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Energy Efficiency Study of Turkey

In-Depth Energy Efficiency Review of the Republic of Turkey
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1 | Introduction & Executive Summary

1.1 Introduction

In today’s world, improving the energy efficiency level constitutes a focal point in Turkey’s energy policies, just as in other countries, in order to achieve a fast and cost effective solution to globalizing energy and environmental problems and to create a sustainable, resource efficient economy which encompasses transformation and growth. In this context for Turkey, while the importance of studies on energy efficiency to ensure energy supply security is increasing, housing constructions which lead to a very high level of energy consumption are also growing.

Energy efficiency is a critical factor which should be taken into consideration when constructing residential buildings. Energy not only constitutes a large portion of the total usage cost of a building but it also plays an effective role in providing the conditions for climatic and visual comfort for the occupants. Thus, ensuring energy efficiency in residential buildings is considered by many countries as a fundamental component for developing cost efficient energy and climate change policies. Residential buildings represent a significant percentage in global energy consumption and associated CO2 emissions, therefore having very high potential to reduce such consumption in a cost effective way.

In this regard, it is observed that existing buildings have a very inefficient structure in terms of energy use, and although new buildings aim to achieve higher performance levels, they fail this goal and remain at similar performance levels of those of existing buildings. Therefore, the fact that most residential building use, directly or indirectly, fossil fuel in very high amounts and that the resources used are scarce and non-renewable with associated impacts on the environment and high energy costs entail an improvement in the residential building’s energy performance.

In terms of energy and cost efficiency, many strategies and strategy combinations to improve energy performance of residential buildings can be developed and the effects of these strategies and strategy combinations on the existing energy performance level can be evaluated.

The core of this Energy-Efficiency Study is to assess the progress of energy efficiency in Turkey, the promotion of measures and the transfer of information. It assists governments in developing and implementing Energy Efficiency policies.
1.2 Executive Summary

General

In 2001 the Turkish economy got its deepest economic crises. Since 2002 Turkey has achieved a GDP growth rate of 5% annually. It’s due to regulation in the banking sector and the massive privatizations of public companies. The Turkish import and export also increased annual by 15% of imports and 14% of exports. With the “foreign” policy of Turkey, a lot of joint ventures and foreign investments increased during the last years. The rates of foreign direct investments are 2.1% of the GDP.

Energy Efficiency

In Turkey the energy use is growing rapidly because of the growing population and industrialization. Economic predictions say that the demand on electricity will increase by nearly 7.3% every year the next decade.

There is a large energy saving potential in Turkey. The World Bank published a report that stated that there is a saving potential of 4.6 Mtoe from the industry, 4.8 Mtoe from the transport sector and 7.1 Mtoe from the households. This leads to a total potential of 16.5 Mtoe of electricity. This amount of saving resembles 2.0 billion euro in the industry, 5.4 billion euros in the transport and 5.8 billion euros in the household sector, total amount of 13.2 billion euros, of costs that could be economized.

The Turkish government issued several policies in the field of energy efficiency such as the Energy Efficiency Law or the Energy Efficiency Strategy paper. Both Issues provide efficiency in the energy use, to reduce the burden of energy costs and to determine political frameworks to support activities in order to reach targets.

An important goal for turkey is, to secure a long-term energy independence from other countries. The actual energy policies promote domestic energy sources and to make use of the available Renewable Energy Sources potential.

Renewable Energy Sources (RES)

The energy generation of Turkey plays a large role in its economy. Nearly 74% of the primary energy supply of Turkey comes from imports and relies of coal, natural gas and oil.

To change this situation the Turkish government has taken several steps to support the development of the Law on Utilization of RES to generate electrical energy from renewable
sources. An assessment showed that the RES potential of Turkey already was a 25,857 MW of renewable energy sources installed capacity in January 2014. But the substantial potential of renewable energy estimated at 740 TWh/year, which is three times higher than the gross demand of 242 TWh in 2012.

The primary target is to increase the share of domestic sources in the Electricity Energy Market and the Supply Security Strategy Paper. There are also further targets to develop RES by 2023:

- 30% share of RES in electricity generation
- Wind plant capacity reach up to 20,000 MW
- Hydroelectric potential will be put into use
- Use of solar energy will be commenced
- The banking system in Turkey has built up considerable experience with financing RES projects.

**Overall Assessment of Progress**

All the power distribution companies are privatized and generation asset privatization is still continuing. A large-scale of rehabilitations of power plants was preceded due to the privatization and is expected ongoing after privatization. A process is now in place to reduce the theft and losses of energy from 14.6% to circa 12% with separate targets for each distribution in 2015.

As described in the part RES, the Turkish government wants to get less dependent on imports for energy generation. To observe this pledge, a strategy paper was issued which set targets for the centenary of the establishment of the Turkish Republic in 2023 to achieve at least 30% of energy generation from RES and to reduce the use of natural gas under 30%.

As part of the EU accession policy, Turkey’s efforts were in the areas as security of supply, energy efficiency, renewable energy, nuclear safety and internal energy market.

Turkey was lauded for the work on a strategy paper which set seven strategic goals that are divided into concrete measures and timelines.
2 | General Remarks about Turkey

2.1 General Information

The Republic of Turkey is a contiguous transcontinental parliamentary republic. It has a total population of over 76.9 million people and a total area of 783,560 square kilometers.

Turkey is located in southeastern Europe and southwestern Asia, bordering the Black Sea, between Bulgaria and Georgia and bordering the Aegean Sea and the Mediterranean Sea, between Greece and Syria. Its location at the crossroads of Europe and Asia makes it a country of significant geostrategically importance.

![Map of Turkey](image)

Fig. 1

Around 97% of Turkey is located in Asia and 3% in Europe. The European portion may be small, but it contains the country’s largest city, Istanbul, and has a population of over 13 million. Over 70% of the population of Turkey lives within an urban environment, while the rest is scattered throughout rural areas. Around 75% of the citizens are ethnic Turks, 18% Kurdish and the remaining 7% are a mix of various other ethnicities from the neighboring surrounding regions. The country's official language is Turkish and it is spoken by approximately 85% of the population. The majority (98%) of the population identify themselves as Muslim.

Geography

The country is encircled by seas on three sides. To the North is the Black Sea, to the West is the Aegean Sea and South by South West is the Mediterranean Sea. Eastern Turkey has a more mountainous landscape and is home to the sources of rivers such as the Euphrates,
Tigris and Aras. This area also contains Mount Ararat, Turkey's highest point at 5,137 meters. Turkey is divided into seven census regions: Marmara, Aegean, Black Sea, Central Anatolia, Eastern Anatolia, Southeastern Anatolia and the Mediterranean.

The uneven north Anatolian terrain running along the Black Sea resembles a long, narrow belt. This region encompasses approximately one-sixth of Turkey's total land area where the inland Anatolian plateau becomes increasingly rugged as it stretches eastward. Turkey's varied landscapes are due to its complex seismic activity. This helped shape the region over thousands of years and is still active to this day, as seen in fairly frequent (and recent) earthquakes and occasional volcanic eruptions. The Bosporus and the Dardanelles owe their existence to the fault lines running through Turkey that led to the creation of the Black Sea. There is an earthquake fault line across the north of the country from west to east, along which many major earthquakes have occurred.

Economy

Turkey's GDP (Gross Domestic Product) is the 17th largest in the world by PPP (Purchasing Power Parity). The country is among the founding members of the OECD (Organization for Economic Co-operation and Development) and the G-20 (Group of Twenty) major economies. The average growth rate of the GDP from 2002 – 2012 was around 5%. Turkey’s major export markets are Germany, Russia, and China. Its top 3 Exported Goods are precious stones and metals, such as; coal, copper and boron, motor vehicles and parts, and industrial machinery. Its top Industries are Textiles, Food Processing, Autos, and Electronics. Other key sectors of the Turkish economy are banking, construction, oil refining, petrochemical products, and food production.
Tourism

Tourism in Turkey has experienced rapid growth through the years. According to the World Tourism Organization, Turkey was ranked as the 6th most popular tourist destination in the world, enriched by its wide variety of tourist attractions, such as its breathtaking coastlines along the Aegean and Mediterranean seas with long sandy beaches and its pristine bays. Adding to Turkey’s natural riches, the country is the birthplace of many ancient civilizations that left their mark in history. The Anatolian Peninsula alone has a vast number of archaeological sites inherited from various empires and diverse cultures, some dating back millennia. From Ephesus to the West and Mount Nimrud to the East, it is common to encounter sacred sites, temples and religious grounds belonging to various cultures and beliefs.

2.2 Climate Zones

The climate in Turkey varies dramatically due to its irregular topography. As a result, it consists of three climatic zones that cover all seven regions: The Mediterranean (Mediterranean, Aegean) Black Sea (Black Sea, Marmara), and Continental (Central Anatolia, Eastern Anatolia, South Eastern Anatolia). Turkey’s varied climate is heavily influenced by the presence of the seas to the north, south, and west, and by the mountains that run parallel across much of the country.

The seas and the mountains create a complex contrast between the interior and the coastal areas. Because of this, several areas have the winter rainfall maximum typical of other Mediterranean regions, but widespread drought in the summer. However, Turkey’s elevation also
causes winters to be much colder than is common in other Mediterranean climates, which produces significant contrasts between winter and summer temperatures.

The coastal areas of Turkey bordering the Aegean and Mediterranean Seas have a temperate Mediterranean climate, ranging from hot, dry summers to cool, wet winters. The coastal areas bordering the Black Sea have a temperate Black Sea climate with warm, wet summers and cool to cold, wet winters. The Turkish Black Sea coast receives the greatest amount of precipitation and is the only region of Turkey that receives high precipitation throughout the year. An example of this is seen in the eastern portion of the Black Sea coast, which averages 2,200 millimeters annually and is the highest precipitation in the country.

Temperatures are also varied wildly throughout the country. The average annual temperature in the country is 14.2 °C. In the southern and western parts of the country, the temperatures vary from 15–20 °C, but drops to 5–7.5 °C in the east. Precipitation varies as well, with an average of 600–1,000 mm per year. The lowest measurements are in central eastern Turkey (250–500 mm) and highest in the mountains of the east Black Sea region (1,700–2,200 mm).
inland, giving the Central Anatolian plateau of the interior of Turkey a Continental climate with sharply contrasting seasons.

Winters on the eastern part of the plateau are especially severe. Temperature drops of −30 to −40 °C can occur in eastern Anatolia. Snow may remain at least 120 days of the year. In the west, winter temperatures average below 1 °C. Summers are hot and dry, with temperatures often above 30 °C in the day. Annual precipitation averages about 400 millimeters, with actual amounts determined by elevation. The driest regions are the Konya plain and the Malatya plain, where annual rainfall is often less than 300 millimeters. The month of May is generally the wettest month, whereas July and August are the driest.

January temperatures are below freezing throughout the interior, and in the east there is a sizable area below −5 °C; extremely low temperatures occur at times, from −20 °C in the west to −40 °C in the east. The duration of snow cover ranges from two weeks in the warmer areas to four months in some mountainous areas in the east. The coasts are mild, with January above 5 °C. Summers are generally hot: July exceeds 20 °C in all but the highest mountain areas, 25 °C along the Aegean and Mediterranean, and 30 °C in the southeast.

2.3 Energy Consumption

Turkey is considered a developing country, and energy use in Turkey has increased rapidly due to its increase in population, production and industrialization. Projections from the International Energy Agency (IEA) show that the electricity demand will increase annually by 6.7% - 7.5% in the next decade. Securing long-term energy independence is a long sought after goal for Turkey. The current energy policy promotes domestic energy sources, and strives to make use of the available Renewable Energy Sources (RES) potential.

Energy Balance

Currently, Turkey’s gross energy consumption relies largely on fossil fuels. According to the IAE, about 74% of the primary energy supply of the energy sector comes from imports. Oil, natural gas and coal make up 99.7% of all energy imports of Turkey. Turkey's primary energy demands have been on the incline since 1990, but stalled during major economic crises.
Renewable Energy Sources

Turkey has vast resources of almost all types of RESs, which range from solar, wind, geothermal, hydro and biomass. There are significant agricultural activities in large areas of the country that could contribute to biomass combustion or gasification. High average annual wind velocities create a potential for the efficient utilization of wind power, in particular along the Mediterranean shores. There is also a large solar energy potential due to favorable climatic conditions, in particular, in the southern half of Turkey. The country is also rich in geothermal power. Existing Hydro Power Plants (HPPs) already cover about 30% of their economic potential. Thus, HPPs are the most developed RES in the country, and there is still a large potential for further implementation.
Electricity

The development of electricity consumption per capita shows an increasing trend, with an average yearly growth of 5% from 1995 until 2012, with exceptions during the domestic economic crisis in 2001 and during the global economic crisis in 2009. The actual level of electricity consumption per capita in Turkey (2,801 kWh in 2012) is, however, well below the average in developed economies; Ex) 6,850 kWh/year per capita in the EU-27.

As both in general and in Turkey, energy (electricity) consumption is related to GDP growth. Turkey is fully electrified, and electrical power is mainly used in the residential and industrial sectors. Electricity is the third most utilized energy source in the country (after oil and natural gas).

The installed generating capacity was about 64.044 MW by the end of 2013, of which Thermal power stations contributed 38.448 MW and Hydro power stations make up the majority of the remaining balance with 22.289 MW. Installed capacity of the non-hydro RES was insignificant until recently. However, investment efforts on generation and transmission of RES have improved in the last few years, reaching 5.2% of the total installed capacity. Conversion to RES for power generation can also provide an important leap forward to improving energy efficiency and environmental impacts of power plants.
Total Final Energy Consumption

The Total Final Energy Consumption (TFEC) by energy source is presented in the graph. Oil, gas and coal dominate at 72%. The remainder consists of electricity (19%), heat (1%) and others (7%).

Final Energy Consumption by Sector

Industrial consumption accounts for 31% of total final consumption in 2011 and is followed by residential (29%) and transport (18%). Services and Non-energy use have a share of about 8% each in final consumption. The following figure shows that the shares of the different sectors have been rather stable over time.
2.4 Constructions & Materials

Turkish Houses

Turkish houses vary from region to region and incorporate the natural resources and climatic conditions in the surrounding areas. Wood and stone were used in the Black Sea Region, stone and wood were used in the West and the Southern Mediterranean and combinations of mud brick and wood in the Central Anatolia and the Eastern parts of Turkey.

With that all said, the basic construction used is a timber frame with infill material and/or plaster lathe. Regardless of location, most houses have at least two stores with the upper store acting as the main living area. The ground floor generally has a high, solid stone wall, almost like a fortification, that supported the upper floor, which usually extended slightly over the street below. The roofs are usually pitched on all four sides and have a very simple form to help avoid any indents. Also, the eaves of the roof were very wide and horizontal.
Reinforced Concrete Frame Construction

Reinforced concrete is one of the most widely used building materials. Fresh concrete can be molded into almost any shape, which is an inherent advantage over other materials. However, concrete can still collapse or become brittle if additional steps are not taken. To prevent this, steel bars, or rebar, are embedded in concrete to form a composite material called reinforced concrete. Currently, reinforced concrete is extensively used in a wide variety of engineering applications, such as; buildings, bridges and dams. Due to its low cost, concrete production is extensively used as the material of choice for residential construction.

Reinforced Concrete Frame Buildings

Reinforced concrete (RC) frames consist of horizontal beams and vertical beams that are connected by rigid joints. These structures are cast and molded, usually, in a single operation either on or off site. RC frames provide resistance to both gravity and lateral loads through bending in beams and columns (Figure 2). There are several sub-types of RC frame construction:

- Non-ductile RC frames with/without infill walls
- Non-ductile RC frames with reinforced infill walls
- Ductile RC frames with/without infill walls

The current WHE database includes over twenty reports describing RC frame construction. The most prevalent type is RC frame with masonry infill walls (Figure 3).
This construction is still practiced. 75% of the building stocks in Turkey are made of this construction type.

Code requirements related to design and detailing of RC frame buildings in seismic zones were significantly changed in the early 1970s. Code requirements have become more focused on the proportioning and detailing of beams, columns, and joints with the objective to achieve a certain amount of ductility in addition to the required strength. Ductility is one of the key features required for desirable seismic behavior of building structures. It can be defined as the ability of a material to stretch (deform) significantly before failure. Steel (and some other metals) exhibit ductile behavior. Therefore, steel reinforcement has a key role in ensuring ductile behavior of reinforced concrete structures in earthquakes.
3 | Analysis of Turkey

3.1 Turkish – German Agreement

Joint Declaration
between the
Federal Ministry of Economics and Technology of the Federal Republic of Germany
and the
Ministry of Energy and Natural Resources of the Republic of Turkey
on cooperation in the energy sector

The Joint Declaration was signed by S.E. Dr. Philipp Rösler (Minister of Economics and Technology, Germany) and S.E. Taner Yıldız (Minister of Energy and Natural Resources, Turkey) on November 15th 2012 in Istanbul. Both Ministers stated that they were anxious to strengthen and deepen the energy cooperation between Turkey and Germany. They are also committed to improve the security of supply of both countries.

To this purpose issued the following joint statement:

I

Both sides share the view that the bilateral cooperation will contribute to the security of energy supply of both countries. Thereby Turkey gets an outstanding hub-function of energy supply. In this context, the sides will strengthen their resource-saving and environment-friendly sustainable development in the field of energy. Thereto the necessary effort is made to ensure that the Turkish-German energy forum will be build and continued.

II

The Energy Forum, chaired by the respective Minister, begins its work with five working groups. In these working groups, both countries will develop concrete proposals to strengthen the cooperation. The five working groups are listed below:

1. Working Group on Renewable Energy
2. Working Group on Energy Efficiency
3. Working Group for conventional power plants, power plant modernization, brown coal mining
4. Working Group for electricity distribution and transmission networks
5. Working Group on the regulation of the electricity and gas markets, introducing an energy and power exchange, consumer interests

III

The Turkish-German Energy Forum will hold meetings once a year, alternately in Turkey and in Germany.

Both sides assume that each should bear their own travel and accommodation costs and the costs of necessary logistics. The cost for the implementation of the Energy Forum will be borne by the respective organizing side.

IV

Both sides intend to compound the cooperation in the areas listed below - in addition to the energy cooperation by the Energy Forum:

1. Promotion of investments and projects in the energy sector, which serve the common advantage.
2. Organization and implementation of visits and meetings between senior officials, institutions and associations of both countries
3. In view of the ongoing accession negotiations between Turkey and the European Union to strengthen the cooperation in various fields of energy and the development of the activities on the harmonization of the Turkish energy legislation with the European energy law and its application.

V

For the realization of the Energy Forum coordination sites as the Directorate for bilateral relations with the Directorate General for External Relations and the European Union at the Ministry of Energy and Natural Resources of the Republic of Turkey and the Department for bilateral cooperation with Turkey at the Federal Ministry of Economics and Technology of the Federal Republic of Germany were determined.

VI

This Agreement is not a binding international agreement. Nothing in this Declaration may be interpreted or applied the gives rise to obligations or rights for one side.
3.2 Laws & Policies

The following laws governing the energy sector have been adopted by Parliament:

- Electricity Market Law (2013); replaced the EML of 2001 and amendment (2013)
- Natural Gas Market Law (2001)
- LPG Market Law (2005)
- EE Law (2007)
- Law on Geothermal Resources and Mineral Waters (2007)

This Law also introduced regulations regarding the utilization of domestic coal resources for the purpose of generating electrical energy, encouraging the establishment of domestic coal-fired thermal power plants.

Electricity Market Law (2013):

The old Electricity Market Law (no. 4628), passed on 20 February 2001, and replaced by a new one on 14 March 2013 (no. 6446), defines legal, economic and social fundamentals for state policy on the sufficient, quality, sustainable, low-cost and environmentally friendly generation, transmission, distribution, trade and use of electricity within the competitive market environment, as well as main directions for policy implementation. With the passage of the Law no. 6446, the previous Law no. 4628 changed to Law on Organization and Tasks of Energy Market Regulatory Authority (EMRA).

The Electricity Market Law requires that individuals and legal entities obtain a special license for conducting activities in the generation, transmission, distribution, retail wholesale import and export of electricity, and market operation, if not otherwise determined by law. Transmission of electricity is conducted by the state-owned firm TEIAS.


The Laws on Natural Gas, Petroleum and LPG Markets cover the regulation about the safe and economical distribution, trade, supply, and using activities of the related energy sources within the competitive market environment in a transparent, fair and stable way.
Law on Utilization of RES for the Purpose of Generating Electrical Energy (2005):

The purpose of the Law on Utilization of RES is to generalize the use of RES in electricity generation, to make use of RES in a quality, reliable and economical way, and to reduce GHG emissions for the protection of the environment.

According to the Supply Security Strategy Paper accepted in May 2009, the main approach is to balance supply and demand, and to make sure the sector develops compatibly with the targets defined for source variability, foreign dependency, environmental impacts, etc. Based on the Strategy Paper, TETAS would purchase electricity through bilateral contracts, public investments on electricity generation will be accelerated and the transmission network system will be improved. The Paper considers also privatization of some entities, which is discussed next.

According to the Electricity Sector Reform and Privatization Strategy Paper approved in March 2004, the country will begin privatization of enterprises in the electricity sector. The Strategy Paper describes the privatization of enterprises in electric power generation and distribution. In accordance with the Privatization Law no. 4046 and the Privatization Administration, local and international investors were expected to participate in the privatization which includes facilities and enterprises in the electricity energy generation and distribution sectors.

Comparison between TS 825 and EnEV 2014

First of all, it must be said that the Turkish Standard 825 is not the equivalent to the German Energy Saving Ordinance 2014. It is merely a calculation method by which the heat transmission resistance can be calculated. It also indicated how the calculations are summarized in a report. Thus, it is more similar to the German DIN 4108. Nevertheless, there are a few similarities between the Turkish Standard 825 and the Energy Saving Ordinance 2014.

Both regulations use the same terminology and nomenclature. Furthermore, both relate to newly constructed buildings and existing buildings. The Energy Saving Ordinance describes, in contrast to the Turkish standard, the two types of building detailed in two sections and nine paragraphs. In the further course the Turkish standard then goes into the calculation method and the Energy Saving Ordinance 2014 goes further into the regulations in the field of energy saving.

In both Regulations requirements are placed on the thermal permeability coefficient of the construction component. In Germany, there is a U-value for the entire building which is used
for the entire country. While Turkey is divided into different region in which different U-values are used, they use distinguish in several construction components such as a wall, a window or a roof. So Turkey has requirements for components but no requirements for an entire building like in Germany.

The different regions and U-Values of the TS 825 and the requirements of the EnEV can be found in the Annex D of this report.

3.3 Mentality on Energy Efficiency

Mentality concerning Energy Efficiency in Turkey

The energy use in Turkey is increasing due to its increasing population, production and industrialization. In addition to that the securing of long-term energy independence is an important policy goal for Turkey. Currently, the energy policy supports domestic energy sources and aims to make use of the available Renewable Energy Source potential.

Turkey’s Energy Efficiency policy wants to increase efficiency in the use of energy resources to reduce high energy costs on the economy to protect the environment.

The Energy Efficiency Law, Which guides the Energy Efficiency policy in Turkey, and other regulations provide the legal basis and support Energy Efficiency improvements, including establishing and operating Energy Efficiency service markets including energy service companies, energy auditors and Energy Efficiency projects, and voluntary Agreement Schemes to encourage energy saving investments.

As already mentioned, Turkey is a developing country and energy use is increasing due to increasing population. Projections show that electricity demand will increase annually by 6, 7%. The securing of long term energy independence is therefore a policy goal for Turkey. Current Energy policy promotes domestic energy sources and strives to make use of the available Renewable Energy Source potential.

Turkey’s greenhouse emissions are growing pretty fast. The Energy production as well as the usage account for more than 77 percent of the greenhouse gas emissions, whereas the industry consumes about 32 percent of total energy.
To reduce waste and contribute to energy security, the country follows an ambitious energy efficiency program. Turkey has the potential to cut 15 to 20 percent of total consumption through energy conservation.

### Renewable Energy Sources (RES) strategy

In the Ministry of Energy and Natural Resources Strategic Plan (2010-2014) and Electricity Energy Market and Supply Security Strategy Paper issued in 2009, the primary target is to increase the share of domestic resources. Accordingly, measures are being taken to promote the use of indigenous resources, with the following targets for development of RES by 2023, the centenary of the establishment of the Turkish Republic.

Here some aims one has planned till 2023 are briefly performed.

- At least 30% share of “Renewable Energy Sources” in electricity generation will be reached
- The wind plant installed capacity will reach up to 20,000 MW by 2023
- The installed capacity for the geothermal power plants will reach up to 600 MW by 2023
- Technically and economically feasible hydroelectric potential will be put into use
- The use of solar energy in electricity generation will be commenced

The share of RES in electricity production was 27.3% in 2012. About 89% come from hydropower including large reservoirs and the portion of the Renewable Energy Sources (RES) in all other consumption lay with 6.7%. The main part for the renewable energy sources in Turkey is the water power and also a huge potential exists in the solar, wind, biomass and geothermal energy.

The “Renewable Energy Sources” development is still far away from reaching its economic potential, even though the situation in Turkey is unique and in some aspects favorable for RES development.

The RES Law is in place, providing feed-in tariffs to RES producers, for 10 years:

- 73 $/MWh for hydro
- 105 $/MWh for geothermal electricity
- 133 $/MWh for solar and biomass/waste electricity
Moreover, if local content is added to the project an additional 23-92 \$/MWh could be earned for 5 years per project.

There is a spot market which can function as an alternative sales point for “Renewable Energy Sources” generators. It is generally preferred by wind and sometimes by hydro generators. The average spot market price has been around 85 \$/MWh over the last three years.

However, due to multiple applications and constraints in the network, tenders to obtain a connection permission have been organized, where RES project developers agreed to pay amounts up to 30-40 \$/MWh generated electricity back to the Turkish government.

The banking systems in Turkey has built up considerable experience with financing RES projects, even though a number of projects have benefited from subsidized financing arrangements. This is especially the case for run-of-the-rive hydro projects.

Economy

In 2010, Turkey became one of the fastest growing economies in the world with a real gross domestic product growth of 9%. Furthermore, Import and Export have been increasing over the last few years, as well as an increase in net imports of goods and services. Turkey’s gross energy consumption relies largely on fossil fuels. About 74% of the primary energy supply of the energy sectors comes from imports. Oil, natural gas and coal together presents about 99, 7% of all energy imports of Turkey.

Figure 1. GDP development of Turkey
In 2013, the export reached about $152 billion with vehicles, machinery, equipment and parts, ferrous metals and goods, textiles and garments, mineral fuels, fruit and vegetables as the main export items. In the same time, Imports reached $252 billion, consisted of mineral fuels, vehicles, machinery, equipment and parts ferrous metals, plastics, precious stones and chemicals. The major destination for the Export of Turkish goods is the EU. Germany, Iraq, Iran, United Arab Emirates, United Kingdom, Russia, Italy, France and the USA are the main trade partners. Beyond that, Turkey is the founding member of the World Trade Organization since the establishment of the Organization in 1995.

3.4 Consumer behavior and necessary actions

The energy industry is one of the most promising future-oriented industries in Turkey. In the last few years there was a rapid development which leads to privatization and liberalization on the market. Due to the growth of population there is an urgent need for a massive investment in near future in order to cover the requirements of energy. In May 2010 the Turkish government and the Russian government signed an agreement to build a new nuclear power station in Mersin/Akkuyu but this decision was not without controversy. To cover the energy needs of Turkey until 2023 there has to be made an investment estimated around 130 billion US-Dollars.

![Completed supply - natural gas](image)

<table>
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<td>12. March 2001</td>
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<td>in use</td>
</tr>
</tbody>
</table>

source: (Enerji Yılı 2011, 2011)
As the population increases in Turkey steadily with a population growth rate of 1.2% per year, also their energy consumption is growing rapidly. More than half of the population is younger than 30 years. Between the years of 1990 and 2010 the consumption rose in average 6.7% per year. In 2012 the consumption levelled in total 242,000 GWh and experts are predicting that until 2020 the consumption will increase to 7.5% which means in total 433,900 GWh. Since 1980 and 1990 the Turkish government has invested in dam projects so that it was possible to cover almost completely the energy needs. Due to extreme weather conditions like extreme long and dry summers the dams could not be refilled and it consequently caused problems with the energy supply. So the government had to import energy. Turkey’s major partner is Russia in the moment. Since the 90s Turkey has had natural gas supply contracts with them. There exist also agreements with other countries like Iran, Algeria, Azerbaijan and others. The dependence on imports is now 73% in total. But they also use their own lignite for power generation. Their needs for the power generation are covered by 86% by their own lignite. Concerning the future experts claim that over the next ten years there will be a doubling of electricity consumption. In 2011 the consumption was 3.244 kWh per person and the industry has a share of 41.7% which means that they are the biggest consumer group. The statistics show that the financial crisis in 2009 has led to lower energy consumption that year.
The energy prices in Turkey are higher than in the neighbouring countries. The OECD-Energy Price index listed the prices in Turkey among the most expensive ones worldwide. Reason for this is also the fact that they have to import natural gas. The gas is also used for heating the buildings and for producing energy. Between 2003 and 2009 according to EPDK around 750 Mio. € were invested in the expansion of the gas lines. Moreover, Turkey has higher gasoline and diesel prices in comparison to all EU countries. The reason is that the tax for gasoline is 90.6% of the price and for diesel it is 88.1% of the price in Turkey. By 2010, the price of electricity should have been unified nationwide by law, but this was not achieved until 2012. For the industry, trade, authorities and commercial uses the energy price has been covered by a single price since 2006.
Electricity prices (TL per kWh) 1)

<table>
<thead>
<tr>
<th></th>
<th>developed provinces</th>
<th>development provinces 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>industry, high voltage current</td>
<td>0,1843</td>
<td>0,1843</td>
</tr>
<tr>
<td>industry, low-voltage current</td>
<td>0,1952</td>
<td>0,1952</td>
</tr>
<tr>
<td>Trade, government agencies, offices</td>
<td>0,2524</td>
<td>0,2524</td>
</tr>
<tr>
<td>privat households</td>
<td>0,2166</td>
<td>0,2008</td>
</tr>
</tbody>
</table>

1) plus 5% municipal tax and 18% MwSt. 2) For this currently includes bu provinces mainly in eastern Turkey, are regularly published in the Official Journal Resmi Gazete, most recently in October of 2009.

Source: Türkiye Elektrik Dağıtım A.S. (Tedes), GTAI

Fig. 21

Gas prices (TL per cbm) 1)

<table>
<thead>
<tr>
<th>selected regions</th>
<th>Industry 2)</th>
<th>Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankara (EGO)</td>
<td>0,5059</td>
<td>0,6125</td>
</tr>
<tr>
<td>İstanbul (İgdaş)</td>
<td>0,5172</td>
<td>0,6251</td>
</tr>
<tr>
<td>Bursa (Bursagaz)</td>
<td>0,5195</td>
<td>0,5666</td>
</tr>
<tr>
<td>Eskişehir (Eşgaz)</td>
<td>0,5131</td>
<td>0,5444</td>
</tr>
<tr>
<td>Kayseri (HSV)</td>
<td>0,5065</td>
<td>0,5411</td>
</tr>
<tr>
<td>Kocaeli (İzgaz)</td>
<td>0,5203</td>
<td>0,6132</td>
</tr>
</tbody>
</table>

1) plus 18% MwSt.; 2) free consumer


Fig. 22

gasoline prices

<table>
<thead>
<tr>
<th>Super Bleifrei 95 Oktan €/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Türkei</td>
</tr>
<tr>
<td>Griechenland</td>
</tr>
<tr>
<td>Niederlande</td>
</tr>
<tr>
<td>Schweden</td>
</tr>
<tr>
<td>UK</td>
</tr>
<tr>
<td>Deutschland</td>
</tr>
<tr>
<td>Finnland</td>
</tr>
<tr>
<td>Belgien</td>
</tr>
<tr>
<td>Dänemark</td>
</tr>
<tr>
<td>Portugal</td>
</tr>
<tr>
<td>EU-16</td>
</tr>
<tr>
<td>Frankreich</td>
</tr>
<tr>
<td>EU-27</td>
</tr>
<tr>
<td>Italien</td>
</tr>
<tr>
<td>Irland</td>
</tr>
<tr>
<td>Tschechien</td>
</tr>
<tr>
<td>Slowakei</td>
</tr>
<tr>
<td>Slowenien</td>
</tr>
<tr>
<td>Ungarn</td>
</tr>
<tr>
<td>Österreich</td>
</tr>
<tr>
<td>Malta</td>
</tr>
<tr>
<td>Lettland</td>
</tr>
<tr>
<td>Spanien</td>
</tr>
<tr>
<td>Luxemburg</td>
</tr>
<tr>
<td>Polen</td>
</tr>
<tr>
<td>Estland</td>
</tr>
<tr>
<td>Litauen</td>
</tr>
<tr>
<td>Rumänien</td>
</tr>
<tr>
<td>Bulgarien</td>
</tr>
<tr>
<td>Zypern</td>
</tr>
</tbody>
</table>

Source: (Enerji Yılığı 2011, 2011)

Fig. 23
3.5 Structural Survey in terms of Energy Efficiency

Assessment of Progress

Overall Assessment

The privatization in the electricity and gas sectors in Turkey continues to grow over the years. The privatization of generation assets has been preceded by a large-scale rehabilitation of power plants, and this process is expected to continue after privatization. Moreover, most gas distribution companies are privatized as well. The eligible customer limit has been lowered to 4.5 GWh in 2014. Also, due to the distribution company privatizations, a process is now in place to reduce theft and losses on average from 14,6% in 2011 to around 12,1% with separate targets for each distribution company. The main objective of the Government of Turkey in the field of energy has been to become less dependent on imports, which currently amount to 82%, for meeting energy demand. To meet this objective, the Power Strategy Document was published in 2009. This document sets as targets for 2023: to achieve 30% of power generation from RES, and to reduce the share in power generation of natural
gas below 30%. It is a concern that Turkey’s energy dependence on foreign imports is very high. Investments in Renewable Energy Source and Energy Efficiency should be accelerated in order to reduce this dependence, which is also a burden on the budget balance of Turkey. This could be stimulated with an effective commitment to an energy efficiency policy. That policy is best delivered through well-crafted energy efficiency programs and measures that meet the priority needs of Turkey.

**Legislative Framework, Policy and Measures to Promote Energy Efficiency**

Under the “European Union - Turkey Progress Report 2013”, which was concluded as part of the EU accession policy, Turkey’s efforts focus in particular on the following areas: security of supply, internal energy market, renewable energy, energy efficiency, and nuclear safety and radiation protection. The progress report concludes: “Good progress has been made in the area of energy. Liberalization of the electricity sector and the level of alignment with the Electricity Directive are advanced. However, a functioning competitive market and progress in legislative alignment in the natural gas sector are still lacking. Progress in the renewable energy sector needs to be speeded up, namely through streamlined administrative procedures. Further efforts are needed in the areas of energy efficiency and nuclear energy, in particular on alignment with relevant EU Directives. Overall, Turkey is at a rather advanced level of alignment in the field of energy.”

**Financing Energy Efficiency**

Different financing models were agreed in the report for Energy efficiencies and were performed. For example in the private sector Sekerbank provides energy efficiency credits, whereas development investment bank “Industrial Development Bank of Turkey” (TSKB) has the largest number of financed projects in the field of energy efficiency and the largest portfolio in Turkey. In addition, international Financial Institutions have set up large funds for energy efficiency and renewable energy investments. The size of these funds is over $3 billion. Currently, the government treats the energy efficiency projects particularly and tries the already agreed regulations to work out measures further and to move.
Institutional Arrangements

There are in addition to the “General Directorate of Renewable Energy” (GDRE) in Turkey various organizations for energy efficiency, such as the Ministry of Environment, Transport, Housing, and Industry, international financial institutions (IFIs), professional and sector associations, universities, research centers, private consultancies and NGOs. However, the efforts of all stakeholders are generally not fully coordinated. Moreover, these stakeholders could be more proactive in proposing and encouraging the government to adopt more progressive policies and programs.

Energy Sources

The most substantial hydrocarbon Energy source in Turkey is lignite. Coal is the second primary energy source supplied in the country, coming after gas, and is by far the largest source of energy produced in Turkey. In 2011, coal provided 15.5% of Turkey’s total primary energy supply, whereas a little less than half of the total coals comes from import, which consists of 87% hard coal. On the other hand 15.8% of the total supply is provided by domestic coal, which consists of 91% lignite.

The total lignite reserve is geographically scattered across Turkey and is about 13.9 billion tons of which 96.7% is proved reserves, 3.2% is provable and about 0.1% is possible.

Turkey has huge resources of almost all typed of Renewable Energy Sources such as solar wind, geothermal, hydro and biomass. There are considerable agricultural activities in large areas of the country that could provide leftovers for biomass combustion or gasification. High average annual wind velocities create potential for the efficient utilization of wind power, in particular along the Mediterranean shores. Also a large solar Energy potential due to good climatic conditions, in especially in the southern half of Turkey. The country is also rich in geothermal power. Existing Hydro Power plants already cover about 30% of their economic potential for further implementation.

The power sector is very important to the development of the Turkish economy as energy and electricity consumption is related to the gross domestic product growth.

Turkey is fully electrified, and electrical power is mainly used in then residential and industrial sectors. Electricity is the third most utilized energy source in the country after oil and natural
gas. Hydro power stations make up most of the remaining balance. About 60% of the electricity generation is based on fossil fuels. There is a strong increase since 1995, and is now a major source for electricity generation. Turkey uses its lignite sources mainly for electricity generation, but the share of imported coal has been increasing. Hydro power is the major renewable source for electricity generation. Firewood is mainly for domestic purposes.

<table>
<thead>
<tr>
<th>Source</th>
<th>Generation (TWh)</th>
<th>Capacity (GW)</th>
<th>Assumed capacity factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro energy</td>
<td>160</td>
<td>52</td>
<td>35%</td>
</tr>
<tr>
<td>Run-off-the-river hydro</td>
<td>38</td>
<td>14</td>
<td>30%</td>
</tr>
<tr>
<td>Wind energy</td>
<td>176</td>
<td>48</td>
<td>30%</td>
</tr>
<tr>
<td>Solar energy</td>
<td>380</td>
<td>217</td>
<td>20%</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>4</td>
<td>0.6</td>
<td>70%</td>
</tr>
<tr>
<td>Geothermal (power)</td>
<td>12</td>
<td>2</td>
<td>70%</td>
</tr>
<tr>
<td>Total power generation</td>
<td>720</td>
<td>332</td>
<td></td>
</tr>
<tr>
<td>Geothermal (thermal)</td>
<td>193</td>
<td>31.5</td>
<td>70%</td>
</tr>
</tbody>
</table>

The following describes all different types of Energy Sources provided in Turkey:

**Hydropower**

Hydro is the main RES contributing to energy supply in Turkey. It accounted for 24% of electricity generation in 2012. Turkey had 20,438 MW of installed hydropower capacity in June 2013. The largest hydroelectric power plant has 2,405 MW installed capacity and is situated on the Euphrates River in Sanliurfa. Furthermore, there are presently five hydroelectric power plants with a total installed capacity of 6,396 MW, three of which are the largest dams of Turkey, namely Atatürk, Karakaya and Keban. The water resources are located in all seven geographical regions in Turkey. There were 72 reservoir-type HPPs amounting to 16,027 MW and 374 run-off-the-river type “Hydro Power Plants” (HPPs) amounting to 5,697 MW in October 2013. There is considerable potential for RES in Turkey and hydro is the most developed among them. According to study, hydro reservoir is estimated to have an economic potential of 160 TWh/year, of which 41.9 TWh was generated in 2012, whereas river-type hydro has an economic potential of 38 TWh/year of which 12.5 TWh was generated in 2012. In total, Turkey has 16% of Europe’s economic hydro potential. The construction of hydropower plants an important role in solving issues of national importance such as flood control, clean production of electricity and the creation of new irrigation systems.
Wind Power

Although there has been little implementation of wind energy in Turkey, interest has been growing. Its use has great prospects in most regions of Turkey. Calculations from governmental institutions suggest that wind has an estimated economic potential of around 38 GW for onshore and about 10 GW for offshore installation, based on the wind atlas as prepared by “General Directorate of Renewable Energy” (GDRE). The “Electricity Energy Market and Supply Security Strategy Paper” of 2009 aims at attaining a 30% share of RES generation in total national electricity generation by 2023, with an expected installed capacity of 20 GW wind power. According to “Turkish Electricity Transmission Co.” (TEIAS), there were 74 “Wind Power Plants” (WPPs) installed with an installed capacity of 2,815 MW in January 2014.

Most windy areas of Turkey are the Aegean Sea coast areas, the northern and western parts of the Marmara Sea coast, and some southern and inner parts of Anatolia. The average annual wind speed reaches 8-9 m/s in Canakkale. Other regions with high average wind speeds are northern Izmir, western Balikesir, and the Hatay province.

Solar Energy

The climatic conditions and geographical location of Turkey provide numerous opportunities for increasing the production of electricity and heat using solar energy. For example, the average global solar radiation is estimated at 1500 kWh/m² per year (4.1 kWh/m² per day) in Turkey and the total annual sunshine duration is 2640 hours (daily average of 7.2 hours). Although the country has a large solar energy potential, no big solar power system is availa-
ble. In 2010, about 12 million m² solar collectors were installed in Turkey with a potential of 76 toe and an annual production volume of 750,000 m². The development of photovoltaic power plant in Turkey has been very low at the beginning and has spread in future with the time. There was at that time also no estimate the economic potential. The expectations in a country with over 2600 hours of sunshine per year are very large, but the development has been very slow due to low incentives and demand.

Solar energy is widely used in Turkey for water heating, greenhouse heating and for drying agricultural products. Solar collectors are available in 3 – 3.5 million residences in Turkey, primarily in the Mediterranean, Aegean and Southeast Anatolian regions.

In the picture performed below is performed the solar energy potential map of Turkey. This is covered an overview to a year. How one can recognize, the biggest potential exists in solar power production in the south of Turkey and in the Centrally Anatolia.

Biomass

The speedy development of industry, agriculture and social services in Turkey opens new possibilities for energy production from biomass. The country has combustible industrial waste, forestry and waste from wood processing, agricultural products and organic wastes, domestic and municipal waste, and waste from areas polluted by oil and petroleum products,
which can be used for energy production. In total, Turkey’s waste potential is about 8.6 billion toe. The current energy use of biomass is mainly for heating purposes. In 2008 there were a total 2,000 small and 50 large unorganized waste areas, 32 organized landfills and four composting plants in Turkey.

When compared to the world and the EU levels, the biodiesel production in Turkey is very limited. Biodiesel is used in the country as a fuel in the transportation sector, in residential buildings and industry instead of fuel oil and explicit for very cold regions.

According to “Ministry of Energy and Natural Resources” (MENR), the total installed capacity of the bioethanol facilities is 160,000 tones. In 2011 there were only three firms producing bioethanol. At the moment the low number of the companies has grown about the years. A legislation issued in September 2011 prescribes that the ethanol content of gasoline used as fuel should be at least 2% as of January 1, 2013, and least 3% as of January 1, 2014.

Turkey’s biogas potential based on animal waste is estimated to be 1.5 – 2 Mtoe. There was in 2013, 38 arrangements primarily from dump gas to the stream production with an achievement of 224 MW.
Geothermal Power

The country Turkey has a strong potential of thermal water. The geothermal potential for heating purposes in the country is about 31,500 MW, with 4,809 MW has been provided by “Mining Research and Study Institute” (MTA) from the end of 2012 are available. Most of this geothermal potential (77.9 %) is located in the Western Anatolian region and 55 % of the geothermal areas in Turkey are suitable for heating practices. Moreover, it is estimated that about 2,000 MW of the economic geothermal potential is suitable for electricity generation while 635 MW of this amount has been proved until the end of 2012. At the end of 2010, 17 out of 190 geothermal fields have a potential suitable for electricity generation. There were 13 geothermal power plants with a total installed capacity of 311 MW by January 2014.

Geothermal energy is directly used for central heating systems, greenhouse heating and thermal tourism purposes (e.g. 805 MW is used for house heating and 2,506 MW for greenhouse heating).

Energy Efficiency on Buildings

Measures on new buildings are focusing on energy performance requirements. The requirements have been defined in the By Law on Energy Performance on Buildings by the Ministry of Environment and Urbanization. That entered into force in 2009 stipulates measures, technical criteria and implementation guidelines to bring a more integrated approach for Energy
Efficiency in buildings by setting minimum standards on the energy performance of new buildings and of which are subject to major renovation. It also includes a common methodology for calculating the energy performance of buildings. The requirement cover energy needs for space and hot water heating, cooling and lightning. Based on the regulation all new buildings must have an energy performance certificate, which is valid for 10 years, indicating their energy performance class, whereas existing buildings will be required to have that certificate by May 2017. Also, central heating and metering systems must be installed for the existing buildings having central heating systems as well. Activities related to sustainable architectural designed green building have been gradually increasing in recent years. There are currently 70 buildings in the private sector awarded with green building certificates such as LEED and BREEAM. Additionally, the Turkish Green Building Association which was established in 2007 to contribute to the development of the construction sector in Turkey is currently developing a green building certificate system specific to Turkey. There is no green building practice in public buildings yet. In order to gain experience three public buildings will be designed and built as green buildings with the scope of the project for increasing Energy Efficiency in buildings. The Energy Efficiency Strategy Paper expects that the number of environmentally friendly, green buildings and sustainable buildings will increase in the upcoming years.

It will be expected that the number of environmentally friendly green and sustainable buildings will increase in the next years, as well as in public buildings.

Turkey also has a four-year-project under the chairmanship of the GDRE to increase Energy Efficiency in Buildings. This project is supposed to improve legal and institutional infrastructure and to increase efficiency of legislative practices.

The Turkish government has enacted legislative and regulatory reforms, but it has not been enough. Even though energy efficiency is the government priority, the strategy has not been taken over by the private sector. The problems are the private sector’s lack of experience as well as the lack of access to energy efficiency finance.

In 2014 MEU applied for a project to increase Energy Efficiency in Buildings, to generate economic gains and to make a positive contribution to climate change and energy security. The increase of Energy Efficiency in new Building designs and existing building rehabilitation’s are supposed to be the result of this plan. Furthermore, the project includes the training and awareness-raising activities for technical personnel employed.

In commercial and private sectors, the focus lies on efficient lightning, heating, air conditioning and insulation. Even households have to apply Energy Efficiency Legislation’s. It requires
fluorescent bulbs, isolation as well as strict energy standards for appliances, especially for refrigerators. The replacement of new motors, compressors, pumps and the switch-over to new process technologies are applied to large industries.

3.5.1 Measures for Energy Efficiency

Building efficiency trends in Turkey

In the last years the global trend has become in energy-efficient and ecologically friendly uses and technologies in the construction branch in Turkey also of great importance. The Turkish government as well as the private sector place because of the rising consciousness for environment and economic efficiency of the subject “Building Efficiency” high value. For Turkey a reduction of the waste of energy is all important for the business development. Turkey pays every year milliards from foreign currency for the import of energy raw materials. In this connection the energy efficient buildings can make an essential contribution.

Up to now only 40 buildings were certificated in Turkey according to international criteria as “Green Building”. These are buildings which can prove an energy conservation between 24% and 50%, one about 33% to 39% of lower CO2 issue, a water consumption diminished about 40% and a waste production reduced about 70%. After the new regulations buildings with a usable area of more than 10.000 m² of certain constancy criteria must be enough. The proof about the observance of these criteria should show at the latest from 2017 the condition for the granting of a planning permission. With the permanence criteria it is among other things about the observance of ecologically friendly and energy efficient structures and processes which prefer on the construction as well as company phase during the whole life span of a building. Within the scope of the energy efficiency strategy standards should be settled for “green” constructions with regard to the used building materials and fuels as well as the water management, sewage management and waste management and the air quality. Important target groups are hotels, shopping centers as well as office houses and dwelling houses in the cities which have a considerable portion in the CO2 issue. At this point it is important to mention that though "Green Building Criteria" the building cost raise by from 2 to 8%, however , the investments would have amortized within 3 years. The concepts such as low or zero energy buildings are hardly known in Turkey. Beside specialists very few people still know these building concepts. Mrs. Dr. Harputlugil of the Karabük Üniversitesi announced that when comparing the widespread application in European countries, taken into account that resulting from the position of Turkey more options are available to take advantage of the sun and use of passive houses to the same extent is beyond question. The first application is
a solar plant built by the management of mining research and teaching in Marmaris in 1977. 30% of the energy used by the building is obtained by passive solar energy system. This was planned by the “Orta Dogu Technical University” in 1976 and is still used to this day.

According to CEBDIK (Association for environmentally friendly construction) 45% of the 20 million homes in Turkey are older than 35 years. As part of the urban renewal program, about 10 million homes are to be renewed. Further, in Turkey about 600,000 annually apartments are needed. This means that by 2023 about 7.5 million new flats must be built. It could be saved even with a portion of only 2% to 3% in “green” buildings for energy and water of 470 million USD.

Energy Efficiency strategy report of the Turkish government

In “Vision 2023”, the Turkish strategy program to the national technology, Turkey has fixed renewable energy, waste management, hydrogen technologies and water treatment as strategically main focuses in the area of Environmental technologies. In early 2008 it was initiated in to a circular by the former Prime Minister „Recep Tayyip Erdogan“, public measures announced and the “National Action Plan to the Energy Efficiency”. In addition, 2008 was appointed by the prime minister as the “year of the energy efficiency”.

Here are some proposed strategies:

- The reduction of the energy volume and the reduction of the loss of energy in the industrial branch and service branch.
- The reduction of the power demand and carbon dioxide issues of energy efficient buildings, as well as the dissemination of Green Buildings and use of renewable energy.
- The introduction of energy efficient products to the market.
- The increase of the efficiency, by the transference, distribution and production of stream, the reduction of the energy losses and the injurious environmental issues.
- The reduction of fossil fuel consumption of motor vehicles, the proliferation of land, sea and rail transport and avoiding unnecessary fuel consumption.
- The effective and efficient use of energy in the public sector.
Rise of the capacities and cooperation, the application of modern technologies, the enlargement of the knowledge state and creation of other financing possibilities outside to state aid.

Building Engineering

The growing population in Turkey leads to a steadily increasing inquiry for new living space. This means that existing buildings must be held in good condition, be renewed or new residential possibilities are to be created. Extensive new building settlements, the origin of new business districts and the increase of the number of shopping centers determine the growth of the building sector in Turkey.

Since the earthquake disaster on 17.08.1999 in Turkey the country has been sensitized to the issue of earthquake safety. To increase the earthquake safety in areas at risk thousands of buildings (such as public and private buildings) are built with higher standards. According to estimate of the metropolis Istanbul a total of 17 billion USD is required within the next 30 years to prepare the construction continuance of the metropolis for a big earthquake. It is also created place for new flats as well as for new business premises and office buildings in attractive situations close to city center, while former industry – and trade areas are dedicated.

The Turkish economy magazine “Ekonomist” reported that state and private apartment building firms in 2011 intend the making of about 124.000 living quarters. According to the inquiries the complete investment sum of the planned projects is guessed roughly on 21 billion TL. It is converted around 9.5 billion euros. The housing association TOKI (Toplu Konut Idaresi) is the forerunner with 250 projects in all regions as well as the making of 60.000 apartment units. TOKI has been completed 485.000 apartments in Turkey. Furthermore, the interest in projects for the construction and operation of shopping centers. Until the end of 2012, according to the “Shopping Center Investors Association” 35 new shopping centers were opened and the total number therefore increases on 330. Within the next five years the number shall further increase to 450. Furthermore the construction of further office complexes and hotels is planned.

Is one of the world’s leading renewable energy companies with the expertise to provide services, across the globe, to develop, engineer, construct and operate projects that contribute to our goal of a low carbon, sustainable future.
4 | Difficulties

Current status analysis of the building sector in Turkey

Buildings represent goods of the longest duration period in the economic sector and produce energy at a wide extend. Therefore is the building sector considered as a sector of great importance regarding the questions of improvement of energy efficiency and climate change.

In Europe and all developed countries, improving energy efficiency in buildings is the central issue concerning the struggle against climate change.

The building sector produced 34 million tons CO2 in 2007 and consumed 28.3 million tons of oil equivalent in 2008. (The ton of oil equivalent (TOE) is a unit of energy defined as the amount of energy released by burning one ton of crude oil. It is approximately 42 gigajoules, although as different crude oils have different calorific values, the exact value is defined by convention; several slightly different definitions exist. The toe is sometimes used for large amounts of energy.) cf. Wikipedia. It is expected that this will increase up to 47.5 million TOES in 2020, what would represent a rise of 50% of CO2 emissions.

According to the building census of the Turkish Statistical Institute of 2000, the number of buildings which came to 4.3 million in 1984, rose of 78% in 2000 and reached 7.8 million. The number of dwelling rose the same year of 129% and reached 16.2 million. According to the number of building permissions given between 2000 and 2008, the residence, industrial and administration building area increase of 56% and reached 1.524 million m², what represents a rising of 7% in terms of number. The growing demand for wider usage areas emphasizes that measures for energy efficiency in the building sector have to be urgently taken.

Another important growing building category in the last 5 years in Turkey are the shopping centers.

The yearly use of coal for housing heating in Turkey represents roughly 14 million tons. When we take into account that from 2012 on almost all provinces of the country will begin to use natural gas, it is to be expected that because of its low price, natural gas will become a widespread heating system over the coming years. According to the statistics of 2008, the consumption of natural gas in the building sector represents the biggest share with 26%, the consumption of electricity represents 24%, and renewable energies like solar energy, geothermal energy, wood coal and biomass represent 21% of the total energy consumption.

In Turkey, more than 1/3 of the energy is used for heating and cooling systems. Therefore is the most important step towards energy efficiency to take measures against the loss of ener-
energy in buildings by preventing the loss of heat, and in the warmer regions by preventing the overheating phenomena in buildings through building insulation. Particularly in the cities of the 1st degree-day area, the external temperatures reach up to 40-45°C. Cooling systems are 3 to 6 times more expensive as heating systems.

In terms of building insulation, which is the more efficient measure in order to reduce these high costs, new residence or administration buildings that are going to be built or buildings that are going to be refurbished at a wide extent, have to respect the TS 825 Standards (Building Insulation Rules) since 14.06.2000.

There is an operating insulation market and service sector in Turkey supporting the implementation of building insulation. According to a research of 1998 on the energy consumption of households led by the Turkish Statistical Institute, 84% of the existing buildings have single-glazing windows, and only 16% of them have roof insulation. According to another research of IZODER (Association of Thermal Insulation, Waterproofing, Sound Insulation and Fireproofing Material Producers, Suppliers and Applicators) about the consumers' behavior towards the question of insulating their own housing, only 9% of them have implemented insulation. The fact that in Turkey only 1/10 of the European consumption of insulation material is used per person shows in a better way the reason of loss of energy in the Turkish buildings.

The biggest problems of the implementation of building insulation in Turkey are on the one hand the lack of education and information on the theme (especially of the operating intermediate staff), and on the other hand the effective control of the executed works. Especially the fact that the consumers are not enough aware of the question of quality of dwellings, and that building inspection institutions do not reach the expected inspection standards have a great impact on the observed results.

Regarding the validity of building requirements, when we even only compare the building stock built before 2000 in Turkey with the actual stand of the building regulation, we can observe that these buildings consume more than twice as much energy as allowed today. While certifying that energy efficiency in buildings has a potential of 35%, the General Directorate of Electrical Power Resources Survey and Development Administration also estimates that 2,400 GWh cooling energy and 2,3 TOE fuel could be saved until 2023 due to the insulation of 10 million dwellings.

The new Regulations on Energy Performance of Buildings (published the 5th December 2008, become effective the 5th December 2009 and revised the 1st April 2010) constitute an important step towards increasing energy efficiency in buildings.
Brief Description of the Building Sector in Turkey

Buildings are the goods of the longest lifetime in the economic sector and consume energy to a wide extent. Therefore they are considered as a priority field of work regarding climate change policies and programs for increasing energy efficiency. In Europe and all developed countries improving energy efficiency in buildings comes at first in the struggle against the effects of climate change.

Following the obligations of the Kyoto Protocol, the EU targets a reduction of 20% of the greenhouse gas emissions and aims at increasing the share of renewable energies of 20%. In 2007 the total energy consumption reached the highest rate of 37% for the dwelling and facility sectors. With the implementation of cost-effective saving measures, it is intended to regain the saving potential of 27% in the dwelling sector and 30% in the commercial building sector until 2020 through the development and implementation of policies.

Buildings and Emissions

The Greenhouse gas (GHG) emissions in Turkey are increasing at an important rate. 170 million tons GHG emissions (CO2 equivalent) were produced in 1990 and increased to 366.5 million tons CO2 emissions in 2008. Even though the rates of GHG emissions per capita are still low in Turkey (5.5 kg CO2/pers.), among the Annex I countries of the United Nations Framework Convention on Climate Change (UNFCCC), Turkey is the country with the highest rate of increase of GHG emissions. The total GHG emissions (CO2 equivalent) of 2008 increased of 96% in comparison to the rates of 1990.
According to the national inventory on Greenhouse Gas of 2008, 16% of the national CO2 emissions (270 million tons) and 18% of the energy sector results from the dwelling sector (48 million tons). According to the actual state of play scenario, it is expected that the energy consumption in the building sector – which is currently of 28.3 million TOE (stand August 2010) - will increase up to 47.5 million TOE until 2020, what means that the CO2 emissions would double until this time. On the other hand, the building sector enables important steps regarding cost-effective emission and energy saving potential. In the first national report that the Turkish government submitted to the United Nations Framework Convention on Climate Change, it was pointed out that reducing CO2 emissions was more cost-effective for developing energy efficiency than using renewable energies.

Construction state of the building stock in Turkey

According to statistics of the Turkish Statistical Institute, the Turkish population grew from 56.5 million in 1990 to 72.5 million in 2009. The population rates in the cities grew from 52.9% in 1990 to 75.5% in 2009. The growing population and the fast urbanization in Turkey increase the dwelling demand particularly in big cities. According to the building census of 2000 realized by the Turkish Statistical Institute, the amount of buildings increased from 4.3 million in 1984 to 7.8 million 2000, what represents an rising of 78%. The residential build-
ings were estimated at 16.2 million the same year – what represents an increase of 129%. According to the building census of 2000, the total area of dwelling, commercial and administration buildings corresponds to 913 million m²; it is estimated that 400 million m² of this total area is being heated. Between 2000 and 2008 550,000 buildings got a construction permit and 470,000 buildings got a residence permit. Except unregistered or illegal buildings, the building stock in Turkey reached 8.6 million.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total building count</strong></td>
<td>7,838.675</td>
<td>7,917.824</td>
<td>7,995.254</td>
<td>8,042.496</td>
<td>8,096.339</td>
<td>8,171.834</td>
<td>8,286.088</td>
<td>8,400.292</td>
<td>8,506.948</td>
<td>8,602.141</td>
</tr>
<tr>
<td><strong>Residential buildings</strong></td>
<td>6,735.813</td>
<td>6,806.105</td>
<td>6,874.619</td>
<td>6,915.403</td>
<td>6,961.390</td>
<td>7,026.676</td>
<td>7,126.133</td>
<td>7,225.955</td>
<td>7,317.888</td>
<td>7,400.265</td>
</tr>
</tbody>
</table>

*Kaynak: TÜİK*

Fig. 32

*Evolution of the number of buildings in Turkey*

### 4.1 Situation in dealing with Existing Buildings

Because of many historical and existing buildings that are in Turkey, there is a high need for measures to building modernization and rehabilitation. Turkey has introduced new standards for economical use of energy in buildings, so for example, certain insulation measures and a consumption-based billing for heating and hot water in old and new buildings with different transition periods required. According to the IZODER only about 10% of 18 Mio. Residential units of Turkey have a significant thermal insulation. The Turkish government has adopted a new regulation on energy efficiency of buildings. According to this regulation every building should get a building pass. This came into force on 12.05.09. The result is that for all existing buildings the building pass must have been issued by 05/02/2017. To get this pass outdated heating systems and air conditioning have to be removed or to be renewed. The government plans to achieve savings of up to 50% of energy use. Carbon dioxide emissions in Turkey could be reduced by 3% to 4%. Every building that cannot be economically repaired is to be demolished. According to some reports, accordingly, there should be around 6.5 Mio. Building demolished in Turkey. It is estimated that in order to achieve these goals around 17 Bil-
lion Dollars will be necessary within the next 30 years. The CEDBIK says in their report that
45% of the residential units are older than 35 Years and 10 Mio. Units must be rehabilitated.

**building stock in Turkey**

There are about 8 Mio. buildings and about 18 Mio. homes in Turkey.

<table>
<thead>
<tr>
<th>data structure construction in Turkey</th>
<th>(on operating prices in Mio. TL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>reference number</td>
<td>2007</td>
</tr>
<tr>
<td>Value of the investment in total, of which</td>
<td>82.662</td>
</tr>
<tr>
<td>public, incl. infrastructure</td>
<td>23.705</td>
</tr>
<tr>
<td>private</td>
<td>58.957</td>
</tr>
</tbody>
</table>


Source: Türkiye Istatistik Kurumu (TÜİK; www.tuik.gov.tr), Ankara

**Issued building permits for buildings in Turkey (number)**

<table>
<thead>
<tr>
<th>reference number</th>
<th>2007</th>
<th>2008</th>
<th>2009 *)</th>
<th>2009/08 *) in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>housing</td>
<td>584.955</td>
<td>503.565</td>
<td>233.842</td>
<td>-13.3</td>
</tr>
<tr>
<td>government sector</td>
<td>37.136</td>
<td>59.291</td>
<td>22.203</td>
<td>-34.6</td>
</tr>
<tr>
<td>private sector</td>
<td>507.303</td>
<td>412.290</td>
<td>193.712</td>
<td>-55.6</td>
</tr>
<tr>
<td>cooperative sector</td>
<td>40.816</td>
<td>31.984</td>
<td>17.927</td>
<td>-55.6</td>
</tr>
<tr>
<td>other Buildings</td>
<td>14.721</td>
<td>13.816</td>
<td>6.249</td>
<td>-55.6</td>
</tr>
<tr>
<td>government sector</td>
<td>1.890</td>
<td>2.235</td>
<td>1.121</td>
<td>-55.6</td>
</tr>
<tr>
<td>private sector</td>
<td>12.061</td>
<td>11.054</td>
<td>4.507</td>
<td>-55.6</td>
</tr>
<tr>
<td>cooperative sector</td>
<td>770</td>
<td>527</td>
<td>621</td>
<td>336.1</td>
</tr>
</tbody>
</table>

*) January-June  Source: TÜİK

**Fig. 33**

### 4.2 Situation in dealing with New Buildings

Since the 12.05.2009 the new regulation of the Turkish government has come to force for
every new building a building pass must be presented. To get that pass the buildings must
fulfil high standards for energy efficiency and Earthquake safety.

In 2013 in Turkey exist 31 Energy efficiency consulting Companies to examine the Projects.
For the certification they are guided by international standards such as BREEM, LEED or
DGNB. The Turkish government has announced in its 2011 annual report, the reduction of
the power consumption of 20-25% which would be possible through measures to increase
energy efficiency in buildings and industry. The Government shows seven target areas for
the achievement of objectives in the strategy report energy efficiency 2010-2023. But the
majority strives to achieve energy efficiency in one action, only the insulation of the facade
with thermal insulation. The Concept of low-energy houses and zero-energy houses is still
not common.

Also the problem is that even in new buildings, there are often differences between building
permit and execution. Quality defects in material and installation often quickly lead to dam-
age and repair needs. In the other hand the need of residential buildings is increasing. One
of the reasons is that more and more of the population want to live in the cities. The popula-
Difficulties

In the big cities, the percentage of buildings increased from 44% in 1980 to 76% in 2010. This means that the construction industry is rising continuously. In 2010, the number of building permits increased by 39.5% to 128,837 buildings. For the

Projects in 2011 according to the investigation study, the total amount of investment planned projects are around 9.5 Billion Euros. But the interest is not only in residential buildings, there are also plans for building shopping centres and office buildings.

### Building permits after categories of buildings

<table>
<thead>
<tr>
<th>Category / Usage</th>
<th>2007</th>
<th>2008</th>
<th>Increase in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>in total</td>
<td>106,659</td>
<td>95,193</td>
<td>-10,8</td>
</tr>
<tr>
<td>B</td>
<td>125,067,023</td>
<td>103,846,233</td>
<td>-17,0</td>
</tr>
<tr>
<td>C</td>
<td>62,179</td>
<td>55,006</td>
<td>-13,1</td>
</tr>
<tr>
<td>D</td>
<td>684,955</td>
<td>503,565</td>
<td>-3,9</td>
</tr>
<tr>
<td>Single-family homes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>24,163</td>
<td>22,753</td>
<td>-5,8</td>
</tr>
<tr>
<td>B</td>
<td>4,492,882</td>
<td>4,185,174</td>
<td>-6,8</td>
</tr>
<tr>
<td>C</td>
<td>2,096</td>
<td>2,202</td>
<td>5,1</td>
</tr>
<tr>
<td>Two or multi family homes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>67,447</td>
<td>56,250</td>
<td>-13,6</td>
</tr>
<tr>
<td>B</td>
<td>85,314,318</td>
<td>70,155,633</td>
<td>-17,8</td>
</tr>
<tr>
<td>C</td>
<td>42,793</td>
<td>40,290</td>
<td>-5,8</td>
</tr>
<tr>
<td>Social housing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>328</td>
<td>374</td>
<td>14,0</td>
</tr>
<tr>
<td>B</td>
<td>750,692</td>
<td>816,449</td>
<td>9,0</td>
</tr>
<tr>
<td>C</td>
<td>360</td>
<td>451</td>
<td>25,3</td>
</tr>
<tr>
<td>Hotels and similar buildings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>877</td>
<td>1,239</td>
<td>41,3</td>
</tr>
<tr>
<td>B</td>
<td>3,218,292</td>
<td>2,335,043</td>
<td>-27,3</td>
</tr>
<tr>
<td>C</td>
<td>1,587</td>
<td>1,281</td>
<td>-19,3</td>
</tr>
<tr>
<td>Office building</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>2,798</td>
<td>2,132</td>
<td>-23,8</td>
</tr>
<tr>
<td>B</td>
<td>4,788,842</td>
<td>4,115,098</td>
<td>-14,1</td>
</tr>
<tr>
<td>C</td>
<td>2,367</td>
<td>2,323</td>
<td>-1,9</td>
</tr>
<tr>
<td>Buildings for wholesale and retail</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>3,498</td>
<td>3,570</td>
<td>2,1</td>
</tr>
<tr>
<td>B</td>
<td>7,596,872</td>
<td>7,322,543</td>
<td>-3,6</td>
</tr>
<tr>
<td>C</td>
<td>3,788</td>
<td>4,182</td>
<td>10,4</td>
</tr>
<tr>
<td>Industrial buildings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>3,696</td>
<td>2,939</td>
<td>-20,5</td>
</tr>
<tr>
<td>B</td>
<td>10,608,756</td>
<td>6,992,750</td>
<td>-36,1</td>
</tr>
<tr>
<td>C</td>
<td>5,111</td>
<td>3,851</td>
<td>-24,7</td>
</tr>
<tr>
<td>Public Buildings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1,313</td>
<td>1,382</td>
<td>5,3</td>
</tr>
<tr>
<td>B</td>
<td>5,027,849</td>
<td>5,212,324</td>
<td>3,7</td>
</tr>
<tr>
<td>C</td>
<td>2,499</td>
<td>2,935</td>
<td>17,4</td>
</tr>
<tr>
<td>Other Buildings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>2,539</td>
<td>2,554</td>
<td>0,6</td>
</tr>
<tr>
<td>B</td>
<td>3,268,520</td>
<td>2,707,219</td>
<td>-17,2</td>
</tr>
<tr>
<td>C</td>
<td>1,579</td>
<td>1,491</td>
<td>-5,6</td>
</tr>
</tbody>
</table>

A = Number of buildings; B = Surface in qm; C = Value in Mio. TL; D = Number of Apartments. Source: TÜRK, Ankara

Fig. 34
4 | Difficulties

Construction permits (New buildings and additions)

- - - Use of building

A. Number of Buildings  B. Floor area (m²)  C. Value (TL)  D. Number of dwelling units  E. Residential floor area  F. Common floor area  G. Nonresidential floor area

<table>
<thead>
<tr>
<th>Year</th>
<th>Toplam</th>
<th>One dwelling buildings</th>
<th>Two dwelling buildings</th>
<th>Trees and more dwelling buildings</th>
<th>Residences for communities</th>
<th>Hotels buildings</th>
<th>Other short stay accommodation buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>A</td>
<td>137,612</td>
<td>24,528</td>
<td>13,711</td>
<td>77,276</td>
<td>665</td>
<td>1,091</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>217,694</td>
<td>51,595,946</td>
<td>4,362,158</td>
<td>151,795,883</td>
<td>1,905,051</td>
<td>5,032,584</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>173,429,278,092</td>
<td>3,878,557,587</td>
<td>3,296,898,032</td>
<td>122,830,431,591</td>
<td>1,491,824,394</td>
<td>3,863,608,553</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>1,014,678</td>
<td>24,538</td>
<td>27,460</td>
<td>967,616</td>
<td>3</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>E</td>
<td>122,374,421</td>
<td>4,837,189</td>
<td>3,357,116</td>
<td>113,949,315</td>
<td>311</td>
<td>6,072</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>26,431,470</td>
<td>373,567</td>
<td>586,022</td>
<td>28,717,764</td>
<td>145,648</td>
<td>561,558</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>58,098,901</td>
<td>146,170</td>
<td>219,020</td>
<td>9,426,784</td>
<td>1,759,062</td>
<td>4,074,934</td>
</tr>
</tbody>
</table>

Fig. 35

<table>
<thead>
<tr>
<th>Office buildings</th>
<th>Wholesale and retail trade buildings</th>
<th>Communication buildings, stations, terminals and associated buildings</th>
<th>Garage buildings</th>
<th>Industrial buildings</th>
<th>Reserves, sites and warehouses</th>
<th>Public entertainment buildings</th>
<th>Museums and libraries</th>
<th>School, university and research buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,674</td>
<td>4,476</td>
<td>79</td>
<td>185</td>
<td>2,119</td>
<td>1,722</td>
<td>364</td>
<td>29</td>
<td>1,377</td>
</tr>
<tr>
<td>12,835,544</td>
<td>7,375,922</td>
<td>255,805</td>
<td>809,881</td>
<td>6,929,862</td>
<td>2,612,019</td>
<td>764,584</td>
<td>131,620</td>
<td>6,177,585</td>
</tr>
<tr>
<td>9,909,801,405</td>
<td>5,807,936,559</td>
<td>188,660,830</td>
<td>638,304,071</td>
<td>5,266,694,406</td>
<td>1,938,689,903</td>
<td>581,003,710</td>
<td>108,205,368</td>
<td>4,601,701,006</td>
</tr>
<tr>
<td>1,744</td>
<td>2,715</td>
<td>0</td>
<td>17</td>
<td>19</td>
<td>98</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>187,534</td>
<td>363,903</td>
<td>0</td>
<td>1,935</td>
<td>1,565</td>
<td>10,475</td>
<td>658</td>
<td>0</td>
<td>864</td>
</tr>
<tr>
<td>3,024,983</td>
<td>1,461,927</td>
<td>816</td>
<td>9,251</td>
<td>394,042</td>
<td>100,904</td>
<td>65,574</td>
<td>2,239</td>
<td>149,020</td>
</tr>
<tr>
<td>6,623,017</td>
<td>5,510,092</td>
<td>264,989</td>
<td>708,675</td>
<td>6,533,685</td>
<td>2,500,643</td>
<td>698,352</td>
<td>129,381</td>
<td>6,027,761</td>
</tr>
</tbody>
</table>

Fig. 36

<table>
<thead>
<tr>
<th>Hospital or institutional care buildings</th>
<th>Sports halls</th>
<th>Nonresidential farm buildings</th>
<th>Buildings used as places of worship and for religious activities</th>
<th>Historic or protected monuments</th>
<th>Other buildings not elsewhere classified</th>
</tr>
</thead>
<tbody>
<tr>
<td>334</td>
<td>359</td>
<td>2,952</td>
<td>496</td>
<td>4</td>
<td>1,065</td>
</tr>
<tr>
<td>3,954,898</td>
<td>1,260,530</td>
<td>4,150,325</td>
<td>653,017</td>
<td>2,992</td>
<td>1,003,075</td>
</tr>
<tr>
<td>3,206,555,869</td>
<td>934,425,763</td>
<td>3,004,961,849</td>
<td>505,812,915</td>
<td>1,101,766</td>
<td>752,926,732</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>138</td>
<td>19</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>1,100</td>
<td>128</td>
<td>14,514</td>
<td>2,724</td>
<td>0</td>
<td>1,330</td>
</tr>
<tr>
<td>78,805</td>
<td>101,115</td>
<td>47,953</td>
<td>19,755</td>
<td>0</td>
<td>31,974</td>
</tr>
<tr>
<td>3,874,983</td>
<td>1,159,289</td>
<td>4,087,808</td>
<td>630,536</td>
<td>2,992</td>
<td>909,471</td>
</tr>
</tbody>
</table>
5 | Measures & Recommendations

5.1 Improvement of Energy-Efficiency on buildings

Energy-saving measures

Example (existing building)

The following example provides a detailed illustration of how a non-insulated two story building (facing the highway) with a garden and a penthouse in Ankara, Gölbashi in the third region, on the lakeside of Lake Mogan, was refurbished into an “Energy Efficient Building”.

- 62% of window space was increased on the south frontage given a total amount of 45%.
- A roof garden was built on the south and north frontals of the roof, giving rise to an open air space.
- Consequently the south frontage space of the building and the penthouse window space were increased.
- Shadowing was focused on the north side of the building and was achieved through an evergreen plantation.

In order to ensure compliance with the TS 825,

- Rockwool of 6 cm thickness was used in outdoor areas that were in direct contact with air and of 8 cm thickness inside unheated walls
- Glass wool of thickness 12cm was used on the roof areas of the ceiling
- 10cm of foam board on open air roof to achieve energy balance of the building
- Foam board of 10cm thickness was used as insulating material for the floors. (10cm floating floorboards were used on floors close to unheated areas)
- Double-glass of the building was replaced by low –E plated heat insulation bridged windows with an up value of 2,4 W/m2K. 3 cm thick cement mortar which had be used on the external walls was also replaced by 7mm thick organic based plastering made of lightweight aggregates, thereby complying with requirements of structure physics.

Ground source heat pump application

In accordance with TS825 concerning heat insulation, optimum annual heating and cooling requirements of the building were achieved through passive methods; In this case a vertical
type ground source heat pump. Energy requirement of the building was observed to be at its highest, 20,497.178 kJ (7.9 kW) in the month of January. A heating pump with a heating capacity of 14.6kW and cooling capacity of 2.4kW was chosen. Since the pump is capable of providing the necessary energy for both heating and cooling the water supply (depending on the season), no solar collector was installed. The table below will analyze the outcome of this particular design. The payback period for this system is 11 years and 11 months. Based on the calculations a 102m borehole is required. Investment costs (inclusive of device, pipe, boring and labor cost) amount to 8472TL (fuel requirements were not taken into consideration because of the pump’s capability to provide the energy needed for heating the building and water)

<table>
<thead>
<tr>
<th>Table 1. Energy audit of the new investment and monetary values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
</tr>
<tr>
<td>Current situation</td>
</tr>
<tr>
<td>Insulation</td>
</tr>
<tr>
<td>Heat pump (heating)</td>
</tr>
<tr>
<td>Heat Pump (cooling)</td>
</tr>
<tr>
<td>PV</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
<tr>
<td>Net Utility (NU) = 3728</td>
</tr>
</tbody>
</table>

**Greenhouse application**

A greenhouse was designed as a part of the passive heating system. The structure was built on the south frontage adjacent to the building with a one way inclined roof made of glass. Roof pitch was designed at an incident angle of 50 ° with sunbeams in winter. As a result heat is gained by areas next to the greenhouse. In order to facilitate optimum utilization of solar radiation, standard insulation with a U-value of 2.6 W/m2K was used. Vents were positioned on the upside and underside of the greenhouse to minimize the adverse effects on the cooling loads during hot summer days by facilitating the airflow. Jalousies designed on the glass surface of the greenhouse and deciduous trees should reduce the radiation from the greenhouse surface. Thermal analysis of this design determines the value of total heat gain.
Fig. 1. Greenhouse, summer application
(jalousie closed, went open)

Fig. 2. Greenhouse, winter application
(jalousie open, went closed)
Water wall application

The wall which separated the greenhouse and the site, was transformed into a thermal mass by using 2 plane Plexiglas boards. This acts as a storage device for thermal energy and also minimizes the light transmittance. In order to improve its effectiveness, water which has one of the highest thermal capacities (4160.103 kJ/m3K) was used to store the thermal energy. An added advantage of using water is that due to the transparency of the whole design, more sun beams could now enter the site on the south frontage. Energy preserves of this thermal mass which was positioned on the south frontage will be of great use in those times of no or not enough sun light.

Heat storage application on bedrock

Bedrock has been formed as a thermal mass on the greenhouse or house floor to support passive heating of the house. It has been anticipated that by means of this thermal mass, storing of excess heat accumulates in the greenhouse during the insulation and utilizing this energy when insulation is not enough.

Other passive system applications

Window spaces on the south frontage of the building have been increased to utilize incident rays in winter. Window space increase has been provided at the rate of 62% on south frontage and a total of 45%.

To prevent living spaces from extreme heating in summer because of new windows which have been placed to utilize the sun beams more effectively in winter, window shades have been placed on top of the windows. These components let the light in which comes with oblique angle in winter but reflect the light out which comes with right angle in summer. Two lines forestation has been done on north to protect the building from north winds. No forestation has been done on South frontage of the building.

Natural air conditioning – vents have been place on north frontage to provide natural air-conditioning in the building. These vents have been placed on stairs column, penthouse bedroom and living room walls. Pressure difference required for these vents to work, when the Windows on South frontage are open and by that air circulation will be provided.
Light shelf systems – Light shelf is a component which is designed to prevent the sun light entering and direct it to the ceiling and placed horizontal or almost horizontal on inner surface or exterior surface of the window. These components will be added to top sides of the windows afterwards.

Two-leaf glass frontage application – Glass frontage cladding has been applied on first floor bedroom and first floor living room to utilize the sun beams on south frontage and two vents are used on the walls. These vents have been placed on top corners and bottom corners of the wall as enter and exit.

Power generation with Photovoltaic panels (PV) – It has been seen that payback period for the system will be too long as a result of feasibility study on whether all energy requirement of the building that becomes independent on heating and providing hot water can be provide with renewable energy or not. In that case, it has been designed to provide electricity requirement for fire exit way illumination and smoke sensors with PV panels instead of entire energy requirement of the house. For this purpose a package unit that consists of 180 W solar battery, 1 charge regulator and control unit, 1 solar accumulator and 4 light bulbs (11 W, 12V) has been selected to be placed on roof. Investment cost for this unit is 1090 TL and it is presented in economic analysis tables mentioned above. Heat insulated garden roof terrace – Besides looking beautiful, roof gardening, which is very common in western Europe, also provides substantial economic and ecological benefits if it is applied with a safe water insulation and well planning. Considering the draught in Ankara, water has become significant and roof gardening application has been decided. Water saving and recycling – To reduce the utility water usage in the house it has been suggested to use type-A water saving sinks and double stage reservoir in bathrooms and to store the rain water handled in gutter and roof gardening to use in both toilet flush tank and watering the garden.

Chimney flue – No change has been made in the chimney which is on the North side of the current house. It has been thought that using the chimney in winter will provide heat gain on the colder north side of the house and also to utilize flue gas heat. Discharge shaft has been designed as a heat transformer to do that. In that design, by placing a second layer of bricks it is targeted to heat the flowing air in between and return it to the environment. Therefore reduced heat requirement for the environment has been provided.

Phototubes (Cold light in hot day) – Sun light has the top quality light among lighting devices. Day light for first floor North bathroom, garage, mechanical room and the penthouse which has been made by roof gardening application has been provided by this system. Therefore there will be electricity saving at the rate of 30%-70%.
Current building has been transformed into an “Energy Efficient Building” by applying heat insulation as well as other several active and passive systems and its ecological footprint has been reduced.

5.2 Measures for Energy Efficiency in the Future

Prefabricated Residential Buildings

Importance of time, economy and quality aspects of buildings has pushed the construction of buildings be more industrialized. Since no builder desires to depend on the weather, most part of the construction process is carried out inside the factory rather than at the construction site. Pre-fabrication rate of the construction is determined by the percentage of the factory process. Building envelope plays a rather important role in estimating energy performance of a building; hence the quality and application of material are of great influence. This is achieved through the use of industrialized methods performed during the production process, carried out in a covered area.

There 4 types of pre-fabricated homes.

- Manufactured homes
- Factory made homes
- Modular homes
- Panelized homes

Some Advantages of pre-fabricated constructions are,

- A rational production process. Assembly line automation (e.g. Automobile production)
- Independent of time and weather, fast production and installation.
- High quality due to all elements being produced in a covered area along with the materials used.
- Economies of scale
- Low level of (heat) energy requirements as a result of high levels of insulation used (roof, walls, etc.)

In addition to the above mentioned advantages the ability to supervise different components with regard to energy efficiency performance should be noted.
5.3 Progress in thermal insulation systems in Turkey and implementation of exterior wall insulation systems especially in dwellings

Thermal comfort can be defined as optimal thermal conditions for healthy and productive environment conditions for people. If thermal comfort cannot be provided, the consumption of energy for heating purposes does not heat the building but the atmosphere, and thus more energy is consumed than actually needed. This high energy consumption increases the usage costs of buildings, but it also increases the environmental pollution by rejecting harmful gases in the atmosphere.

Nowadays, various seminars and meetings are being organised under the motto: “European negotiation processes and strategies”, and the positive or negative developments that would happen with Turkey’s membership to the European Union are being discussed. Everyone knows how delicate the issues about environmental pollution and about energy saving are for the EU. The process of EU-membership would be beneficial for the positive development of the agriculture, environment, health, and also of the building sector in Turkey.

Ireland – that used the funds that it received during the twelve year negotiation process for its technical development – could be a positive example for Turkey thanks the progress this country has made in those above mentioned fields.

All the Institutions and organisations of the building sector that will take part to this progress have to take into account and follow the standards published by the EU, and have to be ready to work in favour of the implementation of these standards. This progress would only be possible though the proper implementation of the regulations on the building and insulation sector in Turkey.

Brief Historical Overview on the Progress of Thermal Insulations Systems in Turkey

When we analyse the regulations on the implementation of thermal insulation in Turkey, we can observe that the first regulation, called “TS 825: Regulation on Building Insulation”, was published in 1970 by the Turkish Standard Institute. However, no obligation had been amended at this period regarding the implementation of this regulation.

In 1977, the publication of the Regulation on the Development of the Energy Efficiency of heating, and steam plants and on the reduction of the air pollution represented an important step in this field. In 1995, the Ministry of Energy and Natural Resources began revision works on the TS 825 Standards on Building Insulation and was approved by the TS Technical
Committee, and then took effect in 1998. The TS 825 Standard became an obligatory the 14.06.2000 and began to be implemented on new building constructions.

The process of EU membership has enabled an important progress regarding energy efficiency in buildings. The TS 825 Standard has set new limits for the consumption of heating energy in buildings according to their area and capacity. All types of buildings that we use and where we need a certain heat comfort like dwellings, offices, theatres, concert and congress centres, cultural centres, education buildings, sports halls, hospitals, dorms, banks or hotels are taken into account by the implementation field of the TS 825.

Nowadays, when we talk about energy saving in buildings, the main issue concerns the field of economies on heating energy. In order to reduce the consumption of energy used for building heating, only the correct implementation of thermal insulation can makes it possible to achieve this goal.

The aim of thermal insulation in buildings is actually to reduce and avoid thermal bridges in walls, roofs, or windows in order to protect the construction. In the early 1990s, with the growing consciousness of energy saving began its first steps towards energy efficiency in the building sector through the use of double glazing windows instead of one glazing windows in dwellings. With this new process in energy efficiency, began also the production of new thermal insulation materials in Turkey.

From 1995 on, the consumption of insulation materials reached about 1.500.000 m³ in Turkey. In comparison to the country, about 30.200.000 m³ of insulation materials were used in Germany, and about 20.100.000 m³ in France. In the following chart we can observe the annual consumption of insulation materials per capita in Turkey and other countries.

<table>
<thead>
<tr>
<th>Türü</th>
<th>Türkiye</th>
<th>İsveç</th>
<th>Almanya</th>
<th>Fransa</th>
<th>İngiltere</th>
<th>Yunanistan</th>
</tr>
</thead>
<tbody>
<tr>
<td>m³/çi/ yı</td>
<td>0,02</td>
<td>1,03</td>
<td>0,33</td>
<td>0,28</td>
<td>0,16</td>
<td>0,05</td>
</tr>
</tbody>
</table>

Fig. 40

Turkey is among the countries that use thermal insulation materials of the lowest thickness.

The worldwide energy consumption of the last 25 years increases of only 5%, whereas it increased of more than 100% in Turkey. According to the official statistics, of 1990, the energy production in Turkey could face 50% of the total demand, whereas today it cannot face more than 30% of the total energy demand. 41% of the energy is used for the dwellings, 33%
for the industry, 20% for the transportation, 5% for the agriculture and 1% for other sectors. About 85% of this energy is consumed for heating aims.

It is to observe that the most energy is consumed in dwellings. Therefore it is important to reduce the loss of heat in the periods of high heat energy demand. Energy saving is possible in dwellings through the use of proper thermal insulation systems.

**Exterior Wall Insulation Systems in Dwellings**

The highest thermal bridges in dwellings occur in construction elements like walls, floors, roofs or windows. The thermal bridges observed in those elements vary depending on the architectural aspect of the construction, its position, its insulation stand and on the properties of the construction materials used. Generally speaking, the higher a building is, the higher the loss of heating energy through the building components is.

When we compare Turkey to European countries, we can observe that according to the data of 1990, the average wall insulation thickness implemented on the exterior walls of buildings was of 10cm in France, 6cm in Germany, 5.5cm in Italy, 5cm in England and 3cm in Turkey. But according to the results of calculations made on three residential building examples, the necessary wall insulation thickness varies from a degree day region to another.

According to the TS 825 Regulation on Thermal Insulation, in the Turkish regions of the 1\textsuperscript{st} degree day zone, the adequate wall insulation thickness for exterior walls is 3cm, in the regions of the 2\textsuperscript{nd} degree day zone 5cm, in the regions of the 3\textsuperscript{rd} degree day zone 6cm, and in the regions of the 4\textsuperscript{th} degree day zone 12cm. (For the calculations, 6-6-6 mm plastic combined double glazing windows were considered.) According to another research made in 2004 in the new settlement area of the province Bursa (2\textsuperscript{nd} degree day zone), they have come to the conclusion that 78% of the dwellings had not implemented any wall insulation, and that the only walls that had been insulated, used 3cm Styrofoam core insulation (between double walls).

This shows clearly that this implemented insulation thickness does not respect the required standards, and that also demonstrates once again the importance of building insulation.

The covering elements used on the exterior shell of dwellings and the glazing components are particularly important for providing a certain thermal comfort within the buildings. Following the results of the calculations made about the above mentioned example buildings, it has been demonstrated that covering elements that were not TSE certified (Turkish Standard
Institute) had caused an increase of 58% of the annual need of heating energy. These results show explicitly the role of the use of TSE certified covering elements on the thermal comfort. Furthermore, the growing energy demand and the environmental question require the use of special glazing that provides more thermal comfort with less energy consumption in dwellings.

The building users in Turkey attach more and more importance to the theme of loss of heating energy provoked by construction elements like windows or walls.

Thanks to the current progress of technology, wall components can consist of a single stratum or also have an integrated insulation layer; they can even consist of several layers. Insulation materials are being used in order to provide a certain protection against humidity, heat, or also against fire. There is no single insulation material that can be used in every insulation cases. The adequate insulation materials have to be chosen according to the characteristics of the usage location.

The most often used insulation materials in Turkey are fibrous and foam materials. The main used fibrous material is wood wool, and the most used mineral insulating materials are rock wool or glass wool. The most used foam insulation materials are polystyrene foams like EPS or XPS, and also polyurethane foams. It is preferable to opt for insulating materials for exterior walls that do not affect negatively the properties of the construction in the contact area with humidity. One should always choose materials that do not lose their insulating properties.

The actual thermal insulation systems in Turkey are mentioned below, depending on the location of its utilisation:

- Thermal Insulation implemented on the exterior surface of walls (Mantle Heat Insulation System)
- Thermal Insulation implemented on the interior surface of walls
- Thermal Insulation implemented between double wall components (Core Insulation System)
- Ventilated Exterior Wall Thermal Insulation System.

**Implementation of Thermal Insulation on exterior wall surface**

Exterior thermal insulation systems that are widely used in Europe and USA have begun to be more frequently used in Turkey the last few years. Exterior construction insulation is considered as the most adequate insulation system regarding the physical characteristics
of constructions. Due to this exterior wall insulation system, the insulation component envelopes the building like a kind of mantle and avoids thus the thermal bridge phenomena. Thanks to this insulation system, distensions or rifts that could appear because of temperature differences can be avoided, and the ventilation of the construction enables it to remain continuously dry.

The exterior wall surface insulation system can be implemented quite easily for new constructions as well as for existing constructions. All the insulation processes of a building that is being used occurs at the exterior of the building and thus does not affect the utilisation of the inner space of the building. Although this insulation system is more expensive than other insulation methods, it remains the most adequate system for buildings of long utilisation period like dwellings.

This exterior insulation system that can both be implemented on new buildings and already existing buildings is a quite cost effective option, because it actually enables the reduction of maintenance and refurbishment costs thanks to its exterior implementation aspect. Thus the lifetime of the building can be lengthened. Nevertheless, in comparison to the above mentioned positive aspects of the exterior wall surface insulation, some negative aspects can be mentioned:

- High implementation costs in comparison to other insulation systems
- Need of protective shell against environmental conditions (rain, wind)
- Need of scaffolding on the whole building façade.
Implementation of Thermal Insulation on interior wall surface

This insulation system that we often find in dwellings in Turkey nowadays is actually more adequate for spaces of shorter utilisation periods that do not need a continuous heating like office buildings, concert and cinema halls. By this system, the walls have a limited heat storing capacity, but the pre-heating time by this system is relatively short. By the implementation of interior insulation systems the risk of condensation in the insulation material – due to vapour diffusion – is relatively high. For this reason, a vapour stopping material should absolutely be used on the warm side of the insulation panels. (cf. picture 2)

Interior insulation system is mostly implemented for insulating existing buildings, or when an exterior insulation implementation is not the suitable option. But in this cases it is important to take measures in order to avoid thermal bridges at the junction points of floors, columns, joists or curtain walls to the outer wall.

Contrary to the negative aspects of the exterior insulation method (complexity of implementation, augmentation of implementation costs), we can observe the following positive aspects of the internal insulation method: easiness of the implementation, low implementation costs, exterior façade not affected, no need of scaffolding, and implementation process not affected by the exterior climatic conditions.

But because of temperature variations, alterations can still appear on the interior construction. If in the summer period no air conditioning is used, the interior room temperature can increase significantly and provoke a loss of interior volume.
Implementation of Core Insulation (thermal insulation between two wall shells)

This insulation system is also called “sandwich wall insulation” in Turkey. The easiest implementation method of this system consists in placing hart foam insulation panels between two wall shells. Both the thickness and load bearing capacity of the wall construction can vary.

By the implementation of core insulation in Turkey, most of the time the reinforced concrete surfaces are not insulated. In order to avoid thermal bridges on these reinforced concrete surfaces, it is possible to insulate the construction from the exterior (mantle system). By the implementation of thermal insulation in other countries, the reinforced concrete surfaces are also insulated in order to avoid this problem of thermal bridge. (cf. picture 3)

Core Insulation System can be implemented with or without air space. The wall construction details of the implementation of this system in Europe are the following alternatives:

- Core Insulation between two concrete blocks
- Core Insulation between interior concrete wall shell and exterior façade brick wall shell
- Core Insulation between interior concrete wall shell of average density and exterior brick wall shell
- Core Insulation between interior autoclaved cellular concrete wall shell (ACC) and exterior façade brick wall shell.

By Core Insulation systems, it is required to fix the two different wall shells to each other through wire or metal cramps with close distance between each other in order to prevent the two wall layers to break away from each other in eventual earthquake situation. By it has been unfortunately observed that this precaution measure is not really being implemented in Turkey, what even leads sometimes to the fact that some entire facades break down. It is therefore necessary to take measures against this problem during the implementation of this insulation system.

In the cross-section of the wall, condensation can appear between the exterior wall shell and the insulation panel. This situation can affect negatively the insulation properties of the insulation material and also lead to unwanted appearance of the inner surface of the wall. By the implementation process of core insulation, drainages should be installed in the cross-section of the walls in order to enable the rainwater or the condensation water – that could infiltrate the construction – to be evacuated to the exterior.
Ventilated Exterior Wall Insulation Systems

It consists in systems with an air gap between the insulation material – that is implemented to the existing wall shell – and the overlay material.

These insulation systems are especially used in high residence buildings (dwellings) which number is rapidly growing in the big cities of the country, but also in office buildings. The loss of thermal energy through the construction elements occur most of the time in the wall constituents, the windows or parapet areas.

The insulation material that would be used in brick or reinforced concrete systems can be implemented in two positions: at the inner or at the exterior surface of the parapet. The implementation of this insulation system on a system without parapet consists in insulating the construction with a panel with an inner integrated insulation material, or with a panel at the inner side of the construction used in the parapet area. If the system is properly implemented, no condensation will appear in the construction cross-section. (cf. picture 4)
It is definitely necessary to keep a ventilation gap between the insulation layer and the façade shell in order to prevent the condensation process.

Implementations of façade insulation where there is no ventilation gap between the two wall constituents unfortunately still exist in the country. Even though the insulation is implemented at the exterior surface of the wall, the condensation process can still occur if the façade is not ventilated, and increasing the thickness of the insulation panel does not have any positive effect on the insulation properties.

### 5.4 Energy Efficiency – Energy Saving

**Conclusion and Recommendations**

Energy efficiency and energy conservation are among most challenging concerns, when it comes to construction of residential buildings. Many resources (time, energy etc.) are wasted in plenty due to the quality of the construction not being accordance with the prevailing standards.

Most of these issues could be traced back to the construction methods and the materials used.

The traditional construction (reinforced concrete) system in turkey could be cited as an example in this regard.

However it is expected, that the demand for quality housing in Turkey will be rather high in the near future. Pre-fabrication methods of construction could be an excellent solution in ca-
tering to this future demand for quality housing. Through this method it would be possible to establish a great many energy efficient, sanitary dwellings in a short period of time, economically.

In the present Turkey, mechanical solutions are used for almost every energy need without hesitation. This approach has to be changed in order to address the prevailing issue of energy wastage. Methodologies such as passive housing approach which are mainly dependent on natural resources for its energy needs are worth investigating. Turkey’s potential for adopting these methods in construction of future buildings should also be looked into.

It’s proven through many simulations (as well as from the refurbishment of the building in Ankara), these so called passive housing strategies were greatly successful in drastically minimizing the energy usage, especially in extreme climate conditions.

Furthermore new usage of technologies like sensor based shading systems which operate depending on the level of solar radiation on transparent surfaces or indoor temperature could enhance the above mentioned energy efficient methods and processes.

Turkey could also benefit from the pre-fabricated systems which are already implemented in different developed countries over the world.

For example, turkey could adopt the Japanese system with respect to production and assembly methods. Competitive systems in Germany and Sweden are very energy efficient due to their envelope properties and are also very appropriate for cold climatic condition.

A special property of their building systems is the wall structure with thick insulation layers.

A good reference point for Turkey is to investigate the criteria that these developed countries (Germany and Sweden) use to determine the thickness of the insulation layer for different cities (Regions).

The system selected for this particular work (refurbishment of the building in Ankara) was heavily dependent on the degree of factory completion, energy efficient design, thermal transmittance values and insulation.
6 | Conclusions

Based on our inquiries there is a large potential for Energy Efficiency measures in Turkey. Heat and electricity consumption will be increasing rapidly due to its increasing population. This leads to investments on more efficient plants.

To sum up, Turkey follows an ambitious energy efficiency program, which is supposed to reduce waste and contribute Energy Efficiency. As Turkey has a large energy saving potential due to its renewable energy sources (e.g. Hydro power, geothermal power, Biomass, solar power and wind power). As a result, the Turkish government issued several policies in field of energy efficiency such as an Energy Efficiency Law and an Energy Efficiency strategy paper. Those guidelines are supposed to reduce energy costs as well as to secure long term energy independence from other countries.

To complete the government plans, new buildings must have an energy performance certificate, whereas existing buildings have to have that certificate by 2017. New and existing buildings must have a central heating as well as metering systems. There are also Energy Efficiency Legislations for a household that sets energy standards for appliances. But there are still many old, energy wasting appliances among Turkey, owing the fact that many Turkish people have not been enough sensitized for Energy Efficiency. Currently the government does not treat energy efficiency project as a special category of investments.

The residential sector makes up a little more than 20% of the primary energy consumption. The most energy saving potential is affiliated with the use of thermal insulation to avoid the heat loss. The insulation and windows replacements should be carried out in eastern Turkey or in buildings that have high cooling costs.

Even though energy efficiency is a priority in the government, the strategy has not been taken over in the private sector. This is a main problem in Turkey, as there is a lack of experience. To solve that problem there is a need in training and awareness raising activities especially for technical personnel. Students in university as well as the private sector should be trained in order to increase the awareness and encourage the use of energy efficiently.

As a conclusion, Turkey should be providing new technologies and tools that can be used in new buildings. Furthermore, the training of experts at university or training for personnel is very important. Only a few people are aware of Energy Efficiency.
Annotations

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Other Matters:

The current report comprises, including the cover sheet and the annex, 70 pages. It is to be used only in its entirety.
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GEMEINSAME ERKLÄRUNG
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DEM BUNDESMINISTERIUM FÜR WIRTSCHAFT UND TECHNOLOGIE
DER BUNDESREPUBLIK DEUTSCHLAND
UND
DEM MINISTERIUM FÜR ENERGIE UND NATÜRLICHE RESSOURCEN
DER REPUBLIK TÜRKIEI
ZUR
ZUSAMMENARBEIT IM ENERGIEBEREICH

Der Bundesminister für Wirtschaft und Technologie der Bundesrepublik Deutschland, S.E. Dr. Philipp Rösler und der Minister für Energie und natürliche Ressourcen der Republik Türkei, S.E. Taner Yildiz, sind am 15. November 2012 in Istanbul zusammengekommen und haben erklärt, dass sie bestrebt seien, die Zusammenarbeit in Energiebereich zwischen der Türkei und Deutschland zu verstärken und zu vertiefen und gemeinsam die Versorgungssicherheit beider Länder zu verbessern.

Zu diesem Zweck geben das Bundesministerium für Wirtschaft und Technologie der Bundesrepublik Deutschland und das Ministerium für Energie und natürliche Ressourcen der Republik Türkei (nachfolgend jeweils einzeln als "Seite", zusammen als "Seiten" bezeichnet) nachfolgende gemeinsame Erklärung ab:

I

Beide Seiten teilen die Auffassung, dass die zwischen der Türkei und Deutschland wachsende bilaterale Zusammenarbeit zur Energieversorgungssicherheit beider Länder beitragen wird. Dabei kommt der Türkei bei der Energieversorgung beider Seiten und Europas eine wichtige Drehscheibenfunktion zu. In diesem Rahmen werden die Seiten zur Vertiefung ihrer bilateralen wirtschaftlichen Zusammenarbeit und zur ressourcenschonenden und umweltverträglichen nachhaltigen Entwicklung die Zusammenarbeit auf dem Gebiet der Energie verstärken. Zu diesem Zweck werden die Seiten die erforderlichen Anstrengungen unternehmen, das „Türkisch-Deutsche Energieforum” zu errichten und fortzusetzen.

II

Das „Türkisch-Deutsche Energieforum”, unter Co-Leitung des türkischen Ministers für Energie und natürliche Ressourcen und des deutschen Bundesministers für Wirtschaft und Technologie, nimmt seine Arbeit mit fünf Arbeitsgruppen auf. In diesen Arbeitsgruppen werden die Seiten konkrete Vorschläge zur Intensivierung der Zusammenarbeit im Energiebereich entwickeln. Die fünf Arbeitsgruppen sind nachfolgend aufgeführt:

1. Arbeitsgruppe für Erneuerbare Energie
2. Arbeitsgruppe zur Energieeffizienz
3. Arbeitsgruppe für konventionelle Kraftwerke, Kraftwerksmodernisierung, Braunkohleförderung
4. Arbeitsgruppe für Stromverteilung u. Übertragungsnetze
5. Arbeitsgruppe für die Regulierung des Strom- u. Gasmarktes, Einführung einer Energie- und Strombörse, Verbraucherinteressen
Das „Türkisch-Deutsche Energieforum“ soll jährlich einmal tagen, abwechselnd in der Türkei und in Deutschland.

Beide Seiten gehen davon aus, dass jede ihre eigenen Reise- und Unterkunftskosten sowie die Kosten der notwendigen Logistik tragen soll. Die Kosten für die Durchführung des Energieforums (z. B. Raummiere, Dolmetschkosten) sollen von der jeweils ausrichtenden Seite des Forums getragen werden.

IV

Beide Seiten beabsichtigen, die Zusammenarbeit in den nachfolgend aufgeführten Bereichen - ergänzend zu der Energiezusammenarbeit, die aus dem „Türkisch-Deutschen Energieforum“ entsteht – zu verstärken:

1. Förderung von Investitionen und Projekten im Energiebereich, die dem gemeinsamen Vorteil der Seiten dienen;
2. Organisation und Durchführung von Besuchen sowie Gesprächen zwischen hohen Beamten, Institutionen und Gesellschaften beider Länder;
3. mit Blick auf die laufenden Beitrittsverhandlungen der Türkei mit der Europäischen Union die Verstärkung der Zusammenarbeit in verschiedenen Bereichen der Energie sowie die Entwicklung der Aktivitäten zur Harmonisierung des türkischen Energirechts an das EU- Energierecht und dessen Anwendung.

V

Zur Realisierung des „Türkisch-Deutschen Energieforums“ wurden als Koordinationsstellen die Direktion für bilaterale Beziehungen bei der Generaldirektion für auswärtige Beziehungen und der EU beim Ministerium für Energie und natürliche Ressourcen der Republik Türkei und das Referat für die bilaterale Zusammenarbeit mit der Türkei beim Bundesministerium für Wirtschaft und Technologie der Bundesrepublik Deutschland bestimmt.

VI

Diese gemeinsame Erklärung zur Förderung der Entwicklung der bilateralen Zusammenarbeit zwischen den Seiten stellt kein für die Seiten bindendes internationales Abkommen dar. Keine der Bestimmungen dieser gemeinsamen Erklärung darf so ausgelegt oder angewandt werden, dass sich daraus für die Seiten Rechte oder Verpflichtungen ergeben.

Unterzeichnet am 15. November 2012 in Istanbul in zwei Exemplaren, jeweils in den Sprachen Türkisch, Deutsch und Englisch

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MINISTER
FÜR ENERGIE UND NATÜRLICHES
RESSOURCEN
DER REPUBLIK TÜRKEI
Annex

Annex B

Extraction of Turkish Standard 825

U values recommended to be accepted as the maximum value according to the regions

<table>
<thead>
<tr>
<th>Region</th>
<th>$U_0$ (W/m²K)</th>
<th>$U_T$ (W/m²K)</th>
<th>$U_1$ (W/m²K)</th>
<th>$U_{0^+}$ (W/m²K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Region</td>
<td>0.70</td>
<td>0.45</td>
<td>0.70</td>
<td>2.4</td>
</tr>
<tr>
<td>2. Region</td>
<td>0.80</td>
<td>0.40</td>
<td>0.80</td>
<td>2.4</td>
</tr>
<tr>
<td>3. Region</td>
<td>0.50</td>
<td>0.30</td>
<td>0.45</td>
<td>2.4</td>
</tr>
<tr>
<td>4. Region</td>
<td>0.40</td>
<td>0.25</td>
<td>0.40</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Extraction of EnEV 2014

Tabelle 1

Ausführung des Referenzgebäudes

<table>
<thead>
<tr>
<th>Zeile</th>
<th>Bauteile/Systeme</th>
<th>Referenzausführung/Wert (Maßeinheit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Der nach einem der in Nummer 2.1 angegebenen Verfahren berechnete Jahres-Primärenergiebedarf des Referenzgebäudes nach den Zeilen 1.1 bis 8 ist für Neubauvorhaben ab dem 1. Januar 2016 mit dem Faktor 0.75 zu multiplizieren. § 28 bleibt unberührt.</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Außenwand (einschließlich Einbauten, wie Rollladenköpfen), Geschosdecke gegen Außenluft</td>
<td>Wärmedurchgangskoeffizient</td>
</tr>
<tr>
<td>1.2</td>
<td>Außenwand gegen Erdreich, Bodenplatte, Wände und Decken zu unbeheizten Räumen</td>
<td>Wärmedurchgangskoeffizient</td>
</tr>
<tr>
<td>1.3</td>
<td>Dach, oberste Geschossdecke, Wände zu Seiten</td>
<td>Wärmedurchgangskoeffizient</td>
</tr>
<tr>
<td>1.4</td>
<td>Fenster, Fenstertüren</td>
<td>Wärmedurchgangskoeffizient</td>
</tr>
</tbody>
</table>