ELECTRIC ENERGY POLICY MODELS IN THE EUROPEAN UNION: CAN THERE BE A MODEL FOR TURKEY?

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_____

Prof. Dr. Sencer Ayata
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

_____

Prof. Dr. Ali Gitmez
Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

_____

Associate Prof. Dr. Hakan Ercan
Supervisor

Examining Committee Members

Assoc. Prof. Dr. Hakan Ercan (METU, ECON) _____

Assoc. Prof. Dr. Aylin Ege (METU,ECON) _____

Assistant Prof. Dr. Galip Yalman (METU, ADM) _____

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ABSTRACT

ELECTRIC ENERGY POLICY MODELS IN THE EUROPEAN UNION: CAN THERE BE A MODEL FOR TURKEY?

Kurbanoğlu, Özgür

M.Sc., Department of European Studies
Supervisor: Assoc. Prof. Dr. Hakan Ercan

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The thesis discusses Turkish energy sector by using examples, projections made by the European Union, and positions of the experts and scholars. The work discusses the process of reformation of Energy sector, and what the obstacles and difficulties are. It is important that Turkey needs progress in the process of reformation that can be satisfied by using a functioning model in the field. Turkey has to apply the legislation of the European Union as an applicant country. Turkey needs a strategy for achieving the application of the energy legislation. Different countries in the European Union have been examined in the work for finding the strategy for Turkish energy sector. The countries have been selected for their peculiarities (Greece) and their strategical approaches for shaping their markets (France, Italy, Germany, United Kingdom – G8 countries in the European Union). The result of the study shows that the energy pool applied in England and Wales of the United Kingdom is a successful example, and it can be used for electricity policy along with some other developments in the field. The work tries to propose a model for the reform to be done, for the benefit of the society.

Keywords: European Union, Energy Policy, Electricity

ÖZ

AVRUPA BİRLİĞİNDE ELEKTRİK ENERJİSİ POLİTİKA MODELLERINDE TÜRKIYE İÇİN BİR MODEL OLABİLİR Mİ?

Kurbanoğlu, Özgür

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Bu tez, Türkiye enerji sektörünü, örnekler, Avrupa Birliğinin projeksiyonları, uzman ve akademisyenlerin görüşlerini kullanarak değerlendirmektedir. Bu çalışma Enerji sektöründeki reform sürecini, ne gibi engel ve güçlükler ile karşılaşılacağını tartışmaktadır. Türkiye'nin bu reform sürecinde ilerleme kaydedebilmesi için bu alanda çalışan bir modele ihtiyacı olduğunun anlaşılması önemlidir. Türkiye, Avrupa Birliğine başvuran bir ülke olarak Avrupa Birliği müktesebatını uygulamak zorundadır. Türkiye, enerji sektöründe müktesebatı başarıyla uygulamak için bir stratejiye ihtiyaç duymaktadır. Bu çalışmada Türkiye enerji sektörü için strateji arayışında Avrupa Birliğindeki değişik ülkeler ele alınmıştır. Bu ülkeler özel durumları (Yunanistan) ve piyasalarını biçimlendirmek için stratejik yaklaşımları (Fransa, İtalya, Almanya, ve İngiltere (Birleşik Krallık) – Avrupa Birliği'ndeki G8 ülkeleri) sebebiyle seçilmiştir. Çalışmanın sonucu İngiltere ve Galler bölgesinde kullanılan enerji havuzunun başarılı bir örnek olduğunu ve elektrik politikasında alanda başka gelişmeler ile birlikte kullanılabileceğini göstermektedir. Çalışma, toplumun çıkarı için, yapılması gereken reformun uyacağı bir model önermektedir.

Anahtar Kelimeler: Avrupa Birliği, Enerji Politikası, Elektrik

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AES : American Energy Company

Agip : Italian exploration and production company for hydrocarbons

AKTAŞ: Electricity Distribution Company Operating in Istanbul Turkey

BBC : Brown Boveri Company, later became ABB as a result of a merger

boe : barrels of oil equivalent

BOO :Build-Own-Operate

BOT : Build-Operate-Transfer

BOTAŞ: Turkish natural gas monopoly

CCPP : Combined Cycle Power Plant

CEGB : Central Energy Generating Board (UK)

CHP : Combined Heat Production

ÇEAŞ : Cukurova Electricity Company in Turkey (Cukurova Elektrik Anonim Sirketi)

DEPA : Greece Gas Supply and Transmission Company

DPT : Turkish State Planning Organization (Devlet Planlama Teskilati)

DTI : United Kingdom Department of Trade and Industry

EdF : French Electricity Company (Electricité de France)

EEX : Power pool in Frankfurt/Main

EIA : Energy Information Administration of Department of Energy of United States of America

EIE : Electrical Power Resources Surveying Administration (Elektrik Isleri Etud Idaresi)

EMO :Chamber of Electrical Engineers in Turkey (Elektrik Muhendisleri Odasi)

EnBW : German electricity company (Energie Baden-Württemberg Aktiengesellschaft)

Enel : Italian electricity company

Eni : Italian oil and gas conglomerate

ENKA : Turkish contracting firm for construction of power plants

E.On : German electricity company

EPDK : Turkish Energy Market Regulatory Authority (Enerji Piyasası Düzenleme Kurulu)

EU : European Union

EÜAŞ : Electricity Generation Company (Elektrik Üretim Anonim Şirketi)

FOR : Fault in Operation Records

G8 : Group of Eight Industrialized nations

GDF : Gaz de France

GME : Electricity Exchange Administrator (Gestore del Mercato Elettrico)

GRTN : Italian Transmission Grid Administrator (Gestore della Rete di Transmissione Nazionale)

IER : Energy Research Institute in Stuttgart, Germany.

INOGATE: Interstate Oil and Gas Transport to Europe

IPE : International Petroleum Exchange

ISO : Independent System Operator

KEPEZ A.S.: Electricity Company in Turkey

LNG : Liquefied Natural Gas

LPG : Liquefied Petroleum Gas

LPX : Leipzig Power Pool

Mtoe :Million Tons of Oil Equivalent

NETA : New Electricity Trading Arrangements

OECD : Organization for Economic Cooperation and Development

Ofgem: England and Wales gas and electricity regulatory body

Ofreg : Northern Ireland gas and electricity regulatory body

PPC : Public Power Corporation

RAE : Regulatory Authority for Energy

RTE : Réseau de Transport d'Electricité

rTPA : regulated Third Party Access

RWE : German electricity company

Snam : Italian company on supply and distribution of natural gas

TEAŞ : Turkish state held Transmission and Generation Company (Turkiye Elektrik Uretim ve Iletim Anonim Sirketi)

TEDAŞ: Turkish Electricity Distribution Company (Turkiye Elekterik Dagitim Anonim Sirketi)

TEIAŞ: Turkish Electricity Transmission Grid Company (Türkiye Elektrik Iletim Anonim Şirketi)

TEK : Turkish Electricity Enterprise

Terna : Italian high voltage grid company

TETAŞ: Turkish Electricity Trade Company (Türkiye Elektrik Ticaret Anonim Şirketi)

TOR :Transfer of Operational Rights

TXU : American energy company based in Texas

UCTE : European International Energy Transmission Networks

UKCS : Untied Kingdom Continental Shelf

USITA: The United States International Trade Administration

Abbreviations for Countries

A : Austria

B : Belgium

D : Germany

DK : Denmark

E : Spain

EL : Greece

F : France

FIN : Finland

I : Italy

IRL : Ireland

L : Luxembourg

NL : The Netherlands

P : Portugal

S : Sweden

TR : Turkey

UK : United Kingdom

CHAPTER 1

INTRODUCTION

This thesis is on Turkey's energy policy. It is written on the necessity of developing a strategy on energy policy, as an applicant country to the European Union.

Energy policy as discussed in the text pertains to electricity and natural gas as it is related to the subject matter. There are two important issues on the subject matter. The first issue is the attitude of Turkey towards the European Union legislation. The Customs Union was realized before Turkey developed its status as an applicant country. Today Turkey is still an applicant country hoping for the membership negotiations to start. Applying the European Union legislation on energy is also a necessity for Turkey.

The second issue is that, Turkey is a country with a strategic geographical location. Limited energy resources of the European Union Countries have to be diversified. Turkey stands between the European Union and the energy sources in the proximity. These are namely oil and natural gas fields by the Caspian, Central Asia, and Middle East. The electricity generation pattern of the European Union will be shifting to the favor of natural gas as they are trying to phase out nuclear energy.

It can be possible that with a suitable policy Turkey can both release the burden of energy problems and can be an actor that fulfils the energy needs of the surrounding countries. This thesis discusses this issue.

However, there are two problems of crucial importance. The first one is that: the European Union legislation, by its nature, has not only one possible application. The suitable one for Turkey should be chosen among

those applications. The directive holds three options for access of electricity utilities to the network:

- Regulated access by third parties,
- Negotiated access,
- The model of a single buyer.

The connections of the electricity network functions, mainly generation, transmission, and distribution, are so interconnected that the unbundling of those functions is a hard task. The binding constraints are not limited to the object of unbundling. The bodies in the energy sector with such connections make opening up the market impossible for the Turkish energy sector.

What is more, Turkish governments have made natural gas purchase agreements. Those agreement were made in case of an expansion of electricity generation. Turkey is under strict 'take-or-pay' agreements which will result in large excess natural gas that will have an economical burden on Turkey. This severely hampers de facto liberalization of the energy sector. This burden can partially be released by selling the excess natural gas.

Those reasons are accentuating the importance of this thesis work. The literature material used in the work are common in the sense that they were gathered through a search in the academic libraries and databases, however, the thesis includes some exclusive work that is gathered from some of the experts in the Turkish energy sector, which were obtained through a series of interviews and talks with those experts.

As to the methodology, the thesis work here is a result of discussion of the experts' views about the future of the electricity and natural gas markets in Europe and Turkey. The discussion presented here cannot be replicated unless the background and the views about the energy sector today are consulted in this specific location in time. The views will change in a different evaluation of the electricity sector. However the results will be more or less parallel.

The materials used in the work are obtained from academic libraries and databases. Some of the materials are obtained from the European Union databases and International Energy Agency. The author makes assumptions via a verbal analysis of the material (including interviews with the experts and their points of views).

The contributions of the green papers, 'Towards a European Strategy for the Security of Energy Supply' and 'European Union Energy Outlook to 2030', to the thesis are great. For an understanding of the subject matter the 'European Commission directives' on 'Energy', 'Energy Products' and 'Energy Taxation' have been examined. 'Turkish State Planning Organization's (DPT) Special Expert Report on Electrical Energy' is a source for Turkish energy foresight. Some of the experts who took part in the preparation of the DPT report have been consulted. The International Energy Agency's databases and documents have been very useful in research of the most recent positions of the markets examined in the thesis. The previous work on the subject matter also includes contributions in the Europa Bridges of Knowledge Programme (Ercan and Oz, 2004) (Mantzos, 2004) (Deketeleare, 2004). The papers of Turkish scholars (Demirbas, 2002) (Demirbas, 2003) (Hepbasli and Ozalp, 2003) (Karaata and Ekmekci, 2002) (Kumbaroglu 2003) (Ozdag, 2002) in the field give an overview of the Turkish energy sector. Finally, the views of Chamber of Electrical Engineers in Turkey form the previous work in the field.

The work will not include energy in a broad sense, instead as explained above it is mostly concentrated on electricity and natural gas in the energy sector.

The issues discussed are handled in the following sequence in the thesis. Understanding what is important to the European Union in the field of energy is a crucial issue in learning about the energy policies of European Union countries. The energy self sufficiency is the ultimate

target. However, that seems impossible to achieve today because of the limits of resources located within the geography of the European Union.

Environmental issues are some of the most commonly discussed objects of the energy sector. The European Union countries which have taken part in the Kyoto Protocol have decided to limit the emissions of greenhouse gases. This is the most significant action taken on environmental issues. However, it seems to be far from enough since the countries have not taken action

The integration process in the European Union goes on in the field of energy as well. The integration starts with adaptations for a single competitive energy and energy products market. The forecasts of the European Union about the energy market(s) give clues about the course of the European Union energy policy.

After the general forecasts of the European Union, the structures of the European Union countries' energy markets and the tendencies of the member countries after the restructuring are discussed. The countries examined are mainly the G8 countries in the European Union which will set examples for the model of the energy market in Turkey.

The structure of the energy markets in the European Union are shaped according to the directives which form the legal backbone of the single integrated energy market. The countries which have some aspects that pertain to or set examples for the energy market formation in Turkey are inspected in this work. The countries inspected in this respect are listed below:

A country slightly separated from the other members of the European Union by geography, Greece, has a specific position. Its need for energy products which may be fulfilled by Turkish action make the country worth examining in this work.

France stands out with its economically centralized industry. Today, privatization, mergers and acquisitions take place in the country. The reason why these movements are accelerating are: compliance to

European Union directives and political initiatives of the government. However, the French electricity monopoly (Electricité de France) does not change its position and after deregulation still dominates the market. Yet, the French electricity monopoly buys electric utilities from other countries. France relies on nuclear energy for overcoming its energy dependence. The action for overcoming energy dependence is a necessary effort for Turkey as well. Though it gives some results, the French reply to the question is inapplicable to Turkey.

Italy has reduced the energy intensity of its industries since the oil crises in 1970s. It has an energy import policy based on diversifying the sources of fuel. Italy has a large refining capacity. Today Italy suffers from the penetration of Electricité de France to the deregulated market. Italy is trying to reorganize the power sector to protect the sector and favor the competition. The reorganization of the power sector to protect must warn Turkey about the possible risk of losing its domestic control over energy.

Energy policy of Germany has affected European Union regulations. All Member States except Germany have chosen a regulated third-party access (rTPA) system for the implementation of market opening. Large companies dominate the energy market in Germany by. As German political leaders are so fond of stating, Germany is a pioneer in developing renewable energy sources and climate policy. German policy implies that by 2010 it will double the proportion of electricity generation from renewable energy sources in 2000. German industry has worked on renewable energy sources and natural gas technologies. Today it develops technology in those fields and sells it to other countries. The German pipeline network and the energy transmission networks have been acting like a trading hub for the European countries. Turkey can possibly develop a role for the sake of natural gas trade for Southern Europe.

The United Kingdom sets a good example for the reform actions taking place in Turkey. It is the most suitable model for a deregulated

liberalizing market. The United Kingdom of Great Britain and Northern Ireland is the largest deregulated energy market of the European Union. It is a result of the efforts that have been going on since the 1980s. All consumers in the market can choose their supplier because of the completed liberalization in the country (England and Wales). The heavy dependence of the actors (which had been state owned) of the power sector has been broken for the first time in the UK. The state owned enterprises have been sold to private companies.

As the complete unbundling and deregulation took place in the UK, the competition has always been favored and controlled for the sake of the consumers. For achieving that, a regulatory body, which is in charge of the electricity transmission network, has been appointed. This is one of the methods advised to the members of European Union who are required to deregulate their power sectors. The directives of the European Commission on energy mostly benefited from the experiences in the UK.

The importance of this work lies in the fact that Turkey is an applicant country to the European Union and will need to reform its power sector for compliance to the European Union. Even if Turkey does not become a member of the European Union, it will still need to obey some rules for complying with the European Union organizations and networks such as the European International Energy Transmission Networks (UCTE) and the single energy market. The single energy market, which the European Union is trying to develop, has caused the members of the European Union to privatize, deregulate and liberalize the energy markets. The dependence of the countries in the European Union to the energy products makes those countries vulnerable to the supply shocks in the markets. Dependence on the energy products causes stress upon the members of the European Union on behalf of demand reduction through efficiency. Searching for new sources and improving the security of energy supply are other paths to follow.

The motivation for the thesis is to point out the necessity for a target in the next two decades. The Turkish power sector relies heavily on public energy investments. The structure of the sector has to be reshaped in order to privatize, deregulate and liberalize about 90% of the market for a period which is dependent upon the state policy. This research shows that Turkey's best strategy for reformation will be modeling the Turkish Power Sector on the energy market in the United Kingdom (i.e. England and Wales).

While some of those countries' energy sectors are deregulated, some energy companies do not give up their positions as monopolies, but reach out to buy the energy facilities in other countries and markets. Energy policies of countries show a variety. The energy dependence of the European countries is a fact, and those countries develop strategies to overcome their dependence.

This thesis' contribution is in the sense that the strategy and the model of the United Kingdom (England and Wales) energy market is the best one for Turkey to adopt. Yet, Turkey has some other aspects of the countries examined. Turkey needs to become a country that oversees the needs of the consumers and obeys the European Union legislation, not only for becoming a member but also for being a part of the large energy network and for the sake of a stronger power sector induced by the consumer. However, the deregulation efforts have been giving the country a course that is realized for the sake of a fully competitive liberalized market, which will be suitable for Turkey only after a couple of decades. Yet, it will only possible if the actors in the energy sector start reshaping today and Turkey can start an initiative that is truly in favor of the competition for the market.

The thesis is organized as follows: in Chapter Two, an illustration of the European energy panorama in the European Union publications is discussed. The energy policies of the selected countries among the European Union are evaluated in detail in Chapter Three. The energy

policy of Turkey is examined in Chapter Four. The discussion is presented in Chapter Five and conclusions are presented in Chapter Six. The following section discusses the European Union in terms of energy.

CHAPTER 2

EUROPEAN ENERGY PANORAMA

It is important to understand point in realizing the European market of energy is a result of European energy policy. The policy is shaped regarding the fact that Europe is dependent on conventional energy sources. The European energy panorama drawn by the EU agencies working in the field is as follows.

European Coal and Steel Community Treaty and the Euratom Treaty are two of the founding treaties of the European community, which are both related to the energy subject. However, the members of the European Economic Community had chosen not to decide on a common energy policy for that time. Later in Maastricht and Amsterdam treaties European Union had failed to initiate a common policy for energy. Today, directives concerning common rules for the internal market in electricity, concerning common rules for the internal market in natural gas, and on the promotion of electricity produced from renewable energy sources in the internal electricity market have been put into use.

These directives are the essence of a common internal energy market. They lay the common foundations of the structure of energy market in each country. Furthermore they set up the rules of a single energy market which will serve European Union and the countries willing to participate. The interdependency of the member states is not only on the issue of forming a single internal energy market, but also on the environmental issues. Climate change has become a great concern beside the security of energy supply.

Being dependent on external supplies today European Union imports 50% of its fuel requirements. By the year 2030 it is expected by

the EU transport and energy directorate that this figure will be almost 70% (European Commission Directorate-General for Energy and Transport, 2003) by 2030.

Even though oil is not the subject of the paper, it is somehow related. Today, oil is the mostly depended fuel since it is widely used for transportation of all kinds. The use of oil as a fuel is abundant; it is also used as a raw material for the petrochemical industry. Even if the European Union can give up using it as a fuel, it will still be a valuable source. (Thus most probably the oil will not be totally depleted, but it will be too expensive to use as a fuel).

The primary source of oil European Union uses is Middle East. During the oil crises it has been realized that the dependence had become too heavy a burden. That burden caused some of the members of the European Union to favor nuclear energy – and recently the new and renewable energy sources (though except hydroelectricity, renewable energy sources are in their infancy.)

Natural gas is the cleanest fuel among fossil fuels. It does not contain heavy hydrocarbons, it is rich in energy, and it is transportable and suitable for both electricity generation and use as a fuel. If it becomes a popular fuel same dangers that have been encountered for oil await the European Union. Since it is exported from Russia, Middle East and, North Africa European Union will still be dependent to sources of those countries. If natural gas becomes a substitute for oil there is also a possibility that it may deplete sooner than projected.

The European Union has taken some precautions regarding the use of energy and market structure. The following section will discuss those precautions.

2.1. Energy Self Sufficiency as a Target

The precautions taken are results of the planning and foresight efforts. Those precautions are taken to protect the community. The need

for energy in an industrialized community is crucial. The use of labor in the production techniques of industry today is becoming less and less. This is due to the fact that the machines can fulfill the requirements of the production technologies better than men do. Maintenance and energy for the machinery is necessary to operate.

As the economy becomes more dependent on machinery, it becomes more dependent on energy. However, machinery used can be developed to use less energy.

The possibility of surviving as an energy intensive economy lies in the fact that it requires foresight and planning. It is foreseen in the next few decades, need for energy will grow as the economy of European Union grows. Energy self sufficiency for European Union seems impossible for a long time unless there is a technological breakthrough. What is more there will be a higher demand for energy with the enlargement of European Union.

As the level of material comfort becomes higher the use of energy becomes more necessary. The households and the service sector will be dependent on energy as well, because of a higher welfare standard.

The use of oil and oil products for transportation is abundant, 98 % of transport consumption is the 67 % of final oil demand. Passenger transport is expected to increase 19% by 2010 within European Union. Goods transport is expected to grow by 38 % (European Commission Directorate-General for Energy and Transport, 2003).

Applicant countries will have to close the gap between the existing members, using extra fuel, and this will result in extra gas emissions. The growth in demand, and strive to overcome the existing gaps will result in saturated transport networks and cities. Another result will be negative environmental impacts.

There are precautions for lessening the effects of the growing energy needs. Some of those are related to use of electricity and heat.

2.1.1 Electricity and Heat

The growth rates of the European economies has been closely related to the amount of electricity they use. It is expected that the demand for electricity in European Union 15 will be expanded by 50 % (i.e. 300 Giga Watts electricity) until 2030 (European Commission Directorate-General for Energy and Transport, 2003).

There will be needs for new power generation units (which also operate on the principles of Combined Heat Production (CHP).) The most common method of generation with natural gas is constructing a combined cycle power plant (CCPP). The CHP is preferred as a precaution since it meets the needs for heat and lessens the use of sources for obtaining energy.

One third of the total consumption of final energy is used for heating in European Union. This figure maybe misleading since it contains household heating to steam production for industrial uses. Some of the countries in European Union have common centralized systems for heating, from individual heating systems to cogeneration heat plants, heat stations and heating networks (which are also common in some of the applicant countries).

Unless there is an extraordinary development in the field of energy this capacity has to be supplied with the already available energy sources (coal, oil, natural gas, nuclear energy, renewable energy sources).

The nuclear energy capacity is not planned to increase totally in European Union, except some countries like France (and the applicant country Bulgaria). Instead some countries are planning to close down nuclear power plants, and that may lead to a gap which has to be closed by building new power plants. If thermal power plants are built instead of these nuclear ones, there may be a slight increase in the green house gas emissions. The scarcity of the fossil fuels leads Europe to an optimistic scenario to meet those demands by using renewable energy sources.

That is a course of action regarding the limited sources of the European Union.

2.2. Limited Resources

The limited amount of fossil fuels in Europe are small and expensive to extract as reserves are concentrated and heterogeneous throughout the planet. This fact calls for an evaluation of how those resources are located.

The most significant oil reserves in European Union are located in the North Sea which is dominated by the United Kingdom. Oil is very expensive to extract in the North Sea Oil Platforms compared to the Middle East Oil Basin.

The natural gas reserves are less heterogeneously dispersed throughout the planet. The reserves in European Union are located in the Netherlands and the United Kingdom.

The use of European Union's sources depends on the use and price of the world's sources. Speed of extraction will be decided according to the price of oil and natural gas (European Commission, 2001).

Almost 80 % (Söderholm, 2000) of European Union's fossil fuel sources are solid fossil fuels (coal, lignite, peat and oil shale) which require mining. Quality of solid fuel is variable and mining costs are relatively high. The geological conditions and the social insurance rules make the European coal disadvantageous for competition (Söderholm, 2000). As a result the imported coal takes on the market. The enlargement won't change the situation in the European Union.

Regarding the nuclear fuels the Uranium mines within the European Union are becoming too expensive for mining relative to the world price (Söderholm, 2000). However, nuclear fuel is different compared to other kinds of conventional fuel, because the fission products

(recovered uranium and plutonium that are separated from the nuclear waste) can be recycled or used in the nuclear weapons industry.

The renewable energy sources have awakened public support and has led to progress. The wind energy seems to be an option. However all of the renewable energy resources are not offered the same opportunities because of the economical reasons (i.e. photovoltaic energy).

The environmental problem of using fuels that are not approved by the experts is another question. There are experts discussing which biomass and bio-fuel products are to be produced and incinerated for a healthy environment (Deketeleare, 2003).

The imported energy use in European Union is increasing for today. After the enlargement there will be a problem of higher energy use which will have to be met (Mantzos, 2003). If the energy problem is to be solved by importing fuel then there will be a dependency problem. If the needs are met through the indigenous sources, there will still be a problem of extraction or mining cost.

Using the indigenous fossil fuels will also result in serious green house gas emissions. This result will be conflicting with the fact that the European Union has to take precautions against the climate change.

2.3. Climate Change

Economic growth and energy consumption have become closely related to environmental considerations in late 20th century, because of the human caused influence on climate, which has resulted in the international treaties signed in Toronto (1988), Rio de Janeiro (1992), and Kyoto (1997) controlling atmospheric gases (Christodoulakis et al., 2000).

The countries in the European Union and the EU institutions have to consider the sustainability of the development, and development against climate change, while making their decisions,. The climate change issue has been on the table in Kyoto and the countries who have taken

part have commitments. The limited solution EU can offer lies in the tools: Taxation, State Aid, demand policy and a mechanism that is called emissions trading (European Commission, 2001).

2.3.1. Climate Change: why is it important?

The importance of the climate change is due to the fact that the face of the planet changes with the climate. The nature is going to find a new equilibrium in which natural events which we may call natural disasters may occur. Adapting to the new equilibrium of nature will cost all of the peoples of the world. The obligations of the Kyoto protocol is a call to the European Union and other developed economies of the planet.

There is an increase in the average temperatures globally. The theory is that the gases that are classified as the green house gases cause the atmosphere to act like a large green house that traps the heat and causes global warming. In average the global temperature increase reaches 0.3 to 0.6^{o}C and it is suspected that it caused the oceans to rise between 10 to 25 cm. The temperature records are what we see as a proof of global warming intensifying over the last 25 years.

The greenhouse gases created by human activity are: Carbon Dioxide (CO_2) (80 % of the total), Nitrous Oxide (N_2O), Methane (CH_4), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFC) and Sulphur Hexafluoride (SF_6). The concentration of these gases increased since 1750s. Primarily the Carbon Dioxide emissions have risen 30% since then (European Commission, 2001).

Emissions that are somehow related to energy sector reach 94 % of man made CO_2 emission. Burning fossil fuels causes the most of the emission. The results of global warming may vary from fires to long heat waves from extreme rains to raising sea (European Commission, 2001).

The fossil fuel dependence in transport sector (mostly the combustion engines) causes most of the green house gas emission.

These gases are recognized as a threat because of the climate change they cause. The climate change may affect the next generations. European Union takes its share of this responsibility. In the Kyoto protocol European Union was given a commitment to stabilize its CO_2 emissions at 1990 levels in 2000 and to reduce overall green house emissions in the period 2008 to 2012 from the 1990 levels down 8 %. (Kyoto Protocol Requirements)

European Environment Agency's projections (Schipper et al., 2001) show that there will be at least an increase of 5.2 % of green house gas emissions between 1990 and 2010 if no preventive action is taken. Total emissions of the new members and the applicant countries have to decline by 11%. However the new member countries have to catch up with the standards of European Union. The transition process may offer a permits exchange program between those new members, applicant countries and the existing European 15. The Kyoto targets seem to be far from achievable (European Commission, 2001).

As an aim, for the reduction of the emissions and for obtaining the security of the necessary supply, minimizing the oil dependence requires action for environmental needs. The owners and users of motor vehicles can be convinced to reduce emissions of CO_2 and fuel consumption by a group of measures.

2.3.2. How to Fight the Climate Change with Financial Tools

The governmental (financial) tools are state aid and taxation programs. However, the amount of taxes to be applied and the state aids are not harmonized among the states.

State aids are regarded as tools for the shaping of the energy market. There are tax exemptions and tax reductions for renewable energy sources. For the promotion of the renewable energy sources the

state aids will be removed from the fossil fuels with regard to the energy and transport policies.

With the Oil crises in 1970s, there emerged a debate about optimal amount of energy consumption. Today's members of European Union have taken some measures at the national level since then. In 1993, the 'SAVE' directive has been adopted by European Union. The directive contains development and implementing energy savings in the industrial, tertiary and residential sectors.

Energy saving efforts has gained importance with the dependence on the information technologies in tertiary sector and dependence on electricity in Industrial sector.

The studies about policies to mitigate global climate change assume countries always choose the measures that will reduce greenhouse gas emissions at the lowest cost to the world. The participating countries are never allowed to choose the policies at the lowest cost to the country taking the action (the strategy may involve higher costs to the world). If a policy reduces the world price of oil, it will increase the full incremental cost of reducing its usage and will decrease the cost of reducing its usage when the fuel is imported (Huntington and Brown 2004).

The countries will incur wealth losses or gains on volumes that are internationally traded. These wealth changes which are called 'terms-of-trade' effects are computed as the change in the fuel price times the level of imports or exports (Huntington and Brown 2004). Energy producers and utilities on the other hand cannot shift the location of their resources and power generation plants in short periods to avoid carbon-mitigation strategies.

Taxation imposed on the usage of fuels according to their carbon intensity is a policy that is adopted. Excise duty and Value Added Tax (VAT) on some products have been covered by a system of taxation (oil products, mineral oils). Denmark, Finland, Sweden and the Netherlands

have CO_2 taxes. Other policies like, Sweden imposes tax on nuclear energy, The tax collected may return to institutions developing clean technology or government subsidies to favor of renewable energy sources. Spain supports national coal industry for a clean coal technology, other members are trying to adopt such measures.

Different taxation schemes of the member countries may endanger the liberalization and unification of gas and electricity markets. For the future of the European Union the harmonization process is required for the tax and taxation procedures.

The upward harmonization between the member states had been foreseen (Huntington and Brown 2004). The future Directive on energy taxation has been analyzed in the European council and the guidelines on energy taxation were prepared during the Spanish presidency (Council of the European Union 2002) in 2002. The decision was to treat different uses of energy and particular areas of production, separately.

Minimum rates of taxation of energy products subject to (leaded petrol, unleaded petrol, gas, oil, kerosene, liquid petroleum gas, heavy fuel oil), and not yet subject to (natural gas, coal, electricity, heat and electricity produced in combined generators) harmonized excise duties have been discussed. How to treat electricity from renewable sources has been set free for member states to decide.

'The Council directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of Energy Products and Electricity' including the results of these discussions (since 1997) is applied since 1 January 2004 (Council Directive 2003). There is a transition period foreseen for the members to adopt their legislation.

The labeling scheme for electrical home appliances has made publicity understand the energy efficiency in use. Labeling directives on appliances and standards on refrigerators and boilers proved to be effective where properly implemented.

Energy need for a growing Europe may be managed by using the improved energy efficiency potential. Regarding efficiency and effectiveness demand reduction is better than supply extension as Verbruggen (2003) shows in his work regarding 24 OECD member states. In his words the electricity bills of nations tend to decrease when end use prices rise: when prices are high, efficiency improves. In practice the economies are biased towards how much energy can be saved and they supply too much energy capacities because of their dependencies.

There is also the target set by the European Union that date back to the days it was named the European Community: doubling the use of cogeneration to 18 % of EU electricity production by 2010. There is hope that with the liberalization of the market and suitable treatment, the combined heat production (CHP-cogeneration) could triple by 2010. (European Commission, 2001)

The energy efficiency in buildings, transport, and industry can be improved with introduction of new standards, just like it had been done in fields such as home appliances. The European Union supports the reduction of growth in demand. The actions for integration of energy markets are favored because of the reduction of prices of energy products such as electricity seems to be possible through competition. The next section discusses this subject matter.

2.4. Integration of Energy Markets

Aim of European Union is integration of the national internal natural gas and electricity markets of the member countries to a single market. The prices are expected to fall (with the opening up of the markets). The uniform legal framework is the directive that imposes obligations on all member states.

Providing alternatives via interconnection, the end user will have a relatively reliable energy source. The electricity and natural gas facilities

should offer their services with some qualities. The member states control these facilities under the provision of the rules of the directives. There are some problems which stand against the formation of a single market that are discussed in the next section.

2.4.1. The Problems in Internal Electricity and Natural Gas Markets

As there were no intentions of making electricity trade in a large scale, throughout the European Union the network was not shaped accordingly. The objective of interconnections being seeking security of supply in the past, today they remain insufficient for trade.

The optimum usage of interconnections of the member states is a must for electricity trade within the European Union. For the optimum usage, those networks have to be developed. Regarding the member states individually this is not an economical problem. The funding has been done by the European Union. It is only a political question for the member states.

For the natural gas there is the same question of transportation. The capacity of the existing transmission lines and the geographical obstacles are important questions to be overcome. There is a need for collaboration for the extension of the networks. It is an obstacle against the completion of the internal market in energy.

There will be a need for a tariff setting for the use of network. That is due to support building sufficient and interconnected infrastructure beyond the European Union (including the new members or applicant countries) far to the Southern Mediterranean and Caspian Sea.

The members already considered the question of dependence to energy from abroad instead of use of the utilization of indigenous energy sources. Energy sources such as combined heat and power production and renewable energy sources can have priority in support for achieving a figure of efficiency. States even can suspend the third party producers

(auto-producers, power generation utilities and private electricity companies) for the sake of security of supply.

The sources will have to be diversified to avoid the dependence on a single source of energy. Thus, the single source which may be the Russian natural gas for new members or applicant countries has to be supported with its alternatives with the liberalization efforts. One source of energy becoming cheaper may also become a problem, and that source may dominate the market. A precaution lies in the directive to give the member state authorization to prevent the market from being taken over by a single depended source (Directive 2003/55/EC of the European Parliament and of the Council, 2003.)

There should be a regulatory body (National Regulator) responsible for the security of energy and correct application of the directives in every state. This regulatory body must make sure that there is non-discriminatory treatment, and public benefit through competition are the priorities. The future of energy in the European Union will be shaped accordingly.

2.5. About the Future of Energy in the European Union

There will be some problems induced by the physical, economic, social or environmental weaknesses of energy supply of European Union.

If an energy source becomes unavailable there will be some problems according to the use of that source. It is important even if it is temporary, but it may be permanent and it may cause problems which are crucial. Temporary disruptions may be an accident, a natural disaster or a crisis, which have been experienced. A permanent disruption may be a fuel that has depleted throughout the world or finished its economical life cycle.

In the case of such a disruption, depending on the source that is out of use, European Union will utilize an amount of its indigenous sources

or at least seek alternatives. Thinking that the indigenous sources are limited in the European Union, that move can be also depleting or overloading its energy sources. If the infrastructure is not developed, that probability might turn out to be a scenario every country must face by itself.

Prices of energy products are the main causes of the economic disruptions, European Union is already trying to fight it by utilizing rules of competition through out the markets. The external economical and political factors, such as the war in Iraq and the embargo going on against Iran, the decisions of OPEC countries, all affect European Union.

If the costs of the accidents and, the harm burning the fuels causes the atmosphere are internalized. The environmental problems caused by the transportation and use of the energy products make the cost of energy more expensive than its price. The European Union has some forecasts in its publications. These forecasts are summarized in the next section..

Table 1 Primary Energy Demand Projections in EU 15 (1990-2030)

Primary Energy Demand in EU 15

Mtoe

	1990	2000	2010	2020	2030
Solid Fuels	302.8	212.4	167.4	179.5	222.5
Liquid Fuel	545.8	586.9	596.5	607.1	604.7
Natural Ga	222.1	338.7	456	529.6	555.6
Nuclear	181.4	222.8	230.3	198.7	180
Renewable	66.3	88.1	122.2	138.9	153.6
Total	1321	1453	1576	1657	1719

Source: PRIMES

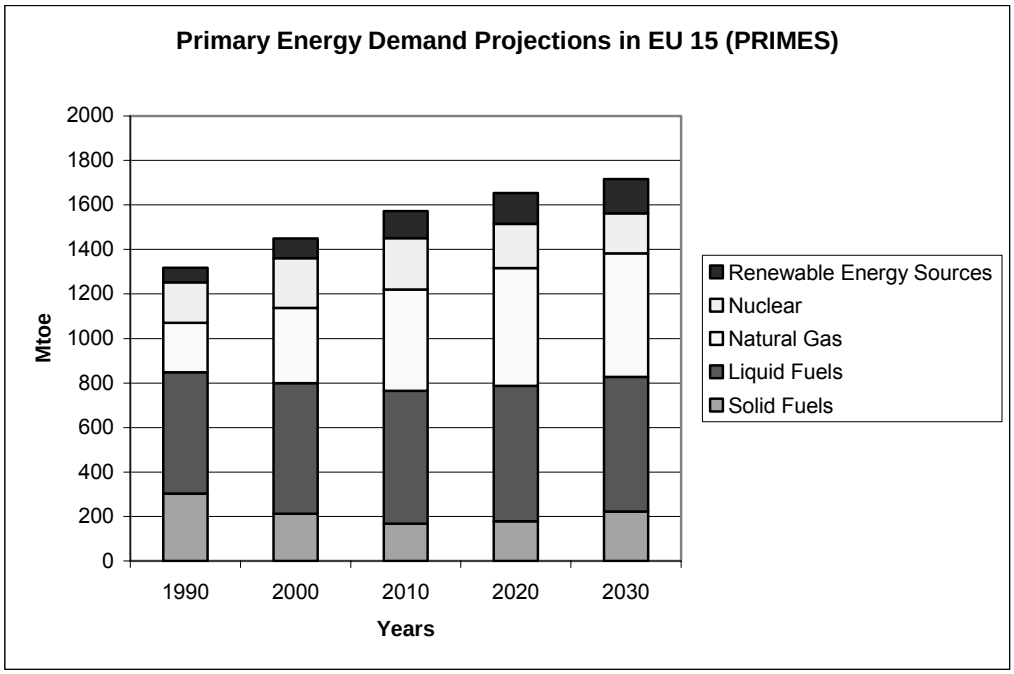


Figure 1 Primary Demand Projections in EU 15 (PRIMES)

Source: European Commission Directorate-General for Energy and Transport (2003) European Energy and Transport Trends to 2030.

2.5.1. Forecasts

The forecast in the community publications (European Commission Directorate-General for Energy and Transport, 2003) is an estimate that shows 90% GDP increase between 1998 and 2030. For that study, it has also been assumed that, the technological progress will improve energy efficiency, European Union energy markets will open up to competition by 2010, energy intensive production will be overcome by steering the economy to activities with high added value. For the generation of energy: efficient use of natural gas for electricity and heat generation, and promoting the use of renewable energy sources will be realized.

It is assumed that the member states won't change their policies regarding nuclear energy, the states without nuclear power plants will not build any. The countries that declared they will not construct new nuclear power plants, will use the existing ones to their economical and technological life spans and replace them with other technologies. France and Finland, in the European 15, will be using nuclear power.

The projections show that gross energy demand will be 11 % higher than 1998 in 2030. The Gross Domestic Product is projected to increase 90 % in the mean time. If that happens to be the case the energy demand growth will be no longer coupled with economic growth.

Structural change in energy consumption is also expected. Natural gas consumption will be 45 % higher in 2030 than 1998. The oil demand is not expected to change in percentage of energy sources. The use of solid fuel is expected to decrease until 2010, but if no strong climate policies are realized it is expected to increase by 33% of the figure in 1998 by 2030.

The projections show that the nuclear power will be peaking around 2010. As the nuclear power plants reach the end of their lifespan, around 2020 nuclear output will be slightly less than 1998 and between 2020 and 2030 it is expected to fall about 50 %.

The share of renewable energy sources will reach 7.7 % in 2030 according to the projections. That is below the 12 % target of the European Union.

Even though the figures show that the economic growth will not be coupled by the energy demand growth, there is still the dependence issue. European Union will be importing 71 % of its energy demand in 2030.

Higher CO_2 emissions will be inevitable considering the growth in demand for energy. To overcome the result of high green house gas emissions it is expected that European Union Members will switch from coal to natural gas. The present policies towards nuclear energy and the share of renewable energy sources show that the share of carbon free energy will be more in 2030 than it is today .

The European Union is also planned to enlarge during the period considered. The enlargement process will bring extra energy consumption because of the energy intensive improvements and strong economic growth.

The European Union of today or the enlarged European Union will both rely on natural gas and oil. The oil and gas imports are expected to increase in total. Nevertheless the projections of real prices show the tendency to increase.

The projections show renewable energy sources' share will be still lower than the aimed 12 %. If there are no additional policies implemented the green house gas emissions will be higher than 1990 (base year of Kyoto Protocol) figures in 2010.

The decoupling of the energy demand growth and GDP growth results in the decline of ratio of energy import quantities to GDP. However the projections show that cost of energy imports will rise faster than GDP.

The forecasts of the European Union show; a dependence of 70 percent energy imports by 2030, renewable energy sources won't make 12 % of primary energy, Kyoto Objectives cannot be met, removal of the nuclear energy from the scene will make it difficult to overcome the climate

change. As a result of the forecasts European Union has put forth its priorities.

2.5.2. Priorities of the European Union

European Union has put some targets and priorities for the future of energy use. Generally speaking the solution to the increasing energy demand seems to be increasing the supply. However, since the indigenous sources are limited and the external sources are out of European Union's control, this is not an easy task to achieve. The solution lies in both the demand and supply side. Controlling the demand within the European Union may solve an important part of the problem (European Commission Directorate-General for Energy and Transport, 2003).

Controlling demand may be possible by using the tools: taxation, legislation, and market instruments. Energy saving must be encouraged by establishing a market in which the prices reflect the real costs. A gas market open to all available gas sources should be encouraged. With that the natural gas sources can be diversified.

Taxation is a powerful tool to manipulate the behavior of the operators. With the directive on taxation of energy products (Council Directive, 2003) put into use in 2004, it is possible to an extent.

Energy saving, regarding the vehicles, must be developed to use fuel more efficiently, and new technologies are to be encouraged. The use of new fuels, alternative to the fossil fuels, is to become more common for transportation and heating. Demand reduction via development, and use of alternative and new technologies are to be encouraged.

The road transport will be tackled with alternative transportation modes like railways and use of inland waterways. The alternatives may reduce the consumption of fossil fuels. The road transport is to be restructured with classification and regrouping of logistics. Railway transport and road transport will be rearranged; measures will be taken

like using tolls for competing roads. Encouraging the public transport will be useful. The principle ‘polluter pays’ should be a notion everyone is aware of.

Regulatory energy saving rules for buildings are to be put into use. The use of renewable energy sources in the buildings as built in systems will be encouraged.

Nuclear energy and solid fuels are to be given up. Oil causes its own security and environmental problems. Renewable energy sources have technological problems that keep them uncompetitive. In the long run the natural gas supplies may face the risk of instability.

New and renewable energy sources (except hydroelectricity that has not got much unused potential for European Union) seem to be the first option for action in relation to security of supply. The European Union target is 12 % share of the energy consumption for 2010. The technology used is expensive and cannot find much application thus. But thinking the external costs of the conventional technologies that the operators do not pay for (the emissions or heat pollution), the money spent for developing the equipment seems to be just.

Since the nuclear energy does not have emission problem, the nuclear energy lifts some load off European Union. The problems of contamination, nuclear waste and fuel management are to be solved. If they are solved then a major problem about the future of the energy supply will be clarified. The development the European Union has been looking forward to is the advancements such as nuclear fusion controlled. The European Union agencies are still working on nuclear technologies, which also bring some income as a result of the technology sales, and power plant constructions.

The nuclear power plants that finish their life cycle and cannot be renewed will be shut down. This will bring a burden to the states that operate them.

Some European Union countries stock oil and natural gas they buy in local reserves which protect them against price fluctuations. In the case of natural gas this means no international agreement in the form of take or pay. European Union considers the amount of reserves for the whole European Union.

The option of coal as an indigenous and reliable energy source is to be thoroughly examined in the European Union.

The economic risks in oil supply can be limited by tightening the competition rules in the refining and distribution portions of the sector. The competition is to be protected by avoiding barriers.

The European Union is to use political and economical influence for flexible and reliable external supply. Relations with the energy producer countries and supply networks gain importance. The construction of new pipelines will open new opportunities to European Union. The network question and the international relations to countries (either producer or on the route of the pipelines) should be evaluated together.

Special attention is paid to INOGATE (Interstate Oil and Gas Transport to Europe) Umbrella Agreement. The interconnections with the neighboring countries and within the European Union should be cleaned of bottlenecks.

These are the priorities of the European Union in setting the policies. In the following chapter, some of the countries in the European Union (Greece and the G8 countries in the European Union) will be verbally examined.

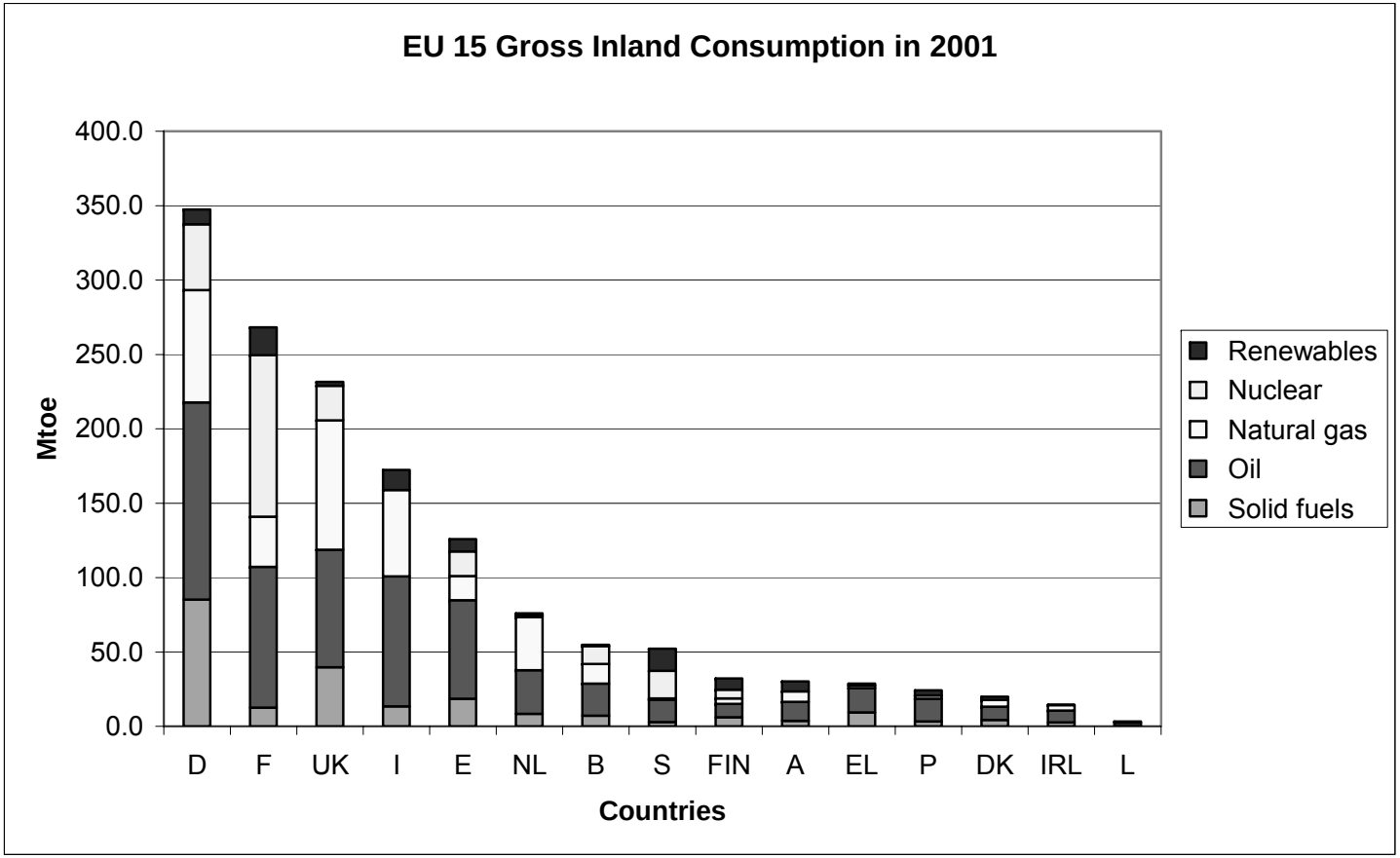


Figure 2 Gross Inland consumption in EU 15

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

CHAPTER 3

ENERGY POLICIES OF SOME EUROPEAN UNION COUNTRIES AND THEIR MARKET STRUCTURES

In this chapter the energy policies of Greece, France, Italy, Germany and finally the United Kingdom will be examined. The chapter will concentrate on their policies about electricity and eventually natural gas.

The geopolitical developments after the destruction of the World Trade Center Towers have uncovered the concerns about the energy security. The subject had always been a question in the minds of world governments: member countries of the European Union had debates about cross-border policies for the construction of energy markets, Asian countries had placed emphasis on using their domestic sources, USA had a policy for protection and use of the domestic sources.

The importance of the energy sector has been understood after the oil crises in 1970s. The literature is focused on the use and dependency of the energy afterwards. The energy was thought to be abundant before, regarding the amount needed and the fossil fuel prices (Lovins and Lovins, 1982).

Political and economical concerns about energy imports have been surfaced with the energy crises. Energy security focuses upon energy vulnerability rather than energy imports. A region wide project had been initiated considering Interstate Oil and Gas Transport to Europe. The program is called INOGATE. The aim is a diverse, secure, environmentally-friendly and cost-effective energy supply for European Union. The umbrella agreement of INOGATE has been signed by

countries involved in energy production and energy product transportation facilities such as oil and gas pipelines.

The climate change issues are also a great concern regarding the energy utilization in the modern world. Policymakers are likely to consider these as well. If the energy imports are to be reduced and domestic energy sources favored, the result will be different climate policies than the ones considering only reducing greenhouse gas emissions.

The climate change policy studies (Huntington and Brown, 2004) have generally focused on the cost of compliance with the Kyoto Protocol recently. The studies relating to the Kyoto Protocol - like the protocol itself – restrict emissions to levels linked to 1990 levels.

With the decisions of the Member countries to phase out nuclear energy the dependence on conventional fuels will be intensified. The elimination of fossil fuels that cause greenhouse gas emissions will lead the European Union to the use of new and renewable energy sources. Only exception to abandoning of fossil fuels seems to be the use of natural gas. Natural gas is preferred among other fossil fuels because of its price and rich energy content. Natural gas has low carbon content compared to other fossil fuels, which means less Carbon Dioxide emissions when burned.

The European Union institutions have started some actions for integration of energy markets (including all energy products and every energy market in the European Union), the most important of those actions being implementation of European Commission directives on energy. The following section concentrates on those directives.

3.1. Steps for the integrated market: Directives

Establishing a single energy market in the member states of European Union which will be based on open and competitive markets is a target to be achieved. With this target European Union is trying to make the mechanism of competition work for the consumer. The competitive

ability of European industry will be higher with cheaper energy. It will be beneficial to the prices and competition power in the international markets. The directives concerning gradual deregulation of electricity and natural gas internal markets were two steps to achieving a single market in energy.

Directive 96/92/EC of the European Parliament and the European Council (1996) on the deregulation of the internal market in electricity came into force in 19 February 1997. The application, which is opening of the market, began on 19 February 1999. From February 1999 on, the producers are free to build, new power plants in any location in the European Union, according to the directive, either regarding the authorization procedure system, or a tendering procedure. Member states have the freedom of choice between two ways of establishing competition provided by the directive, but most member states prefer to use the authorization procedure for the construction of new power plants.

For markets to become competitive, the markets generally needed restructuring for new systems of transactions and new mechanisms to be established. Member states need to adapt to new competitive environment. The member states were required to open up their markets to a minimum. The minimum requirements were same for all member states even though some member states had different targets to achieve. Finland, Germany, Sweden, United Kingdom have undertaken to open up 100 %. Denmark decided to open up 90 % of the market indirectly by permitting all distributors to obtain energy freely. Other markets also decided to open their markets to a greater extent than required. 74 % of the demand will be liberalized, and over two thirds of the consumers will be able to choose their producer by 2007.

The directive clearly states that there will be three methods of accessing the transmission networks. These are:

- Regulated access by third parties,
- Negotiated access,

- The model of a single buyer.

Germany and Denmark have chosen negotiated access, the other member states chose regulated access procedure (Denmark also uses this procedure today, as it has declared before)

The directive requires three measures: Members must ensure the separation of the management of transmission system operator (1), must ensure the accounting and operational separation of the production, transmission and distribution sectors from the other sectors of the enterprise (2), must ensure the establishment of the appropriate mechanisms for preventing the distribution of classified information from the transmission system operator to other sectors of the enterprise (3).

Separation of supply system operators from vertically integrated undertakings was accepted by most of the member states. Eastern Austria, Belgium, Western Denmark, England and Wales of the UK, Finland, Greece, Holland, Italy, Portugal, Spain, and Sweden appointed a independent legal entity as the organization that manages the supply system. Western Austria, France, Eastern Denmark, Germany, Scotland and Northern Ireland of the UK decided to make sure that the entity responsible for prevention of exploitation of the transmission system is independent in terms of management, but without entitling a separate independent legal entity to be appointed.

Categories of public service obligations in the states' general economic interest concentrated under the headings: environmental protection, security, regularity of services provided, and price fixing policy for each state. Each state is to implement the necessary measures for accomplishing those obligations without limiting transactions and competition.

The governments may enforce distribution companies to supply their customers with electricity under the conditions such as the supply of electricity to geographically isolated consumers at reasonable prices, the guaranteed supply of electricity to people with health problems. The

objectivity, transparency and equality of these measures on all enterprises have to be ensured.

The competitive environment established may have its own kind of problems which did not occur before in the member state's market conditions. Those problems require European Commission's attention.

The directive concerning the common rules for the internal natural gas market, directive 98/30/EC, was adopted on 22 June 1998 and came into force on 10 August 1998. Member states were obliged to implement this directive by 20 August 2000. It established the rules for organization and operation of the natural gas sector including the access to the market, system's operation, criteria and procedures followed for storage and natural gas. The natural gas market in European Union will open to competition reaching 33 % of total consumption by the year 2008. Member states are to integrate the rules of the EU directive into their own legislation.

For some member states the deregulation has already been fulfilled. United Kingdom had already deregulated the natural gas market by May 1998, Ireland has opened the market to large consumers, in Germany by April 1998 all customers were able to choose their supplier. Some other member states adopted legislation and opened portions of the market such as Belgium, Holland, and Spain. Rest of the member states announced their proposals to European Union. To achieve the healthy enlargement whilst deregulating the market the European Commission decided to implement a technical support program for the candidate countries.

The market opens to competition with liberalization of the natural gas industry to freely choose its supplier; later on with liberalization of natural gas using electricity utilities; consumers from 25 million m^3 annual consumption to 15 million m^3 and followed by 5 million m^3 consumption, until 10 August 2008.

The customers that are classified eligible are able to negotiate and contract with any chosen national or international natural gas enterprise through two procedures: negotiated access to the network, or regulated access. The procedure is to be set by the member state and state must ensure that administration of both of the procedures to be on objective, transparent, impartial criteria.

The implementation of these two directives, to function together with the later Directive 2003/87/EC on establishing a scheme on greenhouse gas emission allowance trading within the Community, Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market, and Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity are seen to establish a European market for energy that functions within a European Policy for energy.

The country Greece and the G8 countries within the European Union set examples for market structures. As a country neighboring Turkey and having the priorities such as reforming its energy market structure, Greece is a unique and important country to be examined.

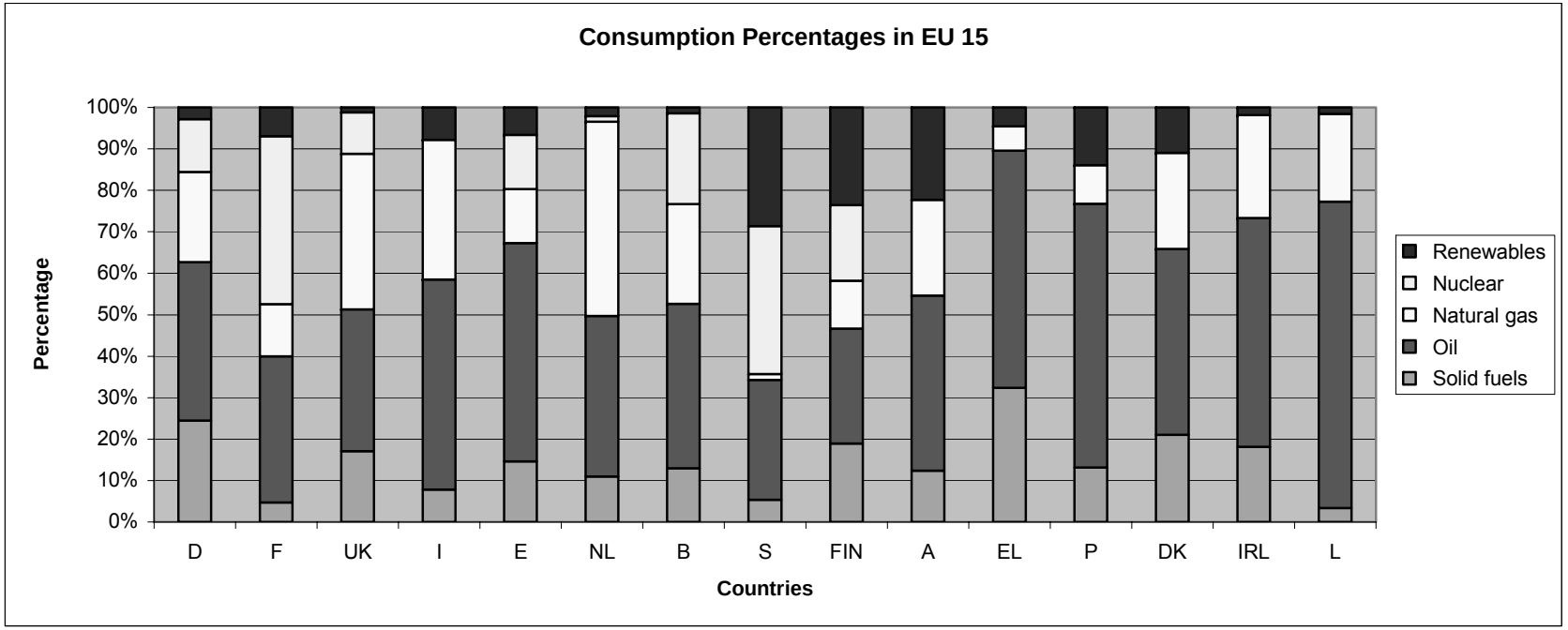


Figure 3 Consumption Percentages

Table 2 Gross Inland Consumption Data for EU 15

2001 - Mtoe	D	F	UK	I	E	NL	B	S	FIN	A	EL	P	DK	IRL	L	EU-15
All Fuels	**348.8**	**262.3**	**232.5**	**176.6**	**126.3**	**77.6**	**55.6**	**51.6**	**33.2**	**30.3**	**28.9**	**24.2**	**19.9**	**14.4**	**3.8**	**1486.2**
Solid fuels	85.0	12.6	39.6	13.5	18.5	8.3	7.1	2.8	6.1	3.7	9.3	3.2	4.2	2.6	0.1	**216.6**
Oil	132.7	94.6	79.2	87.3	66.2	29.4	21.7	15.1	8.9	12.7	16.4	15.4	9.0	8.0	2.4	**598.9**
Natural gas	75.6	33.8	86.8	58.1	16.4	35.5	13.2	0.8	3.7	7.0	1.7	2.3	4.6	3.6	0.7	**343.7**
Nuclear	44.2	108.6	23.2	0.0	16.4	1.0	12.0	18.6	5.9	-	-	-	-	-	-	**229.9**
Renewables	9.9	18.6	2.7	13.5	8.3	1.6	0.8	15.0	7.6	6.7	1.3	3.4	2.2	0.3	0.1	**91.9**

Source: Eurostat

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

3.2. Energy in a neighboring country: Greece

The geographical position and the energy dependence of this country make Greece related to Turkish energy policy. Energy sector is one of the most dynamic sectors in Greece. The high increase of the prices of the oil products had caused inflationary trends during the oil crises. The limited development of the railway industry, development of manufacturing and assembly type operations, lesser usage of the railways are responsible for developments in energy sector (ICAP Delos, 2001). The mild Mediterranean climate lessens the energy consumption of the average consumer for heating. In 1990s the renewable energy sources were introduced to the Greek energy market. Since the middle of 1990s the liberalization movement in the Greek energy has been going on. The production sector of Greece is poor and energy consumption per capita is mild (Christodoulakis and Kalyvitis, 1997). The energy need for heating and cooling has recently climbed up because of the increase in family disposable income.

The public transportation is underdeveloped and the traffic is slow in the cities, facts both of which result in high fuel consumption per capita per kilometer. In building designs the energy efficiency is not one of the criteria considered. The Ministry of Environment and Public Works in Greece introduced an energy identity program for new buildings. The agricultural production is becoming more energy intensive as the needs for pumping water for agricultural output is increasing.

As Greece's gross domestic product per capita converges with the European Union average, it is expected to increase the energy consumption. Without the necessity of extensive heating the Scandinavian and other north European countries need, the energy consumption per capita presumably will not catch up with them. Provided efforts undertaken towards energy conservation and promoting energy efficiency pay off, the energy consumption may grow in a slow pace.

Greece is next to the last places in all the energy consumption ranking in the European Union, which is due to the structure of its production, the GDP composition, and climatic conditions. (Table 4 Energy Balance for the European Union)

The activities in the Greek Energy sector mainly include hydrocarbons, electricity and lignite mining. In the hydrocarbons, natural gas is developing fast. The introduction of natural gas was sponsored by European Union with a 40 % of the investment. Greece has been importing natural gas from Russia, and liquefied natural gas from Algeria (Christodoulakis et al., 2000).

In Greece the main energy source is oil and it is almost completely imported. The exploration within Greece is going on in four different regions. In the North Aegean Region the Prinos oil field produces a limited amount of crude oil (1.6 % of annual production.) Oil is refined in four refineries and marketed by over 20 companies in Greece. The deregulation of retail market in oil products petroleum products was realized in 1992. The consumption of oil products in Greece is lower than it is in other European Union countries (ICAP Delos, 2001).

The energy consumption per inhabitant is the lowest in OECD countries. The comparison shows also a difference in the share of oil in the energy market. The share of oil consumption is comparably higher than the European Union and world, whereas the natural gas consumption is very low. (Figure 2 Gross Inland consumption in EU 15) That is a result of the structure of the electricity market and electricity network infrastructure.

3.2.1. Electricity in a separated network

The geography of the region and Greece being separated from the other European Union members, for today, gives the country a unique position in energy affairs.

The Public Power Corporation was established, for handling electricity generation and transmission at the lowest possible price throughout Greece, in 1950. Electricity generation system includes the mainland system, the connected islands (Crete and Rhodes) and independent systems of remaining islands. The lignite firing power plants PPC owns provide a figure of 65 % of the total electricity demand(ICAP Delos, 2001).

With 33 % of the total energy consumption supplied from solid fuels Greece has the highest figure. The use of solid fuel (Lignite) for some 80 % of the total electricity production in 1998 shows the conventional coal fired power plants were the backbone of the electricity generation system(ICAP Delos, 2001). (Figure 2 Gross Inland consumption in EU 15)

The renewable energy sources' share (Solar, wind, biomass, geothermal energy and hydroelectricity) in Greece's energy consumption reaches up to 6 % of the total demand. The wind energy (reached 110 MW in 2001) is not extensive in Greece. Solar energy is utilized in the form of hot water in the widely used form of simple flat solar water heating panels. The limited photovoltaic systems in the islands (that reach 1 MW) are used for domestic uses and they are simple applications. The geothermal potential is used for electricity and heating. The production of bio-fuels and utilization of vegetal production is below the desired level but there are attempts to promote these resources. (Figure 4 Electricity Generation in Greece)

Only a small portion of the energy market is truly deregulated. That portion is the distribution of the liquid fuels, and sale of oil products from refineries to various stations in different regions of Greece. In 2001 the electricity market has started deregulation, however; the full deregulation will be complete in 2005. For the liberalization of the electricity market there are middle and high tension eligible clients, the low tension and domestic consumers are left out of market liberalization for the time being. The liberalization for natural gas market in the country is to be completed

by 2006. Private initiative is interested in this market and the import capacity of DEPA (Gas Supply and Transmission Company) has become congested (ICAP Delos, 2001).

The customers in Greece which use high and middle tension energy have the option to obtain electricity from producers different from PPC. The competition was planned to start from energy imports. It is estimated that the increase in electricity demand will result in 450 MW additions to the capacity every year from 2004 for 10 years (Christodoulakis et al., 2000).

Greece's cooperation will be necessary in the energy field for a competitive energy market formation in South Eastern Europe. Importing electric energy from countries is made only possible by Greek Laws if: ownership of generating capacity is established and operating in a EU member state; necessary reserved capacity is in the territory of European Union; transmission capacity of the transmission system and interconnection is available. For Greece, the possibility of importing electricity from countries which it has borders to and that are not European Union members depend on concluding bilateral agreements on conditions sorted out by the European Commission.

The definitions of Regulatory Authority for Energy (RAE) and Independent System Operator (ISO), on European models, have started the creation of a new competitive market structure which may lead to development of this sector.

The increase of consumption of energy in Greece and its proximity to Balkan countries and Turkey may cause development of energy import relations from those countries. The political instability in Balkans has caused the electricity network destroyed during the war in Yugoslavia; the Trans European Energy Network had to be extended by an underwater electricity link from Italy to Greece which has a problem of congestion (Directorate General for Energy and Transport, 2001).

Greece's particular geography calls for development of a decentralized energy production in the territory. Small units producing electricity and thermal energy from renewable and traditional sources may find application opportunities. The same geographical conditions make the investment of an infrastructure costly for natural gas and electricity networks that stretch out to the isles through permanent lines (Kabouris and Perrakis,2000).

For establishment of a South Eastern Energy Market the participation of the countries in the region including the only current European Union member in Balkans, Greece, is necessary.

Having examined Greece, a European Union country with decentralized and separate clusters of network, the next section discusses a country that has taken a long way for the sake of self sufficiency after the energy crises, France.

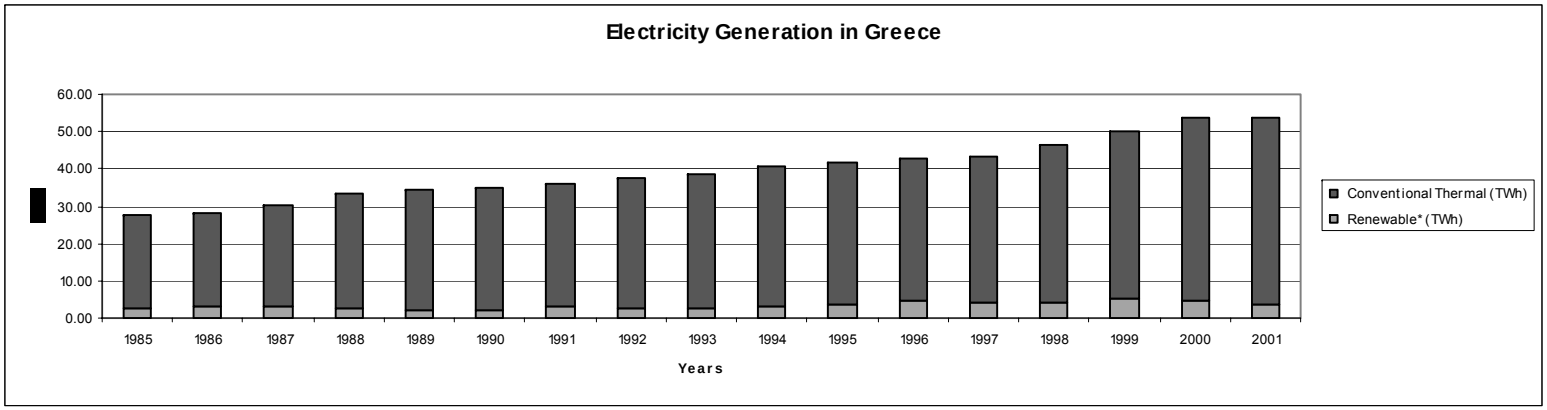


Figure 4 Electricity Generation In Greece

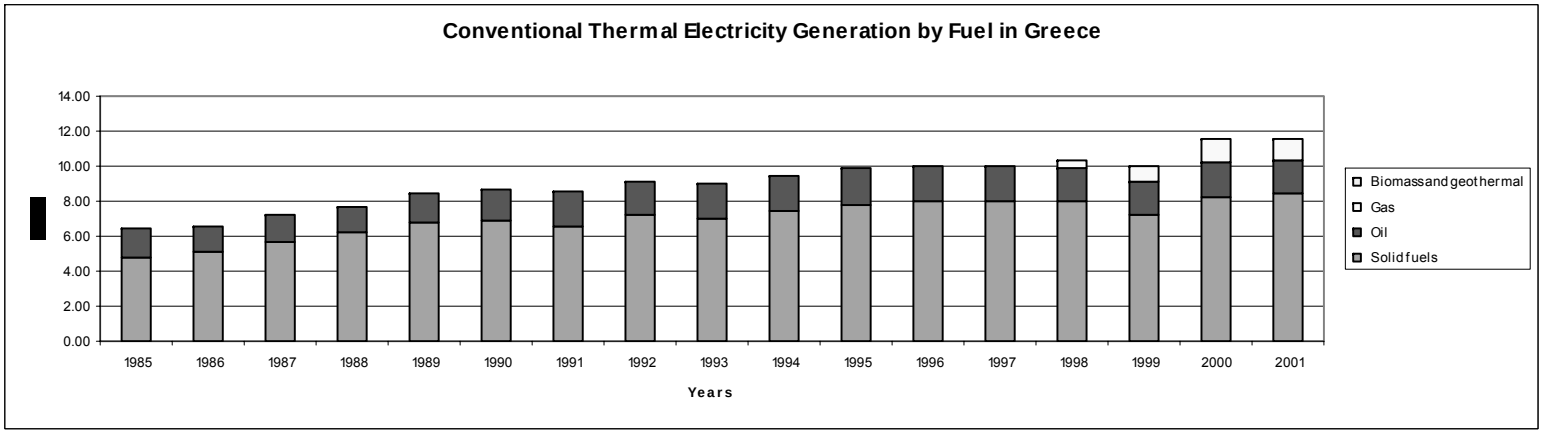


Figure 5 Conventional Thermal Electricity Generationby Fuel in Greece

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

3.3. Action to Overcome Energy Dependence: France

France is the fifth largest industrialized economy of the planet, and also a founding member of the European Union and a member of the Group of Eight Industrialized nations (G8). The French power sector has been shaped for maximum self sufficiency, in spite of the fact that it needs energy imports for economical growth. The growth of France was stronger compared to its neighbors in the past few years. However, the public deficit has breached 3 % ceiling of the European Union's Stability and Growth Pact. The reaction of European Union is to issue 'excessive deficit procedure' which results in fines. Among the Western European Countries, France stands out as an economically centralized industry. The state owned aviation, telecommunications and energy industries, until now. Today, privatization, mergers and acquisitions take place in the country. The reason why these movements came to haste are: compliance to European Union directives, and political initiatives of the government (EIA, 2004).

The large portion of the electricity market is controlled by the French state owned electricity utility company, Electricité de France (EdF), which has acquired some utilities from other member states such as Italy and Spain after the opening up of the market. Today, for the sake of liberalization, the partial privatization of the state owned Natural Gas Company, Gaz de France (GdF) and Electricité de France (EdF) has been going on.

Most of the energy industries in the European Union are facing a challenge today: Liberalization for economic efficiency, and reducing the emissions of gases and pollutants for sustainability. France has a limited supply of fossil fuel resources and the oil crises of the 1970s have affected the country in a negative way.

The oil embargo gave credibility to the ongoing debate about building more nuclear power plants for a cheaper and abundant energy

source (Hadjilambrinos, 2000). France focused on nuclear power and indigenous energy sources, and started to reduce the amount of fossil fuel it imports (Figure 7 Net Fossil Fuel Imports to France). The efforts of the European Union to address the problems of acid precipitation and the increasing concerns over Carbon Dioxide emissions and global climate change were presented as justifications for continuing nuclear development (Hadjilambrinos 2000).

The French consumption of energy is projected to rise 1.1 % per year until 2020. As it will, France plans to increase the amount of nuclear energy it uses. It is projected to increase 0.5 % per annum until 2020, while the use of nuclear energy in west Europe is expected to decrease because of the European Union policies. It is not to be forgotten that France relies on the fissile raw material (Uranium) from African Francophone countries. As the name implies the former colonies are loyal to France. France's policy has changed toward the former African colonies after the emergence of new suppliers in the international market such as the former Soviet states (Pederson 2000). Regarding the planned phase out of the nuclear reactors in Western Europe, France may have problems about nuclear fuel in the future.

95 % of the oil used in France is imported, and oil consumption is expected to increase 0.4 % per annum until 2020. The French administration is extremely conscious of the fact that they are dependent on oil imports. The French oil companies have projects in North Sea, Africa and Latin America(EIA, 2004).

Natural gas France has is a very small supply of its consumption. Thus France is dependent on imports in this field, too. France receives most of its supply from Norway, followed by Russia and Algeria. France's natural gas consumption is projected to increase 4.2 % per annum until 2020. The French coal mines are planned to be shut down by 2005 (International Trade Administration, The Energy Division, 2004),.

The nuclear power program seems not to relieve the pressure of air pollution from France. The major responsible for air pollution is the road traffic transport in the country. Some cleaner motor fuels have been introduced to the market to reduce the emissions.

The oil tanker spills along the Atlantic coast have affected the country in a negative way. There is an attempt for maritime control in France though it has been regarded insufficient by Greenpeace. France has been found faulty by European regulators for non compliance with the Surface Water Directive. The European Court of Justice ruled against France on 8 March 2001 for being out of the limits of nitrates required under the directive. France had also been criticized for lacking a systematic plan to combat pollution. Even though the nuclear power and hydroelectricity relieve some of the burden of green house gases, France has not taken any measures for protection and preservation of the nature.

France has a monopolistic power sector which has not changed after the deregulation and liberalization of the power sector. The electricity monopoly has bought electricity utilities from the other European Union members.

3.3.1. Electricity monopoly in France

France has been slow in privatization of the state owned energy monopoly, and the monopoly has acquired utilities and shares from other countries' energy facilities. The European Union Competition Commission is investigating the involvement of state of France in those acquisitions.

In February 2000, France passed the legislation that started the electricity sector's liberalization. With the legislation 1,800 industrial and commercial consumers became able to choose their supplier. All facilities that consume more tan 7 GWh are free to choose supplier, today. High tension transmission network (Réseau de Transport d'Electricité, RTE), that is independent from Electricité de France (EdF), was established and

became official on July 2000. It offers access to the network, and supervises natural gas deregulation as well. (EIA, 2004)

Gaz de France (GdF) is the state held natural gas monopoly on importation and distribution, and it has the largest storage facility in Western Europe. Not unlike Electricité de France (EdF), Gaz de France (GdF) also has acquisitions from other member countries, and it is a state owned monopoly. The same objections for Electricité de France (EdF) are also valid for it. Gaz de France (GdF) buys gas from mainly Norway, Russia and Algeria with long term contracts. It also buys gas on the spot market and from UK's North Sea with short term contracts.

Gaz de France (GdF) acts like a hub for Western European natural gas. There is the pipeline that connects the Norwegian natural gas field to the French natural gas grid, the NorFra pipeline. French facilities offer gas transportation opportunities with new pipelines. France has also the largest figure of liquefied natural gas imports in Europe. 90 % of its Liquefied Natural Gas comes from Algeria(EIA, 2004). French Energy Regulation Commission has taken a decision that Gaz de France should open its terminals for use by the other energy companies.

The Powernext electricity trading market was activated in France. The Market auctions standard hourly contracts for physical delivery of electricity to customers under responsibility of RTE and guaranteed by Clearnet, subsidiary of the Euronext stock exchange. Powernext trades less than 10 % of the French electricity market, and acts as a price reference (EIA, 2004). The French electricity futures trading consisting of gas electricity futures contracts, Carbon Dioxide and Weather derivatives is planned to be done by Powernext.

Lacking the rich indigenous energy sources, future self sufficiency will depend on conserving energy and developing renewable energy sources. Hydroelectric power today takes up 7 % of the country's power consumption. Geothermal, Solar, and wind power are increasing in share, but their total is less than 1 % of the total annual energy consumption (EIA,

2004). France seems to be eager to meet the Kyoto commitments, and it has taken some long term measures to encourage the use of renewable energy sources. The government target is to provide 21 % of power consumption by renewable means by 2010 (EIA 2004).

France seems to take a strong action on the supply side of the power sector. The next country that will be discussed is Italy. Italy is an example that takes action on the demand side.

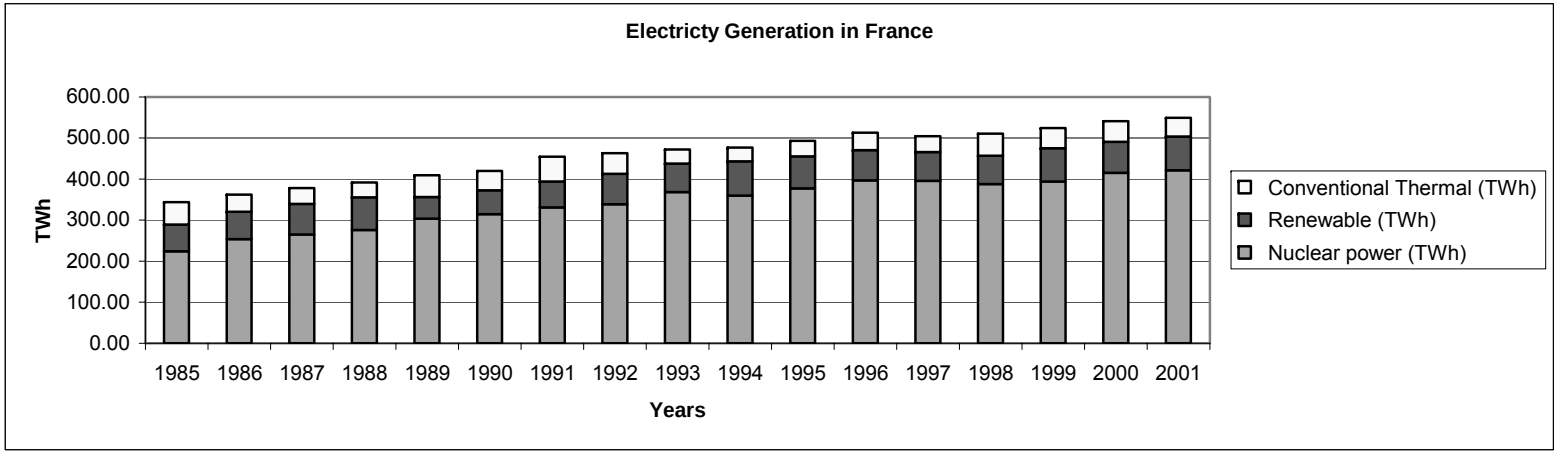


Figure 6 Electricity Generation in France

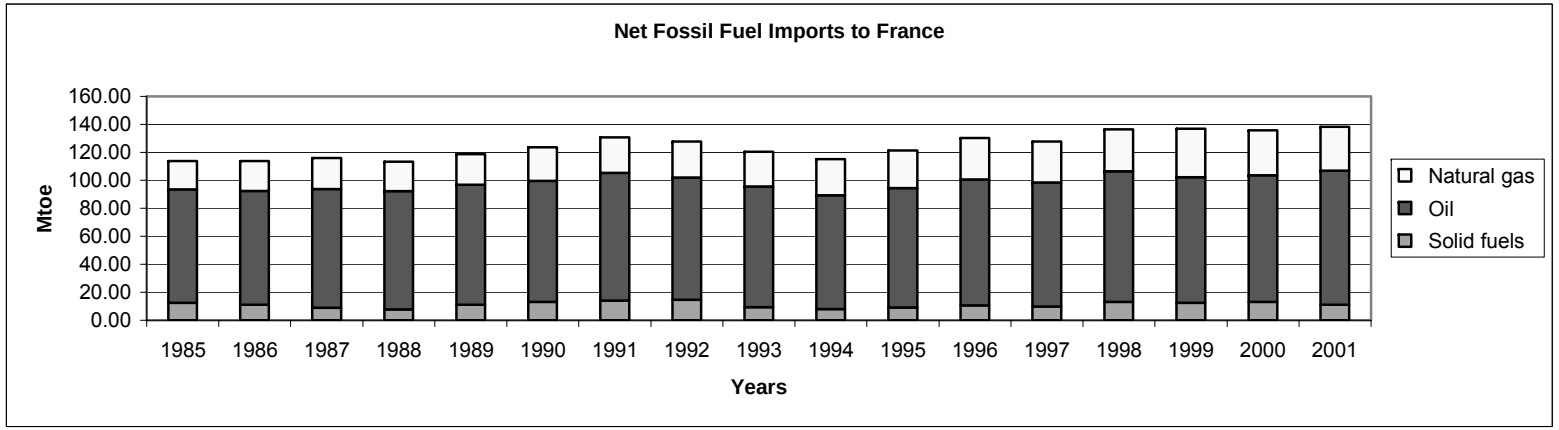


Figure 7 Net Fossil Fuel Imports to France

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

3.4. Energy Intensity Controlled: Italy

Italy is one of the largest economies on the planet, it is one of the Group of Eight (G8) industrialized nations and is a founding member of the European Union. Currently Italy is facing an economical slow down. European Commission stated that Italy is one of the slowest European Union member states in making progress reforming its economy.

Limited domestic energy sources and high consumption cause Italy to be highly dependent on fuel imports. Italy is the third largest oil consumer in Western Europe, though it has managed to decrease its oil consumption (Table 6 Energy Balance for Italy). Italy relies on oil imports from North Africa, mainly from Libya. Italy also increased natural gas consumption. Regarding the fact that natural gas is a cleaner fossil fuel, its use has some positive effects for the environmental requirements. North Africa and Russia are the main suppliers of natural gas for Italy. Italy depends on North Africa in matters of fuel, and this may cause negative implications for Italian energy security. Understanding the oil policy is important in understanding the policy of Italy in matters of energy.

Italian government is supporting the policy of becoming a refining center since 1970s. There are some 17 major refineries in Italy which process crude oil from different sources. Italy has Europe's largest surplus refining capacity (EIA, 2004).

Italy imports oil from Libya, Iran, Saudi Arabia, and Algeria in order of amount, half of the oil imports are from Middle East and North Africa. Italian administration is aware of the dependence on oil. Italy is trying to reduce the amount of oil used for electricity generation and heating where natural gas can be used. Italy has oil fields on the shores of the Adriatic Sea, offshore at the same region and in Sicily. To overcome the dependence on imported oil, Italy has decided to increase domestic oil production. It has the most promising onshore oil and natural gas field in the Western Europe in the Apennine. Eni is the operator of the oil field in a

joint venture with Enterprise Oil. It has also built a 136 km pipeline to connect the oil field to the Taranto refinery. New oil fields are beginning to operate still.

Italy has the largest number of gasoline stations in Europe. Because of rising prices government decided to close down some of the stations. Recently steadily increasing gasoline price has drawn the attention of the anti trust commission of Italy, and it has found oil companies guilty of price fixing at retail level.

Natural gas imports began in early 1970s. Now, Italy relies on imports for 75 % of its natural gas consumption. Italy is the third largest Natural gas market, after Germany and UK, in Europe. By 2010 the projections show that 48 % of electricity will be generated by using natural gas. (European Commission Directorate-General for Energy and Transport, 2003)

Most of Italian natural gas market is under control of Eni and Snam. In 2000, Eni had supplied 87 % of natural gas consumed in Italy. Edison Gas supplying the 5 % of the consumption was the only other remarkable company in the sector. Edison is planning to have 15 % of the market share by 2007. electricity company Enel also imports gas for its generation activities. Enel's target in 2007 is to have 20 % of the market share. Italian consumers pay almost the highest natural gas prices in Europe, today (EIA, 2004).

In January 2003 consumers began to choose their suppliers in the liberalized natural gas market. The suppliers were mainly Gaz de France, BG, BP, Shell, and ExxonMobil. The energy market was outlined by decrees limiting the supplier with the 50 % of the supply. Within the system Enel has 9 storage fields (EIA, 2004) which make the take or pay agreements impossible for Italy.

For the imported supply of natural gas Italy relies heavily on Algeria and Russia. For diversification of sources it relies on alternatives such as Libya, Norway and Liquefied Natural Gas source Qatar.

Today, Italy has only one regasification terminal, which does not have enough capacity for all of the liquefied natural gas. Companies which have projects for Italian market brought proposals under consideration. A gas train with a 4.8 million metric ton capacity, for which the feasibility studies are done in Europe, is also under consideration (European Commission, 2001).

Coal has a small role in Italian energy sector and Italy produces almost no coal. However, the power sector is expected to increase its consumption in following years. The coal is expected to be supplied by the main exporters of steam coal to Italy: South Africa, Indonesia, Colombia, United States of America, Poland, China, and Australia (EIA, 2004).

Today, Italy has taken a task of reorganizing its electricity sector for the sake of reformation European Union asks for.

3.4.1. Reorganizing electricity sector

Restructuring due to the Electricity (96/92/EC) and Natural Gas (98/30/EC) directives has affected the Energy Sector in Italy. The adaptations have caused the energy monopolies to be privatized. The dates are set for liberalization by the European ministers. In 2007 all of the customers will be able to select their energy suppliers.

Liberalization efforts have been going on since the beginning of the 1990s, it has gathered pace with establishment of the Electricity and Gas Authority in 1995. In 1999 ‘Bersani Decree’ (Enel, 2004) has entered into force and provided a legislative base for a liberalized energy market. The decree sets forth the three main principles: provide all customers with freedom of choice (1), provide a reliable and competitive supply (2), and guarantee grid access under equal and non-discriminatory conditions (3).

For reorganization of the market the established entities are:

Transmission Grid Administrator (GRTN, Gestore della Rete di Transmissione Nazionale), responsible for management of energy

transmission and dispatch, issues technical rules for planning and operating connections to the transmission grid;

Electricity Exchange Administrator (GME, Gestore del Mercato Elettrico), monitors and supports all trading activities on the electricity exchange (that includes the issuance and enforcement of market rules);

Single Buyer (Acquirente Unico), responsible for protection of the customers, who are not eligible to access the free market, by energy contracts; guarantees an available energy supply.

Italian Ministry of Industry and Commerce issues licenses for distribution to keep it clearly separated from sales. Energy production, import, export and sales activities are separated and left to be freely traded on the market. The requirements for establishing new power plants and or modification and conversion of existing facilities have been issued by GME in May 2001 (EIA, 2004).

The growth in demand for the energy calls for action to be taken on the supply side which is concentrated and consisted of old generation facilities. Since no single entity is authorized to import or produce more than 50 % of the electricity produced or imported in Italy, it was thought there is almost no possibility of a monopoly existing in Italian electricity market any more. It has the result of divesting the state owned electricity monopoly, Enel, by the 2003 deadline. The companies, Eni (partially state held oil and gas conglomerate), Agip (exploration and production for hydrocarbons), Snam (Supply and distribution of Gas), have been partially privatized. It can be said that liberalization has increased competition between the state-owned companies and other players in the Italian energy markets.

There is a disturbance in the energy market caused by takeover of Italian energy companies by Electricité de France. The Italian authorities decided to restrict the sale from EdF, however European Commission ruled against the decision. For the takeover and voting rights in the Italian

energy companies EdF has offered Enel stake in four nuclear power plants in France.

Enel also had to sell the distribution networks in Italy's large metropolises. It has been stated by the distribution companies that Enel has been blocking access. Enel also owns whole of the Italian high voltage grid company Terna. Enel purchases generating capacity from different countries such as USA and Spain as well. (EIA, 2004)

Since no company is allowed to produce or import more than 50 % of the total electricity produced in or imported to Italy, the generation component of Enel was to be separated into several companies and Enel was to be transformed into a holding company controlling them. The companies are sized for each of all to have sufficient capacity to allow technological innovation and the ability to compete at a national level.(Giulietti and Sicca, 1999)

Italian energy policy is unique in some aspects. Italy is a country that has started closing down the operating nuclear power plants because of a moratorium on nuclear power generation that is the result of a referendum. Today, there are no nuclear power plants utilized for generation of electricity. Because of the policy drivers like 1973 oil shock, energy security concerns, the desire to protect the environment; energy taxes Italy imposes are high. This has helped the country for low energy intensity. Italy has taken some measures to make its energy industry more competitive, energy use more efficient and less carbon intensive. Some of the measures are progressive electricity tariffs, requirements to sell electricity from renewable sources to the grid, and benefits selling cogenerated electricity (CHP) to the grid (Evans, 1999).

Electricity generation in Italy is mostly done from thermal sources (Table 7 Energy Balance for Italy). Lately the generation capacity of oil has been taken up by natural gas. Non-hydro renewable energy generation has taken up 2 % of the total energy generation.

The interconnections with its neighbors give Italy an opportunity to import energy from them. Imports come from France, Switzerland mainly; and to a small extent from Slovenia and via the underwater cable from Greece as a backup source for Italy (EIA, 2004).

Italy seems to be aware of the environmental problems and tries to overcome them. Italy has the possibilities for utilizing renewable energy resources like solar, biomass and geothermal. Environmentalists find the application of Energy Tax Directive too much modified that it has lost its effectiveness. The energy intensity of Italian industry seems to be less, compared to other members of the European Union and OECD average (EIA, 2003). However in the region of Milan which has been a gas trap for emissions of smog from the road traffic and carbon fuel electricity generation plants. Car-free-days have been an attempt for overcoming the road transportation emissions in the big cities. The regional problems of air pollution due to geography of the peninsula require critical measures.

The electricity suppliers have been required to support by selling at least 2 % renewable energy. Tradable Green Certificate program has been put into use for promotion of clean and renewable energy however its application falls short of being effective (Lorenzoni, 2003). Italy seems to fall short of the 2010 target of 25 % of renewable energy sources share in all energy generation.

Utilization of renewable energy sources and promoting renewable energy technology is a target of European Union. Regarding the efforts for that target European Union members have shaped their power sectors. As one of the pioneers the German power sector is inspected in the next section.

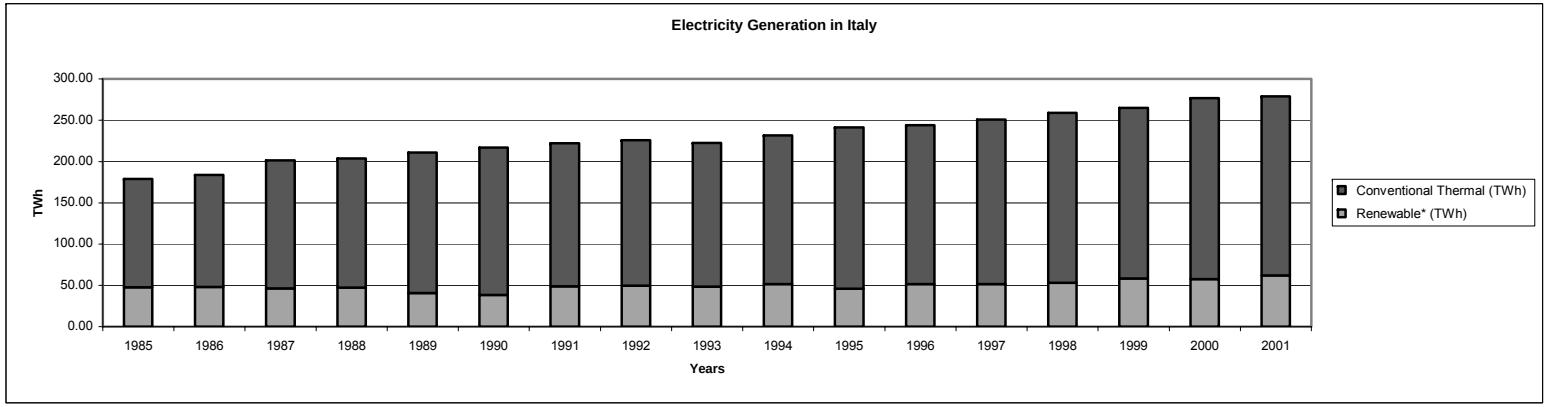


Figure 8 Electricity Generation in Italy

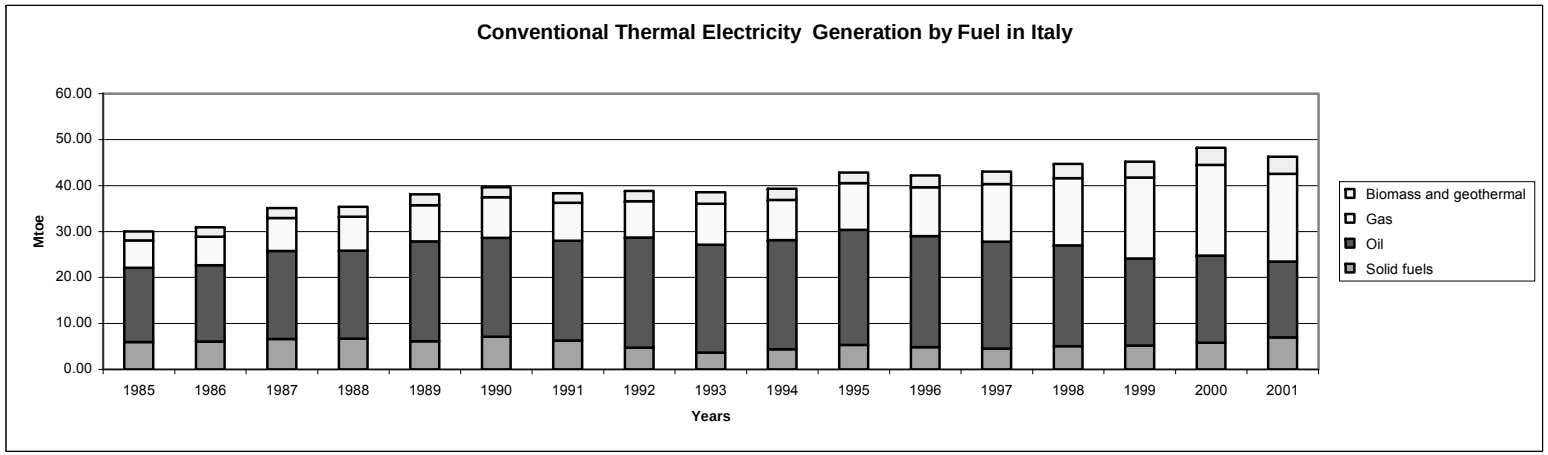


Figure 9 Conventional Thermal Electricity Generation by Fuel in Italy

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

3.5. A Green Approach for Energy: Germany

Germany is one of the largest economies of the world. It is a member of Group of Eight (G8) industrialized nations and is a founding member of the European Union. Germany consumes the largest amount of oil in European Union and second large amount of natural gas.

The German economy relies heavily on exports, the slow global demand and stronger Euro damages German economy. Decrease in spending for German goods, and fall in tax revenues caused German public deficit to be more than 3 % of the Gross Domestic Product which causes a breach in Stability and Growth Pact. The council of European Union finance ministers, Ecofin, will have the right to impose binding fiscal actions against Germany if it braches the pact in 2004, third consecutive year (EIA, 2004).

Energy policy of Germany has affected European Union regulations. The energy market in Germany is dominated by large power companies. Electricity and natural gas prices are higher than the average of European Union and third party access to national grids is limited (EIA, 2004). Germany has not established a regulatory body for natural gas and electricity markets, yet.

Germany has fulfilled difficult tasks such as unification of the East and West Germany energy sectors. East Germany's energy sector was centralized, state owned and dependent on lignite (which is known for its higher emissions of toxins when burned), whereas West Germany had a privately owned system with a high standard of energy efficiency and a commitment for the environmental protection. Energy structure of regions of east had to be adapted to the structure of the west.

Germany is a pioneer in developing renewable energy sources and climate policy. German policy implies that it will double the proportion of electricity generated from renewable energy sources produced in 2000 by 2010. By 2050 it is planned to meet half of German energy needs by

utilizing renewable energy sources (EIA, 2004). Having limited fossil fuel sources is a reason for Germany to concentrate on alternative energy supplies such as renewable energy sources, but climate policy is the reason behind the enthusiasm. The target is to meet green house reduction quotas, within the European burden sharing program. The international emissions trading scheme in European Union will require the participation of members like Germany. The market will allow companies to buy and sell the difference between greenhouse gases they produce and limits set by the member countries.

Almost all of the oil Germany uses is imported, except an oil field off the western coast of German State Schleswig-Holstein. Germany imports the oil from Russia, Norway, United Kingdom and Libya. Oil has been consisting 41 % of Germany's total energy consumption since 1991 (EIA, 2004).

There are different views about the future of energy two of the optimistic reports which are taken seriously by EIA predict that demand in the short run (2005) there will be a small increase in the demand for oil. In the long run these two reports have different predictions the PROGNOS report (Prognos, 2002) predicts a stable oil demand, Mineraölwirtschaftswerband report predicts that there will be a 14 % decline in oil demand between 2005 and 2020. EIA expects that the oil demand will have a modest rise in between 2005 and 2020 (EIA, 2004).

Germany has crude oil imports via pipelines, and seaborne tankers. It distributes the refined oil from its refineries. Germany's oil refining capacity is the seventh largest in the world (EIA, 2004).

Germany is the second largest natural gas consumer in European Union. The production of natural gas lags behind the consumption increase. Thus Germany imports natural gas form Russia, Holland, Norway, the United Kingdom and Denmark. Germany has a system in the natural gas market dominated by few companies which regulate themselves according to a framework agreement. The agreement, called

Verbänddevereinbarung, was signed in July 2000. The regulatory body required by the directive has not been established yet. Germany is the only European Union country which has not established a regulatory body. However the absence of a regulatory body does not mean absence of control as we can see about the merger of E.On and Ruhrgas. German Cartel Office rejected the merger; government overruled the decision emphasizing the good in having a strong German company in the market. This decision was objected by the smaller firms in the market, and later on by making negotiations and agreements, the sides have given up their objections (Lieb-Doczy, 2002).

Germany regarding its geographical location stands both as a destination and a passage for pipelines. Germany has natural gas hubs located within its borders and negotiating on building a new trading hub.

Regarding European Union's coal consumption Germany is the largest producer and consumer. The united Germany reduced the coal production and consumption of former East Germany. The efforts to diversify the fuel mix paid off. The share of coal has been stable for some time (23 % of the total consumption). For electricity generation, over 75 % of German coal production is used (EIA, 2004).

The hard coal production is expensive compared to other producers since the German coal is located deeper than other producers. However, Germany is the largest lignite producer in the world producing one fifth of the output. Germany has started importing coal as the production of coal has been reduced. The coal imports are expected to rise after the nuclear phase out.(Hoster 1998) Considering this and coal industry's being one of the largest employers, Germany subsidizes coal production. German subsidies for coal industries inbound are the largest in European Union (EIA, 2004).

Transport related climate policies have proven to be difficult regarding the Germans' love for cars. The suburban population increases and use of oil increases with it. German Railway Company has deficit

despite the heavy subsidization. The households have been designed energy efficiently because the loans, for insulation of the buildings and constructing the new buildings according to standards, have interest subsidies.

The campaigns and applications such as appliance labeling scheme, according to appliances' energy efficiency, has helped the public awareness of the European Union on demand reduction. Electricity is one of the sectors Germany is pioneering the use of 'green' technology.

3.5.1. Electricity within energy products in Germany

The German government implemented the EU-directive for a common electricity market with the introduction of the new Energy Act (*Energiewirtschaftsgesetz,* EnWG) on 29 April 1998 (Brunekreeft and Keller 2000). The sector had been far from the cartels, traditionally, because of prohibition. There is no regulatory body for the sector specifically. Anti competitive behavior is controlled by antitrust agency and the courts. The network owners are vertically integrated in generation and retail; it is a fact that cause high profits because of the high network access charges on the network, compared to strong competition especially in generation. As the law of single marginalization summarizes:

> *An unregulated input monopolist will set a monopolistic input price and secure marginal-cost pricing at the complementary stage; in other words, it will attempt to secure an as-if competitive outcome at the complementary stage if it can compensate via the input price (here, the access charge). Under certain conditions the input monopolist will be indifferent between vertical integration into the complementary stage or vertical separation. In contrast, if the input price is regulated (sufficiently strongly), the input monopolist will have an incentive to attempt to*

> *lever the market power of the input stage to the complementary stage in order to make monopoly profits at the complementary stage. In order to do so, it will have to foreclose and thereby exclude competitors from the complementary stage.* (Brunekreeft and Keller 2000)

The preference of the negotiated access is different from other member countries' choices for Regulated Third Party access. Regulated access calls for a regulatory body and an access regime control. In Germany there are no constraints on the vertical structure of the sector, either.The new generation capacity is allowed by licensing instead of tendering. The spot markets for electricity are available, but the main trading mechanism relies on bilateral contracts. The antitrust control of the sector is left to the federal antitrust agency.

The total electricity generation capacity of Germany was substantially over the maximum load by 28 Gigawatts in 1998. Fuel mix for electricity generation was dominated by nuclear energy back then. The nuclear phase out will have quite an effect regarding that 33 % of the electricity generation.(Hoster, 1998).

Germany is by far the Europe's largest electricity market. Electricity used in Germany is generated by using fossil fuels, nuclear energy, and small amounts of renewable energy sources. (Table 8 Energy Balance for Germany) German estimates are pointing out 14 % growth in electricity demand between 1999 and 2020. Nuclear energy will be phased out and its share will most probably be covered by other sources. Electricity is imported mainly from France, Czech Republic, Norway and Austria consecutively. Exports are done to Holland, Switzerland and Austria(EIA, 2004).

Another issue is that the large companies are buying small retailer companies, it is the utility companies penetrating the retail market on a large scale. Shortly after liberalization, the retailers started switching the

suppliers, response to that was either to sell directly to consumers via a retail department or to buy the retailers.

The renewable energy sources were boosted by policies of Germany, which can be called an effective but not cost efficient. The renewable energy consumption has increased, wind energy has more than quadrupled in the last decade. Investment subsidies and guaranteed feed-in tariffs to be paid by regional utilities have caused especially wind energy to grow with two digit rates (Michaelowa, 2003). In February 2002, the German state of Schleswig-Holstein generated more than 50 % of its electricity use from wind energy. Germany is the leader in utilization of wind energy with 39 % of wind generation capacity of the world.

The renewable energy act (Das Erneubare Energien Gesetz) has been passed in 2000. It has been designed for doubling the electricity generated from renewable energy sources by 2010, the mid-tem goal will be increasing the figure of renewable energy sources to 10 % of total energy consumption by 2020. There have been other attempts for utilization of renewable energy sources such as 100,000 solar panel roof program, has become successful reaching 300 MW. In September 2004, Shell, along with partners GEOSAL and WestFonds, began operating a 5-MW solar power plant in Leipzig. City Solar AG reportedly is building a 7.4 MW solar power plant at Göttelborn, the world's largest, according to City Solar (EIA, 2004) Combined heat and power law, passed in February 2002, provided 4.5 billion Euro of funding, to reduce greenhouse gas emissions.

There had been mergers in the market which pose no threat to competition, yet. The majority of the firms are in public ownership, only a few are private. The landscape may change for the sake of competition. The industrial electricity prices had been falling from March 1998 to the June 2000. The spot markets of LPX and EEX the power pools in Leipzig and Frankfurt/Main show a little different but parallel data.

80 % of the German electricity market is controlled by four big companies: RWE, E.On, Vattenfall Europe, and Energie Baden-

Württemberg Aktiengesellschaft (EnBW). The rest of the market is shared by almost 900 small companies. The regulatory body does not exist in the German electricity market. The reform has been realized by agreements between the market players. Before, the market had been separated to two district zones and had very little price transparency. With the reform, transmission has been left to those four companies, as they are called "supra-regional companies" (EIA, 2004).

The goal set by German parliament for a sustainable energy policy is to reduce the CO_2 emissions by 80 % by 2050. This goal is evaluated to be feasible. There are strategies for this policy to be realized. The conservatives in the German parliament reject the nuclear phase out initiated by the government. The fact that there is a decision of nuclear phase out, causes a concern on the targets for the future of German energy generation policy. There seem to be three possible scenarios for the future of German energy consumption patterns as the Stuttgart based energy research institute IER and the Wuppertal institute study (Hennicke 2003) shows:

1. Scenario based on transformation efficiency and forecasting economically viable technical innovations allowing disposal of the huge amounts of CO_2 generated in coal fired power plants without harming the climate
2. Scenario relying on efficient use of energy, renewable energy sources and a strategy for the use of relevant technologies
3. Scenario based on fossil fuels and nuclear energy on the assumption of acceptance of the massive use of nuclear energy.

The energy commission recognizes some instruments for the policies to be developed: The emissions trading European Union wide, revising the EURATOM treaty and the creation of an institution for regulation of the European Union energy system; have quite a support as Europe wide instruments. The global trend for liberalization of electricity and gas markets is realized as a tool for competition. There are also

instruments targeting specific industries; such as binding targets for combined heat production and regenerative energy, energy product labels, energy efficiency fund, a program to promote efficient electricity consumption.

The rapid decrease of wholesale electricity prices, because of the liberalization, caused a pressure on the cogeneration plants. As a result the cogeneration plants started to shut down in large numbers in 1999. The policy target was to double cogeneration by 2010. Politicians reacted to overcome this problem, deciding on a subsidy for cogeneration plants until 2004. There had been disputes about the emissions trading, denouncing emissions trading as a complex system which would burden industry with millions of Euros and cost 60,000 jobs (Michaelowa, 2003).

The sensitivity of German governments on emissions, also take reaction of German Industrialists, who consider the amount of money Germany spends on climate change mitigation too generous, regarding the developed countries taking no responsibility.

Nuclear capacity of Germany is the fourth largest in the world. However, the phase- out has been agreed by the owning companies and the government (to success of the Greens, environmentalist party of Germany). According to the deal, by 2021 nuclear energy will be totally eliminated in Germany. The total electricity to be generated by using nuclear energy will be limited until 2020. There has been opposition, however, to the government's nuclear phase-out program. If the current ruling coalition (Social Democrats and Green Party) loses power, the phase-out could be overturned (EIA,2004).

Germany is an exceptional country in using the green technology; however, the market structure has yet to be developed. The information on how a functioning market will be, can be gathered observing the most developed market by far, the United Kingdom energy market.

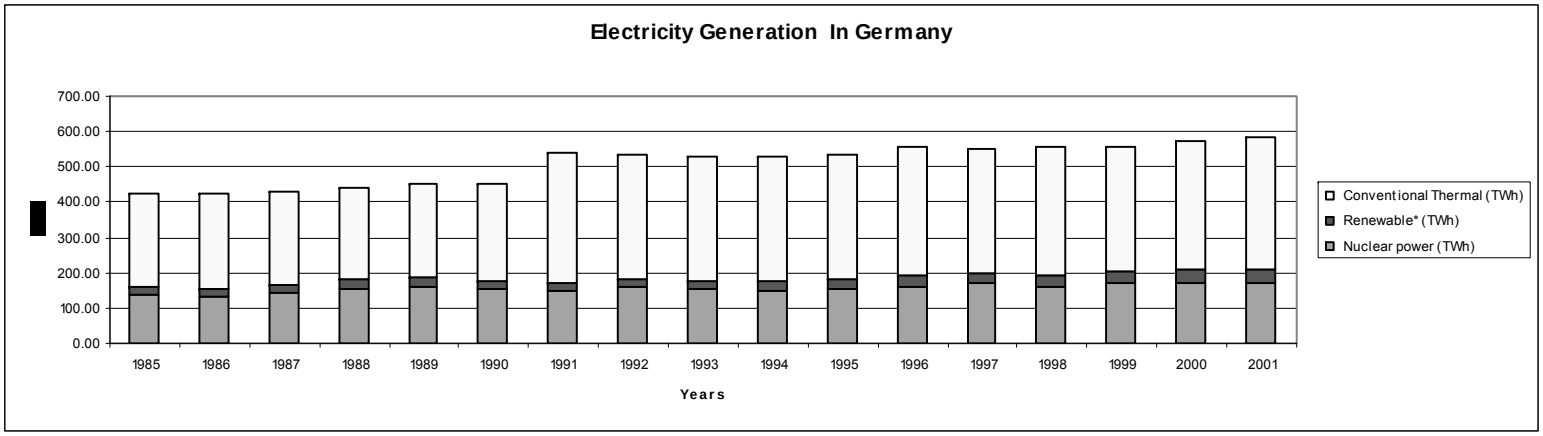


Figure 10 Electricity Generation In Germany

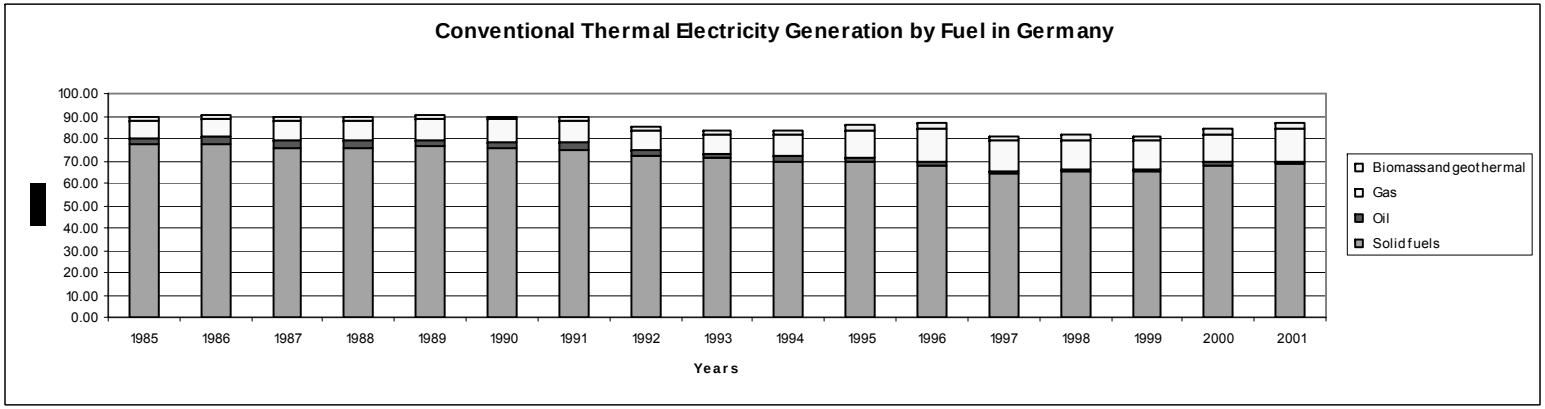


Figure 11 Conventional Thermal Electricity Generation by Fuel in Germany

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

3.6. Deregulation frontiers: United Kingdom Energy Market

United Kingdom of Great Britain and Northern Ireland is the world's fourth largest economy. Joining the European Union in 1973, it has not adopted every condition European Union (like the adoption European Monetary Union.) The United Kingdom has a smaller public sector than other members of the European Union. United Kingdom has a positive growth rate and unemployment has been falling (EIA, 2004).

United Kingdom is the biggest producer of oil and natural gas in the European Union. Most of the reserves located in the offshore platforms north of Scotland. The second largest futures exchange in the world the International Petroleum Exchange (IPE) is located in London. As the production of oil decreases in United Kingdom, the large private companies based in UK turn to other oil fields and explorations, helping the UK economy cancel out the effects of the reducing oil production. The taxes imposed on oil products make the oil in UK among the most expensive, while the electricity prices are decreasing.

The North Sea oil, discovered in 1960s, has a major role in European Union markets with proximity and political stability of the region, and high quality of oil; though it has a high cost of extraction compared to oil fields in the Middle East. (This results also in a trade policy of exporting the produced high quality crude oil while importing the cheap low quality crude oil, for refining, mostly from the Middle East.) The oil and natural gas industry belong to private sector. Management of the sector is a difficult task. For the task British Oil and Gas Industry Task Force has been established. The task force can have recommendations. Furthermore for managing the extraction, licenses are issued. The licenses issued in 2002 cover two terms, after two four-year-period, each half of the license will return to the government (EIA, 2004).

British Gas was the gas monopoly of the UK until 1995 gas act. British Gas had long term contracts which commanded gas supplies from

Untied Kingdom Continental Shelf (UKCS). British Gas owned the gas distribution system, and all gas storage within Britain. More than 20 suppliers of both gas and electricity exist at retail level, today. The customer can buy energy products together or separately, every customer can choose among suppliers in the market. Activities bundled in the natural monopoly have been separated; today, it is unlawful for a gas transmission company to supply gas (Parry, 2002).

After years of being a net-exporter of natural gas, the UK is expected to become a net-importer of natural gas in 2005-2006 timeframe. The UK also expected to become a net importer of oil. In response, the government has not only undertaken initiatives to prolong hydrocarbon production but has also begun developing import infrastructure, such as liquefied natural gas (LNG) regasification terminals and pipelines. Initiatives were outlined in a white paper published in February 2003(UK Secretary of State for Trade and Industry, 2003). At the core of the paper is the UK's intentions to increase renewable energy sources' share of power generation to 20% by 2020. It also seeks to reduce the country's greenhouse gas emissions 60% by 2050.

The gas market was deregulated in 1998 completely that all the customers can choose their supplier. Market is no longer under control of the British Gas alone. BG has been split and sold in a competitive market. Office of Gas and Electricity Markets (Ofgem) is UK's gas and electricity regulatory body. Privatization of the gas industry in UK led to a decrease in prices which in turn caused gas to replace coal as a source of energy.

The consumption of coal in the country has fallen since 1986. 75 % of coal is used for electricity generation. From two thirds of electricity generation from coal fired power plants in 1980s to one third of the generation in 2001. After the long strike of coal miners in between 1984 and 1985 production of coal began falling short of consumption of coal. This difference has been growing each year ever since. Since 1995 the coal industry has been receiving subsidies which are scheduled to end.

The subsidies are for the coal miners to have a decent life, soon some of the coal mines will be shut down. (EIA, 2004)

On the other hand coal production costs have been falling since 1992, allowing the coal to be an efficient option as the phase out of the nuclear energy is in agenda. The imported coal price is expected to increase by the local mining authorities, giving another opportunity for the indigenous coal to rise again. This in fact is an indicator showing energy policy is deeply integrated to the environmental policy (Greening and Bernow, 2004).

The natural gas prices and, the major necessity of the natural gas combustion plants: 'outages for maintenance' have caused an increase in power producers' coal consumption. The British government is investing on clean coal technology, today.

The government policy is to encourage the development of cleaner coal technologies for application both at home and in overseas markets for protecting the global environment, maintaining an international presence, exploiting the market potential, and most important of all, ensuring security of UK energy supply (UK Department of Trade and Industry, 2003). The program objectives include development of an internationally competitive coal component industry, promoting UK expertise and know-how in the main export markets, examining the potential for developing the UK coal bed for methane resource and underground coal gasification technology (UK Department of Trade and Industry, 2003).

The modern nuclear power plants are owned by British Energy Generation as they were privatized. That company became the country's largest private nuclear generator and the planet's first wholly privatized nuclear utility. The older nuclear power plants are run by a state owned enterprise, the Department of Trade and Industry's Nuclear Directorate regulates the British nuclear industry.

The air pollution has been a problem of UK since the first industrial revolution, the invention and use of steam engine. However, the National

Air Quality Strategy was not launched until 1997. The air pollution levels are falling for a couple of decades, which is attributed to the changing composition of the energies UK uses. The energy efficiency strive has resulted in lower energy and carbon intensities. The energy consumption in industrial sector increased slightly, and the residential and commercial sectors remained steady in energy consumption over the past decades. The carbon emissions have been reduced since the 1990s. There are comparisons to Kyoto commitments in the sense that the carbon dioxide emission can be met for the UK. The factor that has caused this is the sharp fall of use of coal (EIA, 2004).

The road traffic is a major source of air pollutants. The carbon emissions from road transport have increased while the carbon emissions from electricity generation and industrial use have decreased. As a solution to the problem there started a taxation procedure by the city governments called ‘congestion charge about £ 5 per vehicle per day, applied first in London. (EIA, 2004)

Non Fossil Fuel Obligation is the legislation, providing a premium price market enabling mechanism for renewable energy sources, which has passed in 1989. The system oversees the payment of the difference between the premium price paid to the ‘green’ electricity suppliers and the market price is financed by the Fossil Fuel Levy. Fossil Fuel Levy is a tax paid by the licensed electricity suppliers and passed on to consumers. The Climate Change Levy has entered into force in 2001, and the tax exemption for the renewable energy sources may attract more attention to them. The share of renewable energy sources in electricity generation is hoped to be 10 % by 2010 (EIA, 2004) Addressing the environmental issues, interaction with the rest of the European Union and cooperation is necessary for joint action.

Inspecting the energy sector in general the next section discusses the deregulated energy market of the United Kingdom in focus. The power

sector is an example of how a deregulated energy market can evolve, and how healthy application can be achieved.

3.6.1. Deregulated Electricity Market

The third largest electricity market in European Union is United Kingdom. The capacity's four fifth is thermal, about one fifth is nuclear and some 2 percent of the capacity is hydroelectric (Table 9 Energy Balance for UK).

Privatization started with the split of Central Energy Generating Board (CEGB), in 1990s, which combined both generation and control of the national transmission system. Generation was divided into two and the high tension grid formed a separate company. Local distribution companies, Regional Electricity Boards, were privatized as separate companies. The generation companies of England and Wales formed an oligopoly to control wholesale electricity prices by taking advantage of electricity trading arrangements known as the pool. The generators' oligopoly has been broken, now. No company has more than 15 % of the generation capacity, today (Parry, 2002). The grid companies of England and Wales became the property of National Grid Company. From Large to small all the consumers were able to choose the supplier by May 1999.

The tool for deregulation of the energy sector is the pool in the UK. The pool works simply in this fashion. For every half hour on the day regarded for bidding, the bids of the available power producers are evaluated. The cheapest available bid is taken into consideration as the price of electricity adding the cost of using the transmission network. The result is the cheapest offer wins the bidding. The internal dynamics of the power sector sometimes causes the offer to reach a minimum price which is even equal to zero. The reason for that being the necessity of running the electricity generation utility on standby for giving an offer for a following (e.g. Prime time) higher offer bidding time.

The pool system is ideal for a controlled electricity market. The biddings are usually done on Day -1 (before the considered time of the day) and the payments are done on day 28 by the regulatory body. If one of the utilities is caught cheating, there are serious rulings against it (which may reach up to a level to cause the company never to participate in the pool again.)

In March 2001 system; electricity pool regulated by the National Grid Company, owner of the transmission network, has changed to a bilateral trading system. New Electricity Trading Arrangements (NETA) were put into use. The bilateral trading occurs between customers, traders, suppliers, and generators. System includes, forwards and futures markets, and National Grid Company as a balancing mechanism.

No matter how sound the planning there can be problems. The TXU, which is a company based in Texas, Untied States of America, became the biggest retailer in the market buying one of the retail electricity and natural gas businesses. The TXU had sold its assets in UK to Powergen. However TXU ended up with long term contracts for purchase, with high fixed price, left in its hand. UK Coal suspended its shipments to the largest coal fired power plant, in 2002, because of the owning firm's, AES', debts. AES could not pay because of the debts of TXU had not been paid to it (EIA, 2002). A deal was reached and shipments were continued after that interruption.

The deregulated market example is the untied market of England and Wales indeed. Two Scottish companies, Scottish Power, Scottish and Southern Energy own the whole Scottish power market. Northern Ireland has a separate electricity and gas market which is connected to Republic of Ireland for imports and exports. Regulatory body it has, Ofreg, is distinct from the England and Wales regulatory body, Ofgem.

The deregulation efforts in England and Wales and the changes in gas and electricity resulted in: separation of monopoly activity – the transport business of pipes and wires, supply of electricity, gas,

connections of customers to networks, metering of supply, storage of gas; competition at all levels of supply for both gas and electricity – restriction of price regulation to natural monopolies, with competition determining all prices (Parry, 2002).

Having examined some of the European Union member's markets and their striking properties, next chapter concentrates on the Turkish power sector. The next chapter is an overall picture of the Turkish energy sector before the discussions and suggestions about how the market should be reformed.

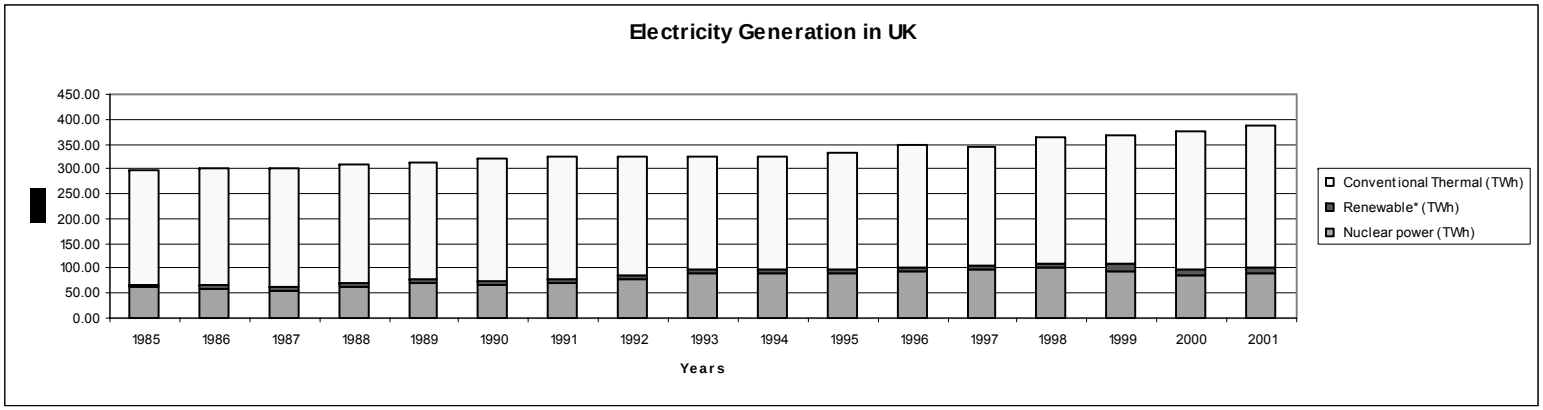


Figure 12 Electricity Generation in UK

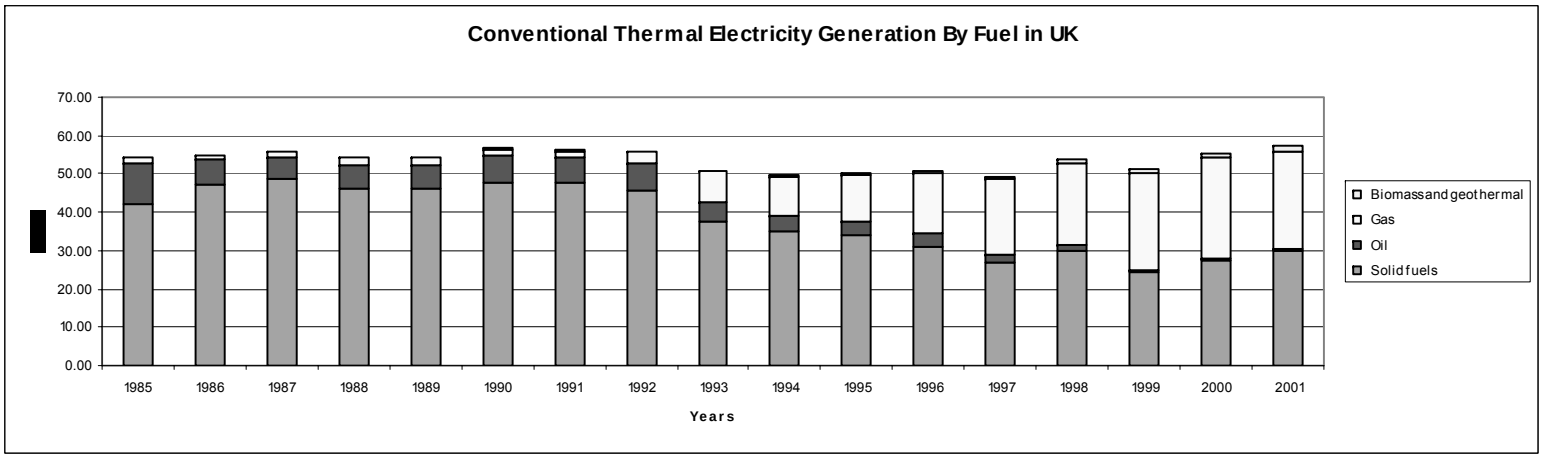


Figure 13 Conventional Thermal Electricity Generation By Fuel in UK

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

CHAPTER 4

ENERGY POLICY OF TURKEY AND ITS MARKET STRUCTURE

Turkey is located in between the energy producers of the Caspian Basin, the Middle East, and the European consumers. Turkey is a land bridge between Southern Europe and Central Asia, therefore Turkey is an important candidate to become the “Energy Corridor”, for the transmission of the Central Asian Countries’ oil and natural gas resources to Europe. It also controls the sea passage through the Bosporus straits between Black Sea and the Mediterranean.

Turkey is an applicant country for the European Union trying to adopt EU legislation for its energy markets. Turkey is an OECD country as well, and international legislation applies to Turkey.

Although Turkey needs to import 80% of its energy, the energy policy that foresees rapid increases in domestic energy demand resulted in an energy surplus, today. Still, there is growth in government agenda in the coming years, with figures which may or may not come true.

Low levels of private and foreign direct investment, relative to its economic size, a large state sector in energy, characterize the Turkish economy. Privatization in general has lost its momentum. Electricity sector privatization is at a low level. The present picture of the Turkish power sector is discussed in the following section.

4.1. Present Energy Situation in Turkey

Turkey’s energy market is one of the country’s fastest developing sectors. Annual demand for electricity has increased by more than 7 %

during recent years and installed capacity and annual generation figures have today reached approximately 32.3 GW and 123.3 TWh respectively. However, since consumption per capita per annum is still as low as 1,800 kWh (compared to 8,500 kWh in Germany and 17,500 kWh in Finland), the potential for further growth in this market is considerable (EIA 2004).

The energy consumption in Turkey is growing compared to its energy production, but this does not necessarily make Turkey a growing energy importer. If Turkey has a growth trend as expected in the near future, there will be a need for large energy investments.

In 2001, energy liberalization law targeting the government's monopoly in the energy sector, has passed from the Turkish Parliament. That was the Energy Charter Treaty, which has been ratified by Turkish authorities in 2001, which was claimed to be parallel to international legal framework (Turkish Republic Ministry of Energy and Natural Sources, 2004)

4.1.1. Energy Institutiuons of Turkey

The Electricity Market Law called for deregulation. TEAŞ, the Turkish state held Transmission and Generation Company was to be separated into generation and trade companies which were to be privatized. The transmission part of the company became Turkish Electricity Transmission Grid Company (Türkiye Elektrik Iletim Anonim Şirketi-TEIAŞ). The regulatory body known with the name, Energy Market Regulatory Authority (Enerji Piyasası Düzenleme Kurulu-EPDK), today; is appointed to the task of overseeing Turkish energy market, setting tariffs, issuing licenses, and preventing uncompetitive practices. The distribution portion of the state held monopoly

Turkish Electricity Enterprise (Türkiye Elektrik Kurumu-TEK) had been broken up to two companies TEAŞ and TEDAŞ, in 1994. TEDAŞ the

distribution company had transferred some of its distribution facilities and its responsibilities into regional companies which are the called as regional distribution companies today.

The regional distribution companies belong to the state, with minor exceptions. (Kayseri and Vicinity Electricity Distribution Company – Kayseri ve Havalisi Elektrik Dağıtım T.A.Ş. – of which the concession had been extended with the Law 3096) TEDAŞ has taken back the distribution rights of the company AKTAŞ in 2002 (which operated in Anatolian side of Istanbul) by the decision of the ministry of energy and natural resources. The cause of the action was that there was no public interest in that application.

In 1984, within the framework of the Turkish Law 3096, two companies (ÇEAŞ and KEPEZ A.Ş.) were granted the privilege to electricity generation. In July 2003, the rights of operation were taken back because of the misuse of the privileges. (Turkish Republic Ministry of Energy and Natural Sources, 2004)

There is an unusual management of power sector in Turkey, today. The TETAŞ (Turkish Electricity Trade Company - Türkiye Elektrik Ticaret Anonim Şirketi) dictates the electricity to be bought, and the electricity is transmitted by the Turkish Electricity Transmission Grid Company, TEIAŞ. In the countries I had examined this task is done by the Grid Company in order to have the most efficient electricity generation and transmission. The fact that TETAŞ chooses the private companies even though it is not advantageous, results in the extension and continuation of the BOO, BOT and TOR agreements. The power plants that belong to the Electricity Generation Company, EÜAŞ (Elektrik Üretim Anonim Şirketi) are not regularly used as they should be. Because of those factors the Turkish Electricity Transmission Grid Company cannot command the operation for the system stability and quality electricity.

BOTAŞ is responsible for the natural gas imports of Turkey as the Turkish monopoly on natural gas. The history of heavy dependence in the field of energy, especially the use of natural gas, date back to 1985. The role of BOTAŞ and the reason(s) behind this dependence is discussed in the next section.

4.1.2. Imported Energy Supply Dependence of Turkey

Oil provided 43 % of Turkey's energy needs and in general the oil consumption in Turkey can be stated to be in an increasing trend in the long run. However daily oil consumption has fallen slightly between 2000 and 2002. The 90 % of the consumption is imported from the Middle East and Russia (EIA, 2004). Ceyhan port in the Southern Mediterranean Shore of Turkey is a terminal for oil pipeline between Turkey and Iraq, and soon a new pipeline will connect the port to Baku and Tbilisi (Baku-Tbilisi-Ceyhan pipeline). There are efforts to liberalize the oil market which resulted in market movements of assets.

The chain of events that lead to today's highly import dependent energy policy started with 1985 operation of Hamidabat natural gas fired combined cycle power plant. The Hamidabat power plant was not a facility that ran on imported natural gas; instead it ran on the reserves located in the vicinity. However, the natural gas reserve was not as much as it was predicted to be. The second part of the power plant, another six units, was contracted to the same contracting firm, ENKA-BBC. For the operation of the second part, and also for operation of the first part of the power plant at full capacity; an agreement with Russia was realized and the first significant effort to buy natural gas for electricity generation was in 1987 and 1988. The deal was made because the Turkish natural gas was not sufficient.

The natural gas prices were indexed or parallel to Fuel Oil, back then. That is important in Turkish energy economy, since Turkey imported crude oil and refined it. The oil was processed and separated into hydrocarbon products such as LPG, kerosene, diesel fuel, fuel oil 5 and 6. In the late 1980s the oil products fuel oil 5 and 6 were excess in amount since there was no sufficient demand. Due to the maladjustments in the Turkish energy policy there were no power plant investments firing Fuel Oil, so the Fuel Oil was sold in the spot market for less than its worth. In order to fully exploit the crude oil that has been imported, the oil products should be treated as valuable as they are. The expert point of view is that it should be used for electricity generation.

There are only two power plants firing fuel oil. One in Ambarli, Istanbul with 560 MW capacity and in Hopa with four units 25 MW each of which were put into operation in 1976. Although the Turkish Electricity Enterprise (TEK) at that time had fuel oil power plants to be built in the plans, no other investment on fuel oil fired power plant was done. This was maladjustment of policy since those power plants were necessary not only for the overall economy but also for the fuel diversification in electrical energy production. Today, Turkey is dependent on natural gas which is imported, but still some of the oil products produced in Turkey are not utilized.

Natural gas is Turkey's preferred fuel for new power plant capacity for several reasons: environmental (natural gas is less polluting than coal, lignite, or oil); geographic (Turkey is located near to reserves of gas in the Middle East and Central Asia); economic (Turkey could offset part of its energy import bill – caused by take-or-pay agreements – through transit fees it could charge for oil and gas shipments across its territory and there is the need for using the natural gas imported); and political (Turkey is seeking to strengthen relations with Caspian and Central Asian countries).

The relative advantage regarding the prices of natural gas in late 1980s was because of the producer countries' intention to form a market

for natural gas. It has become successful. Today there is a larger natural gas market. The natural gas importers may have problems because of the rising natural gas prices. The countries extremely dependent on natural gas imports have been pushed into purchase agreements on 'take-or-pay' basis by the producing countries. The G8 countries that have been inspected in the work have not given up their alternatives. Our extreme dependence is a result of our maladjusted policy.

Turkish Natural Gas demand is projected to increase in the coming years, with the natural gas fired power plants being the largest customers. However, Turkey has signed contracts for more than the natural gas it will need. Because of the 'take or pay' agreements that have been put into action with Iran and Russia, Turkey may have to pay for the unused gas if it fails to take and consume the predetermined gas amount on time. There are worries of Turkish authorities on the surplus gas. Storage facilities are on debate.

The turn to natural gas can be explained by the environmental, political, and economical reasons. However, these reasons will not change that Turkey has a disadvantage. Provided Turkey achieves becoming a transit country, the dependence can turn into an advantageous deal for Turkey. If all the connections happen to realize Turkey will be 70 % dependent on Russian natural gas by 2005. However, the take-or-pay stipulations of Turkey seem not possible to be transferred and therefore the dependence on other countries shall increase.

The pipelines planned for natural gas transportation are: 'Blue Stream' pipeline, from Russia to port of Samsun and to the capital, Ankara; one from Iran to Turkey waiting to be completed; another one contracted by BOTAŞ, Turkish natural gas monopoly, which will connect Turkey to Turkmenistan, the Trans Caspian Pipeline.

If Turkish demand does not support the level of natural gas imports for which it has contracted (from the countries listed above), hopefully Turkey could become an important transit center for natural gas exports to

Greece and beyond. Along these lines, Greece and Turkey signed an agreement in late February 2003 which calls for extending the natural gas pipeline from Iran to Turkey into Greece. Reportedly, the 177-mile-long pipeline would connect Ankara to Alexandroupolis in northern Greece, would supply around 18 Bcf of gas per year, and would cost $250-$300 million. After that, natural gas could be transported to Europe via Bulgaria or via an undersea pipeline to Italy, where gas demand -- especially for electric power generation -- is expected to grow rapidly in coming years.

Also, in December 2002, Hungary's oil and gas company MOL signed a deal to study construction of a gas pipeline from Turkey to Austria, through Bulgaria, Romania and Hungary.

The natural gas monopoly, BOTAŞ, is to split into units for Natural Gas import transport, storage and distribution by 2009; however the foreseen tasks are not completed on time. There are planned Natural Gas storage units near Istanbul, and another project by Tuz Gölü near Ankara. Today, all of the natural gas facilites in Turkey are under control of BOTAŞ.

In the assessment of future natural gas supply options and supply costs for Europe the economy of the natural gas sources becomes an important issue. Turkey may have a chance of transit country of cheaper natural gas for its own benefit. Being dependent on natural gas, the country can have a hand on the supplying mechanism of natural gas and the dependence on natural gas can turn to Turkey’s benefit. However this will only be lessening the effects of the burden.

The take-or-pay agreements between Turkey and the supplying countries such as Russia, and Iran have costs to Turkey, since there is a risk of paying what was not bought. The countries in European Union pay only for the natural gas they utilize, that is neither they do accept take-or-pay agreements, nor the agreements are applicable to them (because of the storage capacities they own.) What is more the storage facilities guarantee a supply in emergencies, for a limited time according o their capacities.

There is a need for the natural gas to be stored within Turkey for security reasons. Considering the storage facilities in European Union which have two to three months' consumption capacity, Turkey should have a storage capacity of 20 % of the yearly consumption. Also a management for coal production and use is necessary. The up to date technology should be used not only for the sake of high efficiency, but also for environment purposes. The use of clean coal technologies may become a viable option in the future.

Natural gas and oil prices are expected to become almost double the price levels today, in 2020, in an optimistic scenario.(Table 9 International Price Assumptions) By 2020 the latest combined cycle gas turbines will have 50 to 60 % more efficiency than conventional coal fired plants. It should be noted that combined cycle gas turbines have to be run in base load to achieve that high efficiency. The high costs of maintenance have to be considered for the gas turbines. The more the size (in power) of a power plant, the less price of electricity generated, because of lesser investment, fuel consumption and facility maintenance costs per produced unit of energy. For the optimum price of electricity the up-to-date technology should be applied.

Cogeneration and CHP is a strong option for using the fuel more efficiently as the thermal efficiency increases to 80 %. As the auto-producers are smaller in size, it makes a difference in the price of electricity generated. The auto-producers are small and industry oriented investments. The use of those power plants for only electricity generation is regarded as a waste because of the proximity to industrial production areas. CHP is an option to be considered in those auto-producer generation units. It makes sense to be dependent on their own, instead of selling the energy they produce to the grid. (Yildirim, 2004)[1]

[1] The information obtained in the heading '4.1.2. Imported Energy Supply Dependence of the Country' is obtained directly from Nur Yildirim, an expert in the field who currently works as the chairman of Research, Planning and Coordination Department in TEIAS.

The indigenous energy sources in Turkey such as coal and renewable energy sources including hydroelectricity has a large share in the fuel mix used for electricity generation. There is also a potential for the future use of those energy sources for electricity generation. The next section discusses those indigenous sources and their utilization.

4.1.3. Indigenous Energy Sources of Turkey Including Renewable Energy Sources

Among the fossil fuels, no other fuel can be as secure and as vast as coal if it is transported, stored and used correctly. Even though coal in Turkey has a low quality, it is the most common indigenous fuel in Turkey. Turkey produces coal, and has quite a reserve of coal. However, there are polluting agents in the coal. The coal production is mainly necessary for electricity generation. There are studies showing that the indigenous coal being sufficient for Turkish energy consumption for a long time (about 200 years) even regarding the scenarios that involve extreme energy needs (Ozdag, 2002). Low quality coal such as Turkish lignite is utilized best, when it is used for power generation, for efficiency and environmental reasons.

There is a large hydroelectric capacity in Turkey which consists of the 38.4 % of the annual production in efficient years. The unsteady regime of the streams permit only 57 % of that potential to be fit for electricity generation with today's technology. The large hydroelectric projects are quite some investment, for this reason they are mostly public projects run by the state or they require state guaranty. If the investments for hydroelectric power plants are not induced by the state, necessary portions of the investment may be ignored for the sake of cost cutting.

Turkey has a gross theoretical hydropower potential of 413 TWh/year, a technically feasible potential of 216 TWh/year and an economically feasible potential of 122 TWh/year. Government aims to

develop 60% of the economically feasible potential, with installed capacity reaching 22 GW. In all, a total of 19,715 MW of hydro capacity is planned for development over the next 25 years, in addition to the projects currently being built (World Energy Council, Energy Information 2001).

The limited economical and technological opportunities for other renewable energy sources prevent them from utilization in Turkey. This will be the situation unless there is a technological advancement manipulating the world markets. The use of solar energy by photovoltaic cells incurs a high cost of investment per unit energy produced. Thermal solar plants seem to be in a crude form which is far from general use. However in smaller scale applications for buildings, such as the solar water heating panels used in Mediterranean coasts of Turkey, which improve the solar efficiency of the buildings, can be put into use. That is a minor issue compared to the large picture.

In Turkey, wind energy has great potential. According to the Special Commission on Electrical Energy of the State Planning Organization (2001), the potential is 10,000 Mw, citing the study of Elektrik Isleri Etud Idaresi – EIE (Electrical Power Resources Surveying Administration). (Karaata and Ekmekci, 2002)

Wind energy can be an economic source for the technology producing countries, where the equipment is not only produced for domestic use, but exported also. Turkey, being a technology buying country, has a higher cost for installing those wind turbines. The transmission system has also some restrictions which cast out the use of wind energy. The extent of wind energy in the whole used capacity cannot exceed 10%.

Turkey has one eighth of the world's geothermal potential and is ranked 7th in the world. The cost of electricity generated from geothermal reserves is between 3-10c/kWh. The bottom end of this range is competitive with conventional systems. A significant factor in Turkey's high geothermal potential, estimated as being in the region of 31 500 MW_t, is

the fact that the country lies on the Alpine-Himalayan orogenic belt. Geothermal exploration began during the 1960's, since when about 170 fields have been identified. Although some of this number are high-enthalpy fields, 95% are low-medium enthalpy resources and thus more suited to direct-use applications. (World Energy Council, Energy Information, 2001).

Biomass has a primitive application field in Turkey. Of the 37 % of total energy consumption is residential. The residential consumptions' about 52 % part is the consumption of biomass based fuels (Demirbas, 2002). In the rural areas people still use animal dung and wood as fuel for heating. There is a need for state intervention for efficient use of that potential, such as biogas production, in order not to waste resources and pollute the environment.

The Turkish government delayed its considerations on building nuclear power plants for a few years, it is most likely that it will obey the European Union principle of not building new nuclear power plants. The Chernobyl nuclear accident has shown us that the risk is not bearable.

The nuclear power plants meet 17 % of the planet's energy needs, and they produce quite an amount of valuable isotopes that help mankind in various ways (EIA, 2004). The drawback of nuclear is that, it creates a deal of nuclear waste and need some extra facilities such as nuclear fuel production facilities. Turkey has mineral nuclear fuel reserve, but no facilities for processing the nuclear fuel. Instead, the Turkish Government could develop cleaner, safer and cheaper alternatives to meet its power needs. The nuclear power option seems to be suspended. The world needs some technological innovation for safe and harmless nuclear energy.

There had been attempts to use mobile power plants in Turkey. (It was decided first to introduce them in small capacities, about 10 to 20 MW, in order to increase the voltage to defined level for the consumers, since in the eastern part of the country it drops drastically.) Those power plants are

used in ex-colonies of the developed world for exploitation of the natural sources using the electricity generated in those power plants. When the operation for those natural sources is over, the power plants are dismantled.

Having seen what is possible and what is not in the field regarding indigenous resources, the next section will discuss the needs in Turkish power sector, such as the necessity for growth and control.

4.2. Necessity for Growth in Electrical Energy System

The growth of electricity generation capacity seems necessary (Figure 16 Gross Inland Consumption in Turkey). However; there are huge deviations in the Turkish State Planning Organization's (Devlet Planlama Teskilati – DPT) targets (Ercan and Oz 2004), which harm the reliability of the organization's forecasts. The Eighth Five Year Plan, Report of Special Commission on Electrical Energy, of the State Planning Organization forecasts a need for an addition of 4 GW to the generation capacity each year.

Turkey has been a fast growing power market for two decades. It is hoped by the Turkish authorities that Turkey will have a growth streak until 2020. If so it will need a huge capacity (that quadruples today's capacity). There is a question that Turkey has to limit its public expenditure because of the financial reforms that have been going on under the supervision of IMF. Private sector contribution is expected at this point.

During the recent decades Turkish authorities have inspected various market models in Europe which has resulted in a natural awe for the pool system in the UK (England and Wales) market.

By 2002, the electricity generation composition of Turkey's energy generation consists of hydroelectric power plants by 38.4 %, Coal fired conventional power plants by 20.4 %, combined cycle natural gas plants

by 30.5 %, liquid fuel fired power plants by 8.4 % and the renewable energy sources excluding hydropower 0.1 %. (Figure 17 Electricity Generation in Turkey) In most European Union statistics the hydropower is included in the renewable energy sources. The transmission system restrictions limit the renewable energy sources such as wind energy. The market composition is also suitable for a competition policy used in the UK.

Turkey had made a bilateral agreement with Bulgaria according to which Turkey would buy electricity from Bulgaria and sell contracting services for infrastructure and motorways. (EIA, 2004) However, the deal was off with the reason, contracts with Bulgaria could not be realized.

Turkey has an electricity generation surplus until 2006, now it runs on 80 % of its installed capacity because of that surplus. The expensive electricity has to be bought from BOTs (Build Operate Transfer), BOOs (Build Own Operate) and TORs (Transfer of Operational Rights) utilities because of purchase guaranty under long term contracts. Because of the price of electricity and operational conditions of the national interconnected transmission system, Turkey cannot export electricity. The cheapening of the electricity will result in an advantageous position in the internal markets since there is no possibility in exporting. A model like the pool used in England and Wales could improve the situation in the long run regarding exports.

There is a huge amount of illegal usage of electricity in Turkey (estimated about 20 %). High electricity prices, low income and, ignorance of the state causes this figure. Illegal use of electricity in statistics includes the amount of electricity used free of charge like in mosques and street lighting within the municipalities. It is to be noted that the reduction of the illegal usage of electricity causes a reduction in demand. That is due to the fact that consumers will care more for the amount of electricity they

use if they pay for it. The privatized distribution companies can offer solutions to this problem where government actions have failed.

The electricity transmission system is the backbone of the system. The transmission system planning principles are, the maximization of electricity supply quality and continuity, establishing an economic easy operated system that is open to development, optimal investment planning, and using the existing facilities as long as their economic life lasts. The criteria for the planning should be; that planned system should transmit energy in a well balanced network refraining from congestion or high density in a small circuit or a single transformation unit. The transmission system should be open to use alternative plants in case of extraordinary load due to a malfunction in the power generation facilities, the power grid should be shaped for the use of electricity in the proximity of the location it is generated. Planning the electricity transmission system is becoming a difficult task regarding there is no certain foresight of where power plants are going to be built. Transmission via DC in high tension network is an expensive but loss free method. It is not applicable for Turkey. The access control being in the hands of a regulatory body the pool system can be effectively run.

Realizing interconnection beyond borders is an important target due to several reasons. Possibility of efficient use of auxiliary power capacity, lessening the necessary extra capacity, limiting the power outages because of malfunctioning plants, use of natural sources efficiently, and increasing the electricity trade may be listed as those reasons. As the peak load in Turkey may reach twice the base load, dispersion of the load throughout the day is essential. The interconnection is an opportunity to achieve lessening the necessary amount of electricity investments. The tariff is also changed to achieve this; the users have to be informed about the cost of electricity differing throughout the day (Yildirim, 2004).

Another issue limiting the actions of Turkey is the environmental concerns which are discussed in the next section.

4.2.1 Environmental impacts for Turkey regarding the Field of Energy

Environmental problems fossil fuel fired plants cause can be summarized as: Gas emissions (CO_2, SO_x, NO_x), Liquid wastes (water pollutants), Solid wastes (ashes, slag, gypsum)(Kumbaroglu, 2003)

Environmental problems power plants utilizing renewable energy sources cause can be summarized as: Hydroelectric power projects have microclimatic, hydrological, biological, cultural effects; Geothermal brings the underground water to the surface with pollutant agents it may have; Wind Power may cause noise and electromagnetic waves, and visual interference; Solar power requires big space compared to other renewable energy sources for the same amount of energy to be produced. Biomass can cause emissions of poisonous gases after burning. Also the transmission lines cause electromagnetic waves.

European Union's environmental legislation has limitations for emissions of new power plants that are to be put in operation. SO_2 Emissions should be limited by establishment of new coal fired plants with flue gas treatment facility. NO_x Emissions should be limited by establishment of gas fired plants with Low NO_x Burner. Dust and Ash Emissions will be limited by eliminating all power plants operating above the emission level.

The United States International Trade Administration (USITA) estimates that four sub sectors of the pollution control equipment market will grow most rapidly in coming years: (1) municipal water treatment and waste water, (2) non-marine related hazardous wastes, (3) non-industrial

air pollution and (4) solid waste disposal. In addition, the USITA projects rapid growth in recycling and waste-to-energy markets (Demirbas, 2003).

Finally, having evaluated the environmental aspects as well, the information for the discussion of the subject matter for Turkey has been gathered, the next chapter will include the discussions about the subject matter.

Table 3 International Price Assumptions

	International Price Assumptions				
	Average border Prices in the EU ($00/boe)				
	1990	2000	2010	2020	2030
Crude oil	27.9	28	20.1	23.8	27.9
Natural gas	15.6	15.5	16.8	20.6	23.3
Hard coal	13.1	7.4	7.2	7	7

Source:POLES

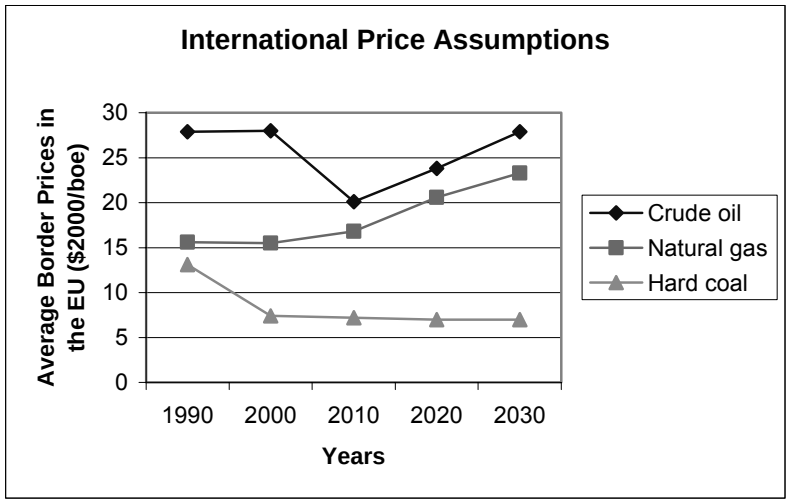


Figure 14 International Price Assumptions

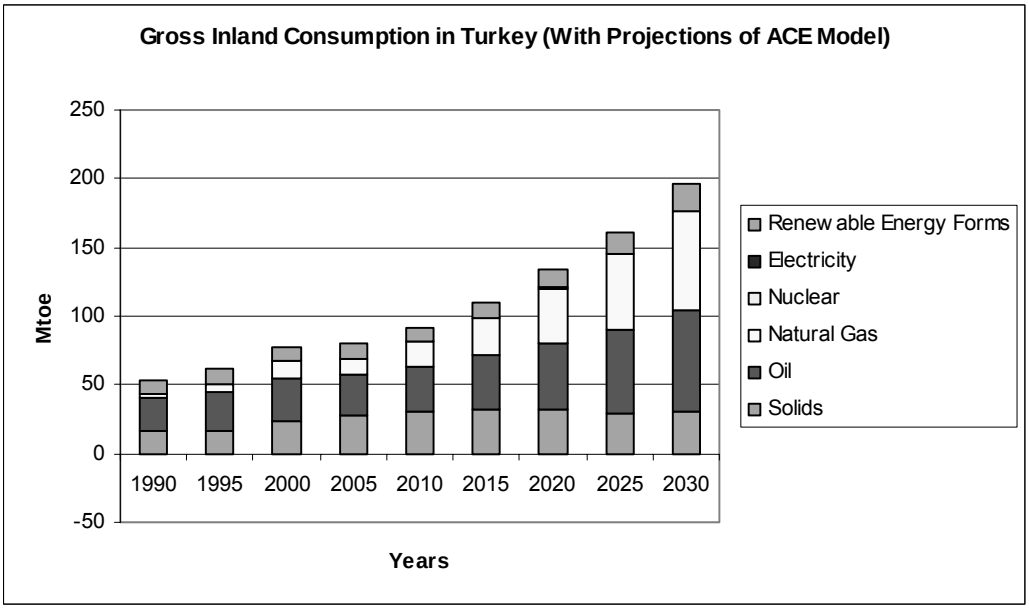
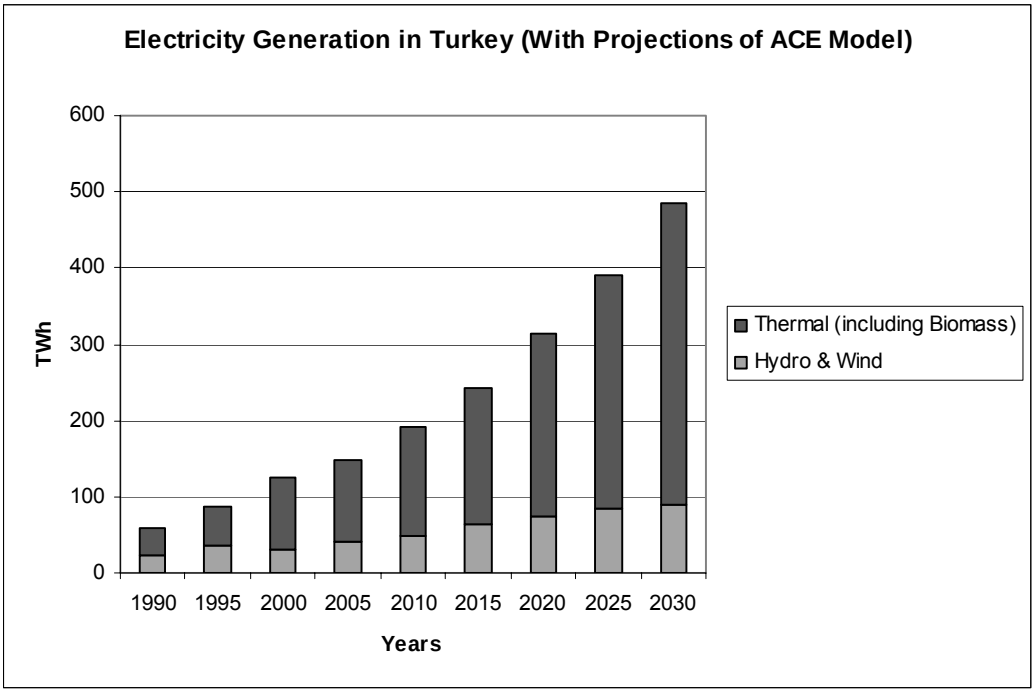


Figure 15 Gross Inland Consumption in Turkey
Source: European Commission Directorate-General for Energy and Transport (2003) European Energy and Transport Trends to 2030



]Figure 16 Electricity Generation in Turkey

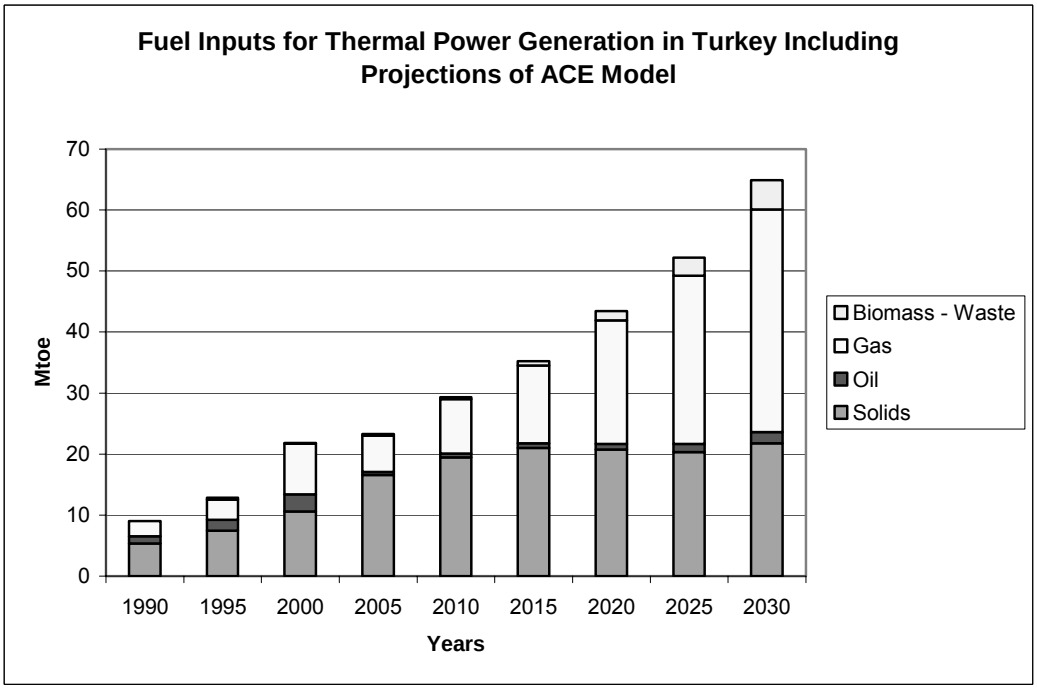


Figure 17 Fuel Inputs for Thermal Power Generation in Turkey
Source: European Commission Directorate-General for Energy and Transport (2003) European Energy and Transport Trends to 2030

CHAPTER 5

COMPARATIVE DISCUSSION

The eagerness of Turkish governments for applying the European Union legislation can be seen in their actions such as the customs union realized before Turkey has developed its status as an applicant country. Today, Turkey applies the directives in the legislation, and adopts the harmonized standards of the European Union.

The Directive 96/92/EC of the European Parliament and the European Council on the deregulation of the internal market in electricity came into force in 19 February 1997.Turkey adopted this directive for its energy sector.

The directive requires three measures: Members must ensure the separation of the management of transmission system operator (1), must ensure the accounting and operational separation of the production, transmission and distribution sectors from the other sectors of the enterprise (2), must ensure the establishment of the appropriate mechanisms for preventing the distribution of classified information from the transmission system operator to other sectors of the enterprise (3).

The directive holds three options for access of electricity utilities to the network:

- Regulated access by third parties,
- Negotiated access,
- The model of a single buyer.

All of those three options can be viable at the same time for a country's electricity market. Only Germany uses the negotiated access method for the entire market. The most common option for promoting the

competition is Regulated Access by third parties. The most beneficial application method of this option will be forming an energy pool where the least possible price wins the market, under the supervision of a transparent regulatory body which controls the transmission system operator.

The transmission grid company has been established, and taken the name Türkiye Elektrik İletim Anonim Şirketi (TEİAŞ), in 2001. The functioning of the company should be overseen to make sure that; it is independent from all inflictions, it has taken all the transmission facilities over, it collects all the revenue for the transmission, it takes the precaution, buying and organizing ancillary services, it sorts the generation order regarding the lowest cost. However this body is far from acting for the benefit of the consumer. it works on interconnection with neighboring countries and networks such as the Trans European Network or UCTE Network. In order to join the UCTE Network, system's quality should be improved with decreasing the electrical fault index, increasing quality of frequency and tension. There is a need for application of a master plan, continuous evaluation regarding the evolution of the grid. The constant control of the quality of the services can be done by appointing a regulatory body functioning like Ofgem of UK.

Today Ofgem controls the electricity market through the transmission grid company. However appointing a body like Ofgem may not be enough. There should be a single buyer mechanism to protect the underprivileged people when they are the customers. Single buyer takes responsibility at those times when those people need electricity and ancillary services. Regarding the rural areas and people in need of health care, the necessary amount of electricity and services can be bought for the customers in need by the single buyer, government appoints.

As the negotiated access is concerned there are flaws today, which Turkey faces, already. The purchase agreements, without the overseeing

regulatory body, causes problems in Germany. There are companies unwilling to provide services to some parts of the country in whole European Union. Some of the power companies even do not want to obey the rules of the regulatory systems of transmission grids such as UCTE and UCPTE because of the immediate cost of those provisions.

The liberalization of the energy market can be endangered by the actions of the bodies functioning in the system. The generation, transmission and distribution services must be diversified and accounting should be done separately by all of those distinct bodies. This is due to the fact that the payments should be verified by all of the participating bodies.

European Union has put some targets and priorities for the future of energy use. Nuclear energy and solid fuels are to be given up. Oil causes its own security and environmental problems. Renewable energy sources have technological problems that keep them uncompetitive. In the long run the natural gas supplies may face the risk of instability (European Commission Directorate-General for Energy and Transport, 2003)

New and renewable energy sources (except hydroelectricity that has not got much unused potential for European Union) seem to be the first option for action in relation to security of supply. The European Union target is 12 % share of the energy consumption for 2010. The technology used is expensive and cannot find much application thus. But thinking the external costs of the conventional technologies that the operators do not pay for (the emissions or heat pollution), the money spent for developing the equipment seems to be just.

Some European Union countries stock oil and natural gas they buy in local reserves which protect them against price fluctuations. In the case of natural gas this means no international agreement in the form of take or pay. European Union considers the amount of reserves for the whole European Union.

The option of coal as an indigenous and reliable energy source is to be thoroughly examined in the European Union. The developed countries are investing in clean coal technologies.

The European Union is to use political and economical influence for flexible and reliable external supply. Relations with the energy producer countries and supply networks gain importance. The construction of new pipelines will open new opportunities to European Union. The network question and the international relations to countries (either producer or on the route of the pipelines) should be evaluated together.

Political and economical concerns about energy imports have been surfaced with the energy crises. Energy security focuses upon energy vulnerability rather than energy imports. A region wide project had been initiated considering Interstate Oil and Gas Transport to Europe. The program is called INOGATE. The aim is a diverse, secure, environmentally-friendly and cost-effective energy supply for European Union. The umbrella agreement of INOGATE has been signed by countries involved in energy production and energy product transportation facilities such as oil and gas pipelines.

The climate change issues are also a great concern regarding the energy utilization in the modern world. Policymakers are likely to consider these as well. If the energy imports are to be reduced and domestic energy sources favored, the result will be different climate policies than the ones considering only reducing greenhouse gas emissions.

Kyoto protocol on climate change requires CO_2 green house emissions in the term 2008-2012 to be 5 % under what it was in 1990 (Kyoto Protocol). It also uses some tools such as emission trade, joint projects and clean development mechanism. Turkish parliament has recently ratified the Annex-1 of this protocol (change of climate). The electricity generation produces 30 % of Green House gases in the Kyoto Protocol. The plants that have been designed according to the old limits are a problem. Technological research for conventional thermal power

plants and emission control methods is necessary. These methods can most easily be controlled by a functioning regulatory body.

With the decisions of the Member countries to phase out nuclear energy the dependence on conventional fuels will be intensified. The elimination of fossil fuels that cause greenhouse gas emissions will lead the European Union to the use of new and renewable energy sources. Only exception to abandoning of fossil fuels seems to be the use of natural gas. Natural gas is preferred among other fossil fuels because of its price and rich energy content. Natural gas has low carbon content compared to other fossil fuels, which means less Carbon Dioxide emissions when burned.

The nuclear power plants meet 17 % of the planet's energy needs, and they produce quite an amount of valuable isotopes that help mankind in various ways. The drawback of nuclear is that, it creates a deal of nuclear waste and need some extra facilities such as nuclear fuel production facilities. Turkey has mineral nuclear fuel reserve, but no facilities for processing the nuclear fuel. Turkey's nuclear power projects seem to be suspended. Instead, the Turkish Government could develop cleaner, safer and cheaper alternatives to meet its power needs. The world needs some technological innovation for safe and harmless nuclear energy.

Directive 96/92/EC of the European Parliament and the European Council on the deregulation of the internal market in electricity came into force in 19 February 1997. The application, which is opening of the market, began on 19 February 1999. From February 1999 on, the producers are free to build, new power plants in any location in the European Union, according to the directive, either regarding the authorization procedure system, or a tendering procedure. Member states have the freedom of choice between two ways of establishing competition provided by the directive, but most member states prefer to use the authorization procedure for the construction of new power plants.

For markets to become competitive, the markets generally needed restructuring for new systems of transactions and new mechanisms to be established. Member states need to adapt to new competitive environment. The member states were required to open up their markets to a minimum. The minimum requirements were same for all member states even though some member states had different targets to achieve. Finland, Germany, Sweden, United Kingdom have undertaken to open up 100 %. Denmark decided to open up 90 % of the market indirectly by permitting all distributors to obtain energy freely. Other markets also decided to open their markets to a greater extent than required. 74 % of the demand will be liberalized, and over two thirds of the consumers will be able to choose their producer by 2007.

The energy commission recognizes some instruments for the policies to be developed: The emissions trading European Union wide, revising the EURATOM treaty and the creation of an institution for regulation of the European Union energy system; have quite a support as Europe wide instruments. The global trend for liberalization of electricity and gas markets is realized as a tool for competition. There are also instruments targeting specific industries; such as binding targets for combined heat production and regenerative energy, energy product labels, energy efficiency fund, a program to promote efficient electricity consumption.

The relative advantage regarding the prices of natural gas in late 1980s was because of the producer countries' intention to form a market for natural gas. It has become successful. Today there is a larger natural gas market. The natural gas importers may have problems because of the rising natural gas prices. The countries extremely dependent on natural gas imports have been pushed into purchase agreements on 'take-or-pay' basis by the producing countries. The G8 countries that has been inspected in the work have not given up their alternatives. Our extreme dependence is a result of our maladjusted policy.

Share of fuels and renewable energy resources in the overall composition of electricity generation has to be determined, according to the policy of diversification of sources and priority of indigenous sources, for the security of energy supply. If the investment on infrastructure is done without regarding a plan or diversification of sources, it won't solve the energy problems. Power plant capacities, compositions and locations should be determined according to a plan shaped by the needs and policies. The purchase agreements with companies should not be long, in order to benefit from the advancements in technology. Power purchase agreements can be replaced by a pool system for some regions promoting the use of new technology.

Efficiency and economy of electricity has to be regarded beyond investment planning (Hepbasli and Ozalp, 2003). Fault in Operation Records (FOR) and analyses (Verbruggen, 2003) show that economy can be achieved through efficiency and healthy operation. The electricity generation can be more economically executed by operating the Combined Cycle Gas Turbine Plants in the base load. Simple gas turbines also offer the possibility of cogeneration. Due to natural gas purchasing (take or pay) agreements, operating the natural gas fired power plants seem to be more economical since the gas is already bought. Systems interconnected beyond time zones offer a possibility of peak load sharing.

Goals for automation in transmission system are; distributing the clients according to their demand among the active power plants, Supervision and maintenance, Tension and frequency control, Control of the load distribution. The functions to be added to the transmission system, as a result of the deregulation movement in Turkey, are; Short term generation planning, Short term load prediction, Remote Control. All of which can be done by controlling the market with a pool system devised in the UK.

In distribution, the most important principle is standardization, which also enables fair competition. Standards should be set on, operation and maintenance codes, customer service codes, distribution methodology. Losses in distribution system originates from, use of less suitable hardware due to the circumstances of the grid, distribution lines and transformers either overloaded or under loaded due to lack of planning, new lines and distribution centers lagging due to lack of planning, losses due to high and not compensated reactive energy consumption.

The losses are increasing because; some projects do not comply with the required standards, the phases cannot be regulated in the present transformers, the citizens are unaware of the consequences of illegal use of electricity, the subject is underestimated or ignored by the administration.

Precautions to overcome the losses are; planning, design, construction, and operation steps should be realized regarding standards which shall be revised periodically, under-qualified personnel should be eliminated by autonomous human resources policies, cost/benefit analyses of the distribution projects and infrastructure should be carefully realized, Reactive load compensation should be taken seriously for industrial purposes, the customers should be examined for good use and elimination of illegal use. The illegal usage of electricity in category of losses can be eliminated by the intervention of private distribution companies fulfilling the requirements may also be a solution for Turkish electricity facilities.

For competition to be realized in the energy sector: there should be enough supply to meet the demand; the infrastructure has to be sufficient to fulfill the tasks of the supplier, transmission of electricity, transportation of gas, and the tasks of the producer; producers and suppliers have to be obeying criteria on quality and pricing. For liberalization program, Energy Market Regulatory Authority (Enerji Piyasası Düzenleme Kurulu-EPDK)

has been authorized. Yet EPDK is not functioning as regulatory body should (i.e. like Ofgem in the UK.) The Regulatory body mentioned in the European Union Energy Directives has to deal with regulating the tendering procedures for new generation capacity, solving the disputes about denial of rights acquired by agreements on gas transportation, energy transmission and purchasing, forming sufficient mechanisms that eliminate misuse of the system through control transparency. Excess profit making efforts and cheating of the consumers have to be monitored and this type of actors in the field should be eliminated by establishing a tough disciplinary system.(EMO, 2000)

In this section the necessary reshaping has been discussed. The reshaping is inevitable as it is also mentioned in the Turkish State Planning Department's (Turkish State Planning Agency, 2001) Eighth Five-Year-Plan. The change has been scheduled according to the plan. Further than that the reasons explained above require a long time in the process. Suggestions and conclusions for the Turkish energy sector follow in the conclusions chapter.

CHAPTER 6

CONCLUSIONS

In this thesis, the European Union's energy policy and the European Union energy markets, which may set models for Turkey or which may be important in understanding how the energy markets are shaped, have been examined. It is a work that will help the reader understand Turkish energy market in the sense that it needs a strategy such as applying a market model.

Turkish electricity market has started the process of reformation. The reform includes deregulation and liberalization of the energy market on paper, however the process does not seem to be fulfilling the European Union requirements, yet. For the de-facto liberalization, the purchase agreements for electricity and gas remain as obstacles.

This thesis' first conclusion would be, that the need for a cheaper energy and a competitive market can be met by a model of pool and maybe an organization transforming with the liberalization of the market, just as we see in the UK. Regulatory body will have tasks in this model such as maintenance of efficiency, control, automation and tendering procedures under technical responsibility of the transmission grid company.

Efficiency in generation and transmission can be realized through; obeying efficient design criteria; reduction of plants' internal energy consumption by selecting of suitable fuel, type and design of plants, evaluation of cogeneration possibilities for nearby industry, electricity generation for the proximity to eliminate transmission losses.

Control and automation in generation system is necessary; For protection, For lower cost, For higher quality. Office automation in the field

is also necessary for accounting, stock control, and protective maintenance. These will be important for a pool system to be activated.

For the automation in electricity distribution systems, master plan for development and automation, distribution management system establishment, and application of demand management is necessary. Online remote diagnostic system(s) and Data-information center(s) are necessary as administrative tools, for the distribution system(s).

A reformation of the energy market seems necessary and the best example seems to be The England and Wales Energy pool to be applied in the next few decades by the de-facto deregulation and liberalization of the energy market.

The pool being useful and necessary for achieving some long term reforms, may leave its place to another market system that offers solutions valid for the long run.

Public sector did not have sufficient resources for extensive energy investments. Energy investments require large outlays of capital that may not be usually done by the private sector. Large projects for generation which require heavy investment have been limited due to heavy burden for the investor. There will be new structuring and management requirements for deregulation and liberalization.

The second conclusion of this thesis would be, that beyond the need for imported energy products such as Natural Gas, Turkey may become a transit country that is paid for the energy products transported through the territory. The dependence of Southern European Countries on those energy products can be used for a policy based on benefit of all the parties. Action of this sort will release some of the financial burden caused by the take-or-pay agreements.

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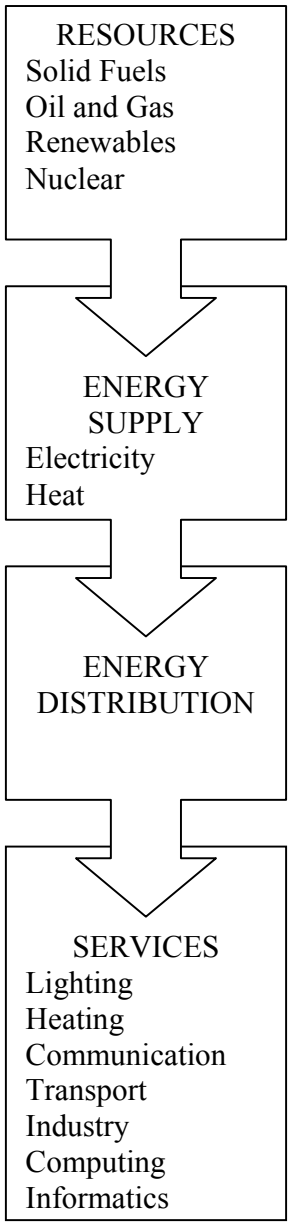
APPENDICES

APPENDIX A

ELECTRICITY AS A FORM OF ENERGY



The present energy sources of our planet can be crudely classified as:

Fossil Fuels: Coal, Oil, Natural Gas

Renewable: Hydroelectricity, Solar, Wind, Geothermal, Biomass

New: Nuclear, Fuel Cells, Hydrogen Energy

Another categorization may be primary or secondary energy, energy sources derived from other sources are secondary sources, and primary sources are sources like fossil fuels.

Electricity is a secondary energy form.

Primary sources can be summarized as fossil fuels, hydro, nuclear, geothermal, wind, solar, biomass.

Whether it is a primary or secondary energy electricity has to be used for industry, computing, and informatics. We have almost no substitute for its uses.

The most common method of obtaining electricity is using a thermal power plant.

A.1. How A Thermal Power Plant Operates

In a thermal power plant, water in a boiler is heated and evaporated by reaction of a fuel. The high pressure vapor passes through the turbine and condensates. after the turbine via cooling by water pumped from a nearby river or lake, or air taken from cooling towers, and pumped once again to the boiler. The cycle continues like this and through this an amount of mechanical energy is extracted from the turbine. As it is there are losses at every stage of this cycle. For example the turbine can transfer about approximately 80 -85 % of the energy to the generator, generator can generate electricity to a ratio of 90 % of the mechanical energy. Theoretically the losses except the friction can be avoidable and friction can be reduced. However the efficiency of those cycles is really high. Because the real loss is at the stage of converting the water's thermal energy to the turbine's mechanical energy, the efficiency of cycle of 'water at work' has, is limited to 40 % by the laws of thermodynamics that have been discovered by Sadi Carnot. This theoretical definition is a limitation that we cannot overcome even if we perfect the cycle.

In some of the conventional thermal power plants, they use the hot gas from the gas turbine outlet that is taken to the burning chamber instead of releasing it to the atmosphere. This process is called 'topping'. Topping process is used to increase efficiency of the coal (or fuel-oil) burning conventional type power plant.

The natural gas is burned in the combustion chamber of a gas turbine the combustion gas is used for the revolution of the combustion turbine (just like a jet engine). If the heat of the flue gas is to be used there are options. Two thirds of heat produced by burning the fuel will cause thermal pollution unless used with heating through 'cogeneration' or 'combined cycle'. The natural gas power plant is somewhat different from a conventional power plant. The difference is that in a simple cycle natural gas firing power plant there is no steam generation. The steam turbine is used for the natural gas firing 'combined cycle' power plant. In this the flue

gas is used to heat water and obtain steam. The steam is used for the revolution of a steam turbine. In this process called 'combined cycle' higher efficiency is obtained, since the efficiency of a simple cycle gas turbine is about 30-35 %.

What is more how the fuel is burned can be of great importance. Through use of coal the burning process may not take place through all of the coal. The coal particles can be released to the atmosphere through the stack. Even worse some of the carbon atoms can burn without finding enough oxygen can be released as carbon monoxide (a poisonous gas) instead of carbon dioxide.

If a coal fired power plant is not located on top of a mine, transportation may be a major problem. A 1000 MW power plant will burn about 1 million ton of (2400 kCal/kg) coal daily. To make it livelier: that means 100 cars with capacity of 10 tons each have to transport coal for everyday to the Power plant. That is one train each two hours. If the power plant is close to seaside, everyday a 1,000 ton capacity ship has to board.

A.2. Nuclear Option

As the nuclear energy lies between conventional and the clean energy types, it has its own problems. A nuclear power plant operates more or less in a similar method with the conventional type thermal power plant. Except the fact that the fuel reaction is not a chemical reaction, but a nuclear reaction and there is the radioactivity requiring special attention.

The nuclear power plants are being reconsidered as they are not regarded safe, because of the nuclear accident in Chernobyl, Ukraine. What is more the nuclear wastes have this threat of radioactivity to the organic tissues. The nuclear power plant may also become a target for the terrorist attacks. The gas emission of the nuclear power plant is none (but there is a high risk of water contamination). This brings the nuclear as an option to be reconsidered. For burning less fossil fuel for electricity generation the nuclear seems to be an alternative.

The wastes of the nuclear power plant have to be treated. The wastes are considered to be stored in underground galleries for almost five hundred years before they are taken as safe. Surveillance of nuclear waste for such a long period brings out other questions.

The reactors that are used today work with nuclear fission. (Which mean the breaking up of the heavy elements to lighter elements.) This brings the problem of finding fuel for the nuclear plant. The nuclear fuel has to be treated before use in the reactor. If human beings can use fusion, making up heavier elements with the lightest element, hydrogen. Hydrogen which is an element easier to find compared to the heavy elements uranium and plutonium. Nuclear fusion occurs in the stars and the hydrogen bomb explosions, however nuclear fusion has not been induced under control, yet.

A.3. Clean Energy

The energy kinds that do not directly release extra pollutants to the atmosphere are hydroelectricity, wind, solar, geothermal, biomass and nuclear.

- The OECD countries have largely been using their hydroelectric potential for some time. On the other hand there are objection to large hydroelectric projects because of environmental and social concerns. Thus the hydroelectric potential has already been limited.
- The solar energy is being used for heating water on a domestic scale. Using parabolic mirrors is an expensive option being tested in prototypes.
- The wind turbines are on the verge of becoming economical, they have reached the level of 1 MW. It has become comparable to its fossil fuel competitors.

The solar and wind options are interrupted options. Not continuous, thus the energy needs to be stored for backup and for storage it needs to be converted. Each conversion of energy means extra loss.

- Photovoltaic cells are an expensive way to obtain energy. The developed countries have been investing on these clean but expensive technologies.

The developing countries are in a different situation and their options are somewhat limited. Their economies are still small and their population grows at a rate of 2-3 % annually. They have to grow as quickly as possible and they have to increase their energy production. They use one tenth of the annual per head energy consumption of the developed countries' average, but their productions' energy intensity is high. They cannot have the precautions for the economical efficient use of energy. The energy efficient electrical appliances cannot penetrate their markets easily. Their electricity transmission and distribution networks have high loss and illegal usage figures.

Even though they use less energy, the energy is obtained from mostly polluting sources. As a result they are polluting the planet more than the developed portion of the world. As their most problematic source is capital they are unable to improve their situation in a short period.

Unless there are technological advancements such as the nuclear fusion or high efficiency energy conversions becoming suddenly economical, the energy agenda of our century will contain difficult decisions. The natural line of development will be that every country will have her own set of solutions. These solutions will most probably be the use of an optimal mixture of sources instead of depending on simply one source.

APPENDIX B

ENERGY BALANCES FOR THE EUROPEAN UNION AND TURKEY

Table 4 Energy Balance for the European Union

Energy Balance for the European Union

Mtoe	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	739.00	752.40	749.50	739.83	722.89	708.87	710.72	704.73	711.16	724.53	740.13	765.35	759.09	754.62	768.10	762.91	761.19
Fossil fuels	523.94	527.59	518.22	496.47	474.30	460.44	453.87	445.16	440.77	454.07	464.14	479.44	466.55	458.02	462.47	450.26	437.21
Nuclear energy	147.38	158.50	162.04	173.33	182.43	181.44	187.02	188.27	197.56	197.27	201.24	208.86	212.61	212.05	220.21	222.85	229.94
Renewable energy	67.69	66.31	69.25	70.02	66.16	66.99	69.83	71.31	72.83	73.18	74.75	77.05	79.93	84.55	85.43	89.81	94.05
Net Imports	526.67	551.66	561.69	578.25	622.05	642.09	666.51	678.59	650.44	630.62	651.08	679.22	691.50	723.66	705.56	738.25	765.86
Solid fuels	74.48	73.19	73.13	73.16	77.49	88.95	95.10	97.76	86.64	86.39	94.47	95.34	98.48	101.50	98.64	110.15	119.42
Oil	382.30	403.63	405.60	420.67	453.44	458.52	475.78	483.93	466.85	445.17	446.39	465.43	468.10	489.50	457.51	472.68	494.58
Natural gas	68.57	73.62	81.40	82.33	88.83	92.23	94.33	95.22	94.91	97.37	108.61	118.45	124.16	131.46	147.29	151.69	148.89
Electricity	1.33	1.22	1.55	2.09	2.30	2.33	1.22	1.62	1.88	1.55	1.50	-0.14	0.67	1.13	2.04	3.64	2.87
Gross Inland Consumption	1243.58	1259.74	1282.42	1291.19	1310.43	1318.56	1345.34	1335.53	1335.83	1335.51	1364.23	1413.74	1406.19	1437.81	1440.76	1454.83	1486.16
Solid fuels	317.81	311.72	311.52	305.29	305.97	301.69	285.22	265.12	246.66	242.75	237.91	234.90	223.41	223.07	206.97	215.02	216.63
Oil	511.45	521.51	525.39	533.95	537.97	543.81	562.02	571.40	564.43	566.90	575.20	587.66	586.85	601.41	596.43	587.70	598.85
Natural gas	197.93	200.48	212.68	206.50	215.61	222.03	239.70	237.69	252.29	253.72	273.51	305.24	302.61	315.53	329.60	335.71	343.73
Others	216.39	226.03	232.84	245.44	250.88	251.03	258.40	261.33	272.46	272.14	277.61	285.93	293.31	297.80	307.77	316.40	326.95
Electricity Generation (TWh)	1816.95	1856.33	1921.79	1968.19	2019.63	2060.84	2221.65	2229.83	2230.49	2267.83	2327.23	2411.30	2426.46	2492.58	2532.97	2600.98	2671.37
Nuclear power (TWh)	573.78	621.38	636.50	682.02	723.39	720.20	747.35	761.56	794.28	791.95	810.27	851.20	859.89	854.18	867.24	863.92	891.39
Renewable* (TWh)	318.32	303.99	329.56	346.82	286.79	296.76	307.32	327.97	331.53	339.57	339.07	343.87	355.05	372.95	382.76	411.53	436.68
Conventional Thermal (TWh)	924.85	930.97	955.72	939.35	1009.45	1043.88	1166.97	1140.30	1104.69	1136.30	1177.90	1216.23	1211.52	1265.45	1282.97	1325.54	1343.31
Fuel Inputs for Thermal Power	248.00	248.99	254.22	250.70	263.65	267.78	272.37	268.98	256.97	260.87	271.75	279.85	273.72	283.74	287.37	296.92	299.07
Solid fuels	170.34	174.30	176.62	173.69	178.14	182.28	184.41	176.39	163.19	162.83	161.85	160.88	150.02	154.36	146.95	155.57	157.45
Oil	39.86	36.99	37.61	36.69	42.20	42.04	43.97	47.21	41.58	40.67	43.49	41.49	38.56	38.74	38.09	34.22	32.39
Gas	29.93	29.72	31.89	32.07	35.69	36.66	36.90	37.14	43.13	47.72	55.12	64.97	71.61	76.19	87.18	90.53	91.46
Biomass and geothermal	7.86	7.98	8.09	8.24	7.62	6.79	7.08	8.24	9.07	9.66	11.29	12.51	13.54	14.45	15.16	16.60	17.77
Non-Energy Uses	71.19	74.65	75.91	82.34	84.49	84.11	87.65	90.18	84.51	92.12	93.95	92.91	97.87	94.84	94.14	95.37	92.95
Total Final Energy Demand	826.48	839.89	854.20	856.85	855.16	861.21	881.67	875.55	882.68	876.69	897.76	935.85	928.01	945.11	951.56	951.05	970.31
Solid fuels	101.13	94.36	92.79	89.03	85.06	79.89	68.89	60.75	54.39	51.44	48.46	45.81	45.62	42.17	38.45	37.42	36.34
Oil	373.91	389.77	389.93	395.82	391.27	395.35	407.21	412.13	416.11	413.38	417.08	429.33	428.47	437.02	438.30	435.65	445.95
Gas	164.59	165.71	174.86	172.19	175.13	178.61	193.45	191.55	198.24	195.60	208.15	229.26	218.48	223.26	225.50	230.39	233.94
Electricity	136.31	139.75	145.05	148.98	153.75	155.93	158.80	160.10	161.01	163.59	169.31	173.81	177.21	181.69	185.49	191.71	196.47
Derived Heat	15.75	15.84	16.56	16.58	15.93	16.44	16.73	15.88	17.59	18.07	19.15	20.94	20.49	20.86	23.88	15.04	15.91
Renewable sources	34.78	34.46	35.01	34.26	34.02	34.99	36.59	35.15	35.34	34.60	35.62	36.69	37.74	40.11	39.94	40.84	41.71
CO_2 Emissions (Mt)**	2995.43	3026.93	3057.73	3043.90	3064.72	3075.00	3111.30	3064.96	3009.98	2995.95	3052.02	3136.14	3065.74	3122.70	3106.87	3136.24	3174.48
Energy intensity (toe/M€95)	237.02	233.73	231.69	223.93	219.53	215.35	216.63	212.37	213.31	207.52	207.07	211.21	204.97	203.67	198.77	194.03	195.19
Import dependency, %	41.42	42.70	42.74	43.71	46.34	47.47	48.32	49.54	47.45	46.05	46.54	46.82	47.81	48.92	47.66	49.32	50.07

Source: Eurostat

** including pumping **without maritime bunkers*

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

Table 5 Energy Balance for Greece

Energy Balance for Greece

Mtoe	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	7.33	7.76	8.42	8.62	9.28	9.15	9.06	8.97	8.80	9.15	9.70	10.14	9.92	10.04	9.46	9.95	9.94
Fossil fuels	6.23	6.61	7.30	7.54	8.18	8.05	7.83	7.81	7.62	7.94	8.41	8.76	8.58	8.71	8.02	8.54	8.62
Nuclear energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable energy	1.10	1.15	1.12	1.09	1.10	1.10	1.23	1.16	1.18	1.20	1.29	1.37	1.34	1.33	1.44	1.40	1.32
Net Imports	11.81	13.33	12.57	13.62	14.19	15.37	15.62	17.74	17.24	15.80	18.21	18.83	19.20	21.11	19.74	21.98	22.32
Solid fuels	1.23	1.13	1.11	0.86	0.78	0.99	0.93	1.40	0.88	0.98	0.92	1.17	0.76	0.85	0.73	0.77	0.86
Oil	10.52	12.09	11.41	12.74	13.38	14.32	14.63	16.29	16.28	14.78	17.21	17.54	18.11	19.43	17.78	19.53	19.58
Natural gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.13	0.69	1.22	1.69	1.67
Electricity	0.06	0.11	0.05	0.03	0.03	0.06	0.06	0.05	0.07	0.03	0.07	0.12	0.20	0.14	0.01	0.00	0.21
Gross Inland Consumption	18.34	18.01	18.93	20.16	22.14	22.25	22.41	23.04	22.61	23.61	24.14	25.41	25.59	26.88	26.76	28.08	28.94
Solid fuels	6.08	6.34	6.79	7.42	7.97	8.09	7.72	8.18	7.96	8.48	8.78	8.95	8.82	9.16	8.52	9.04	9.31
Oil	11.02	10.32	10.86	11.50	12.90	12.85	13.27	13.52	13.30	13.85	13.95	14.91	15.06	15.53	15.56	15.93	16.41
Natural gas	0.07	0.10	0.11	0.13	0.14	0.14	0.14	0.13	0.09	0.05	0.04	0.05	0.17	0.73	1.22	1.70	1.68
Others	1.17	1.26	1.17	1.11	1.14	1.17	1.29	1.21	1.25	1.24	1.36	1.49	1.54	1.47	1.46	1.40	1.53
Electricity Generation (TWh)	27.75	28.24	30.27	33.39	34.46	35.00	35.82	37.41	38.40	40.62	41.55	42.56	43.51	46.33	49.86	53.84	53.70
Nuclear power (TWh)																	
Renewable* (TWh)	2.81	3.35	2.96	2.59	2.15	2.00	3.17	2.40	2.59	2.88	3.82	4.54	4.13	3.94	5.22	4.56	3.48
Conventional Thermal (TWh)	24.94	24.89	27.31	30.80	32.31	33.00	32.64	35.01	35.81	37.74	37.74	38.02	39.37	42.39	44.64	49.28	50.22
Fuel Inputs for Thermal Power	6.44	6.55	7.19	7.71	8.43	8.72	8.58	9.16	8.97	9.48	9.88	10.02	10.05	10.29	9.98	11.60	11.61
Solid fuels	4.81	5.14	5.65	6.23	6.81	6.89	6.58	7.18	6.96	7.48	7.79	7.98	8.02	8.03	7.23	8.23	8.44
Oil	1.64	1.40	1.53	1.47	1.60	1.80	1.97	1.96	2.00	1.99	2.08	2.02	1.96	1.90	1.88	2.04	1.87
Gas	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.01	0.01	0.01	0.01	0.02	0.07	0.35	0.87	1.33	1.27
Biomass and geothermal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Non-Energy Uses	0.54	0.53	0.48	0.52	0.60	0.64	0.57	0.52	0.47	0.42	0.44	0.45	0.50	0.60	0.56	0.65	0.66
Total Final Energy Demand	12.49	12.25	13.13	13.70	14.31	14.53	14.70	14.96	15.21	15.35	15.81	16.87	17.26	18.16	18.16	18.51	19.11
Solid fuels	1.28	1.20	1.15	1.20	1.18	1.07	1.10	1.04	1.10	1.09	1.08	1.08	0.96	0.96	0.77	0.89	0.90
Oil	8.29	8.10	8.94	9.29	9.77	10.05	10.10	10.29	10.43	10.45	10.80	11.72	12.02	12.67	12.63	12.58	12.99
Gas	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.08	0.14	0.20	0.25	0.32
Electricity	2.05	2.07	2.15	2.31	2.41	2.45	2.52	2.64	2.68	2.81	2.93	3.06	3.19	3.38	3.51	3.71	3.83
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03
Renewable sources	0.86	0.87	0.88	0.88	0.94	0.95	0.96	0.97	0.98	0.98	0.98	1.00	1.00	1.00	1.01	1.05	1.04
CO_2 Emissions (Mt)**	56.69	56.88	61.89	65.66	70.13	71.10	70.78	73.35	73.32	75.55	78.22	82.13	82.87	85.60	82.57	89.28	91.04
Energy intensity (toe/M€95)	230.82	225.60	242.53	247.73	262.07	263.26	257.33	262.66	262.00	268.11	268.52	276.12	268.32	272.67	262.05	264.20	261.57
Import dependency, %	60.74	67.58	60.65	61.33	58.58	62.06	63.14	69.02	67.04	58.74	65.79	66.05	66.87	69.56	66.15	69.47	68.90

Source: Eurostat

** including pumping **without maritime bunkers*

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

Table 6 Energy Balance for France

Energy Balance for France

Mtoe	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	91.85	97.93	100.91	101.68	106.41	108.32	114.79	115.14	122.09	119.60	123.32	125.86	124.17	120.99	123.15	130.73	131.95
Fossil fuels	18.34	17.32	16.41	14.44	14.68	13.54	13.76	13.01	12.95	11.99	11.44	10.14	8.70	7.37	7.32	6.09	4.70
Nuclear energy	57.27	64.59	67.24	70.18	76.76	79.13	82.93	83.74	91.32	89.85	93.99	97.85	98.77	96.64	98.19	107.09	108.62
Renewable energy	16.23	16.02	17.26	17.05	14.97	15.66	18.10	18.39	17.82	17.77	17.90	17.87	16.71	16.98	17.64	17.54	18.64
Net Imports	111.74	111.59	113.34	110.14	114.94	119.76	126.06	123.11	115.14	109.58	115.30	124.30	122.07	131.56	131.54	129.88	132.43
Solid fuels	12.55	11.14	8.96	7.81	11.02	13.00	13.92	14.56	9.30	8.07	9.01	10.72	9.68	13.06	12.40	13.20	11.20
Oil	81.08	81.37	84.72	84.52	85.91	86.56	91.38	87.40	86.26	81.35	85.42	89.88	88.67	93.32	89.77	90.45	95.65
Natural gas	20.11	21.28	22.21	20.98	21.64	24.10	25.32	25.78	24.86	25.59	26.88	29.62	29.35	30.13	34.81	32.20	31.46
Electricity	-2.01	-2.19	-2.55	-3.18	-3.62	-3.91	-4.55	-4.63	-5.28	-5.43	-6.01	-5.92	-5.62	-4.95	-5.43	-5.97	-5.88
Gross Inland Consumption	204.00	207.34	211.64	210.14	218.24	223.12	235.64	232.81	235.78	226.53	235.63	249.17	243.21	250.78	250.81	254.48	262.32
Solid fuels	24.40	20.37	18.93	18.27	20.17	19.96	20.83	18.79	14.88	14.36	15.29	16.25	14.58	17.16	15.36	15.24	12.56
Oil	83.90	84.46	86.01	84.48	86.10	87.67	90.51	89.28	88.53	82.79	85.50	90.43	87.44	91.54	90.57	88.39	94.59
Natural gas	24.19	24.09	24.75	23.34	23.87	24.61	27.82	27.23	28.51	27.19	28.96	32.69	31.34	33.41	34.48	32.19	33.79
Others	71.50	78.42	81.95	84.06	88.11	90.88	96.48	97.51	103.86	102.19	105.88	109.80	109.85	108.67	110.40	118.66	121.38
Electricity Generation (TWh)	343.77	362.43	378.00	391.74	408.93	419.96	454.74	463.01	472.28	476.34	493.44	513.05	504.23	510.81	523.98	540.65	549.18
Nuclear power (TWh)	224.10	254.16	265.52	275.52	303.93	314.08	331.34	338.45	368.19	359.98	377.23	397.34	395.48	387.99	394.24	415.16	421.07
Renewable* (TWh)	65.10	66.17	73.87	79.74	51.96	58.77	62.94	74.33	69.76	82.98	78.13	72.75	70.25	68.88	80.41	75.76	82.85
Conventional Thermal (TWh)	54.57	42.10	38.61	36.49	53.04	47.11	60.46	50.24	34.34	33.39	38.08	42.96	38.49	53.94	49.33	49.74	45.26
Fuel Inputs for Thermal Power	12.93	10.92	9.98	9.42	12.25	10.91	13.14	10.86	7.17	6.91	8.49	9.01	8.93	12.73	11.74	12.32	10.72
Solid fuels	9.32	7.36	6.42	5.85	7.41	7.33	8.87	7.62	4.98	4.72	5.44	5.76	4.96	7.95	6.71	6.23	4.85
Oil	1.16	1.03	1.22	1.13	2.51	1.92	2.73	1.74	0.63	0.56	0.61	0.59	1.17	1.84	1.67	1.27	0.95
Gas	1.53	1.53	1.32	1.41	1.50	1.42	1.30	1.24	1.32	1.36	1.22	1.28	1.50	1.62	2.06	3.28	3.33
Biomass and geothermal	0.92	1.00	1.02	1.04	0.83	0.23	0.25	0.25	0.24	0.27	1.22	1.38	1.30	1.33	1.31	1.53	1.58
Non-Energy Uses	11.91	12.16	12.23	12.63	12.46	13.08	16.47	16.30	15.20	15.77	16.59	16.85	18.54	16.48	16.52	15.44	14.48
Total Final Energy Demand	131.10	132.17	134.12	132.15	134.73	136.00	142.48	143.10	143.43	137.48	141.24	148.62	145.65	150.83	150.76	148.53	155.71
Solid fuels	10.89	9.99	9.67	9.36	9.36	9.05	8.77	8.40	7.19	6.49	6.90	6.94	7.04	6.75	5.78	5.77	5.04
Oil	65.83	66.85	67.28	66.81	67.17	67.57	67.52	68.89	69.60	66.62	68.03	70.78	69.06	72.38	71.63	71.43	76.33
Gas	22.70	22.99	23.33	22.51	23.19	23.69	26.95	26.47	27.28	26.17	27.10	29.92	29.43	30.22	31.44	28.35	30.08
Electricity	21.75	22.75	23.72	24.09	25.33	25.96	27.61	28.38	28.57	28.70	29.46	30.57	30.54	31.57	32.22	33.11	34.01
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable sources	9.94	9.59	10.12	9.37	9.68	9.73	11.63	10.96	10.79	9.51	9.75	10.41	9.58	9.91	9.70	9.86	10.24
CO_2 Emissions (Mt)**	359.88	350.59	347.94	340.85	355.57	354.14	368.81	362.77	347.52	333.40	344.99	362.24	355.57	380.72	372.72	363.56	374.07
Energy intensity (toe/M€95)	212.54	210.95	210.00	199.32	198.70	197.98	207.03	201.54	205.93	193.85	198.32	207.43	198.69	198.13	191.99	187.70	190.00
Import dependency, %	54.14	53.21	52.99	51.87	52.12	53.08	52.91	52.31	48.34	47.93	48.42	49.36	49.60	51.87	51.85	50.45	49.97

Source: Eurostat

** including pumping **without maritime bunkers*

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

Table 7 Energy Balance for Italy

Energy Balance for Italy

Mtoe	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	24.94	27.08	26.20	27.43	27.30	27.40	27.90	28.81	30.02	31.45	30.84	31.68	31.72	32.63	31.66	30.71	30.28
Fossil fuels	14.28	15.93	17.46	18.65	18.69	19.07	18.71	19.51	20.52	21.54	21.73	21.95	21.81	21.25	19.35	18.23	16.67
Nuclear energy	1.98	2.44	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable energy	8.67	8.72	8.69	8.78	8.60	8.32	9.18	9.30	9.49	9.91	9.11	9.72	9.91	11.38	12.32	12.48	13.61
Net Imports	114.41	114.94	123.70	120.25	130.50	131.95	129.10	134.23	127.20	125.82	134.69	134.46	134.24	140.37	143.48	152.59	147.26
Solid fuels	14.77	13.94	14.49	13.24	13.96	13.79	13.71	12.07	9.59	10.85	12.99	11.45	10.64	11.55	11.85	13.19	13.62
Oil	81.57	82.68	88.07	84.81	90.19	89.88	84.85	90.84	87.46	87.54	89.96	89.36	88.29	90.43	87.53	88.58	84.67
Natural gas	16.04	16.41	19.14	19.51	23.45	25.30	27.52	28.28	26.75	24.20	28.53	30.43	31.98	34.89	40.49	47.01	44.81
Electricity	2.04	1.90	1.99	2.69	2.90	2.98	3.02	3.04	3.39	3.23	3.22	3.21	3.34	3.50	3.61	3.81	4.16
Gross Inland Consumption	136.05	138.94	143.96	147.04	153.35	154.76	156.74	158.62	156.15	154.23	162.74	162.49	164.61	170.64	173.36	175.79	176.61
Solid fuels	15.16	14.37	14.81	13.92	13.70	14.64	13.96	12.19	10.45	11.39	12.33	11.28	11.22	11.71	11.77	12.66	13.49
Oil	81.01	82.64	86.36	88.09	91.25	89.82	89.12	92.97	90.86	89.15	93.43	92.20	92.66	92.92	90.10	88.90	87.25
Natural gas	27.20	28.88	32.06	33.57	36.90	39.00	41.46	41.11	41.95	40.54	44.65	46.07	47.49	51.13	55.57	57.94	58.10
Others	12.69	13.06	10.73	11.47	11.50	11.30	12.20	12.34	12.88	13.14	12.33	12.94	13.25	14.88	15.93	16.30	17.77
Electricity Generation (TWh)	184.50	191.13	201.38	203.66	210.75	216.88	222.05	225.92	222.41	231.50	241.11	244.07	250.77	259.05	264.99	276.62	279.00
Nuclear power (TWh)																	
Renewable* (TWh)	47.79	48.21	46.48	47.52	40.78	38.47	49.05	49.50	48.43	51.44	45.74	51.47	51.40	53.04	58.41	57.76	62.20
Conventional Thermal (TWh)	130.93	135.35	154.72	156.14	169.97	178.41	172.99	176.42	173.98	180.07	195.37	192.60	199.37	206.02	206.59	218.86	216.80
Fuel Inputs for Thermal Power	30.05	30.91	35.08	35.38	38.07	39.62	38.37	38.85	38.54	39.28	42.80	42.20	43.05	44.74	45.21	48.22	46.24
Solid fuels	5.92	6.11	6.66	6.68	6.17	7.07	6.32	4.72	3.65	4.37	5.34	4.89	4.51	5.09	5.18	5.83	6.99
Oil	16.20	16.53	19.13	19.14	21.69	21.53	21.72	23.94	23.50	23.77	25.01	24.15	23.26	21.93	18.99	18.96	16.51
Gas	5.92	6.22	7.13	7.41	7.89	8.90	8.24	7.95	8.89	8.72	10.16	10.60	12.52	14.58	17.60	19.75	19.05
Biomass and geothermal	2.01	2.05	2.16	2.15	2.32	2.11	2.09	2.24	2.50	2.42	2.29	2.56	2.76	3.15	3.45	3.68	3.70
Non-Energy Uses	8.41	8.95	9.18	10.14	10.13	9.84	9.77	13.07	12.38	12.91	13.88	13.51	14.00	10.55	10.63	11.04	10.33
Total Final Energy Demand	96.54	97.62	102.88	105.21	109.15	109.48	112.25	112.36	112.56	110.98	115.75	116.48	117.26	121.64	126.20	125.95	129.70
Solid fuels	5.12	4.06	4.51	3.86	3.86	4.28	4.29	4.56	4.20	4.31	4.14	3.72	3.87	3.94	3.72	3.51	3.81
Oil	52.61	53.01	54.57	55.37	55.79	53.62	53.34	53.39	52.88	51.32	53.10	52.99	53.51	54.56	57.20	56.15	57.46
Gas	20.74	22.02	24.46	25.81	28.35	29.68	32.34	31.81	32.81	31.84	34.51	35.57	35.03	36.59	37.90	37.94	38.80
Electricity	14.93	15.40	16.21	17.03	17.79	18.41	18.82	19.16	19.24	19.86	20.44	20.65	21.31	21.90	22.44	23.43	23.85
Derived Heat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Renewable sources	3.13	3.13	3.13	3.13	3.35	3.49	3.46	3.43	3.43	3.65	3.56	3.54	3.54	4.64	4.92	4.92	5.79
CO_2 Emissions (Mt)**	339.59	343.52	366.20	369.89	386.12	388.26	387.02	386.30	383.18	379.42	402.46	398.66	400.09	412.12	419.07	421.68	424.39
Energy intensity (toe/M€95)	198.87	198.08	199.30	195.82	198.53	196.48	196.26	197.11	195.77	189.19	193.96	191.57	190.21	193.70	193.71	190.95	188.47
Import dependency, %	82.04	80.64	84.03	80.12	83.59	83.82	81.06	83.35	80.22	80.36	81.56	81.60	80.38	81.02	81.63	85.48	82.07

Source: Eurostat

** including pumping **without maritime bunkers*

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

Table 8 Energy Balance for Germany

Energy Balance for Germany

Mtoe	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	210.04	202.21	202.00	203.40	200.80	186.39	165.56	160.40	148.88	142.15	141.34	139.48	139.52	133.32	135.70	133.22	133.01
Fossil fuels	169.07	164.00	160.67	158.10	154.44	142.53	123.35	114.89	104.74	98.40	96.83	93.07	89.75	84.54	82.23	78.85	77.74
Nuclear energy	34.87	32.00	35.00	38.89	40.10	37.67	36.13	39.00	37.54	36.84	37.32	38.92	41.11	38.91	43.85	43.75	44.19
Renewable energy	6.11	6.20	6.33	6.42	6.26	6.20	6.08	6.50	6.60	6.91	7.19	7.49	8.66	9.87	9.62	10.61	11.08
Net Imports	152.83	165.72	166.06	163.81	157.39	166.85	180.11	186.58	188.48	191.41	195.15	207.79	208.36	212.75	202.56	204.70	215.65
Solid fuels	-0.07	3.31	3.20	2.27	-0.33	4.84	7.17	9.47	9.13	9.75	10.99	12.41	14.86	17.32	17.35	21.60	25.77
Oil	118.24	126.36	123.64	123.61	116.18	120.13	129.33	133.00	131.80	132.11	130.81	135.78	135.54	139.44	127.82	125.97	131.44
Natural gas	34.43	35.51	38.56	37.75	41.44	41.81	43.65	44.56	47.48	49.25	52.93	60.06	58.16	56.04	57.30	56.87	58.20
Electricity	0.23	0.54	0.65	0.18	0.09	0.07	-0.05	-0.46	0.07	0.30	0.41	-0.45	-0.20	-0.05	0.09	0.26	0.23
Gross Inland Consumption	359.34	359.09	363.96	363.61	358.51	356.07	347.16	340.44	339.02	336.02	337.09	348.81	345.32	344.71	338.62	340.08	348.84
Solid fuels	148.01	145.21	143.03	140.86	139.23	133.10	115.28	104.33	98.38	95.32	92.17	90.92	86.72	85.58	80.11	83.72	85.04
Oil	120.55	124.96	124.61	124.54	118.29	124.04	131.91	133.85	135.90	135.02	133.57	136.86	137.08	137.67	132.95	129.87	132.71
Natural gas	49.57	50.19	54.34	52.72	54.55	55.00	57.81	57.20	60.52	61.62	66.42	75.08	71.95	72.73	72.00	71.85	75.59
Others	41.20	38.74	41.98	45.48	46.44	43.94	42.16	45.05	44.22	44.05	44.93	45.96	49.57	48.73	53.56	54.63	55.50
Electricity Generation (TWh)	424.19	421.74	431.40	443.15	452.63	453.59	539.56	537.39	526.39	527.71	536.24	555.00	551.57	556.71	555.47	571.55	581.58
Nuclear power (TWh)	138.64	130.49	141.73	156.82	161.67	152.47	147.43	158.80	153.48	151.20	154.09	161.61	170.33	161.64	170.00	169.61	171.31
Renewable* (TWh)	23.74	24.47	25.98	26.66	23.98	23.06	22.07	24.79	25.31	26.99	29.71	30.80	27.36	30.97	34.39	41.49	40.63
Conventional Thermal (TWh)	261.81	266.78	263.68	259.68	266.97	278.07	370.05	353.79	347.61	349.52	352.44	362.59	353.88	364.10	351.07	360.46	369.65
Fuel Inputs for Thermal Power	89.14	90.51	89.22	89.52	90.44	89.89	89.39	85.36	83.54	83.88	85.69	86.68	81.10	81.44	81.12	84.28	87.29
Solid fuels	77.50	77.70	75.91	76.03	76.45	75.54	75.04	71.93	70.90	69.95	69.15	67.75	64.10	65.15	65.14	68.07	68.35
Oil	2.63	3.34	3.50	3.18	2.87	2.86	3.21	2.89	2.27	2.24	2.07	1.68	1.32	1.26	1.18	1.11	1.11
Gas	7.38	7.84	8.21	8.60	9.72	10.09	9.66	8.54	8.33	9.56	12.19	14.94	13.37	12.61	12.85	12.91	15.03
Biomass and geothermal	1.64	1.63	1.60	1.71	1.38	1.40	1.48	2.00	2.04	2.13	2.28	2.31	2.30	2.42	1.95	2.20	2.80
Non-Energy Uses	20.29	20.31	20.31	22.76	22.91	22.80	21.23	21.69	20.96	22.95	22.82	23.11	23.86	24.98	24.37	25.19	24.85
Total Final Energy Demand	233.46	237.31	239.23	235.48	228.71	227.22	224.32	218.41	219.33	215.46	222.34	230.90	226.13	224.93	220.39	213.44	214.87
Solid fuels	48.60	45.54	45.31	43.05	41.29	37.14	26.08	19.96	17.22	15.95	14.89	13.75	13.36	11.78	10.49	10.93	10.29
Oil	94.67	101.76	99.51	98.45	92.14	96.74	103.09	104.82	106.87	103.69	104.47	106.42	105.42	104.59	101.25	98.05	100.78
Gas	41.06	40.32	43.38	43.05	43.59	42.72	45.73	45.62	47.59	48.04	52.59	59.83	54.75	54.80	54.87	58.01	56.70
Electricity	36.51	36.98	37.83	38.40	39.14	38.39	37.38	36.83	36.48	36.72	38.91	39.38	39.70	40.11	40.20	41.50	42.15
Derived Heat	9.50	9.59	10.09	9.41	9.46	9.15	9.03	8.50	8.47	8.33	8.74	8.74	8.74	8.74	8.74	0.00	0.00
Renewable sources	3.12	3.12	3.12	3.12	3.10	3.07	3.01	2.67	2.70	2.73	2.73	2.78	4.15	4.92	4.84	4.96	4.96
CO_2 Emissions (Mt)**	987.74	1000.02	992.93	980.06	957.62	944.89	920.81	881.62	871.35	857.97	869.70	879.54	837.33	832.03	814.78	826.37	835.09
Energy intensity (toe/M€95)	238.88	232.84	232.08	223.69	213.14	205.06	194.41	186.47	187.73	181.80	179.28	184.11	179.76	176.00	169.75	165.51	168.82
Import dependency, %	42.13	45.58	45.20	44.70	43.60	46.53	51.57	54.52	55.24	56.62	57.54	59.23	59.96	61.36	59.45	59.81	61.43

Source: Eurostat

** including pumping **without maritime bunkers*

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

Table 9 Energy Balance for the United Kingdom

Energy Balance for the United Kingdom

Mtoe	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Production	236.48	245.73	241.03	231.70	207.16	204.49	211.10	211.09	219.08	238.99	250.31	262.29	262.41	269.67	277.53	268.82	258.49
Fossil fuels	219.56	229.07	225.12	214.39	188.43	186.85	192.75	190.91	195.56	215.88	227.06	238.18	237.05	241.50	250.52	244.25	232.52
Nuclear energy	15.98	15.69	14.98	16.34	17.73	16.57	17.29	18.74	22.09	21.20	21.25	22.18	23.25	25.83	24.54	21.94	23.24
Renewable energy	0.93	0.98	0.93	0.98	0.99	1.07	1.07	1.44	1.44	1.91	2.00	1.93	2.12	2.33	2.47	2.63	2.73
Net Imports	-31.65	-37.34	-34.66	-20.39	8.20	5.93	11.24	9.24	0.96	-30.13	-36.13	-33.26	-34.39	-36.39	-46.95	-39.03	-20.83
Solid fuels	6.59	4.82	5.51	7.90	7.59	9.12	11.54	13.08	12.16	9.24	10.38	11.75	12.83	14.43	12.69	14.58	22.04
Oil	-49.62	-53.13	-51.14	-38.33	-9.28	-10.40	-7.28	-9.97	-15.87	-42.64	-48.55	-46.81	-48.05	-50.26	-55.32	-45.52	-35.42
Natural gas	11.39	10.61	9.97	8.93	8.80	6.18	5.57	4.69	3.23	1.82	0.64	0.36	-0.59	-1.63	-5.54	-9.31	-8.35
Electricity	0.00	0.37	1.00	1.10	1.09	1.03	1.41	1.44	1.44	1.45	1.40	1.43	1.43	1.07	1.22	1.22	0.89
Gross Inland Consumption	203.61	204.26	206.48	208.46	210.70	210.09	215.27	215.39	218.16	218.55	218.75	228.25	222.54	230.17	228.72	230.64	232.49
Solid fuels	62.77	66.13	68.92	66.93	64.32	63.31	62.76	59.42	52.66	49.32	46.61	44.23	39.82	41.03	34.22	35.95	39.64
Oil	77.29	73.86	71.95	76.88	80.83	80.90	81.87	83.64	82.76	84.44	82.38	82.51	79.75	80.55	82.10	81.40	79.17
Natural gas	46.64	47.24	48.70	46.22	45.75	47.20	50.88	50.71	57.78	60.22	65.12	75.96	76.18	79.34	84.16	87.50	86.82
Others	16.91	17.03	16.91	18.42	19.81	18.67	19.77	21.62	24.96	24.56	24.65	25.55	26.79	29.24	28.24	25.80	26.87
Electricity Generation (TWh)	296.85	300.63	301.60	307.83	313.69	318.96	322.84	323.91	323.58	325.40	334.04	347.38	345.38	362.02	368.36	377.31	385.83
Nuclear power (TWh)	61.10	59.08	55.24	63.46	71.73	65.75	70.54	78.47	89.35	88.28	88.96	94.67	98.15	100.14	95.13	85.06	90.09
Renewable* (TWh)	6.93	7.00	6.24	7.06	7.37	7.83	7.65	9.26	7.35	8.49	8.46	7.28	8.53	10.66	13.09	13.08	12.45
Conventional Thermal (TWh)	228.82	234.55	240.12	237.31	234.60	245.38	244.65	236.18	226.88	228.63	236.62	245.43	238.70	251.22	260.14	279.16	283.28
Fuel Inputs for Thermal Power	54.35	55.02	55.96	54.44	54.31	56.62	56.16	55.89	50.92	49.60	50.15	50.96	49.33	53.75	51.29	55.44	57.20
Solid fuels	42.13	46.95	48.53	46.40	46.38	47.57	47.67	45.61	37.53	35.11	34.15	31.14	27.08	30.16	24.16	27.20	30.06
Oil	10.72	6.83	5.51	6.09	6.02	7.17	6.41	7.00	5.32	3.91	3.40	3.19	1.61	1.07	0.65	0.81	0.62
Gas	1.22	0.95	1.63	1.67	1.70	1.67	1.84	2.96	7.64	10.01	11.97	15.97	19.84	21.55	25.31	26.03	24.90
Biomass and geothermal	0.29	0.29	0.29	0.29	0.21	0.21	0.24	0.32	0.43	0.57	0.62	0.67	0.79	0.97	1.17	1.41	1.62
Non-Energy Uses	7.93	9.34	9.38	10.17	12.24	11.50	12.66	11.95	11.99	12.54	12.55	12.41	11.70	11.65	11.89	11.19	9.97
Total Final Energy Demand	131.38	135.07	136.06	138.56	136.78	136.83	140.98	139.76	141.93	142.27	142.44	150.43	147.73	148.48	151.58	151.48	151.86
Solid fuels	15.99	15.92	15.00	14.89	13.08	12.04	12.52	11.68	11.01	10.18	8.90	8.37	8.03	7.28	6.94	5.55	5.88
Oil	51.65	54.30	53.77	56.93	59.18	58.77	59.31	58.99	60.59	61.07	60.20	62.20	61.59	61.69	63.11	62.48	62.32
Gas	42.62	43.04	44.72	43.20	40.45	41.56	44.12	44.25	45.09	45.70	47.15	52.65	50.60	51.53	50.62	52.01	52.04
Electricity	20.81	21.52	22.26	22.82	23.25	23.60	24.17	24.20	24.60	24.44	25.27	26.28	26.59	27.14	27.75	28.33	28.70
Derived Heat	0.01	0.01	0.01	0.44	0.44	0.45	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	2.51	2.31
Renewable sources	0.29	0.29	0.29	0.29	0.39	0.42	0.43	0.64	0.63	0.87	0.93	0.93	0.91	0.84	0.67	0.60	0.61
CO_2 Emissions (Mt)**	555.37	569.40	571.39	571.47	562.26	567.40	575.99	568.65	548.28	540.68	536.40	551.96	531.72	546.61	533.87	544.13	551.81
Energy intensity (toe/M€95)	301.20	290.69	281.18	269.86	267.01	264.15	274.45	273.97	270.76	259.16	252.10	256.31	241.58	242.60	236.06	231.02	227.85
Import dependency, %	-15.38	-18.10	-16.62	-9.70	3.85	2.79	5.16	4.24	0.43	-13.64	-16.34	-14.41	-15.25	-15.60	-20.32	-16.77	-8.87

Source: Eurostat

** including pumping **without maritime bunkers*

Source: European Union Energy & Transport in Figures 2003 European Commission Directorate General for Energy and Transport in co-operation with Eurostat

Table 10 Turkey Energy Balance

Turkey energy balance (Source: ACE Model)

Mtoe	1990	1995	2000	2005	2010	2015	2020	2025	2030
Primary Production	**25.5**	**26.02**	**26.19**	**31.55**	**34.58**	**36.76**	**36.68**	**35.38**	**36.79**
Solids	12.41	12.08	13.29	18.24	20.44	20.41	17.8	14.21	12.1
Oil	3.61	3.47	2.73	2.72	2.97	3.5	3.56	3.77	4.04
Natural Gas	0.17	0.15	0.53	0.49	0.74	1.1	1.65	1.78	1.81
Nuclear	0	0	0	0	0	0	0	0	0
Renewable Energy Sources	9.3	10.31	9.64	10.1	10.43	11.75	13.67	15.63	18.85
Hydro	1.99	3.06	2.66	3.53	4.22	5.39	6.55	6.74	6.93
Biomass	7.21	7.07	6.46	6.17	5.86	5.74	5.93	6.92	8.7
Waste	0	0	0.02	0.04	0.05	0.1	0.22	0.42	0.66
Wind	0	0	0	0	0.01	0.08	0.25	0.49	0.8
Solar and others	0.02	0.05	0.26	0.2	0.29	0.44	0.72	1.06	1.75
Geothermal	0.08	0.14	0.24	0.16	0	0	0	0	0
Net imports	**28.1**	**36.62**	**51**	**48.46**	**58.1**	**74.49**	**98.61**	**126.93**	**160.53**
Solids	4.21	4.47	9.24	10.28	10.82	12.19	13.98	15.65	17.99
Oil	21.28	26.54	29.41	26.59	30.01	36.59	46.34	57.43	71.9
crude oil and feedstocks	20.85	24.52	21.43	21.13	23.07	27.23	33.95	41.51	50.93
oil products	0.43	2.03	7.98	5.46	6.93	9.35	12.39	15.91	20.97
Natural gas	2.68	5.66	12.05	11.3	16.94	25.35	37.89	53.41	70.18
Electricity	-0.06	-0.06	0.29	0.29	0.33	0.36	0.41	0.43	0.47
Gross Inland Consumption	**52.65**	**61.39**	**77.1**	**79.58**	**92.11**	**110.5**	**134.28**	**160.99**	**195.65**
Solids	16.94	16.62	23.46	28.52	31.25	32.61	31.78	29.87	30.09
Oil	23.61	28.74	31.08	28.88	32.42	39.33	48.89	59.88	74.26
Natural Gas	2.85	5.79	12.64	11.79	17.68	26.45	39.53	55.18	71.99
Nuclear	0	0	0	0	0	0	0	0	0
Electricity	-0.06	-0.06	0.29	0.29	0.33	0.36	0.41	0.43	0.47
Renewable Energy Forms	9.3	10.31	9.64	10.1	10.43	11.75	13.67	15.63	18.85
as % in Gross Inland Consumption									
Solids	32.2	2701	30.4	35.8	33.9	29.5	23.7	18.6	15.4
Oil	44.8	46.8	40.3	36.3	35.2	35.6	36.4	37.2	38
Natural Gas	5.4	9.4	16.4	14.8	19.2	23.9	29.4	34.3	36.8
Nuclear	0	0	0	0	0	0	0	0	0
Renewable Energy Forms	17.7	16.8	12.5	12.7	11.3	10.6	10.2	9.7	9.6
Electricity Generation in TWhe	**57.54**	**86.25**	**124.92**	**147.92**	**192.59**	**243.75**	**318.96**	**390.07**	**485.08**
Nuclear	0	0	0	0	0	0	0	0	0
Hydro & Wind	23.15	35.54	30.91	39.61	49.29	63.61	73.14	84.31	90.61
Thermal (including Biomass)	34.4	50.71	94.01	108.31	143.3	180.14	239.81	305.76	394.48
Fuel Inputs for Thermal Power Generation	**9.02**	**12.84**	**21.8**	**23.3**	**29.33**	**35.24**	**43.46**	**52.23**	**64.92**
Solids	5.34	7.42	10.63	16.59	19.48	21.03	20.74	20.32	21.79
Oil	1.19	1.8	2.8	0.49	0.6	0.74	0.94	1.37	1.8
Gas	2.49	3.34	8.27	5.98	8.92	12.77	20.25	27.54	36.5
Biomass - Waste	0	0.28	0.1	0.25	0.33	0.7	1.53	3	4.82
Geothermal heat	0	0	0	0	0	0	0	0	0
Hydrogen - Methanol	0	0	0	0	0	0	0	0	0
Fuel Input in other transformation processes	**28.55**	**31.07**	**27.68**	**27.26**	**29.18**	**33.69**	**40.39**	**48.59**	**59**
Refineries	23.93	27.1	23.76	23.85	26.04	30.73	37.51	45.47	55.44
District heating	0	0	0	0.01	0.01	0.01	0.01	0.03	0.05
Biofuels and hydrogen production	0	0	0	0	0.01	0.07	0.13	0.5	1.06
Others	4.63	3.97	3.92	3.4	3.12	2.88	2.74	2.59	2.46
Energy Branch Consumption	**1.96**	**2.44**	**2.68**	**2.78**	**3.1**	**3.59**	**4.33**	**5.06**	**6**
Non-Energy Uses	**2.85**	**3.87**	**3.58**	**3.67**	**3.83**	**4.01**	**4.2**	**4.43**	**4.7**
Final Energy Demand	**38.49**	**44.84**	**54.33**	**56.41**	**65.25**	**79.61**	**98.49**	**120.08**	**147**
by sector									
Industry	12.01	13.18	20.16	20.23	22.19	25.27	28.27	30.72	32.91
Residential	14.27	15.68	16.84	17.32	19.48	22.44	26.28	31.01	36.87
Tertiary	2.64	3.81	4.87	5.12	6.01	7.57	10.01	13.64	18.46
Transport	9.58	12.17	12.46	13.74	17.57	24.33	33.93	44.71	58.76
by fuel									
Solids	8.09	6.95	10.92	10.48	10.5	10.45	9.97	8.55	7.35
Oil	18.12	22.74	23.44	23.69	26.89	33.32	42.24	52.3	65.64
Gas	1.17	2.64	4.9	6.21	9.02	13.76	19.27	27.5	35.22
Electricity	3.87	5.6	8.25	9.78	12.76	16.19	21.24	26.05	32.5
Heat (from CHP and District Heating)	0	0	0	0.1	0.21	0.26	0.34	0.49	0.67
Other	7.24	6.9	6.82	6.15	5.87	5.63	5.43	5.2	5.61
CO_2 Emissions (Mt of CO_2)	**128.6**	**154.2**	**204.6**	**218.1**	**253.5**	**299.9**	**354.6**	**414.5**	**495.3**
Electricity and Steam Production	32.3	44.8	72.8	84.3	103.4	119	135.5	151.5	179.1
Energy Branch	4.7	5.7	5.9	5.8	6.1	6.9	8.1	9.4	11.1
Industry	35.4	35.8	57.9	57.5	60.6	64.8	66.1	66.6	63.9
Residential	21.6	23.8	23.2	22	23.8	27.6	32	39.2	48.2
Tertiary	5.9	7.9	8.3	8.1	7.9	10	13.5	17.7	23.2
Transport	28.6	36.2	36.5	40.4	51.8	71.5	99.4	130.1	169.7
CO_2 Emissions Index (1990=100)	**100**	**119.9**	**159.2**	**169.6**	**197.2**	**233.2**	**275.8**	**322.4**	**385.2**

Source: European Commission Directorate-General for Energy and Transport (2003) European Energy and Transport Trends to 2030

Table 11 Turkey Energy Indicators

Turkey energy indicators (Source: ACE Model)	1990	1995	2000	2005	2010	2015	2020	2025	2030
Main Energy System Indicators									
Population (Million)	56.2	61.64	67.46	72.06	76	79.94	83.79	87.64	90.99
GDP (in 000 Meuro'00)	125	146.4	177.7	190.3	247	333.6	444.8	579.9	738.4
Gross Inland Consumption/GDP (toe/Meuro'00)	421.2	419.3	434	418.2	373	331.2	301.9	277.6	265
Gross Inland Consumption/Capita (toe/inhabitant)	0.94	1	1.14	1.1	1.21	1.38	1.6	1.84	2.15
Electricity Generated/Capita (kWh/inhabitant)	1024	1399	1852	2053	2534	3049	3807	4451	5331
Carbon Intensity (t of CO_2/toe of GIC)	2.44	2.51	2.65	2.74	2.75	2.71	2.64	2.57	2.53
CO_2 Emissions/Capita (t of CO_2/inhabitant)	2.29	2.5	3.03	3.03	3.34	3.75	4.23	4.73	5.44
CO_2 Emissions to GDP(t of CO_2/MEuro'00)	1	1.1	1.2	1.1	1	0.9	0.8	0.7	0.7
Import Dependency %	53.3	59.5	65.8	60.6	62.7	67	72.9	78.2	81.4
Energy intensity indicators (1990=100)									
Industry (Energy on value added)	100	88.2	111.2	105.5	89.1	74.5	62.2	52.2	44.4
Residential (Energy on private income)	100	95.9	83	81.1	73.1	63.3	55.5	49.8	45.9
Tertiary (Energy on Value added)	100	126	131.2	128.8	115.7	109.3	109.3	114.4	121.4
Transport (Energy on GDP)	100	108.5	91.6	94.3	92.9	95.2	99.6	100.7	103.9
Carbon Intensity indicators									
Electricityand Steam Production (t of CO2/MWh)	0.56	0.52	0.58	0.57	0.53	0.48	0.42	0.38	0.36
Final Energy Demand (t of CO_2/toe)	2.38	2.31	2.32	2.27	2.21	2.18	2.14	2.11	2.08
Industry	2.95	2.71	2.87	2.85	2.73	2.56	2.34	2.17	1.94
Residential	1.52	1.52	1.38	1.27	1.22	1.23	1.22	1.27	1.31
Tertiary	2.25	2.06	1.71	1.58	1.32	1.32	1.35	1.29	1.26
Transport	2.99	2.98	2.93	2.94	2.95	2.94	2.93	2.91	2.89
Electricity and Steam Generation									
Generation Capacity in GWe	**22.43**	**29.98**	**41.32**	**51.59**	**64.8**	**82.85**	**97.49**	**117.19**	
Nuclear	0	0	0	0	0	0	0	0	
Hydro (pumping excluded)	10.77	12.49	16.97	20.33	25.91	31.5	32.38	33.25	
Wind and Solar	0	0.02	0.02	0.1	0.61	1.86	3.76	6.38	
Thermal	11.66	17.47	24.33	31.16	38.28	49.49	61.36	77.56	
of which cogeneration units	*0.17*	*0.29*	*0.13*	*0.26*	*0.33*	*0.44*	*0.61*	*0.81*	
Open cycle (including biomass-waste)	8.33	11.54	14.97	17.42	19.23	20.84	22.68	25.67	
Supercritical polyvalent/clean coal and lignite	0	0	0	0.03	0.33	1.12	3.55	6.97	
Gas turbines combined cycle	3.08	5.68	9.11	13.34	17.74	25.46	31.85	40.59	
small gas turbines	0.23	0.23	0.25	0.37	0.98	2.07	3.27	4.33	
fuel cells	0	0	0	0	0	0	0	0	
geothermal heat	0.02	0.02	0.01	0	0	0	0	0	
Indicators									
Efficiency for Thermal Electricity production (%)	33.8	37	40	42.1	44	47.5	50.4	52.3	
Load factor for gross electric capacities (%)	43.9	47.6	41.3	42.6	42.9	43.9	45.7	47.3	
CHP indicator (% of electricity from CHP)	0	0	0.5	0.7	0.8	0.7	0.9	0.9	
Non fossil fuels in electricity generation (%)	41.6	25	28	26.1	27.2	26.9	25.1	23.3	
Nuclear	0	0	0	0	0	0	0	0	
Renewable energy forms	41.6	25	28	26.1	27.2	26.9	25.1	23.3	

Source: European Commission Directorate-General for Energy and Transport (2003) European Energy and Transport Trends to 2030