MEDITERRANEAN ENERGY PERSPECTIVES

TURKEY

EXECUTIVE SUMMARY

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Observatoire Méditerranéen de l'Energie

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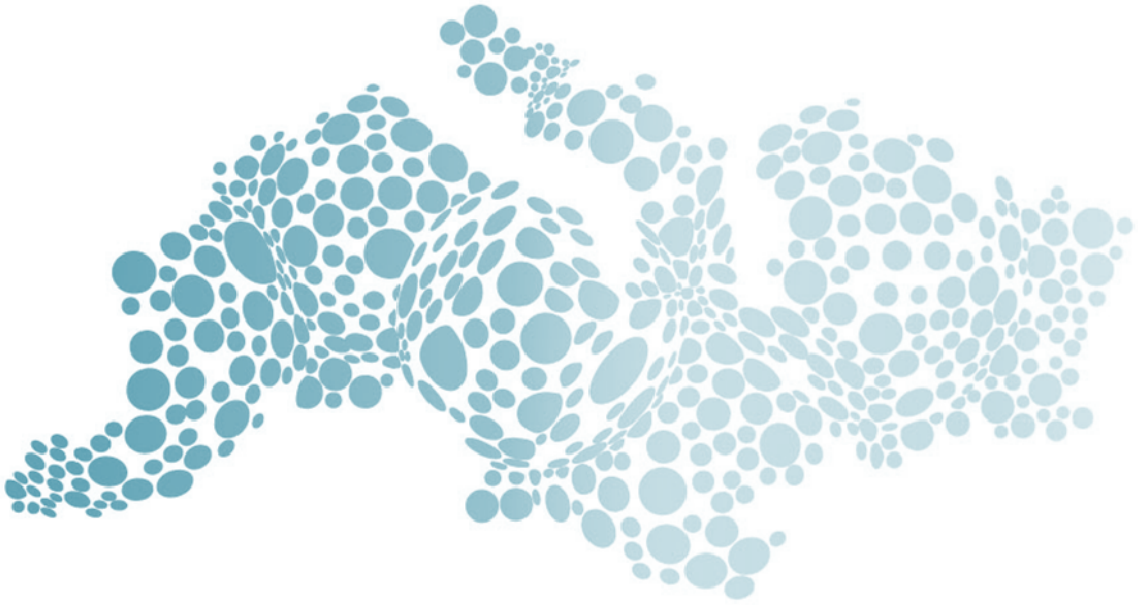

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EXECUTIVE SUMMARY

This in-depth study provides insight into Turkey's energy profile from the early 1960s to the present and an outlook to 2030. MEP-Turkey presents detailed analysis and data on the supply and demand balance for the major components of the energy sector with particular emphasis on sectoral analysis. It is based on OME's proprietary Mediterranean Energy Econometric Model for Turkey developed for this publication.

The outlook to 2030 presents two possible pathways for energy demand based on different assumptions.

- The Conservative Scenario considers past trends, policies in force and on-going projects, but takes a cautious approach regarding the implementation and timing of policy measures and planned projects.
- The Proactive Scenario assumes effective achievements to lessen dependence on imported fuels by giving emphasis to production of domestic resources, stronger efficiency programmes and a more diversified energy supply mix including more renewable energy. To achieve ambitious energy efficiency levels and implement as much renewable energy sources as foreseen in the Proactive Scenario will require unwavering political will, strong policies and measures, as well as sizeable investments, especially by the private sector.

Both scenarios, built from the same assumption for population, economic growth, and international fossil-fuel prices, are based on the premise that energy demand will be met.

Turkey's future, stimulated by a booming economy and population, an export-oriented industry and a blossoming domestic market, looks bright. The energy needed to fuel this growth will depend greatly on the paths chosen. In this context, the country finds itself at a historical crossroads in its development, as the energy policy choices it makes today will shape Turkey's energy future and its ability to attract the considerable investments required in the energy industry.

TURKEY'S ENERGY FUTURE IN A NUTSHELL

According to OME projections, energy demand in Turkey is set to double by 2030 in the Conservative Scenario. Fossil fuels will still largely dominate the energy mix accounting for over 85% of the total in 2030. The share of renewables (including hydro) in the energy mix would remain unchanged at around 10%. Therefore, the energy mix would be roughly similar to that of today with the exception of nuclear. This path is clearly unsustainable,

as, in addition to the existing burden of overreliance on fossil fuel imports, it would lead to an increase in electricity intensity and a doubling of Energy-related carbon dioxide (CO_2) emissions.

In the Proactive Scenario, energy demand would be 19% lower in 2030 compared to the Conservative Scenario, energy intensity would also be 19% lower and CO_2 emissions would be reduced by 26%, which is not negligible. The cumulative energy savings until 2030, 415 Mtoe, would be equivalent to the past four years worth of Turkey's primary energy demand. This Scenario would allow for, not only a reduction in demand for all fossil fuels, but also a diversification of the energy mix itself. The energy mix would thus include a bigger share of renewable energy sources, accounting for over 15% of the total energy mix by 2030, and nuclear for 9%. While it would still be dominated by fossil fuels, their share would be reduced substantially, to 76% compared to 90% today.

Regardless of the Scenario, however, oil will remain the dominant fuel in Turkey's energy mix in the future, while gas and coal demand would be reduced more significantly in the Proactive Scenario.

From the supply side, Turkey is not richly endowed with oil and gas, but has large lignite resources and substantial potential of renewable energy resources and energy efficiency. However, today only one quarter of the energy demand is met by domestic production. According to OME forecasts, this share would increase to 32% in the Conservative Scenario and to 43% in the Proactive Scenario by 2030.

From both demand and supply sides, the Proactive Scenario is clearly more sustainable than the Conservative one and improves the security of supply of the country.

SECTORAL ENERGY CONSUMPTION WILL CONTINUE TO MIMIC THE PATTERN OF THE TURKISH ECONOMY

The Turkish economy transformed from one focused mainly on agriculture into one oriented towards the industry and tertiary sectors. In 1923, when the Republic of Turkey was established, the economic structure was completely based on agricultural production and the changes in GDP were dependent on the harvests. This structure changed in time in favour of the industry sector and the share of agriculture in GDP fell to 8% in 2012 compared to over 30% in the 1960s. Nevertheless, agriculture will continue to remain one of the important components of the Turkish economy in the future. Currently, the industry, agriculture and tertiary sectors dominate the economy, and by 2030 this structure will persist.

Energy consumption followed the same structural patterns and evolution. As a result, in 2012, industry and residential sectors accounted for the lion share of total final energy consumption with about 30% each, followed closely by the transport sector (20%), the

services sector (8%) and the agricultural sector (5%). By 2030, the industry sector will continue gaining shares, reaching 32% by then. Energy consumption in transport sector is set to increase the most compared to other sectors, reaching 25% of total final energy consumption by 2030.

Over the past decades Turkish industry has undergone major structural changes. It has evolved from domestic oriented towards export oriented production, thereby changing the energy structure in the sector. Overall total industry energy consumption is expected to more than double in the Conservative Scenario, reaching 55 Mtoe by 2030. In the Proactive Scenario, energy efficiency measures in industry sub-sectors would moderate this increase. However, even then, total final energy consumption in the industry sector would increase by about 80%, reaching 45 Mtoe in 2030.

Iron and steel, construction, non-metallic minerals (cement), chemicals (especially petrochemicals), and textile have played and will continue to play an important role in the economy and hence these sectors will continue to account for the bulk of the increase in industry energy consumption. Moreover, the number of households in Turkey is set to increase at an impressive pace boosting domestic demand for new housing and thus energy demand in the construction and non-metallic minerals sectors. Energy demand in the construction sector is expected to grow at the fastest rate to 2030.

Energy consumption in the transport sector skyrocketed over the past five decades. It increased from less than 1.5 Mtoe in 1960 to above 17 Mtoe in 2012. Transport energy consumption is set to double to 30 Mtoe by 2023, representing nearly 6% growth on average per year, in both Conservative and Proactive scenarios. By 2030, it could further increase to 40 Mtoe in the Proactive Scenario and exceed that level in the Conservative Scenario. Over the past decades much has changed in terms of type of energy used in this sector. While coal use disappeared, diesel has become the dominant fuel, LPG use has overtaken gasoline and recently some alternative fuels such as compressed natural gas, biofuels and electricity have entered the transport fuels mix. In the future, diesel and LPG will continue to be the dominant fuels and biofuels and electricity will experience a substantial increase.

In Turkey, road transport is the dominant transportation mode both in terms of passenger and freight. No radical change in modal shares is expected, meaning, road will remain the preferred mode of transportation even though rail, domestic navigation and air transport will become more widespread. Road transport will account for more than 90% of total energy consumption in the transport sector. However, the Proactive Scenario envisages increased use of cleaner road transportation methods, three times more electric vehicles and eight times more natural gas-fuelled buses in 2030 than in the Conservative Scenario.

Turkey's residential energy consumption has been increasing over time, as standards of living improve, population grows, and the number of households increases, reinforcing the need for appliances. Residential energy demand is therefore expected to increase by 42% from 2012 to 2030, led by its electricity demand which, would more than double

during the same period. Several measures may however be applied in the residential sector to moderate this growth, notably for appliances where the scope for efficiency gains is sizeable. These measures would lead to potential energy savings at least of 9% for the overall energy and of 30% for the electricity consumption in the Proactive Scenario compared with the Conservative Scenario in 2030.

The services sector is expected to play a progressively more important role in the economy, especially led by the expected boom in tourism. As a result, energy consumption in the sector is expected to nearly double by 2030. Efficiency measures put in place in the tourism sector, as well as in the public administration and public infrastructure, could lead to substantial energy savings in the Proactive Scenario. Savings could reach some 25% compared with the Conservative Scenario in 2030.

As a whole, total final energy consumption has increased from about 10 Mtoe in 1960 to over 87 Mtoe in 2012, and is expected to increase by over 60% to 2023 and nearly double to 2030 in the Conservative Scenario.

THE STRATEGIC CHOICE OF COAL: THE BEGINNING OF A NEW ERA

Coal has always been one of the most important primary energy sources in Turkey's energy mix. Although coal's share in Turkey's total primary energy supply has remained steadily around 30% since 1960, its share in electricity generation dropped from around 50% to 30% in 2012.

Turkey aims at securing coal's place both in its energy mix and electricity generation. To achieve that, the government plans to put all of available coal resource to use by 2023 in order to keep the share of coal in the electricity generation and energy mix at a minimum level of 30%. This, however, will be challenging and will require substantial investments.

Most of Turkey's 14.3 billion tonnes of coal reserves are lignite with a very high ash and moisture content. The most realistic and economical way of utilizing Turkish lignite reserves seems to be power generation.

The government is the largest producer of coal in Turkey. Today, TKI (Turkish Coal Enterprises) and EÜAŞ (state-owned electricity generation company) produce more than 90% of the lignite in the Thrace, Aegean and inner Anatolia regions. With its five state enterprises, the TTK (Turkish Hard Coal Enterprises) produces the majority of the hard coal in the Zonguldak and Bartin coal basins, although the production by 22 small and 4 big private sector companies operating under rodovans regime, in which licensees pay a royalty and/or provide parts of the output to the state on a per ton basis, has been increasing in the past decade.

OME expects total coal production to more than double between 2012 and 2030, and reach 150 Mt. This assumes the realization of several mining projects, though not necessarily within the announced periods. Majority of the increase will essentially come from lignite. Domestic hard coal production is expected to increase in the future but to remain below 5 Mt through 2030, while lignite production is expected to double by then.

Demand for all types of coal in Turkey has increased tremendously in the past five decades, from 6 Mt in 1960 to over 100 Mt in 2012. Increase in the use of imported hard coal in electricity production, as well as in industry and residential heating have played an important role in this growth. However, this staggering growth in coal demand in physical units represents only one side of the story. In energy units, demand for coal in Turkey has increased less, from a little over 3 Mtoe to 35 Mtoe, because the average net heating value of hard coal is roughly three times more than that of brown coal.

In recent years input to power generation accounted for almost half of the total coal demand in Turkey, while process heating in industry sector and space heating in buildings has taken up roughly 40%. Coal use in electricity generation will not only remain the most important element in the coal industry but it will continue to play a key role in Turkey's energy market as well. Under the Conservative Scenario, OME expects the demand for coal in energy units to grow almost 70% by 2030. Under the Proactive Scenario, which assumes a strong push for the use of renewables in electricity generation as well as energy efficiency measures, the demand for coal is estimated to be 25% less by 2030 compared to the Conservative Scenario. Majority of this discrepancy is due to less coal use in power generation under the Proactive Scenario. Nonetheless, electricity generation will represent around 45% of total coal demand in 2030 in this scenario, compared to 48% today.

Turkey had long been self sufficient in coal but today domestic production covers only around half of the total coal demand. Turkey consumes all the lignite it produces but imports around 90% of its hard-coal needs from several countries. Even though coal production will increase significantly in the future, domestic production will not be able to satisfy demand. Like today, the majority of the coal demand will be satisfied by imports. Net coal imports are expected to reach 40 Mt in 2023 and exceed that level in 2030 under the Conservative Scenario. In the Proactive Scenario, however, net coal imports are set to decline considerably, to almost 18 Mt in 2030. In other words, in this scenario, Turkey would import 40% less coal in 2030, compared to today's import level.

Numerous challenges are facing the coal industry in Turkey. The safety issue in the coal mining industry remains one of the most pressing challenges to be overcome in the near future in addition to environmental concerns.

RELIANCE ON OIL WILL ENDURE

Turkey's oil reserves are quite small, but the insufficient exploration to date raises some hopes for future discoveries. In the future, three main factors will help increase Turkey's oil reserves. The first is increasing the average recovery rate. The second is more aggressive exploration activities, especially offshore in the Black Sea and the East Mediterranean, and in internal basins and paleozoic structures. The third is unconventional resources. Turkey has great investment potential in all these areas. The new Petroleum Market Law is expected to intensify the activities in these fields.

Nevertheless, OME expects the declining trend in crude oil production to continue in the future, albeit at a slower pace, from 2.3 Mt (or 45 kb/d) in 2012 to 1.7 Mt (or 32 kb/d) by 2030. These levels are far from meeting the domestic oil demand, which has increased tremendously over the last four decades.

OME estimates total oil demand in Turkey to more than double in the Conservative Scenario, and to increase by 80% in the Proactive Scenario between 2012 and 2030,. Transport sector, particularly road transport, will remain the largest oil consuming sector in both scenarios, with almost 60% share in total oil demand in 2030 compared to 51% in 2012. Also, in both scenarios, around 65% of the incremental oil consumption in end-use sectors will come from the transport sector.

Today, highways and motorways are the dominant mode of both passenger and freight transport in Turkey. The reason is that railways were neglected and maritime transport had lost its importance in the country over the last half-century. As a result, road transport accounts for almost 93% of the energy consumed in total transport sector.

Oil presently accounts for 98% of total energy consumption in the transport sector. This is despite pump prices of gasoline and diesel in Turkey amongst the highest in the world. Consumption of oil products in the transport sector will grow on average by more than 5% between 2012 and 2030 in the Conservative Scenario. This growth could fall to less than 5% in the Proactive Scenario, which considers bigger expansion of hybrid and electric cars, more promotion of alternative fuels, and bigger role for railways than those assumed in the Conservative Scenario. Despite that in absolute values, consumption of oil products in the transport sector more than doubles by 2030 in the Conservative and exactly doubles in the Proactive Scenario. Around 70% of this increase will come from the middle distillates.

More middle distillates are consumed by end-users in Turkey than light and heavy oils combined. In the future, while the shares of middle distillates and light oil will increase slightly, the share of heavy oils will decline in both scenarios.

Currently, Turkish Petroleum Refineries Corporation is the only refining company operating in Turkey. The company has four refineries with a combined annual crude oil processing capacity of 28.1 Mt (or 613 thousand barrels/day). Turkey's refinery capacity may nearly double by the end of this decade, when, and if, all the planned projects are realized.

Net oil imports kept growing in the past decades and made Turkey more and more reliant on foreign sources. At present, more than 90% of Turkey's oil demand is met by imports. According to OME model forecasts, net total oil (crude oil and oil products) imports will continue to increase, from over 30 Mt in 2012 to 67 Mt or 57 Mt by 2030 under Conservative Scenario and Proactive Scenario respectively. In both cases, the share of crude oil in net total oil imports will be higher than that of today.

Turkey's oil import bill has long been one of the major burdens in the economy. Not only increasing import volumes but also high international prices have led to the growth of this burden. OME expects Turkey's oil import bill in 2030 to be at least twice as much as the oil bill in 2012.

THE FUTURE OF GAS IN TURKEY IS AT THE CROSSROAD

Unfortunately, Turkey is not a rich country with respect to conventional natural gas deposits. However, offshore areas and most of the internal basins remains unexplored. In addition, there are numerous potential unconventional gas resources in basins located in different geographical regions. Growing interest in offshore areas and unconventional gas has recently given an impetus for investment in the Turkish upstream gas market.

Domestic gas production is negligible, 670 million cubic meters in 2012. OME's production forecast shows a slightly growing trend until 2018 mainly from tight gas sands. Afterwards several small to medium sized gas discoveries, onshore and offshore, could bring Turkey's annual gas production to a peak of 1.7 billion cubic meters (bcm) towards the end of the next decade. Following a few years of peak-plateau level, it is likely that production will start to decline.

Since domestic production is far from satisfying the growing demand for gas, Turkey relies heavily on imports, mostly on long-term take-or-pay contracts. Import volumes have grown rapidly in the past years and exceeded 45 bcm in 2012, making Turkey one of the biggest gas markets in Europe.

The role of natural gas in meeting Turkey's growing energy need has become increasingly important since it was introduced as a source of energy on a commercial scale with the start of imports in 1987. A fast growing economy, industrialization and concerns about growing air pollution in big cities have played a major role in tremendous increase in gas consumption. Today, natural gas has become the fuel of choice in industrial and household consumption as well as in power generation.

The government, however, wishes to reduce the weight of natural gas in the energy mix and bring energy security forefront in its energy policy. According to OME forecasts, the volume of gas imports and consumption will continue to increase in the Conservative Scenario but will remain relatively stable under the Proactive Scenario.

In the Conservation Scenario, the demand for gas exceeds 80 bcm in 2030. Over 60% of the increase in gas demand will be driven, as is the case today, by the growing demand coming from the power generation sector. In the Proactive Scenario, the demand for gas increases slightly until the beginning of the next decade and remains nearly flat at around 50 bcm afterwards, mainly due to substantial reductions in the use of gas for power generation. OME scenarios suggest that the share of gas in electricity generation will decline from about 45% in 2012 to 40% in 2023 and onwards in the Conservative Scenario, whereas in the Proactive Scenario it will drop to 22% in 2023 and to 11% in 2030.

Depending on which path the future gas demand will take, its impact will be remarkable. It will either maintain Turkey's dependence on natural gas imports, hence weighing further on the country's energy import bill, or will unleash it from this heavy burden.

Net gas imports will follow the same trend as demand for gas. Contracted natural gas import volumes will peak at 57 bcm in 2021.

Even if expiring contracts of BOTAŞ and private sector are extended, and also the existing but uncontracted LNG import capacity is fully utilized (by means of long term or spot LNG imports) there would still be a supply gap starting in 2022 in the Conservative Scenario. If uncontracted LNG import capacity is not fully utilized, then the problems would occur as early as 2018. In the Proactive Scenario, where net gas import requirement is expected to be much lower than the Conservative Scenario, there would not be any serious concern until 2022. Indeed, already contracted supply volumes, as well as the potentially available LNG import opportunities, would already be in excess of import requirement. Supply deficit issue that would occur afterwards could be solved either by extending some of the existing contracts or by replacing those volumes from new suppliers and routes in order to improve the supply diversity.

Turkey has an extensive gas transport infrastructure, composed of several international pipelines as well as two LNG import terminals. In addition, the country has an ever-expanding national grid. In 2013 total gas import infrastructure capacity was 57 bcm. When the project underway come online, this capacity will be sufficient to meet the expected gas import need in the Conservative Scenario. In the Proactive Scenario, however, even the existing import capacity would suffice to meet the expected import need.

Having sufficiently large contracted gas volumes and in place gas import infrastructure capacity does not guarantee gas supply security, especially in countries like Turkey, where seasonality in consumption is high. In this sense, lack of enough natural gas storage capacity is the weakest part of the natural gas system in Turkey. If all the planned underground storage projects are realized, total gas storage capacity would be around 12 bcm. However these speculative projects might not sufficiently address security of supply concerns.

An important factor contributing to the attractiveness of the Turkish gas market is that Turkey has, to a large extent, harmonized its legal framework of the domestic gas market with the EU. Nevertheless, there is still room for improvement.

CURBING ELECTRICITY DEMAND IS POSSIBLE

Electricity demand in Turkey has grown spectacularly over the last decades driven by strong economic growth and improved living standards. It is expected to continue increasing rapidly in the future. Future evolution of electricity demand can be better analyzed by breaking it into its components: final electricity consumption, own use of electricity by power plants, and transmission and distribution losses.

Final electricity consumption (by end use sectors) increased from around 2 TWh in 1960 to 193 TWh in 2012. The industry sector accounted for almost half of it, while the shares of residential and service sectors were about 24% and 26% respectively.

Final electricity consumption is expected to reach 450 TWh in the Conservative Scenario. Industry will remain the biggest electricity consuming sector. Iron and steel and construction sectors will lead the electricity consumption within the industry sector. In the transport sector, electric cars are not expected to make a significant contribution until 2020. Most of the electricity consumption in that sector will occur in rail transport due to Turkey's ambitious high-speed rail network plans. The major contribution to electricity consumption growth will come from the services sector, followed by the residential sector.

In the Proactive Scenario, a forceful implementation of demand management measures and higher efficiency standards will dampen the growth and lead to more moderate consumption rates. As a result, final electricity consumption will increase to 325 TWh in 2030, which is only 70% higher than 2012. This Scenario results in lower electricity consumption in all end use sectors except for the transport sector. In addition to railways, this scenario assumes an increase in electric cars after 2015. The ranking of the sectors in total final electricity consumption mix, however, remains the same as the Conservative Scenario.

Finally, while own use and losses almost double to over 90 TWh between 2012 and 2030 in the Conservative Scenario, in the Proactive Scenario they increase slowly until the early 2020s and remain nearly flat until the end of the forecast period. And yet overall they will register 16% increase between 2012 and 2030.

The installed electricity generating capacity increased by a factor of fifty in the past five decades, from less than 1.3 GW in 1960 to over 64 GW in 2013.To accommodate the expected electricity demand increase outlined above, almost 70 GW additional electricity generating capacity will need to be installed until 2030. In the Proactive Scenario the requirements would be nearly 15 GW less. It stems from slowing electricity demand growth in the Proactive Scenario, due mainly to energy efficiency and conservation measures.

While the share of fossil fuel fired plants in total installed capacity will decrease from 61% in 2012 to 52% in 2030 in the Conservative Scenario, this decrease will be much more pronounced (to around 35%) in the Proactive Scenario.

Total installed capacity of hydropower plants in both scenarios are expected to register nearly 85% increase between 2012 and 2030 to reach 36 GW. Total installed capacity of nuclear power plants in both scenarios reaches 9 200 MW in 2030, with assumes some delays in the realization of nuclear plants.Following the agreements signed in 2010 with Russia and in 2013 with Japan, Turkey now has two concrete nuclear power plant projects in Akkuyu (Mersin) and Sinop with a combined capacity of 9 200 MW. Both plants are planned to be in operation in the next decade.

Total installed capacity of coal fired power plants would increase some 90% in the Conservative Scenario (reaching almost 24 GW in 2030), whereas only a 36% increase is expected in the Proactive Scenario. Total installed capacity of oil-fired plants in 2030 is half of its value in 2012 in the Conservative Scenario whereas in the Proactive Scenario it is only a quarter.

In both scenarios, total installed capacity of non-hydro renewables register a tremendous growth between 2012 and 2030, from 2.6 GW to 14 GW in the Conservative Scenario and almost 26 GW in 2030 in the Proactive Scenario. The latter assumes some 4.2 GW of solar and 20 GW of wind power capacity, with the remainder comprised geothermal and biomass.

A striking difference between the two scenarios arises from the natural gas-based electricity generation capacity. While in the Conservative Scenario gas based capacity doubles between 2012 and 2030, in the Proactive one the increase is nearly insignificant due to price and efficiency dynamics.

Annual gross electricity generation between 1960 and 2012 increased from less than 3 TWh to almost 240 TWh.By 2030 it is expected to be around 540 TWh in the Conservative and 380 TWh in the Proactive Scenario.

Electricity generation from hydro and nuclear plants exhibit the same characteristics in both scenarios. The future electricity generation in the Conservative Scenario is dominated by fossil fuels and renewables do not live up to their full potential. However, in the Proactive Scenario, the share of gas in total electricity generation is reduced substantially, from 44% in 2012 to 11% in 2030, and the share of coal declines slightly, from over 28% to almost 27%. In both scenarios coal does not fulfill its full potential despite all the efforts to incentivize it. Generation from non-hydro renewables, majority of which will come from wind, still makes a modest contribution in the Conservative Scenario, while doubling in the Proactive Scenario.

Important steps have been made since 2001 in order to establish a liberal and competitive market structure, to increase efficiency, to enhance reliability and quality of supply in Turkey. The aspiration of Turkey to become a member of the EU has also been one of the factors for the still undergoing electricity sector restructuring. As a result, the share of private sector in the market continues to increase.

The rapid increase in installed power capacity over the past decade has occurred alongside the massive restructuring and liberalization of the power sector, with the open access policy and a dynamic wholesale market effectively underpinning the capacity expansion and deeper competition. Although investors are pouring into the electricity market, they hardly build large base load plants. Therefore, in the future, there may be a need to invest in such plants. The government is already aware of this and has begun auctioning coal mines for electricity generation. The results are yet to be seen.

The electricity transmission system plays a vital role in the Turkish power market. The Turkish transmission network covers a wide area and is one of the biggest in Europe. The transmission network is expected to grow further in the future, which will require substantial investments. The Turkish transmission system is interconnected with its neighbouring countries. However, except for the European connection, interconnections with other countries are asynchronous. Today, the Turkish electricity system can benefit from the synchronous interconnections with the European platform of ENTSO-E, which will be further developed in the future to increase the cross-border capacity with Europe, and thus improve trading opportunities. The Turkish transmission and distribution grids are operated not as tie-lines, but as service lines supplying isolated areas, on the borders with Georgia, Iran, Iraq, and Syria.

Today the total length of transmission lines is over 50 000 km and the total distribution network line length exceeds 1 million km. Transmission losses in the bulk system have been around 2.5% for the last 10 years which is comparable to international standards. However, losses in the distribution sector, around 15%, are well above the OECD average. An important expected benefit from privatization is to reduce the loss and illicit use ratios to a reasonable level. In the coming years, distribution load factors are expected to be shaped by Turkey's seasonal trends. The regional imbalances during summer-winter and spring periods tend to deviate quite substantially. The bulk of investments by distribution companies is expected to be on new transformers and new lines.

The Turkish experience in liberalizing the electricity distribution sector since the early 1990s can be considered as a real revolution, something that has not yet been achieved even in most European countries where the governments have retained control of the electricity distribution sector.

The market structure is based on bilateral contracting between buyers and sellers. Roughly 75% of electricity in Turkey is traded through bilateral contracts. The remaining energy is traded mainly in the Day Ahead Market and imbalances are resolved in the Balancing Power Market. Derivative and financial markets have also been implemented, although the volume of transactions has not yet reached an adequate level. The development of the over-the-counter markets, however, has been progressing rather slow.

In principle, the prices in the wholesale market are determined either by bilateral contracts or in the Day Ahead Market and Balancing Power Market through competition. Wholesale prices are not regulated except for TETAS's wholesale price, which is regulated by EMRA.

Wholesale prices, therefore, may be influenced indirectly by the government but due to increasing share of private sector in generation the government influence on the prices will get smaller.

Even though the Law envisages a cost-based tariff principle, government intervention on the end-user electricity prices can be observed. Introduction of an automatic price mechanism for maintaining full cost recovery has avoided several chronic diseases in the structure of the market and economy.

TAPPING THE SUBSTANTIAL RENEWABLES POTENTIAL: A WINNING STRATEGY

Renewables account for about 10% of total primary energy supply in Turkey (12 Mtoe). Although increasing in absolute terms, their share in total primary energy supply has been declining over the past twenty years, due to the strong growth in energy demand which has been largely met by fossil fuels.

In 2012, more than half (53%) of renewable energy supply in Turkey was used to generate electricity. The remainder, consisting of geothermal, solar thermal, and biomass and waste, was consumed by the end-use sectors, primarily in residential applications. Only a small amount of biofuels were used in the transport sector.

Biomass and waste makes-up for 60% of renewable energy consumption in end use sectors, nearly all of which in the residential sector. Wood-based industries burn their wood wastes in furnaces and boilers to contribute their own energy needs. Besides, biomass based substances are also used for electricity generation and for biofuels production. Some applications of solar thermal are fuelling the industry sector and geothermal heat consumption currently occurs in the residential sector.

Total installed capacity of renewable electricity generation technologies in Turkey has doubled between 2000 and 2013. At the end of 2013 there were 590 renewable electricity generating power plants in Turkey with a combined capacity of over 25 GW. Even though hydro power accounts for the bulk of this amount (around 87%), wind power demonstrated a significant growth, from less than 20 MW to 2.9 GW over the same period.

Solar power is still scarcely exploited for electricity generation to date, whereas solar heating and cooling applications are quite widespread. There is currently no utility scale solar PV plant. EMRA launched in June 2013 the first ever solar energy licenses for a total capacity of 600 MW. Hundreds of applications, mostly from Turkish investors, totalling about 8.9 GW of capacity have been received.

Concentrating solar power is still a costly technology for Turkey. Since it has not been applied in the country before, except for a small solar tower built in Mersin in 2013 for

research purposes, there are no expected economies of scale in the very near future, which hampers its competitiveness.

However, Turkey has a very well developed solar thermal market, with several players as well as high quality manufacturing and exporting capacity. Despite that there is limited awareness on and hence applications of solar heat for industrial processes.

Turkey is considered to be one of the most promising countries in the world for geothermal potential. Yet, development of this potential has been slow until recently. Installed geothermal electricity capacity of Turkey exceeded 310 MWe. Majority to additions to this capacity occurred in the past five years. There are numerous projects under development or in planning stage, which currently places Turkey the third biggest country in the global geothermal power projects or prospects under development.

OME expects renewables to account for around10% of the country's primary energy mix in 2030, around 23 Mtoe compared to today's level of 12 Mtoe in the Conservative Scenario. In the Proactive Scenario the renewables share would reach 15%, or 29 Mtoe. In absolute terms, hydro is set to dominate the renewable energy mix regardless of the Scenario, nearly 40% of the renewable energy mix in the Conservative Scenario and nearly 32% in the Proactive Scenario. Since OME assumes that the hydro potential of the country will fully be exploited by 2030 in both scenarios, all the expected additional increase in renewables under the Proactive Scenario will stem from non-hydro renewable. Under the Proactive Scenario non-hydro renewables energy demand will reach 20 Mtoe by 2030. In the Conservative Scenario it will be considerably less, at just under 14 Mtoe in 2030.

Consumption of renewable energy sources in end use sectors is expected to rise to nearly 8 Mtoe in 2030 in the Conservative Scenario, and to nearly 10 Mtoe in the Proactive Scenario.

Solar thermal energy consumption is expected to more than double in the Conservative Scenario, reaching 1.6 Mtoe in 2030 and more than quadruple in the Proactive Scenario at 2.7 Mtoe, from less than 1 Mtoe currently.

The development of the geothermal potential for end-users is expected to be tapped further, reaching 3.4 Mtoe by 2030. Most of the efforts to develop geothermal for end-users are already in motion and are expected to be realized in full in the Conservative Scenario. No further deployment is assumed in the Proactive Scenario.

Biomass and waste is an ambiguous fuel by nature as it includes what is referred to as "traditional" biomass – the biomass used in place of modern energy by the poorest fringe of the population. Traditional biomass use is expected to decline in time; as people get wealthier they switch to modern fuels for heating and cooking. "Modern" biomass, notably use of waste for power generation, is expected to increase over time and more so in the Proactive Scenario. As a result, total biomass and waste energy demand is expected to decrease to around 3 Mtoe in the Conservative Scenario and increase slightly to over 4 Mtoe in the Proactive Scenario in 2030.

By 2030, biofuels demand would reach 1.8 Mtoe in the Conservative Scenario and 2.6 Mtoe in the Proactive Scenario. The push for biofuels will be spurred by excise tax reduction and enforced biofuel contents in gasoline and diesel. Such measures would help revitalize the biofuel refinery sector, whose production capacity is currently underutilized.

Turkey has adopted concrete targets, introduced progressive legislation to set up a favourable legal and regulatory framework, and provided numerous incentives that would pave the way for the development of renewable energy technologies and an increased utilization of renewables, particularly for power generation. The government has set both an overall target and technology-specific objectives to be reached by 2023. The goal is to achieve 30% of electricity generation from renewables. To reach this goal, the government aims to exploit all the economical and possible 36 GW of hydroelectricity potential, increase the installed wind capacity to 20 GW and solar capacity to 3 000 MW, and expand the utilization of geothermal capacity to 600 MW.

Since currently installed renewable electricity capacity represents only a small fraction of the techno-economic potential, especially for non-hydro technologies, it is quite natural that there is a big interest in constructing renewable power plants in Turkey. Despite there are plenty of renewable electricity generation projects which have obtained license, at least more than half are estimated yet to arrange financing, making the sector perhaps the most important sector for the Turkish financial institutions.

Around 70 GW of electricity generating capacity will need to be added to the currently installed capacity by 2030 in the Conservative Scenario. Some 28 GW of this will be based on renewables (16 GW of hydro and 12 GW of non-hydro renewables).

In the Conservative Scenario, renewables based electricity generating capacity is expected to reach 50 GW in 2030, more than 40% of the total installed electricity generation capacity in the same year. Hydropower will account for about 72% of total renewable capacity (and 29% of total installed capacity). OME expects hydropower capacity to reach almost 35 GW in 2023 and 36 GW in 2030 in both Conservative and Proactive Scenarios, so in line with the announced government target of fully exploiting the hydropower potential, although some years later.

The Proactive Scenario would require adding an extra renewables capacity of nearly 12 GW, all of which from non-hydro technologies as hydropower capacity is assumed to be at its maximum in both scenarios. In this scenario, renewables would account for more than half (56%) of total installed electricity generating capacity in the country in 2030.

Installed wind power capacity would reach 8 GW by 2023 and 12 GW by 2030 in the Conservative Scenario, compared to 2.3 GW in 2012. In the Proactive Scenario it would be 20 GW in 2030, suggesting that the government target of 20 GW wind capacity will not be met by 2023, but some years later.

Solar PV capacity is expected to reach 1 GW by 2030 in the Conservative Scenario and 3.5 GW in the Proactive Scenario. Given the numerous applicants for licenses in this

technology, its deployment is expected to boom in the Proactive Scenario and be more contained in the Conservative Scenario. In both scenarios most of the additions will occur after 2023. Solar CSP capacity is expected to reach 300 MW in 2030 in the Conservative Scenario and 700 MW in the Proactive Scenario, which assumes a push for this type of technology in the future.

Geothermal electricity generating capacity would increase in both scenarios. In the Conservative Scenario the 600 MW government target would not be reached by 2023 (around 400 MW is expected) but would be achieved by 2030. However given the license applications under evaluation, geothermal capacity has the potential to be developed at a much faster pace to reach 900 MW in 2030 under the Proactive Scenario.

Rather bleak future development of electricity generating capacity based on biomass and waste is expected in the Conservative Scenario. Installed electricity generating capacity from biomass and waste is expected to increase slightly, to 210 MW in the Conservative Scenario and to 500 MW in the Proactive Scenario in 2030, from less than 160 MW in 2012.

Renewables contributed 69 TWh in 2013 to total electricity generation. Around 88% of this was generated by hydro power facilities, with the remainder mainly from wind. A small contribution came from geothermal and biomass and waste. By 2030, renewable electricity generation is projected to more than double in the Conservative Scenario (144 TWh, or 27% of total electricity generation which is the case today) and almost triple in the Proactive Scenario (173 TWh – 45% of total electricity generation).

Hydro based electricity generation will nearly double to 106 TWh in 2030 over the forecast period in both scenarios. Electricity generated from wind will increase at an average annual growth rate of 10% in the Conservative Scenario and reach 31 TWh by 2030. In the Proactive Scenario it will grow nearly 13% per pear and reach 52 TW has a result of government incentives to make the most out of the wind potential in the country. Solar PV electricity generation is expected to grow at a faster pace in the Proactive Scenario than in the Conservative Scenario, reaching respectively 6 TWh and nearly 2 TWh in 2030. Solar CSP is also expected to be thriving from 2015 to 2030but at a slower pace than solar PV. By 2030, electricity generation from solar CSP would reach 0.7 TWh in the Conservative Scenario and 1.5 TWh in the Proactive Scenario. Geothermal electricity generation is expected to increase from less than 1 TWh in 2012 to 3.3 TWh and 5 TWh in 2030 in the Conservative and Proactive Scenario respectively.

Overall, the main differences between the two OME scenarios in terms of renewables deployment lie in the extent to which announced or anticipated policies and measures are implemented. Reaching the rather ambitious targets set in the Strategy Paper will require additional efforts to remove the main barriers which still hinder sustainable energy technology penetration in Turkey. In particular, more aggressive measures in the field of grid connection and reinforcement, more effective administrative procedures, long-term financing and social acceptance are needed to speed up the renewable energy growth in order to reach the 2023 targets.

POTENTIAL FOR SIZEABLE IMPROVEMENTS IN ENERGY EFFICIENCY: TIME TO ACT

Increasing energy efficiency is a priority for Turkey to help improve energy supply security, protect the environment, and mitigate climate change. Since several years, the Turkish Government has begun addressing policy and regulatory issues promoting energy efficiency and is now preparing to scale up energy efficiency investments.

Turkey's energy intensity, the amount of energy needed to produce a unit of GDP, remains below the world and EU averages. By 2030, in the Proactive Scenario energy intensity would be 19% less than in the Conservative Scenario. As mentioned earlier, the cumulative energy efficiency gains over the outlook period would be equivalent to Turkey's cumulative primary energy use in the past four years, which is not negligible.

Implementing adapted policies and measures to promote and enforce efficiency measures would bring the energy intensity down steeply (-13%) in 2023 and (-22%) in 2030 in the Proactive Scenario compared to 2011 level. While energy intensity reduction in the Proactive Scenario would be impressive it would still fall short compared to the Government's 2023 objective of a 20% reduction from 2011 levels. This target would only be reached by 2029 according to OME Scenarios. In 2030, half of the efficiency gains could be realised in the end-use sectors, with 22 Mtoe that could be spared in the Proactive Scenario compared to the Conservative Scenario.

On a per-capita basis, primary energy demand in Turkey increased threefold since 1970 reaching 1.6 toe in 2012. Nevertheless, it remains below the world average and corresponds to less than half of the European Union average in 2012.By 2030, in the Conservative Scenario, per capita energy demand in Turkey would reach 2.6 toe–more than 70% increase from 2012. The Proactive Scenario results in a lower per capita energy demand in 2030 than in the Conservative Scenario, and yet, it would still be 38% higher in 2030 compared to current levels.

One of the hallmarks of Turkish energy demand is its impressive growth in electricity use over the past decades. Electricity consumption is not yet decoupled from economic growth in Turkey and the Turkish economy is becoming more and more electricity intensive. Indeed, electricity intensity in Turkey nearly doubled since 1990 to reach EU27 average in 2011. It is expected to continue increasing in the Conservative Scenario until the mid-2020s and then start declining afterwards. In the Proactive Scenario, where scope for efficiency gains in electricity is considerable, electricity intensity in 2030 would be 29% less compared to the Conservative Scenario, and it would be 22% lower than that of 2011.The government's Energy Efficiency Strategy aims at achieving 20% reduction in electricity intensity by 2023 compared to 2011 levels. According to OME Scenarios, even in the Proactive Scenario this target would not be achieved before 2029. By 2023, electricity intensity would only be 9% lower than 2011 level.

Cumulative electricity savings until 2030 would be equivalent to more than five years of Turkey's current annual electricity production. More than five years of electricity generation could thus be saved over the next 16 years under the Proactive Scenario.

Electricity consumption per capita in Turkey increased fourfold since 1990. It surpassed the World average in 2005; it is, however, well below EU27 average. Taking into account the GDP and population increase, per capita electricity consumption is expected to continue increasing regardless of the scenario. Nonetheless, the Proactive Scenario would lead to a per capita electricity demand 29% lower than the Conservative Scenario.

POLLUTION FROM FOSSIL-FUELS: A GROWING CONCERN

Rapid urbanization, growing industrialization and pressure on water resources from competing agricultural and urban demands are posing environmental challenges. Turkey has already integrated many efficiency and pollution-reducing measures into production and consumption activities, largely driven by existing policy signals from national legislation, EU Accession requirements or by market demand for cleaner and greener products.

With the adoption of the renewable energy law, the energy efficiency strategy and some awareness-raising projects, investments on energy efficiency and renewable energy are growing. Awareness-raising on mitigation and in particular on adaptation to climate change is needed at all levels. Turkey is one of the largest emitters that has yet to formulate a greenhouse gas emissions reduction target. An overall target will need to be put in place in upcoming years to develop Turkey's carbon market mechanisms.

Currently the bulk of energy-related emissions in Turkey are from fossil-fuel combustion. Energy-related carbon dioxide (CO_2) emissions have increased tenfold since the mid-sixties and have doubled since 1990. Amongst fossil fuels, coal has always been the main emitter of CO_2. In the last few years CO_2 emissions from gas have overtaken CO_2 emissions from oil.

Power generation accounts for the lion share, responsible for over 37% of Turkey's CO_2 emissions in 2012. Industry accounts for 18% and transport for 17% (mostly from energy used in road transport) while the remainder comes from other sectors.

The outlook for CO_2 emissions in both scenarios shows an upward trend from current levels. CO_2 emissions would nearly double in the Conservative Scenario, and would grow by 38% in the Proactive Scenario over the outlook period. While CO_2 emissions would thus be 26% lower in the Proactive Scenario compared to the Conservative Scenario, favouring coal rather than gas will induce a stronger carbon content in the thermal electricity generation. As a result, in 2030, coal would account for 41% of total CO_2 emissions in the Proactive Scenario – marginally lower than the 42% in the Conservative Scenario.

FOSSIL-FUEL IMPORT DEPENDENCE WILL EXACERBATE THE ENERGY IMPORT BILL

As highlighted earlier, fossil-fuels are set to remain the cornerstone of Turkey's energy demand in both scenarios and they would still account for more than 82% of primary energy demand in 2030 in the Conservative Scenario – corresponding to a near doubling of fossil fuel imports, from 86 Mtoe in 2012 to 159 Mtoe in 2030. Regardless of the scenario, nearly all oil and gas demand will need to be imported.

Import dependence can be reduced by favouring the domestically produced fuels and curbing energy demand. This would drop the dependence on energy imports to 76% in 2030 in the Proactive Scenario and alleviate the negative consequences of the energy import bill on the economy. However, even in this case, fossil fuel imports would reach 108 Mtoe in 2030.

Rising demand for energy is costing Turkey billions of dollars per year, with major consequences in Turkey's economy. Gross energy imports in monetary terms accounted for a quarter of total imports in 2012. On the other hand, in the same year, over 60% of total foreign trade deficit was due to net energy imports.

In the last two decades, Turkey's net energy imports (in energy units) tripled, while net energy import costs (measured in 2012 USD) increased by a factor of seven. In 2012, Turkey's net energy import bill exceeded USD50 billion.

OME expects Turkey's net annual energy imports between 2012 and 2030 to increase by 85% in the Conservative Scenario and by 25% in the Proactive Scenario. As a result, net annual energy import costs will double in the Conservative Scenario (more than USD100 billion, in 2012 dollars) in 2030 and increase almost 50% in the Proactive Scenario (nearly USD80 billion). Oil will account for more than 60% of this bill.

Between 1970 and 2012, Turkey's cumulative net energy import bill (for over 1 450 Mtoe of energy it imported) was USD500 billion (in 2012 USD).Until 2030 Turkey will need to import much more energy and pay substantial amounts of money for it to satisfy its energy demand in both scenarios. According to OME estimates, between 2013 and 2030, Turkey will need to import some 20% or 50% more energy, depending on the scenario. And that, Turkey's cumulative net energy import bill over the same period will be more than USD1 trillion – USD1.4 trillion in the Conservative Scenario and USD1.1 trillion in the Proactive Scenario.

TURKEY'S ENERGY SECTOR WILL REQUIRE SUSBTANTIAL INVESTMENTS

Turkey also needs to pour substantial amount of money into energy sector investments in the future to meet the growing demand. These investments will range from upstream activities to refining, to new underground gas storage facilities, to new power plants, to energy transport, transmission and distribution activities etc.

According to OME estimates, more than USD260 billion (in 2012 dollars) need to be invested in these activities by 2030. Around two-thirds of this amount (or USD173 billion) needs to be invested before 2023. The electricity sector is expected to account for more than 65% of these investments by 2030. It is followed by oil and gas sectors (around 25%). Investments in coal sector make up the reminder.

Already, growing domestic and foreign investor interest in Turkey's energy sector is a reflection of confidence in the future of Turkey's energy market. When the ultimate objective of creating a fully functioning, transparent, and competitive free market environment is achieved more private investment into the sector will be attracted. But the push for privatization should not lead to guaranteed business opportunities. A public-private sector partnership must ensure the speedy structuring, financing and development of projects in the energy sector. In this sense, government guarantees should be minimized and the government should clear its image as a risk taker and guaranteed job provider.

TURKEY AS AN INTERNATIONAL ENERGY CENTER

Thanks to its geographical situation, Turkey has the potential to play an important role in the future development of regional natural gas and electricity markets in the Euro-Mediterranean region, as well as to become a major hub for oil worldwide.

Turkey is and will continue to be simultaneously a large energy consumer and importer, and an energy investor. At the same time, the country is turning into an energy gathering and dispatching centre. These characteristics make Turkey an emerging regional and global energy player.

For a long time, Turkey has strived to become an energy corridor between the major energy producers and energy hungry consumers. Existing and planned pipelines are part of this intention that is growing in importance on the world stage – geopolitically, strategically and economically.

Turkey has long been actively involved in opening an oil and gas transport corridor from the Caspian region to Europe. Turkey's ambition to become an energy bridge of international

significance had been partly fulfilled thanks to the Baku-Tbilisi-Ceyhan (BTC) crude oil pipeline, which also helped to ease the increasing oil traffic through the Turkish Straits. Furthermore, the port of Ceyhan has already become one of the important outlets for Iraqi oil shipments. Alongside the BTC runs the South Caucasus pipeline, carrying Azeri gas to Erzurum in Turkey. With the inauguration of the Greece-Turkey natural gas pipeline in 2007, Azeri gas is transported further to Greece.

The final investment decision for the second stage of the Shah Deniz gas field development in December 2013 has given a go-ahead for the plans to expand the South Caucasus pipeline and to link it with TANAP and TAP. This will open the door for delivering Caspian natural gas to markets in Europe and hence will help boost the energy security of south east and south Europe. This and other planned gas pipelines from Iraq, Iran and perhaps eastern Mediterranean will strengthen Turkey's role as a major corridor in the Eurasian energy landscape. Turkey will surely face several challenges, but if managed carefully and with wisdom, those challenges can be converted into opportunities and can pave the way for realizing Turkey's ambition of establishing itself as an interregional energy hub and energy centre.

Observatoire Méditerranéen de l'Energie

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