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Opportunities for Improving Energy Efficiency in Turkey

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Introduction

As the Turkish economy grew at a rapid pace in the last decade, the energy demand of the country also increased rapidly to accommodate the growing economy. The total electricity demand of the country almost doubled between the years 2001 and 2013, from 122 to 240 TWh[1]. Accounting for this demand was no easy task especially when it is considered that Turkey doesn't have substantial reserves of conventional fuels. Nearly all of the oil and natural gas demand and a share of the coal demand in the country have to be met by imported sources. The rapid increase in energy demand over the years only exacerbates the problem of import dependence. For the year 2013, around 56% of the electricity generation in the country was fueled by imported sources[2]. If the economy is to continue its fast-paced growth, the problem of energy dependence is bound to be more acute in the near future. On the other hand, the recent increase in the GHG emissions of the country constitute yet another problem while a new global agreement for climate change mitigation is being negotiated. For the foreseeable future, the main policy struggle for Turkey on the field of energy will be to reduce the import dependence of the country while supplying energy to the market at reasonable prices and keeping the GHG emissions of the country at an acceptable level.

To address the energy supply problems in the country, the government is currently pursuing a number of policies. Considerable focus is given to diversifying the electricity mix of the country, both in terms of diversifying the sources of imports and diversifying domestic sources. Renewable energy sources like hydro, wind and solar energy are promoted for this aim and the construction of a nuclear plant has already begun to introduce nuclear energy in the electricity generation mix. Moreover, substantive plans to expand the coal capacity in the country has been developed to exploit the significant amounts of lignite reserves in the country[3]. In addition to these measures, another policy alternative that can help Turkey solve its energy problems is promoting energy efficiency. Judging from its applications throughout the world, energy efficiency has often proven to be the least costly way to offset energy supply needs and to reduce GHG emissions while increasing competitiveness of an economy. Energy efficiency can be a powerful component in a country's energy policy if effective policy tools can be employed in its management. The importance of energy efficiency has also been acknowledged by the policy makers in the country, exemplified by the fact that a target to improve

[1] Turkish Statistical Institute, accessed on 7.22.2015 from http://www.tuik.gov.tr/
[2] Energy Market Regulatory Authority(2014), "2013 Electricity Market Development Report", p. 12

[3] The Guardian (August,8), 'Is it too late to stop Turkey's coal rush?' accessed from http://www.theguardian.com/environment/2015/aug/06/is-it-too-late-to-stop-turkeys-coal-rush on 8.10.2015

the levels of energy efficiency by 20% has been set for the year 2023[4]. The focus of this paper will be to examine the current energy efficiency policies and to highlight several policy alternatives. A number of studies have demonstrated that there is substantial potential for efficiency improvements in the country across various sectors.

The benefits of pursuing energy efficiency policies are manifold for Turkey. According to a report by the International Energy Agency, energy efficiency can have positive effects on five diverse areas of macroeconomic development, public budgets, health and well-being, industrial productivity and energy delivery[5]. Improvements in energy efficiency can reduce the country's energy import needs, increasing its energy security and reducing the need for energy infrastructure investments. Lower energy imports would help reduce the current account deficit and reduce the risk of external shocks to the Turkish economy that can result from import availability constraints and price volatility[6]. Higher efficiency would translate into lower energy costs for business which would increase the general competitiveness in the economy, especially among the sectors that have high energy requirements. Additionally, improving the energy efficiency of industrial production enables companies to bear higher and volatile energy prices relatively more easily, providing them with a competitive advantage[7].

Moreover, the issue of energy efficiency is intertwined with the international efforts to fight climate change. Although its per capita emissions are still relatively low, Turkey has a responsibility in combating climate change as a relatively large mid-income country. This responsibility has also been partly acknowledged by the Turkish public. According to a recent country-wide survey issued by EDAM, around 51% of the public give their support for Turkey to pursue climate change mitigation policies either unconditionally or conditional to other countries also pursuing policies to reduce their emissions[8]. The GHG emissions of the country have rapidly increased in recent years and the increased policy focus on coal utilization could cause the emissions to further increase in the near future. Investing in energy efficiency can provide Turkey with a cost-effective way to manage its GHG emissions by making a share of the anticipated expansion in coal capacity redundant. Turkey will also be hosting the G20 meeting conference on November, 2015 and the issue of energy efficiency has

[4] Official Gazette No: 28215, 'Energy Efficiency Strategy Paper 2012-2023'
[5] International Energy Agency, 'Capturing the Multiple Benefits of Energy Efficiency' (2014), pp.21-22
[6] World Bank, 'Tapping the Potential for Energy Savings in Turkey' (2011), p. 1-6
[7] Enerdata and the Economist Intelligence Unit, 'Trends in Global Energy Efficiency 2011: An Analysis of Industry and Utilities' (2011), pp. 8-9
[8] 'Public Opinion Surveys of Turkish Foreign Policy 2015/3, Conditional Support in Turkey to take on responsibility in the struggle against Climate Change' , accessible on: http://edam.org.tr/en/File?id=3172

been an important item in the previous G20 meeting in the recent past[9]. As the host country, Turkey will undoubtedly be expected to lead the discussion on energy efficiency in this year's conference.

With effective measures, energy efficiency can play an integral part of the long term energy strategy of the country and contribute to the aims of reducing the reliance on imported energy sources and curbing the greenhouse gas emissions of the country. In light of this, the first part of this report will analyze the energy efficiency situation both from the demand and supply side perspectives and assess the existing energy efficiency policies. In the second part, several policy alternatives for furthering the energy efficiency goals will be identified. Current fossil-fuel based energy system in the country and how energy efficiency can contribute to changing this existing system will also be analyzed.

What is energy efficiency?

A clear definition of energy efficiency first needs to be made in order to further elaborate the policy options. Energy efficiency is a way of managing and restraining the growth in energy consumption. Something can be regarded as more energy efficient if it delivers more output for the same energy input or it delivers the same output for less energy input[10]. Energy efficiency is a reduction in the energy consumption per unit or product amount without decreasing the amount or quality of services that are generated. Improvements in energy efficiency reduce energy consumption without undermining economic development and social prosperity. The reduction in energy demand can be achieved by technological advancements or simply by better management and organization. Energy intensity is often used as a measure of energy efficiency. The measure for energy intensity is the amount of energy use per unit of economic output often calculated as Gross Domestic Product (GDP). Lower energy intensity refers to a higher energy efficiency and higher energy intensity levels signify a lower energy efficiency. A decrease in energy intensity means that the desired economic output can be reached with less energy input.

Energy efficiency is often confused with a similar concept called energy conservation. Energy conservation comprises of conscious decisions to use less energy even though the targeted output also reduces. So energy conservation involves using less energy to achieve less amounts of output which would be considered beyond the scope of energy efficiency. The line between energy efficiency and conservation may be blurry at times but both can be regarded as important tools in

[9] G20 Australia Report, 'G20 Energy Efficiency Action Plan, Voluntary Collaboration on Energy Efficiency' (2014)
[10] International Energy Agency, accessed from http://www.iea.org/topics/energyefficiency/ on 22.07.2015

reducing energy demand and GHG emissions[11]. Even though taking conservation measures can also be an important part of energy policy, this report does not include energy conservation policies.

Energy efficiency improvements themselves can be divided into two main categories. These are the improvements that can be achieved on the demand side of the energy market and the improvements that can be achieved on the supply side. Demand-side energy efficiency management encompasses any measures that can be taken to achieve desired outputs in the economy using less energy demand. Supply-side energy efficiency management, on the other hand, involves minimizing energy losses at the generation, transmission and distribution phases of the energy supply chain. While demand-side policies target the energy consumers, the supply-side policies target energy producers. Thus, while demand-side management helps to lower energy demand, supply-side management can help to increase energy supply by reducing supply losses. Ultimately, both approaches achieve the same aim of generating economic output by using less energy input.

Current Energy Efficiency Situation

The levels of energy efficiency have been significantly improving throughout most of the world for the last three decades[12]. This decline in energy intensity was mostly due to improved energy efficiency in the main end-use sectors such as household appliances, vehicles and industry. Different policy measures that the governments have implemented over the years have played an important role in this decline along with advancements in technology[13]. The relation between energy efficiency and the level of development is not linear. As developing countries industrialize, the levels of energy intensity tend to increase. However, after a certain level of development is reached, the energy intensity levels tend to decline[14].

The energy intensity levels differ greatly across the world. The world average energy intensity was 0.24 kilograms of oil equivalent (koe) per 2005 US dollars on the year 2012, whereas the average energy intensity among the OECD countries was 0.13. Currently, Western Europe is currently the leading region in terms of energy efficiency. The levels of energy intensity in France, Germany and the United Kingdom were 0.11, 0.1 and 0.8 koe/2005 US dollars respectively for the same year. On

[11]Öztürk, İlhan, 'Energy Dependency and Security: The Role of Efficiency and Renewable Energy Sources' (2014), pp.4-5

[12] World Energy Council, 'World Energy Perspective, Energy efficiency policies: what works and what does not' (2013), pp. 19-26

[13]Öztürk, İlhan, 'Energy Dependency and Security: The Role of Efficiency and Renewable Energy Sources' (2014), pp.4-5

[14]Türkay, Metin, Yılmaz, Şuhnaz and Akça, BelginŞan, 'Turkey's Energy Efficiency Assessment and Targets' (2012), Koç University, p. 23

the other hand, energy intensity levels were around 0.1 koe/2005 US dollars for Japan, 0.15 for the US, 0.61 for China and 0.57 for India[15]. Policy choice is an important factor in determining the disparity between different regions in terms of energy efficiency along with the level of development and cultural differences. Even though the European Union and United States are comparable in terms of the level of development, there is considerable disparity between the two parties on energy efficiency. Meanwhile, it can be observed that the energy intensity levels in the developing parts of the world are considerably high. Even though considerable global progress has been made on improving energy efficiency levels, the International Energy Agency estimates that through policy changes, 1.200 million tons of oil equivalent (Mtoe) of energy could be saved globally by 2040[16].

Turkey's energy use per capita of 1.56 toe per capita was significantly low compared to the OECD average of 4.13 on 2012. However, the Turkish economy is relatively energy intensive. This can be observed by looking at the figures for energy use per unit of GDP. In Turkey, the energy intensity levels were 0.19 koe per 2005 US dollars on the year 2012[17]. This figure is well below the world average of 0.24 and much lower than the energy intensive economies of some of the other developing countries but it is considerably high in comparison to the OECD average of 0.13 or the averages for the Western European countries. The energy intensity level of the country hasn't changed much since 1990 when the figure was 0.2 koe per 2005 US dollars. However, the per capita energy demand in the country rapidly rose in the same period, from 0.96 to 1.56 toe[18]. The gap between Turkey's energy intensity levels and the developed countries signify that there is substantial room for improvement. As the Turkish economy grows, the per capita energy consumption is set to rise. The energy needs of the country may increase very rapidly if energy efficiency improvements can't be made in the process.

Energy efficiency stands out as an important issue for Turkey especially when recent trends in the country's energy policy are considered. The Turkish government is planning a large expansion in its electricity generation capacity in the coming years. A large part of this expansion will be realized by the expansion of coal fueled capacity in the country, supplied by both domestic and imported sources. The government plans involve expanding the current electricity generation capacity of around 70 GW to 121 GW by 2023. Along with increases in other sources, the plan involves increasing the coal capacity in the country to around 25 GW from the current levels of around 14

[15] International Energy Agency, '2014 Key World Energy Statistics'
[16] International Energy Agency, 'World Energy Outlook 2014', p. 279
[17] International Energy Agency, '2014 Key World Energy Statistics'
[18] International Energy Agency, accessed from http://www.iea.org/topics/energyefficiency/ on 22.07.2015

GW[19]. If this increase is realized, it would translate into a significant increase in the GHG emissions in the country and make it harder for the country to pursue its climate change mitigation responsibilities. The current government plans forecast a very sharp increase in energy demand. With significant energy efficiency improvements, the future demand can be substantially curtailed to make extensive investments in the energy infrastructure redundant. Energy efficiency could also reduce the country's dependence on imported energy sources and contribute to the climate change mitigation effort. Additionally, improved energy efficiency would also have a positive effect on the country's economic development and competitiveness. To realize these aims, there is considerable potential for progress to be made both on the supply and demand sides of the market.

Supply-Side Efficiency

On the supply side there is room for considerable improvement in the electricity industry in its components of electricity generation, transmission and distribution. Most of the process of energy generation actually involves conversion of a form of energy into another form, like converting heat into electrical energy. Energy conversion inevitably involves energy losses due to the physical laws of our universe. Therefore, it must be accepted that a share of energy will always be lost during the conversion process. However, these losses can be significantly reduced if proper measures are taken. Measures can aim to increase efficiency levels at the existing power plants and there are measures that can be taken to ensure that the newly built power plants will be more energy efficient. These measures can be classified as those aimed at reducing the energy consumption in these facilities and those aimed at generating energy more efficiently.

Efficiency at power plants is relevant when looking at energy efficiency at power generation. In the case of Turkey, a predominant part of the electricity generation is originated from thermal and hydro-power plants. The coal plants that use local lignite sources are especially inefficient due to the low thermal value of the lignite sources in Turkey. When 13 coal power plants which use local source were examined, it was seen that between the years 2010-2012, the thermal efficiency of generating electricity was only 29% when on-site consumption is also included[20]. In other words, only 29 calories out of a 100 could be fed to the grid as electricity in these facilities while the rest were lost, used on-site or contributed to harmful carbon emissions. The coal-fired power plants have low efficiencies in general but those in operation in Turkey are even less efficient. The worldwide coal-fired power plant

[19] Bloomberg New Energy Finance(2014), 'Turkey's changing power markets', p. 18
[20] Algedik, Önder, 'KömürüFinanseEtmek, Türkiye'ninYüksekKarbonAritmetiği' (2015), p.3

efficiency was 35.1% on average on 2007[21]. Today, efficiencies above 46% can be reached in coal-fired generation, with the aims of reaching 50% in the recent future[22]. The efficiency levels of new power plants in Turkey using imported coal are expected to be higher than the existing ones, but they can still be considered low. The design efficiencies of such power plants are expected to be around 42-44%[23]. It can be expected that the actualized efficiency levels after the plants become operational will be considerably lower than the figures for design efficiency.

There are also significant problems throughout the transmission and distribution phases of the electricity market. High loss ratios in the transmission and distribution sectors exacerbate the country's growing power supply needs. For the year 2012, the average transmission and distribution losses in the country had amounted to around 14%[24]. Out of this figure, the losses in the transmission system were around 2.6%, whereas losses in the distribution system were 12.7%[25]. These losses are higher than the world average for transmission and distribution losses of 12%[26] and considerably high especially when compared to the developed country averages. For example in the US the average losses were around 6% while the losses amounted to around 4% for both Japan and Germany on the same year[27]. Aside from technical losses, a large part of the losses in the transmission and distribution sectors result from pilferage. Out of the 21 distribution regions in the country, three regions have especially high pilferage rates, resulting in transmission losses ranging from 25% to 75%. When the three problematic regions are omitted, the country average for transmission and distribution losses falls to around 9%, which can be considered a more acceptable rate[28]. The implication of transmission losses is that a significant portion of the generated electricity goes to waste each year, increasing the power capacity needs and the funds that are used to import resources for fueling power generation.

[21] International Energy Agency, 'Power Generation from Coal, Measuring and Reporting Efficiency Performance and CO2 Emissions' (2010), p. 57

[22] World Energy Council, 'World Energy Perspective, Energy Efficiency Technologies Overview Report'(2014), p.18

[23] Algedik, Önder, 'KömürüFinanseEtmek, Türkiye'ninYüksekKarbonAritmetiği' (2015), p.4

[24] Energy Market Regulatory Authority(2014), "2013 Electricity Market Development Report", p. 59

[25] Energy Charter Secretariat, 'In-depth Energy Efficiency Policy Review of the Republic of Turkey' (2014), p. 49

[26] World Energy Council, 'World Energy Perspective, Energy Efficiency Technologies Overview Report'(2014), p.20

[27] World Bank, accessed from http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS on 28.07.2015

[28] Energy Market Regulatory Authority(2014), "2013 Electricity Market Development Report", p. 59

Demand-side Efficiency

Significant progress is possible in the country through demand-side management. The potential mostly lies in energy intensive sectors like industry, construction, transportation and household appliances. According to the International Energy Agency, the total primary energy demand of the country was 87 Mtoe for the year 2012. Of this amount, around 30% originated from the industrial sector, 24% originated from the residential sector, 20% from the transportation sector and 12% from the commercial and public services sectors[29]. There are significant savings that can be realized in each of these sectors. On 2011, the World Bank estimated that there was a potential for 4.6 Mtoe of savings from the manufacturing sector, 4.8 Mtoe of savings from the transportation sector and 7.1Mtoe from the household sector compared to 2009, making up a total of 16.5 Mtoe. In financial terms, this figure corresponded to a total savings potential of 13.2 billion euros[30]. Significant savings can be realized on the electricity and natural gas demand in the country through efficiency improvements in the residential, industrial and commercial sectors. On the other hand, the transportation sector is heavily reliant on the petroleum products so the improvements in this sector would enable savings to be made from the oil imports of the country.

Current Policy Framework

The Turkish policy makers have given the issue of energy efficiency considerable emphasis in their planning. Several policies are currently being implemented for the aim of boosting energy efficiency levels. One of the three main focuses of the Turkish energy policy is assessing energy efficiency potential, according to the Fifth National Communication of Turkey under the United Nations Framework Convention on Climate Change. The goal is defined as 'using energy resources and energy efficiently and rationally from production to consumption'[31].

The Energy Efficiency Law No. 5627 which Turkey adopted on 2007 and its secondary regulations make up a foundation for the energy efficiency policy in the country. The purposes of the law are to increase efficiency in the use of energy resources, to reduce the burden of energy costs on the economy and to protect the environment. The piece of legislation provides the legal basis to promote energy efficiency with provisions on establishing and operating energy efficiency service

[29] International Energy Agency, accessed from http://www.iea.org/statistics/statisticssearch/report/?year=2012&country=TURKEY&product=Balances on 22.07.2015
[30] World Bank, 'Tapping the Potential for Energy Savings in Turkey' (2011)
[31] 'Turkey's Fifth Communication under the UNFCCC'(2013), p.104

markets[32]. A number of policy measures for promoting energy efficiency are outlined in the legislation to be implemented on the industrial, transport, building, services and electricity sectors. Some of the policies used to promote energy efficiency include investment subsidies for energy efficiency projects in industrial applications, voluntary agreements signed with industrial enterprises, training, audit and consultancy support for small and medium sized enterprises, energy manager training programs, supporting co-generation plants, retrofitting and energy efficiency projects for thermal and hydroelectric power plants and activities related to sustainable architectural design and green buildings[33]. The legislation also involves awareness raising activities. After the adoption of the legislation, such activities have begun and several civil society organizations active on the field of energy efficiency also started to develop[34].

So far, the most comprehensive outline for detailing the energy efficiency action plan of the country is the 'Turkish Energy Efficiency Strategy Document (2012-2023)', which was published on February, 2012. The document was prepared for the purpose of 'activating with a collaboration and a participatory approach of public sector and private sector entities and NGO's and defining a political set supported with result oriented and concrete targets and determining necessary actions to be made for reaching these targets and also describing the responsibilities of the entities undertaken during this process'. The document underlines a target 'to decrease at least 20% of amount of energy consumed per GDP of Turkey in the year 2023'[35]. A detailed account of various policies and measures that will be taken for this aim are provided in the document under 7 main strategic purposes. The strategic purposes and some of the corresponding actions include:

1-Reducing energy intensity and energy losses in industry and services sectors, by

-Performing periodical energy audits

-Encouraging energy efficiency investments

-Obliging enterprises to establish an energy management units or nominate energy managers

2-Decreasing energy demand and carbon emissions of the buildings; to promote sustainable environment friendly buildings using renewable energy sources, by

[32] Official Gazette No: 26510, 'Energy Efficiency Law'
[33] Energy Charter Secretariat, 'In-depth Energy Efficiency Policy Review of the Republic of Turkey' (2014), pp. 72-73
[34] Türkay, Metin, Yılmaz, Şuhnaz and Akça, BelginŞan, 'Turkey's Energy Efficiency Assessment and Targets' (2012), Koç University, p.23
[35] Official Gazette No: 28215, 'Energy Efficiency Strategy Paper 2012-2023'

- Bringing the buildings maximum energy requirements and maximum emission limitations

- Applying administrative sanctions to those buildings that don't meet the requirements

- Requesting attribute of sustainability from newly constructed buildings

- Promoting local production applications in the public housing projects

3-Providing market transformation of energy efficient products, by

- Limiting the sales of goods using energy inefficiently and to activate market inspection

4-Increasing efficiency in production, transmission and distribution of electricity, decreasing energy losses and harmful environment emissions, by

-Increasing the total average cycle efficiency of the coal thermal power plants

-Making applications of progressive stage tariff, multiple term counter and smart network

-Providing the free market entry of load decrease of demand side.

5-Reducing unit fossil fuel consumption of motorized vehicles, increasing share of public transportation in highway, sea road and railroad and to prevent unnecessary fuel consumption in urban transportation, by

- Encouraging environment friendly vehicles

- Enforcing transport master plans at metropolis interested in public transportation

- Decreasing the share of road transportation in the total transportation

- Promoting smart transportation systems and smart traffic management applications

- Shifting road transport load to railway or sea road in the case of long distance mass transportation

- Promoting biomass sources or synthetic fuels in transportation

6-Using energy effectively and efficiently in the public sector, by

- Activating efficiency improvement applications in the buildings and facilities of public enterprises

- Defining the minimum efficiency criteria for the commodity and service procurements and construction works in the public procurements

- Clarifying the vehicles that fulfilled their economic lives in the public enterprises

- Realizing efficiency improvement applications in the buildings and facilities that belong to the public sector with Energy Performance Agreements

7-Strengthening institutional capacities and collaborations, increasing use of state of the art technology and awareness activities, developing financial mechanisms except public financial institutions, by

- Strengthening the institutional structure, capacity and mutual cooperation of implementing organizations

- Increasing the number of certified energy managers and the number of energy efficiency consultancy companies

- Supporting research and development efforts

- Promoting awareness and encouragement activities

- Preparing a road map or a Strategical Document directed to establishing a carbon market

The issue of energy efficiency is also included in the 'Strategic Plan 2015-2019' issued by the MENR as one of the main themes of the national energy policy. Several actions that are specified in the document include rehabilitating and modernizing the power plants that are under the responsibility of the public sector, achieving a 40% reduction in energy demand from lighting, limiting the electricity transmission and distribution losses to 10%, achieving energy efficiency improvements in public buildings and enterprises and developing the capacities of MENR to form policies on energy efficiency and monitoring the effects of these policies[36]. A new 'National Energy Efficiency Action Plan' is also in preparation phase, compatible with and building largely on the Energy Efficiency Strategic Plan. A draft of the document was launched for public consultation by the end of July, 2015[37].

The main governmental body responsible for carrying out energy efficiency policies is the General Directorate of Renewable Energy (GDRE), a branch of the Ministry of Energy and Natural Resources (MENR). Within the framework of the Energy Efficiency Law, the institution supports efficiency improvement investments in the industrial sector. A share of the cost of such investments is provided by government funds. In 2014, 68 different industrial enterprises got their energy efficiency projects partially funded through the GDRE[38]. Since 2014, it is mandatory for enterprises to have energy

[36] Ministry of Energy and Natural Resources, 'Strategic Plan 2015-2019'
[37] National Energy Efficiency Action Plan, Draft No: 7, accessed from http://www.eie.gov.tr/duyurular_haberler/document/UEVEP_TASLAK_YeniSurum.pdf on 30.07.2015
[38] General Directorate of Renewable Energy, Accessed from http://www.eie.gov.tr/duyurular_haberler/document/VAP_2014_Liste.pdf on 25.07.2015

management units to apply for investment support[39]. Voluntary agreements with industrial enterprises are also made through GDRE and several other awareness raising and education programs are being carried on by the GDRE. Additionally, with the pioneering of the MENR, a 'National Energy Efficiency Forum' is convened on an annual basis. Other governmental institutions with responsibilities related to energy efficiency include the Ministry of Environment and Urbanization and the Ministry of Industry and Commerce. Another influential organization in preparing national strategies is the Energy Efficiency Coordination Board, which was mandated by the 'Energy Efficiency Law' and which includes high-level representatives from all ministries related to energy efficiency[40].

There are also several private institutions active on the field of energy efficiency that are being supported by MENR. The Energy Efficiency Association is one of foremost of these institutions. The Small and Medium Industry Development and Support Administration (KOSGEB) offers subsidies to small and medium sized enterprise for training, study and consultancy services on energy efficiency[41]. Additionally, the Scientific and Technological Research Council of Turkey (TUBİTAK) supports academic projects on energy efficiency and The Technology Development Foundation of Turkey offers project support particularly for industrial investors. Several private enterprises which provide energy management and efficiency education services to other institutions have also been formed. These entities can perform energy audits in both industrial enterprises and residences by obtaining the appropriate authorization from the GDRE[42].

Overall, it can be stated that energy efficiency is viewed as an important policy focus by Turkish policy-makers. Turkey is committed to pursuing policies to benefit from energy efficiency improvements. Several policies are already in effect for this aim and new policy options are being prepared. There are also several alternate policies that can be considered to benefit from the untapped energy efficiency potential in the country.

[39]Türkay, Metin, Yılmaz, Şuhnaz and Akça, BelginŞan, 'Turkey's Energy Efficiency Assessment and Targets' (2012), Koç University, pp. 23-25
[40] World Bank, 'Republic of Turkey Institutional Review of Energy Efficiency in Turkey' (2015), p. 17
[41] European Environment Agency, '2011 Survey of Resource Efficiency Policies in EEA Member and Cooperating Countries. Country Profile: Turkey' (2011), p.16
[42]Ibid. p. 25

Future Policy Options

1. General Measures

1.1 Setting up a comprehensive Energy Efficiency Roadmap

Even though the energy efficiency policy framework has been strengthened in recent years, there are also several areas open to further improvements. There is a need to complement the 'Energy Efficiency Strategy Document' with a comprehensive energy efficiency policy roadmap which details specific targets and action plans for each sector up to 2023 and possibly beyond. The 'National Energy Efficiency Action Plan' that is currently in preparation is set to help to fill that gap. It would be beneficial to adopt legally binding quantifiable targets for specific years as envisaged by the EU legislation[43]. There is also the need to assess the cost-effectiveness of technical solutions in each sector and devise policies accordingly to give priority to the least expensive options to benefit from efficiency improvements. Unbiased studies of profitability should be undertaken by government agencies to provide a clear picture of the costs and benefits of different efficiency technologies. Potentials can be determined for each sector and sector specific targets can be determined accordingly[44]. Developing a plan for the financing of investments and innovations can also be useful[45].

1.2 Fostering the Growth of the ESCO Market

A report on the energy efficiency market in Turkey prepared by the World Bank on 2011 provides several suggestions on the energy efficiency legislation in the country. Under the current legislative framework several mechanisms to promote efficiency investments are provided such as voluntary agreements, a subsidy program and efficiency improvement projects carried out by energy service companies (ESCO). However, the current framework doesn't provide adequate guidance for preparing and implementing efficiency projects. Under the current framework, large industrial enterprises are often the only ones that have the know-how and resources to implement energy efficiency investments. Even though small public and private entities may also have considerable savings potential, they lack the capacity to realize them. The adoption of new legislation to further support the ESCO industry may help address the situation. Better functioning ESCO's can identify and implement small or large scale energy efficiency investments across a wide range of sectors to

[43] Union of Chambers of Turkish Engineers and Architects, Chamber of Mechanical Engineers, 'Energy Efficiency in the World and in Turkey, Chamber Report' (2008), p. 43

[44] Energy Charter Secretariat, 'In-depth Energy Efficiency Policy Review of the Republic of Turkey' (2014), pp.17-18

[45] World Energy Council, 'World Energy Perspective, Energy Efficiency Technologies Overview Report'(2014), p. 28

facilitate transition to new and more efficient technologies. One specific field on which the current law is lacking is providing support to encourage new entrants into the energy service market. Some form of support can be included to such enterprises to strengthen the energy service market. One additional area which can be strengthened is providing an insurance mechanism for the ESCO's. Since most of these companies provide efficiency financing for their clients in addition to expertise, they take on most of the energy efficiency implementation risks. There currently is no clear recourse or arbitration mechanism to deal with delinquent fee payments to ESCO's. Any potential disputes over the size of the delivered energy savings can pose a significant financial risk. In order to minimize such risks, an independent arbitration mechanism can be created to set up a resolution process between the ESCO's and their clients to address any potential disputes. The current legislative model only supports the assured savings model. Additionally, alternative models can also be included in the legislation. The energy performance contract model and the shared savings contract model are two such models that can provide additional options for energy service companies and clients to take into consideration when determining an energy efficiency investment plan[46]. Also kick-starting the ESCO market initially through the public sector and more as service providers rather than financiers can be effective approaches to facilitate the market in the long term[47].

1.3 Strengthening the Institutional Framework

The energy efficiency policy framework in a country can have three distinct components of policy determination, policy application and the monitoring of results. It has been observed that in the successful countries these three functions have been assigned to different institutions. Such a division of labor should also be implemented in the institutional framework in Turkey[48]. The World Bank lists the common characteristics of successful energy efficiency agencies as being 'autonomous and flexible, visible and accountable, properly staffed and resourced, and collaborative across a variety of stakeholders'. Instead of broad-based energy agencies, more specialized agencies allow for 'easier decision-making, staff retention, access to specialized skills, and program implementation'. Another factor for increasing the effectiveness of an institution is the inclusion of private sector

[46] World Bank, 'Tapping the Potential for Energy Savings in Turkey' (2011), p. 55
[47] World Bank, 'Republic of Turkey Institutional Review of Energy Efficiency in Turkey' (2015), p. 45
[48] Union of Chambers of Turkish Engineers and Architects, Chamber of Mechanical Engineers, 'Energy Efficiency in the World and in Turkey, Chamber Report' (2008), p. 42

stakeholders into policy formulation and implementation[49]. These basic principles should be taken into account in the formulation of a new institutional structure in Turkey.

1.4 Improving the Measurement and Monitoring Capacities

Having access to reliable, timely and detailed data is one of the basic requirements when devising effective policies. Therefore the monitoring and the verification capacity of the country should be enhanced. Currently, there are serious deficiencies in this regard. Standardized measurement and verification protocols should be set up to ensure consistency in evaluating energy efficiency savings and quantifying the benefits of improvements[50]. Data should be periodically collected and updated based on the determined criteria. Technical coordination should be established with the private sector for this aim. Monitoring should measure the effectiveness of the policy implementations and prepare performance reports on a periodical basis. The dissemination of data is also important, the gathered data should be made available to the public through different means[51].

1.5 Accounting for the Rebound Effect

One factor that always needs to be kept in mind when considering energy efficiency improvements is a phenomenon named the rebound effect. Rebound effect refers to a certain collateral effect that energy efficiency improvements occasionally cause. Sometimes, improved energy efficiency may cause energy demand to increase instead of decreasing. That is because improved energy efficiency reduces the cost of energy and the reduced energy cost may increase energy demand by making energy more affordable for the customers. Therefore, the energy efficiency gains are sometimes used to access more energy services rather than achieving reductions in energy demand[52]**.** For example, when someone buys a car with more fuel efficient car, they may start driving more due to their decreasing fuel costs. This factor can potentially prevent the full benefits of energy efficiency improvements to be realized. The amount of expected energy savings from an efficiency improvement can be biased if the rebound effect is not taken into consideration or if it is overestimated.

[49] World Bank, 'Republic of Turkey Institutional Review of Energy Efficiency in Turkey' (2015), p. 44
[50] International Energy Agency, '25 Energy Efficiency Policy Recommendations, 2011 Update' (2011), p.6
[51] World Bank, 'Tapping the Potential for Energy Savings in Turkey' (2011), pp. 53-54
[52] International Energy Agency, 'Capturing the Multiple Benefits of Energy Efficiency' (2014), p.23

Some measures can be taken to limit the effects of the phenomenon. However, the rebound effect can't always be classified as a negative factor as at times it may instead be desirable. When energy savings are negated in the achievement of health benefits, poverty alleviation, or improving productivity, the rebound may be viewed as a desirable outcome[53]. Overall, it is important to assess the effects of this phenomenon when devising an energy efficiency policy or when evaluating the effectiveness of a policy. Any welfare benefits of energy efficiency should be included in the consideration of energy efficiency policy benefits. Thus, the purpose of energy efficiency policy shouldn't solely be achieving energy savings, the side benefits of efficiency improvements should also be considered[54]. The rebound effect shouldn't be categorized as a deterrent against devising energy efficiency policies.

2. Supply-Side Measures

2.1 Improving Efficiency of Electricity Generation

On the supply-side, efficiency in electricity generation has an important part in curbing energy losses. As mentioned, an important share of Turkish electricity generation is fueled by local and imported coal sources and the coal fueled power capacity is expected to increase in the recent future. A majority of the coal-fired power plants in the country have low thermal efficiencies, especially those that use domestic lignite sources which have low caloric values. Only a small share of these sources thermal values can be used to generate electricity, most of the thermal calories gets lost during the conversion process as heat or dissipates into the air causing GHG emissions. This creates a situation in which relatively small amounts of electricity are being generated at the expense of large amounts of GHG emissions. This would not only keep the supply energy efficiency levels of the country low but also make it harder for the country to honor its responsibilities in the context of the broader global struggle against climate change.

Several measures can be taken to increase efficiency in existing power plants. Energy audits and retrofitting can be utilized to achieve moderate amounts of energy savings. A study made for the United States lists various design features that can be changed to improve efficiency in coal-fired power plants which include combustion control optimization, cooling system heat loss recovery, flue gas heat recovery, low-rank coal drying, soot blower optimization and steam turbine design. Reportedly, each of these changes in design can improve efficiencies in a power plant at differing

[53] Ibid.
[54] Gillingham, Kenneth, Rapson, David and Wagner, Gernot, 'The Rebound Effect and Energy Efficiency Policy' (2014), p.24

levels ranging from 0.1% to 2.6%[55]. Each of these options can be explored for the coal plants in Turkey to determine which ones can be considered cost effective. Pilot programs can be set up across different power plants to measure the benefits of different options. Tax incentives can be utilized to provide incentives for older power plants to adopt efficiency measures.

As power plants age it is natural for their efficiency levels to decrease. However with good O&M practices, this decline in efficiency can be limited. The human factor plays an important role in this regard, so training practices can be established to spread the adoption of best practices.

The efficiency of newly being built power plants is also of great importance. Potentially, efficiencies can be greatly enhanced by replacing the coal-fired plants with natural gas plants and to a smaller degree with biomass plants. However giving priority to natural gas would exacerbate the import dependency problems of the country. Priority can be given to licensing plants that utilize new technologies. Different technologies that can help achieve higher efficiency levels include the use of advanced materials, coal cleaning and drying and co-generation of heat and power. Another alternative could be to make use of hybrid thermal plant designs that would utilize coal along with a renewable source such as solar thermal or biomass to cut back on the GHG emissions[56]. Carbon capture and storage schemes can also be items of interest but as of yet they are not proven to be commercially cost-effective[57]. Higher standards can be envisaged for newly being built power plants such as enforcing base efficiency requirements for new coal plants possibly with differing standards for different types of coal. The phase-out from the oldest and least efficient coal plants can also be considered. A target date can be determined or in the least an intention to phase out of power plants below a certain level of efficiency can be stated. Overall, the International Energy Agency has advised that all newly built coal power plants should have more than 40% efficiencies and the existing power plants should be assessed for upgrading to reach around 40% efficiency[58]

There is currently an extensive amount of subsidies made available for coal power plants in the country. Reportedly, the amount of subsidies provided to the coal industry had reached 730 million US dollars in 2013, not including the various types of indirect subsidies that are hard to quantify[59]. Some part of these subsidies are provided to low income families as consumer subsidies but the rest is used to support coal-fired power plants. Removing the producer subsidies for coal-fired power

[55] Campbell, Richard J., 'Increasing the Efficiency of Existing Coal-Fired Power Plants' (2013), Congressional Research Service, pp. 12-14
[56] Ibid. p. 20
[57] Ibid. p. 2
[58] International Energy Agency, 'Power Generation from Coal, Measuring and Reporting Efficiency Performance and CO2 Emissions' (2010), p.61
[59] Acar, Sevil, Kitson, Lucy and Bridle, Richard, 'Subsidies to Coal and Renewable Energy in Turkey'(2015), p.10

plants or adjusting them to favor higher efficiency plants can help increase the efficiency in the country's thermal power plant stock. The removal of energy subsidies 'for all consuming sectors except where they contribute to welfare policies' is also among the recommendations provided by the International Energy Agency to promote energy efficiency[60].

2.2 Reducing Transmission and Distribution Losses

Transmission and distribution losses are also considerable factors in determining supply-side efficiency. The average transmission and distribution losses of the country are significantly higher when compared to the developed country averages. These losses can be broadly separated into two categories, the technical losses and the losses due to pilferage. While technical losses can be reduced by technological and organizational solutions, reducing the pilferage losses would require a renewed political commitment and relevant social and legal solutions to be formulated.

One method to reduce the transmission and distribution losses would be to reduce the need for transmission and distribution. This can be done by promoting on-site generation from renewable energy sources across the industrial, commercial and residential sectors. Different types of renewable energy sources can be used for electricity and heating needs.

There is also an unnecessary technical loss due to redundant power capacity in transformers in those medium voltage transformers that have much higher peak power capacities than needed. Significant savings can be achieved by changing these transformers with those that have the appropriate capacity levels[61]. Other similar technical solutions can also help reduce the energy losses such as investing in smart grid systems.

Pilferage is a persistent problem in a few of the electricity distribution regions in the country. The problem is hard to solve since the regions with the high pilferage rates are parts of the country with low socio-economic standards. Strategies should be devised to reduce electricity theft combining enforcement measures with welfare measures based on the social and economic circumstances in each region[62].

[60] International Energy Agency, 'Regional Energy Efficiency Policy Recommendations, Arab-Southern and Eastern Mediterranean (SEMED) Region' (2014), p. 6
[61] Union of Chambers of Turkish Engineers and Architects, Chamber of Mechanical Engineers, 'Energy Efficiency in the World and in Turkey, Chamber Report' (2008), p. 43
[62] Ibid. pp. 43-45

3. Demand-Side Measures

3.1 White Certificates and other Innovative Policy Alternatives

One alternative policy to improve energy efficiency is to set energy efficiency obligation schemes. Currently, six countries in Europe are using some kind of efficiency obligation scheme and many other countries are considering to implement such a system. Poland, Denmark, Ireland, Great Britain, France and Italy all have employed the policy while the last three also implemented a complementary policy called the white certificates scheme[63]. The white certificate scheme is a market based instrument that allows for the trading of energy savings and allows the obligated parties to meet their required targets in a flexible manner, according to their cost-effectiveness considerations. White certificate schemes put obligations on the suppliers and distributors of energy to achieve a quantified target of energy savings and the savings are certified using standardized calculations. The energy savings can be sold in the exchange market to allow obliged parties to meet their obligations. This scheme effectively creates a functioning energy savings market and provides an additional incentive for businesses to achieve energy efficiency gains.

White certificates have been in use for some time. They have been implemented in Great Britain in 2002, in Italy in 2005 and in France in 2006. Even though the basic premise of the scheme is the same, the specifics of the policy differ greatly based on different national circumstances[64].

There are several considerations that need to be taken into account when designing a white certificates scheme. Five key considerations when establishing a white certificates scheme are the scope of energy saving obligations on some category of market actors, technical processes to support the scheme, the tradable instrument and rules for trading, cost recovery mechanisms and enforcement mechanisms and sanctions[65].

One large difference between different practices is in the scope of obligations. In Great Britain, for example, only the suppliers of gas and electricity are classified as obligated parties, while in France all types of end-use energy suppliers except gasoline are obligated. On the other hand, in Italy, the electric and gas distributors are obligated parties. The decision regarding which non-obliged parties

[63] 'Energy Saving Policies and Energy Efficiency Obligation Scheme', ED3.2: Report Workshop on Article 7 of the Energy Efficiency Directive, p. 5

[64] Giraudet, Louis Gaetan, Bodineau, Luc and Finon, Dominique, 'The costs and benefits of white certificates schemes' (2011), Centre International de Recherches sur l'Environnement et le Developpement, p. 2

[65] Bertoldi, Paolo, Rezessy, Sylvia, Lees, Eoin, Baudry, Paul, Jeandel, Alexandre and Labanca, Nicola, 'Energy supplier obligations and white certificate schemes: Comparative analysis of experiences in the European Union', Energy Policy 38 (2010), p. 1456

will be eligible for white certificates is also important. For example, the British scheme covers only the household sector but the scope in the other countries is extended to all end-use sectors.

Another key consideration is the size and unit of the obligation. The standardized measurements used to calculate the savings also differ between different countries. Units of electricity saved is used in Great Britain and France, for example, while in Italy a primary energy unit is used instead[66]. Another option could be to use the extent of GHG mitigation. The targets can also be either expressed in cumulative terms such as the case in Great Britain and France or in annual terms such as in Italy.

The rules for certificate trading is another important aspect of white certificate schemes. While in Italy and France rules of trading are framed in the scheme, in Great Britain no formal trading framework has been established, certificates can only be traded between obliged parties[67]. Other important considerations include the type of the enforcement mechanism to determine the penalty for the obligated parties who don't fulfill their obligations. Different penalty systems are being applied in different countries such as a fee based on kWh or a fee based on each missed certificate.

Different studies made on the subject confirmed that white certificate schemes are a cost effective way to generate energy savings. The costs of energy efficiency improvements sometimes called the 'negawatt-hour' costs, have been measured to compare favorably to kilowatt-hour costs. It has been demonstrated that white certificate schemes have been paying for themselves in their countries of implementation and have instigated several economic, environmental and social benefits[68].

Utilizing a white certificates scheme could be an option for Turkey going forward to meet the targeted 20% reduction in energy efficiency by 2023. A study undertaken by Kömürgöz and Düzgün attempt to evaluate the applicability of white certificates for the Turkish market[69]. In the Turkish market energy obligations can be potentially established upon electricity, natural gas and fuel and LPG markets. In the electricity sector, the main potential candidates for energy obligation schemes are the generation companies, whole sale companies, transmission companies, distribution companies, retail sale companies and end-users while in the natural gas sector the natural gas importers and transmitters would be the main candidates. Currently the state-owned BOTAŞ controls

[66]Giraudet, Louis Gaetan, Bodineau, Luc and Finon, Dominique, 'The costs and benefits of white certificates schemes' (2011), Centre International de Recherches sur l'Environnement et le Developpement, p. 5
[67] Power Point presentation, 'Assessment and Experience of White Certificate Schemes in the European Union' Paolo Bertoldi, European Commission, Directorate General JRC (2011)
[68]Giraudet, Louis Gaetan, Bodineau, Luc and Finon, Dominique, 'The costs and benefits of white certificates schemes' (2011), Centre International de Recherches sur l'Environnement et le Developpement, p.23
[69]Düzgün, B. and Kömürgöz, G., 'Turkey's energy efficiency assessment: White Certificates Systems and their applicability in Turkey', Energy Policy 65(2014)

a dominant share in natural gas imports and transmission. Deciding the scope of the obligations would be an important aspect of the scheme. The market can be set up in the Market Financial Reconciliation Center as an environment market such as is the case in Italy where the 'GestoredeiMercatiEnergitici' is responsible both for electricity trading and certificates trading. Another key consideration would be deciding the regulatory authority would be responsible for verification, registration and the issuance processes of the certificates. In the Turkish case, the likely candidate is the Energy Market Regulatory Authority. Alternatively a new agency can be set up[70].

For establishing a successful white certificate scheme, several guiding principles must be followed. In theory at least, the benefits of the scheme would be greater if the scope of the scheme both in terms the types of eligible sectors and the eligible projects would be wider. A binding long term target in efficiency gains should be expressed with a clear timeframe. Common standardized measurement procedures should be devised and implemented in order to prevent uncertainties in energy savings calculations. The rules of trading the certificates should be established to keep compliance costs low by allowing flexibility for the obliged parties in meeting their obligations. It would also be beneficial for the scheme to be technologically neutral in order to spur competition between different technology options. Additionally, setting up a transparent cost recovery mechanism and a concrete penalty system are important components of a white certificates framework. The actors in the market should be informed of the specifics of the scheme some time before the implementation so as to allow them to make the necessary adjustments and investment plans beforehand[71].

Other interesting policy choices also exist which Turkey can consider. Voluntary agreements can be used in a complementary fashion with white certificates to make use of voluntary actions to enhance investments in innovative energy savings projects[72]. Energy sales targets are also a proposed alternative. They involve the imposition of a cap on the GHG emissions associated with annual energy sales, either with or without a trading mechanism[73]. An energy efficiency feed-in tariff can also be an alternative to utilizing white certificates. Such a scheme involves an opposite approach to white certificates. Instead of establishing a quantity of desired savings and letting market determine

[70]Ibid, pp. 471-473
[71]Oikonomu, Vlasis and Mundaca, Luis, 'Tradable white certificate schemes: what can we learn from tradable green certificate schemes?', Energy Efficiency (2008) p. 232
[72]Oikonomou, V., Patel, M. K., van der Gaast, W. and Rietbergen, M., 'Voluntary agreements with white certificates for energy efficiency improvement as a hybrid policy instrument', Energy Policy 37 (2009) p. 1970
[73]MacGill, Ian and Passey, Robert, 'Energy sales targets: An alternative to White Certificate schemes', Energy Policy 37 (2009) 2310–2317

the price of savings, an energy efficiency feed-in tariff establishes a fixed price for energy savings and lets the market determine the quantity of savings[74].

3.2 Utilizing Labels and Standards for Household Appliances

Minimum energy performance standards and labelling for household appliances constitute an important part of energy efficiency policy. Electrical appliances account for a large share of household energy demand. Establishing high efficiency standards for appliances can curb electricity demand by a significant amount. Energy labels and standards can be seen as complementary tools. While labeling works as an incentive for manufacturers to differentiate more efficient products in the market from their competitors, standards can directly remove the less efficient products from the market[75].

Turkey had first adopted the energy efficiency labeling scheme on 2001 in line with the European Union Directives. The EU labeling scheme is currently being applied to most of the appliances sold in Turkey and there are plans to expand the labeling program to new types of products.

Turkey exports substantial amounts of energy efficient products to developed countries that have high efficiency standards. However, in the domestic market many small scale manufacturers still produce low-quality appliances. Different types of incentive programs can be devised in order to overcome this issue.

One of the main problems of the standard and labeling scheme in Turkey is that there isn't sufficient human and financial resources to enforce the regulations. The lack of consumer awareness is another impediment to the effective implementation of the policies. Activities to increase consumer awareness should be implemented to direct the attention of consumers to more energy efficient products. Also, the number of products that are included in the standards and labeling programs should be increased[76].

New and more efficient standards should be established on household appliances on a regular basis. Standards should be regularly revised to avoid stagnations in energy efficiency improvements. Such a policy would spur the manufacturers to continually seek to improve their products efficiency instead of stagnating after their products efficiency reach the standards required at a specific time.

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[74] Neme, Chris and Cowart, Richard, 'Energy Efficiency Feed-in-Tariffs: Key Policy and Design Considerations'(2012)

[75] World Energy Council, 'Energy Efficiency Policies around the World: Review and Evaluation'(2008), p. 43

[76] Kama, Özge and Kaplan, Zeynep, 'Energy Efficiency Policies in Turkey: The Case for Standards and Labels' (2013), International Journal of Energy Economics and Policy Vol. 3, Special Issue

3.3 Considerations for the Industrial Sector

The industrial sector accounts for a very large share of energy demand in the country, therefore any efficiency improvements in the sector would have an important effect on the energy efficiency levels in the economy. Since the industrial sector is a very diverse sector including lots of subsectors, the energy efficiency solutions would also be diverse. A macro planning strategy can help to reduce the energy intensity levels of the industry in the long run by giving priority to manufacturing technology intensive energy efficient products.

In-terms of improving energy efficiency in the existing facilities, cost-benefit studies should be conducted by undertaking widespread energy audits in the industrial sector to determine the areas with most potential gains. Any incentives that will be devised should prioritize the most cost-effective solutions. Several measures can be taken to improve energy efficiency in the existing facilities such as refurbishing and maintaining equipment, replacing and retiring obsolete equipment, using heat management to decrease heat losses, streamlining processes, using new production concepts, reusing and recycling products and materials and increasing process productivity[77]. The current financial incentives that are being provided in the industrial sector should be continued and made more widespread. Even though the large industrial facilities generally have the know-how to invest in energy efficiency, the small and medium sized enterprises often lack such capacities. Therefore, focus should be given to prioritizing efficiency incentive for these facilities. The role of energy service companies is important in this regard, the energy service market should be expanded. The voluntary agreement scheme has been an important policy tool which should be continued and the training of energy managers for industrial enterprises should be another point of focus.

3.4 Considerations for the Buildings Sector

The building sector constitutes another prominent sector in terms of energy demand. The two main measures that can be taken in this sector are retrofitting the old building stock to increase energy efficiency and applying higher standards for the newly being built buildings. High efficiency standards should be continuously established for new and existing buildings with energy efficiency labelling schemes and minimum energy performance standards. Co-generation and the use of renewable energy sources can be promoted in large residences and commercial buildings to curb some of the energy costs of buildings. Insulation and different architectural designs in buildings can potentially

[77] Tanaka, Kanako, 'Review of policies and measures for energy efficiency in industry sector', Energy Policy 39 (2011), p. 6532

help to reduce the heating and cooling needs in buildings. The public sector can play a leading role in this regard by undertaking retrofitting projects in the old public buildings and setting an example by applying high efficiency standards on the new buildings. It is often more cost-effective to apply efficiency measures on the old building stock than constructing new buildings. It was reported that the total energy efficiency gains in the buildings could help realize a 15% saving potential in the total energy demand in the country which would correspond to a financial saving amount of 4-5 billion dollars[78].

3.5 Considerations for the Transportation Sector

The main aim of energy efficiency policy in the transportation sector would be to reduce the country's reliance on oil imports. Any efficiency improvements in the transportation sector would help to reduce the country's large needs of oil imports and the GHG emissions that originate from the transportation sector.

An extensive macro planning in the country's transportation policies is needed to fully benefit from efficiency improvements in the sector. Transportation through highways consume approximately two times more energy per unit compared to railroad transportation and nearly three times more energy compared to water transportation[79]. Increased emphasis and investments on these modes of transportation instead of motorways would help to reduce energy demand from transportation in the long term. The development of air transportation will also help in reducing the overall efficiency levels as air transportation is more energy efficient in comparison to land transportation. In terms of intra-city transportation, increased focus on city planning that prioritizes mass transit options can contribute.

The utilization of standards and labels in cars is also necessary to boost efficiency levels in the existing stock. Efficiency standards should be applied and regularly updated to continually transform the existing automobile stock to be more energy efficient. The public sector can play a pivotal role by replacing its transport assets with more efficient ones.

Another policy option is to adopt measures to increase the share of relatively energy efficient alternative fuels like biodiesel. Incentives should be provided spread the use of more energy efficient technologies in the automobile fleet. Tax incentives and other types of financial support can be used

[78]Türkay, Metin, Yılmaz, Şuhnaz and Akça, BelginŞan, 'Turkey's Energy Efficiency Assessment and Targets' (2012), Koç University, p. 156

[79] Union of Chambers of Turkish Engineers and Architects, Chamber of Mechanical Engineers, 'Energy Efficiency in the World and in Turkey, Chamber Report' (2008), p. 50

for this purpose. Finally more innovative policy thinking to foster sustainable transport schemes and practices ranging from inter-city or intra-city car sharing to more effective congestion management have to be envisaged.

Conclusion

The role of energy efficiency will be very important for Turkey in the near future to address the issues of import dependence in energy, growing GHG emissions in the country and making its economy more competitive.

An overwhelming share of the oil and natural gas demand in the country has to be met by imported sources. Additionally, more than half of the electricity generation in the country is fueled by imported sources including natural gas and a rising share of imported coal. This degree of dependence on foreign sources causes billions of dollars to be spent on energy imports each year with an increasing trend. The persisting problem of the current account deficit in the country is largely due to energy import needs. Each unit of energy efficiency increase in the transportation sector could decrease the country's dependence on oil while efficiency increases in other sectors would help reduce the dependence on natural gas and imported coal sources.

Turkey's GHG emissions have increased by 133.4% between the years 1990 and 2012. In the same time frame, the emissions caused by coal combustion from power plants increased by 219%[80]. While most of the developed world has been reducing coal production, the government plans in Turkey include a rapid expansion of coal-fired generation capacity. Moreover, Turkish coal reserves prominently consist of lignite which has significantly low thermal quality and which causes an extensive amount of emissions relative to its use in electricity generation. Lignite can be considered as the dirtiest type of fossil fuel. The CO2 emission factor of lignite is 101.2 Tonnes/TJncv while the same figure is 94.6 for hard coal, 74.1 for oil and only 56.1 for natural gas[81].

According to the reference scenario prepared by the Turkish Electricity Transmission Company, the electricity demand in the country is set to reach 415680 GWh by the year 2023[82]. Thus, every additional 1% increase in electricity efficiency can potentially reduce the electricity demand in the country by 4157 GWh by 2023. If this reduction can be achieved solely through reducing generation

[80]Algedik, Önder, 'KömürüFinanseEtmek, Türkiye'ninYüksekKarbonAritmetiği' (2015), p.9

[81]Ecofys, 'International comparison of fossil power efficiency and CO2 intensity - Update 2014' (2014), p.12

[82]TürkiyeElektrikİletimAnonimŞirketi, 'TürkiyeElektrikEnerjisi 5 YıllıkÜretimKapasiteProjeksiyonu(2014-2018)' , accessed from http://www.teias.gov.tr/YayinRapor/APK/projeksiyon/KAPASITEPROJEKSIYONU2014.pdf on 14.08.2015

in the lignite-fired plants, the total CO2 mitigation would amount to around 4 million tons, using the lignite conversion factor adopted by the US Energy Information Administration[83]. Meanwhile, the total CO2 emissions of the country amounted to 439,9 million tons on 2012[84].

The ongoing expansion of coal capacity in the country is threatening the environmental and societal well-being of the society and undermining the country's efforts to address the climate change problem. If an ambitious energy efficiency policy can be implemented across different sectors, most of the additional capacity needs in the country can become redundant. The current government projections point to a rapid increase in the energy demand of the country in the following years. However, with a strong energy efficiency policy and a less energy intensive growth trajectory, the economy can continue to grow and become more competitive without increasing the energy demand as much as it has in the recent past.

[83]Energy Information Administration, accessed from http://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11 on 14.08.2015

[84]Turkish Statistical Institute, accessed from http://www.tuik.gov.tr/PreHaberBultenleri.do?id=16174 on 14.08.2015