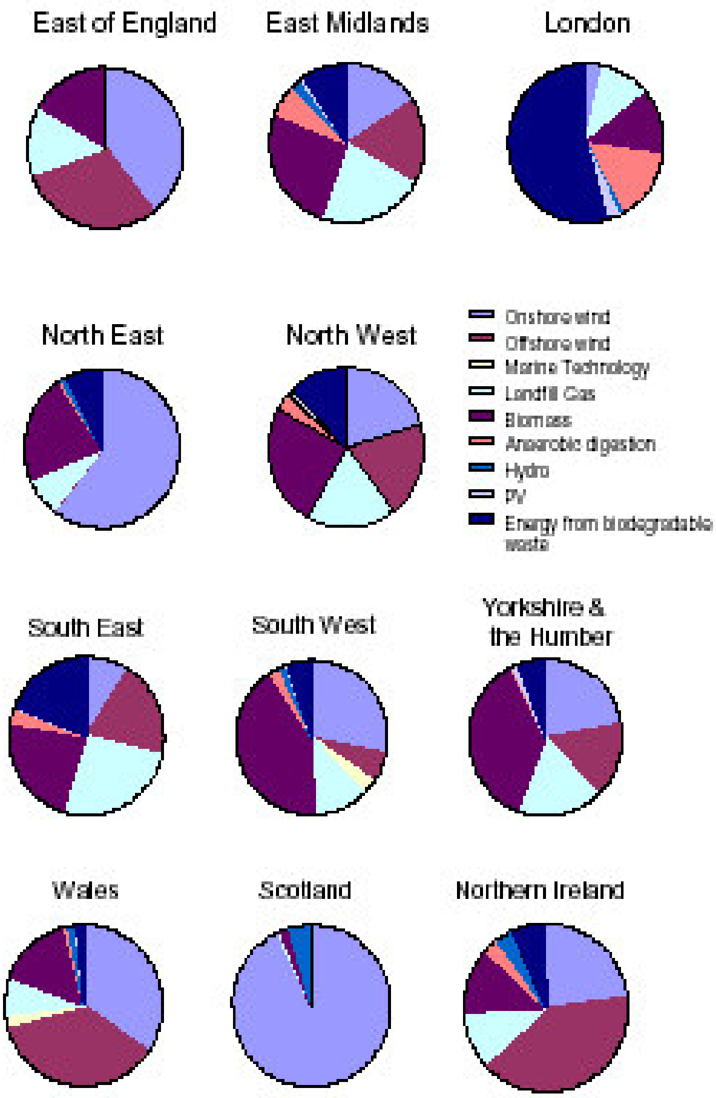

Figure B.1.Technology mix by output for the high assessment (Oxera &Arup, 2002)

As it is included in the report, each type of resource is taken into consideration in terms of site suitability, visual impact, noise, traffic generation, interference, land usage, ecology and conservation, and the structure plan under the topic of environmental and planning issues. The study identifies that greatest potential for renewable energy in the County is from wind energy, followed by energy crops and combustion of biomass arising from the treatment of farms slurry and sewage sludge.

> Parts of Devon and Cornwall… exhibit the conditions necessary for wind-generated electricity… In areas where the appropriate wind conditions prevail, development plans should include policies for both wind farm development and individual turbines… Policies should set out criteria, which show the circumstances within which turbine development would be acceptable. Plans should take account of the cumulative effect of existing and proposed wind farms in a particular area.(ETSU, 1996, p: 4).

Included in the RPG for South West, which was published in 1994, and as recorded in PPG 22 that 378 km of Cornwall's coastline is designated as heritage coast or AONB, more emphasis is given to landscape and visual impact assessments, and survey of public attitudes.

The appendix A of the report includes the visual impact assessment of Delabole Wind Farm. This study was carried out by the Council to assist them in developing Structure Plan policies on wind energy developments. Adapted form the guidelines prepared by the Countryside Commission, the methodology used in assessing the landscape quality, character and visual impact of the farm includes desktop study to evaluate landform, vegetation cover, land use and the proximity of settlements; identification of areas subject to detrimental effect; site inspection; determination of Zone of Visual Influence (in this case, extending 7.5 km from the center of the development with the ranges of 7.5 km - 5 km - 2.5 km), the use of digital terrain model computer program; determination of the landscapes types that comprise the area covered by the ZVI; definition of the status and quality of landscape by referring to statutory designations, local planning policies, official reports, local guides and site inspections; and then assessment of the impact through visualization techniques, such as photographs taken from important points identified in ZVI plans. Landscape character zones presented in the plan are coastal-type, valley-type, plateau-type and moorland-type landscapes.

APPENDIX C

PLAN DEFINITIONS IN DRAFT LAW ON DEVELOPMENT

Ülke Mekansal Strateji Planı: Ülke bütününde bölgesel stratejik değerlendirmeler kapsamında afet risklerinin azaltılması hedefini gözeterek, toplumsal yapının geliştirilmesi, verimliliğin yükseltilmesi, yeni istihdam merkezleri ve yeni kent ve yerleşmelerin planlanarak dengeli büyümenin sağlanması, doğal, tarihsel, kültürel ve çevresel değerlerin korunmasına ilişkin ülkesel, sektörel ve tematik konularda vizyon, politika, program ve hedeflerin mekansal stratejilerini katılımcı süreçlerle belirleyen, kamu kurum ve kuruluşları, kalkınma planları ile uyumlu ve dinamik yıllık programlara sahip rapor ve eklerinden oluşan planı,

Bölge Strateji Planı Kalkınma planları ve yıllık programlarla biçimlenerek, planlama amaç ve ihtiyaçlarına göre Ülke Mekansal Strateji Planı'nda belirlenecek bölgelerde, doğal, toplumsal, tarihi ve kültürel ve ekonomik kaynak, olanak ve potansiyeli değerlendirerek sektörel ve fiziksel faaliyetlerin korunması, kullanılması, sınırlandırılması ve gelişimi ile bu faaliyetlerin bölge içinde dağılımına ve afet tehlike ve risklerini en aza indirmeye yönelik hedef ve ilke kararlarından oluşan, yeni istihdam merkezleri, yeni kent ve yerleşmeler ile ana ulaşım ve altyapı sistemleri öneren, alt düzey planlara veri teşkil edecek bölgesel düzeyde sektörel, mekansal ve tematik vizyonları, politika, program, hedef ve stratejileri oluşturan, açıklama raporu ile bir bütün olan planı,

Yerleşme Ana Strateji Planı: Mekansal ve işlevsel bütünlük içeren bir veya birden fazla il sınırları bütününde veya bir kısmında veya metropoliten alanlarda, ülke mekansal strateji planı ve bölge strateji planlarına uygun olarak, afete maruz ve afet riskli alanları, doğal kaynaklar ile tarihi ve kültürel varlıkların koruma alanlarını, konut, sanayi, tarım, turizm, ulaşım gibi yerleşme ve arazi ana kullanımı kararlarını yürürlükteki tüm mevzuat hükümleri doğrultusunda yerel kalkınma amaçlı sektörel, mekansal ve tematik vizyon, politika, program ve hedeflerin mekansal stratejilerini katılımcı süreçlerle belirleyen, dönüşüm projeleri ve uygulama alanlarını bölgeleme mantığı içinde ele alan, sektörler arasında koruma kullanma dengesi sağlayan, idareler ve disiplinler arası eşgüdüm esaslarını içeren, alt düzey planları yönlendiren, açıklama raporları ve plan notları ile bir bütün olan planı,

İmar Planı: Bölge ve Yerleşme Ana Strateji Planı kararlarına uygun biçimde, yöre halkının sosyal ve kültürel gereksinimlerini karşılamayı, doğal, kültürel ve tarihi mirası korumayı, sağlıklı ve güvenli bir çevre ve afete karşı dayanıklı ve sağlıklı yapılaşma oluşturmayı, enerji verimliliğini ve yaşam kalitesini artırmayı hedefleyen ve nazım imar planı ve uygulama imar planı olmak üzere hazırlanan planları,

Nazım İmar Planı: Onaylı güncel sayısal halihazır haritalar üzerine kadastral durum, afet tehlike ve mikrobölgeleme haritaları işlenmiş olarak, doğal, kültürel ve tarihi mirasın korunması, afete karşı dayanıklı ve sağlıklı yapılaşma ilkeleri gözetilerek, Bölge ve Yerleşme Ana Strateji Planlarına uygun biçimde hazırlanan, arazi parçalarının genel kullanış biçimlerini, başlıca bölge tiplerini, bölgelerin gelecekteki nüfus yoğunluklarını, yerleşme alanlarının gelişme yön ve büyüklükleri ile ilkelerini, ulaşım ana sistemlerini ve problemlerinin çözümü gibi hususları içeren ve yerel kalkınmayı hedefleyen, sektör ve sorunlara yönelik ana planlarını, dönüşüm projeleri ve uygulama alanlarını içeren, yerbilimsel veriler, kentsel risk analizleri çalışmaları ile üretilen, riskleri dışlayan ve azaltan politika ve uygulama kararları ile sonuçlandırılan, harita ve raporlar ile uygulamaya konulan Kentsel Sakınım Değerlendirmelerini ve eki Eylem Program Alanlarını kapsayan, kentsel bölgeleri ve plan ve proje uygulama alanlarını gösteren, uygulama imar planlarının hazırlanmasına esas olan ve uygulama etaplarını belirleyen, plan notları ve detaylı açıklama raporu ile bir bütün olan planı,

Uygulama İmar Planı: Onaylı güncel sayısal halihazır haritalar üzerine kadastral durum, afet tehlike ve mikrobölgeleme haritaları ve bilgileri işlenmiş olarak nazım imar planı ve eklerindeki kararlara uygun olarak, doğal, kültürel ve tarihi mirasın ve siluetin korunması, afete karşı dayanıklı, sağlıklı yapılaşma ve çevre oluşturma, enerji verimliliğini artırma ilkeleri gözetilerek hazırlanan, yerel kalkınma planlarını, tasfiye, iyileştirme dönüşüm proje uygulama alanları ilke, karar ve sınırlarını, arsa ve arazi düzenleme sınırlarını, uygulama için gerekli imar programlarına esas olacak uygulama etaplarını ve esaslarını, bölgelerin yapı adalarını, yörenin özelliğine göre parsel tasarımları, bunların kullanma kararlarını, yoğunluk, alan büyüklüğü ve ölçülerini, düzenini, yaya ve trafik yollarını, yolların eğimlerini, köprüleri, geçitleri, meydanları, umumi hizmet alanlarını, kamu hizmet alanlarını, peyzaj alanlarını ve yapılaşmaya ilişkin, taban alanı katsayısı, kat alanı katsayısı, yükseklik, yaklaşma mesafeleri, ön ve arka cephe hatları silueti öngören kısımlarda belirlemelerin yapılarak siluet hattının tespit edilmesi kıyı kenar çizgisi gibi tüm bilgileri ayrıntıları ile gösteren, gerektiğinde alanın özelliğine göre kentsel tasarım projelerinide içeren ve raporu ve plan notlarıyla bütün olan planı,

Kırsal Yerleşme Planı: Mülkiyeti gösteren halihazır haritalar kullanılarak, ekonomik hayatın, peyzajın, doğal koşulların ve sosyo-kültürel değerlerin bitkisel üretim, el sanatları, tarım ve hayvancılık üzerine kurulu olduğu bir veya birkaç kırsal yerleşme ve civarını da kapsayan kırsal alanlarda yaşayanların yaşam kalitesini geliştirmeye yönelik olarak tarım, hayvancılık, ekonomik, sosyal, kültürel ve doğal değerlerin sürdürülebilir biçimde korunması ve geliştirilmesi, afete karşı dayanıklı ve sağlıklı yapılaşma oluşturulması ve kırsal kalkınma amacı ile Bölge ve Yerleşme Ana Strateji Planlarına uygun olarak hazırlanan, sosyal ve teknik alt yapı ihtiyaçları kırsal yaşam biçimine göre belirlenen planı,

Dönüşüm Projesi ve Uygulama Alanları: Yerleşme Ana Strateji ve imar planlarında plan kararları getirilen, mevcut yapı stokunun, kentsel veya kırsal çevrenin standartlarının iyileştirilmesi, sağlıklı, güvenlikli ve estetik yapı ve çevreler elde edilmesi, doğal, tarihi ve kültürel değerlerin korunması, afet zararlarının azaltılması, yaşam kalitesinin arttırılması, yeterli donatı alanlarının oluşturulması amacıyla yapılan sosyal, ekonomik ve fiziksel kararları içeren koruma, kullanma, yenileme, geliştirme, güçlendirme veya tasfiye düzenlemelerinden bir veya bir kaçını kapsayan proje ve alanları,

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"*Windfarms in our landscapes: a new legend in our plans*", Paper presented in the Fourth International Thermal Energy Congress, 8-12 July 2001, Çeşme-Turkey.

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