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DECARBONIZATION OF TURKEY'S ECONOMY

long-term strategies and **immediate challenges**

Facts, insights and ideas from cross-sector dialogue

Turkey 2050 Climate Policy Dialogue Project
TR2015/DG/01/A5-02/147A

Decarbonization Of Turkey's Economy: Long-Term Strategies And Immediate Challenges

Facts, insights and ideas from cross-sector dialogue

Policy document produced within the project "Turkey 2050 Calculator: Facilitating Climate Policy Dialogue through Adaptation of an EU Low Carbon Pathway Tool" (Contract no. TR2015/DG/01/A5-02/147), jointly Implemented by Climate Action Network (CAN) Europe, SEE Change Net, The Economic Policy Research Foundation of Turkey(TEPAV).

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Author: Ceren Ayas

Editor: Barney Jeffries

Translation from English: White Noise Productions

Contributors: Ana Rankovic (SEE Change NET), Bengisu Özenç (TEPAV), Elif Cansu İlhan (CAN Europe), Elif Gündüzyeli (CAN Europe), Garret Patrick Kelly (SEE Change Net), Özlem Katısöz (CAN Europe)

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The project Turkey 2050 Climate Policy Dialogue - provides a dialogue opportunity for Turkish and wider European civil society organizations to cooperate on dealing with climate change and to exchange knowledge and best practices linked to the EU energy and climate policy goals.

We hope that the project – supported by the EU within the scope of Civil Society Dialogue Programme under the coordination of Turkish Ministry of Foreign Affairs/ Directorate for EU Affairs – will be the foundation for building a 2050 Climate Calculator model for Turkey, which would be an excellent tool for fact-based debate!

Bülent Özcan, Director of DG Financial Cooperation & Project Implementation, Ministry of Foreign Affairs - Directorate for EU Affairs, the Government of the Republic of Turkey

INTRODUCTION

A public dialogue on the long-term transition to a low carbon economy – given its far-reaching implications at the technological, economic and societal levels – will become a pressing necessity in Turkey in the years to come. To support this process, the Turkey 2050 Climate Policy Dialogue Project initiated an in-depth dialogue to discuss, share and envision potential pathways for a sustainable and just transition. The project used the scenario methodology, based on the approach of the 2050 Carbon Calculator utilized by SEE Change Net.

As a policy support tool, the 2050 Calculator provides a scientifically based, transparent and comprehensive framework to explore an extensive portfolio of lifestyle and technological levers that we can put in motion between now and 2050 in different sectors of the economy, and assess the implications they have on energy demand and supply, emissions, costs, and the environment. Anyone using the tool can assess the technical feasibility of simultaneously expanding low-carbon energy supply and reducing the overall energy demand; and compare the impacts of such pathways on costs, emissions or energy security with 'business as usual' scenarios.

In order to demonstrate the potential of such tools and provide a granular understanding along with the means for engagement, during the project we used the calculators developed for the EU 28 plus Switzerland[1] and for accession countries of South East Europe (SEE)[2] . We hope to see the 2050 Calculator developed for Turkey in the near future, as it would help bring together the energy and climate debates as well as strengthen civic engagement: this would create an enabling environment for facilitating the low-carbon transition.

Ana Rankovic, SEE Change Net

A series of dialogues was organized over the last year involving civil society, academia, and the public and private sectors from Turkey, the EU and the Western Balkans. In addition to stakeholders in Ankara, Brussels and Sarajevo, the project mobilized communities and encouraged deliberations outside the capital cities – in Adana, Çanakkale, Izmir, Sinop and Zonguldak – stressing the significance of understanding local perspectives and approaches.

The dialogues provided a space for sharing insights and ideas about the practical steps and critical components needed to achieve low-carbon pathways in the medium to long term: among many other issues these include low-carbon mobility circular economy applications, demand reduction, decarbonization of the power supply and of industrial processes, and socio-economic and environmental impacts. While building a better understanding of energy and climate policies, solutions, best practices and lessons learned in the European context, the dialogues also helped to refine and articulate some of the key challenges and dilemmas within the energy sector at local and national levels in Turkey.

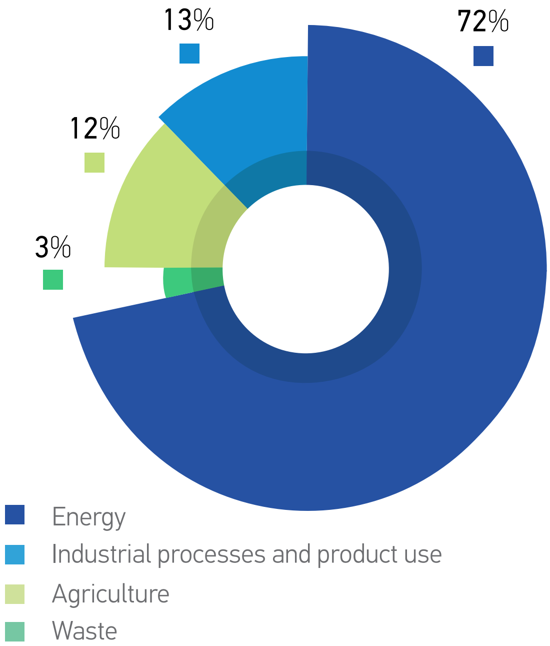
As a high-level takeaway from the dialogues, we can say that while there are clearly gaps in understanding among different stakeholder groups concerning economic and institutional capacities, diverse interests, and varying levels of readiness to embark on a more ambitious transformation of the current development trends, there are nonetheless a number of areas where there is more consensus than conflict. These, for example, include a clear preference for renewables-based low-carbon development and the numerous co-benefits it brings, such as cleaner air and improved health conditions, green jobs and economic opportunities, and its potential for improving Turkey's energy security while minimizing negative environmental impacts. Further, most stakeholders agreed that Turkey would benefit significantly from an internationally coordinated action to limit the global temperature increase to 1.5–2°C, given the dangerous consequences of climate change for biodiversity and freshwater resources, and thus for agriculture and food security in Turkey.

[1]http://tool.european-calculator.eu/intro
[2]https://see2050carboncalculator.net

This publication has been produced in the midst of the COVID-19 pandemic, which gives us some idea of the vulnerabilities and the scale of disruptions that we may experience more frequently due to the climate crisis. Ironically, in many places around the globe, it has also provided a taste of the cleaner air we could be breathing in a low-carbon system.

The way we are collectively working to mitigate the pandemic offers important lessons on the risks in an interconnected world and the need for both individual and collective action to protect our global commons from the negative consequences of climate change.

Bengisu Özenç, TEPAV



Turkey's greenhouse gas emissions by sectors (CO_2 equivalent), 1990 -2018, TurkSTAT

The energy sector is the single greatest contributor of Turkey's greenhouse gas (GHG) emissions. Total GHG emissions have grew by 137% between 1990 and 2018, and the energy sector's share stands at 72%. Following this fact, without ignoring the importance of emissions arising from industrial and agricultural processes, this report focuses on the energy sector and power sector in particular – as a critical enabling factor for the decarbonization of Turkey's economy.

Along with environmental and health benefits, decarbonization of the energy sector poses opportunities for economic activity with increased investments and employment that such investments would bring and relieves pressure on the current account deficit due to reduced primary energy imports. The EU Green Deal provides an important policy blueprint that covers socio-economic aspects of the decarbonization pathways, which is also discussed in this report.

Technological advancements already exist that can make a low-carbon energy transition feasible. Renewable energy solutions are economically competitive and there is a significant potential and opportunity to "raise the bar" when it comes to energy savings. This can all however be hindered by excess coal capacity which may lock in carbon-intensive energy infrastructure for decades. Continued strengthening of economic incentives and removing barriers to new investment in renewable energy technologies instead of building additional coal plants will take Turkey closer to 1.5°C climate target and bring us multiple economic, technological and environmental advantages.

Elif Cansu Ilhan, Climate Action Network Europe

This report reflects on the main considerations identified during the dialogues, and is structured around the key transformation parameters of long-term decarbonization: technology choices, socio-economic impacts and environmental impacts. We argue that these considerations need to be more openly discussed, and should be integrated into national strategies and planning processes.

We hope that this publication will serve as a timely, relevant and useful resource to support the decarbonization of Turkey's power sector.

PREAMBLE

This report provides a big-picture perspective of the most pressing challenges for Turkey to overcome in achieving a low-carbon 2050 vision. We summarize key issues regarding the viability of high-carbon and non-emitting controversial infrastructures; we explore socio-technical solutions based on low-carbon technologies; we evaluate the freshwater, land-use, biodiversity and air quality dynamics in which electricity generation has a significant footprint; and we analyse the social dynamics of business-as-usual and alternative energy outlooks towards a 2050 vision. The section continues with lessons learnt from European Union (EU) countries and globally for staying within the planetary boundaries mandated by the Paris Agreement.

Chapter I provides the contextual framework for Turkey. Turkey is at the crossroads of transitioning its electricity system to a renewable or coal-based infrastructure in its effort to reduce reliance on imported natural gas. The current energy narrative of Turkey – whose energy demand and emissions are both increasing faster than in any other OECD country – focuses on increasing local coal and renewable energy. Turkey's reliance on imported natural gas and the contribution energy imports make to its current account deficit are decisive factors in the carbon-intensive outlook of the oversupplied power market.

Chapter II discusses demand/supply dynamics and the significant role that energy efficiency plays in curbing energy demand and emissions. The significance of planning of supply and the cost-effective alternatives in Turkey's Energy Efficiency Action Plan are discussed. The section continues with lessons we can learn from the EU and at a global scale with regards to decoupling countries' growth trajectories from their energy demand. The section concludes with a look at sectors which have high potential for low-carbon alternatives, and explores ways of putting the necessary measures in place.

Chapter III discusses the viability of coal infrastructure. With a special emphasis on the prioritization of lignite, the future of coal in Turkey's oversupplied market, the financial viability of coal and the impacts of coal are discussed. The section continues by looking at lessons learned from the EU and globally on the political aspects of phasing out coal infrastructure, and the stranded asset risk that arises as a result of political support for decarbonization.

Chapter IV provides solutions based on renewable technologies. The section provides information on the ambitious renewables targets across sectors and the site auctions for utility-scale generation, along with the steadily increasing clean energy investment of the last decade. The section also assesses the viability of photovoltaic (PV) and wind technologies, and goes on to analysis of the leading project owners and project lenders in the renewable sector. We conclude with a discussion on system flexibility and the effectiveness of large-scale integration, as well as providing lessons learned from countries in the EU and around the world.

Chapter V critically evaluates the role of natural gas in Turkey's low-carbon transition. The section provides an overview of the significance of natural gas in the current account deficit, its vulnerability to political tensions, and of the cost competitiveness in Turkey's oversupplied market where emerging technologies are disrupting the merit order. The section highlights some of the contradictory aspects of natural gas, and takes a critical standpoint on balancing or transitioning technology. The section draws attention to key oversupply and overdependency challenges experienced at EU level.

Chapter VI takes a critical look at the role of nuclear power plants within Turkey's low-carbon vision for 2050. The section provides a brief history of nuclear energy in the last 50 years, notes some drawbacks of nuclear technologies currently under consideration, and explores the energy dependency of the technology and the viability of nuclear energy in market dynamics. Risks associated with earthquakes are discussed, along with the risks that the technology poses to land, water and livelihoods. The section concludes by looking at what we can learn from Europe, and current EU trends towards the phase-out of nuclear energy.

Chapter VII looks at Turkey's freshwater resources, air quality, biodiversity and land use, surveying the impacts of climate change and different sources of electricity generation on these global commons. We assess the competing interests of agricultural, industrial and residential sectors; and explore how to accommodate their demands in light of Turkey's energy outlook. The section provides a closer look at coal-fired power plants, which are among the most polluting industries for livelihoods.

Finally, chapter VIII provides a lens on the social dynamics of Turkey's business-as-usual and alternative visions towards long-term decarbonization. The section provides information on the allocation of public money that may result in carbon lock-in. It also looks at the social impacts of decarbonization, with a particular emphasis on employment. The role of decentralized renewable technologies in the democratization of electricity generation is also discussed. The section concludes with a comparative analysis of the impacts of high- and low-carbon technologies on human health, providing Turkey and EU data to put the results in perspective.

Chapter IX provides concluding remarks and recommendations.

CHAPTER I

CONTEXTUAL FRAMEWORK

"The EU Green Deal can be basically understood as the EU's answer to the 2015 Paris Agreement. But it actually goes much beyond: it is our new growth strategy to turn climate and environmental challenges into opportunities but also to address the cost of non-action. It implies a shift of paradigm in the way we buy, move, eat, dress, consume, produce and more."

Guilemette Vachey, European Commission / Directorate-General for Neighbourhood and Enlargement Negotiations

Turkey's Energy Sector Today

Turkey has become one of the fastest growing economies in the world, with the highest rate of growth in energy demand among OECD countries over the last 15 years. According to the 11th Development Plan, Turkey will be among the countries with the highest income and human development levels, with a GDP of $1,080 billion, an increase in per capita income of $12,484, exports of $226.6 billion, a decrease in the unemployment rate to 9.9%, and a significant decrease in inflation rates. This trajectory necessitates new sources of growth along with a restructured labour force and the adoption of new technologies, all of which has significant implications for the energy sector. The 11th Development Plan – which takes as its foundation a growth model based on exports and efficiency where the industrial sector plays a pivotal role – projects annual growth of 4.3%, which means big changes for Turkey's energy sector: installed capacity is projected to increase to 109.4 GW in 2023 following the increase in primary energy demand to 174,279 Billion Tons Equivelent Petroleum (BTEP) and electricity demand to 375.8 TWh (Ministry of Development, 2019[3]).

Turkey's economic integration and liberalization have been drivers for economic progress in the last decade but the country is now encountering economic slowdown[4] and stagnation. These have been exacerbated since March 2020 by the significant impact of COVID-19. The economic recession has impacted the power sector and increased exposure to commodity risk.

Turkey's energy sector is at a crossroads: will it pursue a decarbonized pathway through investment in efficiency and low-carbon technologies, or continue business as usual based on high-carbon technologies with a stranded asset risk that can lock-in energy sector investment potential for decades to come? The former pathway may have broader implications for Turkey's current account deficit depending on whether infrastructure runs on domestic or imported resources. It may also have an impact on the economic agenda due to its potential to mitigate the risk of the so-called 'middle income trap', which is the unsatisfactory convergence performance of a country's GDP with that of rich economies.

Although the public sector remains dominant, public-private energy infrastructure partnerships have increased substantially. One of the most important challenges for the energy sector in Turkey is to meet the growing demand. The growth trend has been reflected in the increase in installed capacity, which has reached 90.4 GW – a threefold increase in 15 years which has oversupplied the market. Turkey has a strong dependence on energy imports, since energy

[3] www.sbb.gov.tr/wp-content/uploads/2019/07/OnbirinciKalkinmaPlani.pdf

[4] The OECD report (2019) notes if current uncertainties continue to prevail and confidence remains fragile, Turkey would remain vulnerable to turbulences and headwinds and GDP growth would be weaker.

production from domestic sources can only meet 26% of its total consumption.

The other significant challenge that the energy sector is facing is its reliance on imports, which is due to the unavailability of fossil fuels other than lignite with low calorific value. The cost of energy commodity imports, such as oil, gas and coal, continues to exceed $40 billion annually, increasing Turkey's current account deficit. Turkey's energy imports had reached $53 billion (6% of GDP) in 2014. In 2017, import costs declined to $36 billion following the fall in global energy prices. The import bill is likely to remain high given the volatility in energy prices. The latest data from the Central Bank of the Republic of Turkey shows that the current account deficit reached $53.4 billion between February 2017 and February 2018, with energy imports comprising the largest part of that shortfall.

If Turkey strengthened its intended nationally determined contribution (INDC) on a trajectory towards 100% renewables by 2050 (meeting its Paris Agreement obligations to keep global warming below 2°C and ideally 1.5°C), it could reduce its annual fossil fuel dependency by at least 41 million tonnes of oil equivalent (Mtoe) beyond its current NDC reductions, bringing annual cost savings of approximately $17 billion – a total of $23 billion compared to the current policy scenario, equivalent to about 3% of Turkey's 2014 GDP (Day et al, 2016).

In order to fulfil the supply security goal of the growing market, the key pillars of the energy sector that are set out in the 2019-2023 Strategic Plan are:

- Ensure sustainable security of supply by increasing the share of domestic and renewable resources in total installed capacity to 65% (from 59%)
- Include nuclear energy in the supply sources and increase its share in the energy supply
- Strengthen the natural gas and electricity infrastructure
- Accelerate exploration and production of oil and natural gas
- Realise technological transformation in the power sector

Ministry of Energy and Natural Resources, 2019.

The energy outlook for Turkey is not Paris-compliant, and assumes a doubling of GHG emissions compared to its current levels. Turkey's emissions will increase under current policies and it will exceed its 'Critically Insufficient' – but not yet ratified – INDC in terms of emissions reductions if it follows a business-as-usual scenario. According to the official INDC of Turkey issued on 30 September 2015, with the current policies total emissions will rise to 1,175 $MtCO_2e$ by 2030. In other words, Turkey will see a 155% increase on its 2013 emissions (UNFCCC, 2015). According to the reference scenario laid out in the INDC, even if the 21% mitigation target is achieved (keeping emissions at 929 $MtCO_2e$ in 2030), the increase is still more than double the starting value (Sahin et al, 2016).

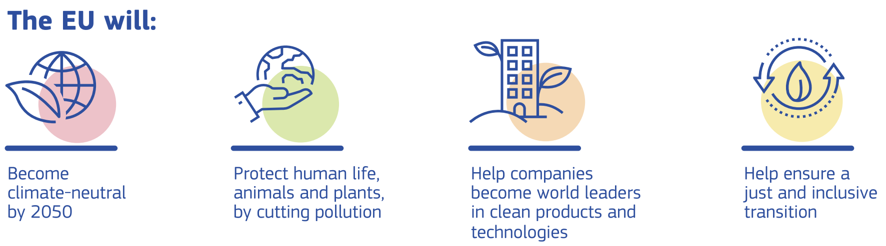
Turkey has the fastest growth in energy demand and emission levels of all the OECD countries. The key challenge is to use local resources to meet the increase in demand. To do so, Turkey can either continue its reliance on fossil fuels or it can set an ambitious decarbonization agenda for a sustainable and renewable-based energy system coupled with significant efficiency measures.

Keeping Pace with EU Decarbonization is Critical for Turkey's Exports

Over the last few decades, the EU has been modernizing and transforming its economy, decoupling energy and emissions from growth. Between 1990 and 2018 GHG emissions fell by 23% while the economy grew by 61%. However, if current trends continue, GHG emissions will not be reduced far enough for there to be a reasonable chance of achieving the universally agreed ambition of limiting global temperature rise to 1.5°C in line with climate science.

European Commission President Ursula Von der Leyen outlined the new European Green Deal proposal in December 2019, aiming to make the EU a global leader in tackling climate change while at the same time bringing new jobs and promoting business. The European Green Deal offers a new vision and growth strategy, one that aims to transform the EU into a modern, resource-efficient and competitive economy with net zero GHG emissions by 2050, a thriving society where economic growth is decoupled from resource use and no person or place is left behind.[5]

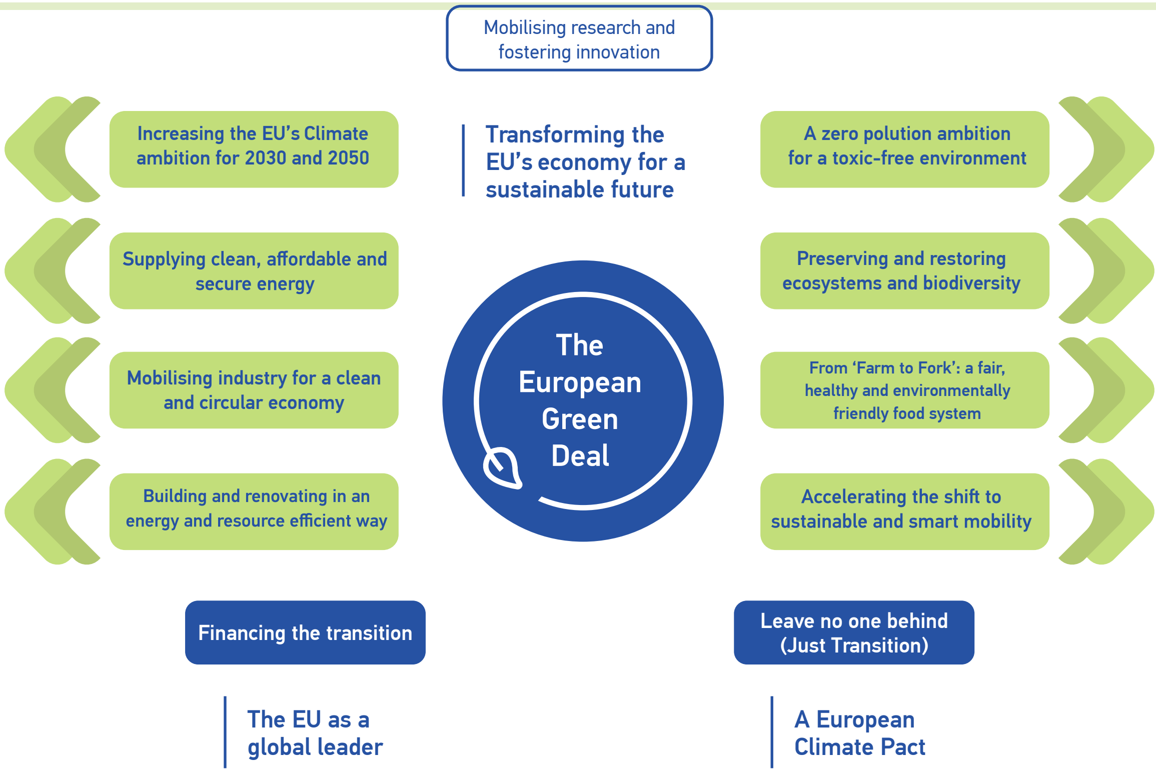
The European Green Deal is about improving the well-being of people. Making Europe climate-neutral and protecting our natural habitat will be good for people, planet and economy. No one will be left behind.



What is the European Green Deal? https://ec.europa.eu/commission/presscorner/detail/en/fs_19_6714

The Green Deal takes a comprehensive approach to accomplish a transition away from fossil fuels and environmental degradation, with 47 key actions addressing almost every aspect of the EU's economy, as well as the life of its citizens. By turning climate and environmental challenges into opportunities across all policy areas, it strives to pave the way for sustainable growth and increased social welfare.

[5] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en



The European Green Deal, https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF

The Green Deal gives Europe the opportunity to lead the world by example. It gives the EU a first mover's advantage in the green transition, in terms of innovation and development of standards that it can export. At the same time, it aims to trigger a global race to the top, raising standards globally in the long run, not only at EU level. [6]

Dialogue is now taking place in the EU and internationally on the implications of the Green Deal for trade, international cooperation and investment. Trade policy in particular is highlighted by the European Commission as an instrument to support the EU's transition. As a part of the EU Green Deal a Border Tax Adjustment (BTA) mechanism is likely to be imposed on goods imported into the EU, in order to avoid carbon leakage and sustain the competitiveness of European industrial production. It notes that if its "international partners do not share the same ambition (on climate) as the EU, there is a risk of carbon leakage, either because production is transferred from the EU to other countries with lower ambition for emission reduction, or because EU products are replaced by more carbon-intensive imports. If this risk materializes, there will be no reduction in global emissions, and this will frustrate the efforts of the EU and its industries to meet the global climate objectives of the Paris Agreement." On the contrary, forging partnerships around the Green Deal can give a first mover advantage to all parties involved and avoid the risk of countries becoming locked in to unsustainable development pathways. [7]

Although the details of a possible BTA are still under discussion, Turkey is likely to be one of the most impacted countries if such a mechanism is implemented. The EU (including the United Kingdom, which left the Union on 31 January 2020) is Turkey's single largest export partner with a total volume of $90 billion, or 53% of total exports (EuroStat database). Therefore, given the low-carbon pathway that the EU is following, efforts to decarbonize Turkish manufacturing industry would increase its competitiveness in the EU market.

[6] www.iddri.org/en/publications-and-events/blog-post/can-green-deal-be-core-eus-project-its-external-partnerships
[7] https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf

Turkey Energy Outlook

The power generation market in Turkey is oversupplied (91GW as of January 2020) as a result of a slowdown in economic growth and official forecasts in the past that overstated the need for new generating capacity.

Installed capacity
91GW

Power generation
291Gwh (by 2019)

Coal capacity
37% of total power generation capacity

Renewable capacity
12,198MW

New renewable capacity:
2,586MW

Electricity demand
303.6TWh (by 2019)

Electricity consumption
1.81kWh/person/day

Share of domestic resources:
150.0TWh

GDP
$743 billion – 19th largest economy, 7th biggest economy within Europe (government debt is 32% of GDP)

GDP/capita
~$9k (2019)

Inflation rate
11.39% YoY (by May 2020)

Population
83.15 million (end of 2019)

Climate commitments
No target for peaking emissions (21% reduction by 2030 compared to BAU)

CO_2 increase
177% net, 167% energy sector (1990-2018)

Import dependency
55% in power sector, 73% in primary energy demand

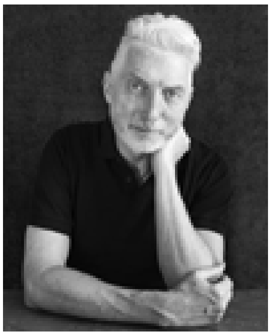
Unemployment rate
13.8% (by January 2020)

Power demand
4.3%/annum (2008-2018 average)

Sources
Bloomberg New Energy Finance, 2019, TURKSTAT, Ministry of Energy and Natural Resources, Intended Nationally Determined Contribution

CHAPTER II

DEMAND SUPPLY DYNAMICS



Improving energy efficiency is a catalyst to addressing many economic and social issues and it has been rightly addressed as the first fuel for the EU economy. Further, as many say, "the cheapest watt is the one that's never created."

Reducing energy demand through energy efficiency is a critical part of the cost-effective long-term solution to deliver greater energy security and reduce the need for building new fossil fuel plants. By improving energy efficiency and taking advantage of renewable energy, we can ensure that investments are spent wisely – helping to simultaneously lower air pollution, boost competitiveness and bring significant social, health and well-being benefits to citizens and communities.

Garret Patrick Kelly, SEE Change Net

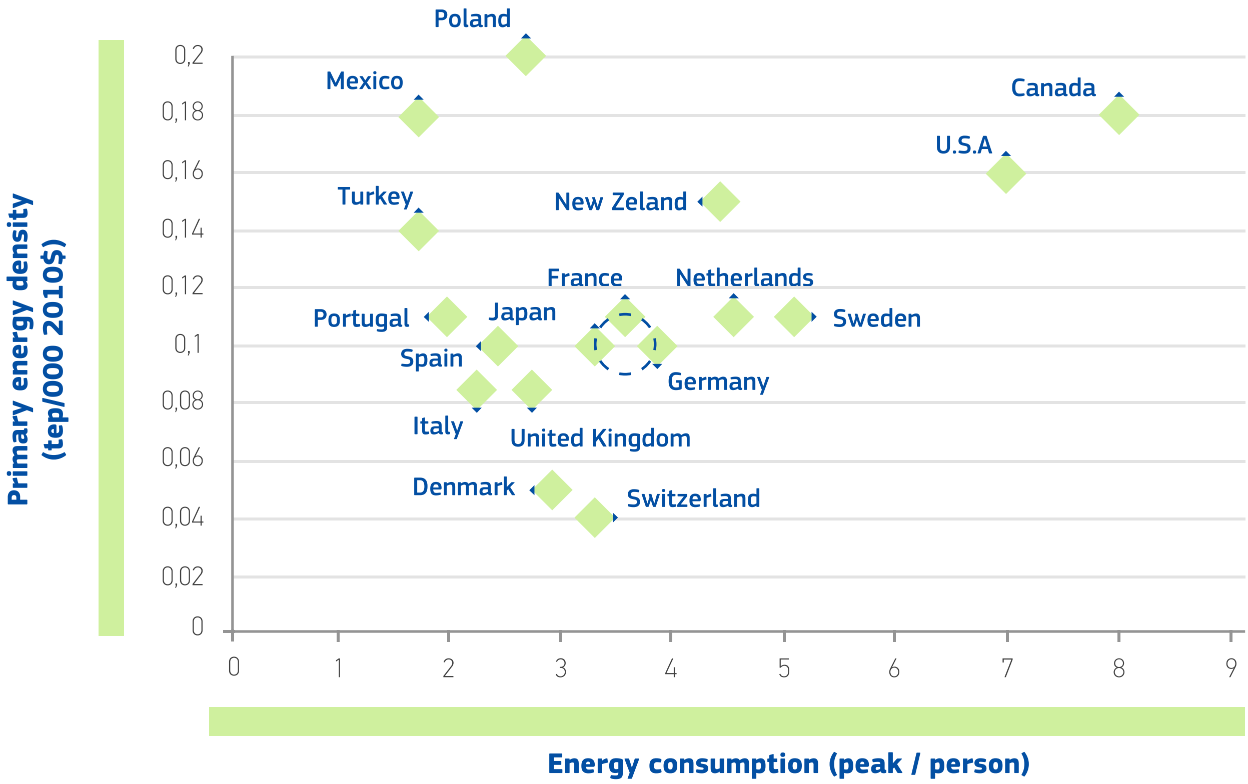
Improving energy efficiency is achievable and applicable to several sectors in a cost-competitive way. Its potential to increase security of supply and enhance overall economic competitiveness has been officially recognized, and there is the political willingness to take measures to achieve it.

Turkey's annual per capita power consumption increased dramatically between 1990-2012, and it is still increasing. The 11th Development Plan draws attention to the legislation and technical infrastructure for enhancing energy efficiency measures. The National Energy Efficiency Action Plan indicates that Turkey is more energy-intense than OECD and EU27 nations, and targets a decrease in energy intensity to OECD levels (0.11 TEP/000 2010$) from its current level of 0.12 TEP/000 2010$.

According to the National Energy Efficiency Plan, six-year cumulative values for energy efficiency measures by 2023 are:

- 14% decrease in primary energy consumption
- 23.9 million TEP energy savings
- $8.4 billion monetary savings
- $10.9 billion investment
- 66.6 billion tonnes CO_2 reduction
- 25,000+ jobs created

Gul,2017.



Primary energy intensity and energy consumption (retrieved from Gul, 2017, data based on IEA, 2017)

The regulatory and institutional frameworks to promote energy efficiency and secondary legislation have existed in Turkey since 2011. The government adopted an Energy Efficiency Strategy in 2012 (targeting a 20% reduction in energy intensity by 2023) and in 2018 it adopted the National Energy Efficiency Action Plan for 2017-2023. Credit lines for efficiency have been put in place, and international financial institutions are contributing to finance efficiency measures.

The National Energy Efficiency Action Plan involves actions in different sectors, including transport, buildings, industry and agriculture. If fully implemented, the Plan is expected to reduce Turkey's emissions by 14% below current policy projections by 2030 (New Climate Institute and Climate Analytics, 2019). The focus in the transport sector is on promoting energy-efficient vehicles and reducing traffic intensity in cities to shift to a more efficient transport mode. In the buildings sector, expanding the use of renewable energy and promoting the use of central and district heating/cooling systems are two major focus areas. The government plans to support 1.7 million households to improve energy efficiency through thermal insulation.

The industrial sector, which at 32.3% accounts for the biggest share of energy consumption after buildings (32.8%), also has the potential to save $10 billion through energy efficiency improvement projects and increased use of combined heat and power. A shift toward more energy-efficient practices would enable companies to reduce operating costs, increase productivity, and potentially create at least 25,000 more jobs. Additionally, the government is planning to replace 30% of the country's 7.5 million streetlights with more energy-efficient models by 2023.

While energy efficiency performance has and will continue to gradually improve in Turkey in the years to come, one can nonetheless question whether the bar has been set high enough. Could higher ambition in reducing energy demand help to avoid the need for new fossil fuel power plants that might lock Turkey in to a carbon-intensive infrastructure for decades? Could some of the demand management measures such as electric vehicles or 'smart' buildings reduce demand for gaseous energy carriers, and thus address the challenges of balancing the grid and reliability as more and more renewable energy resources are able to connect to infrastructure?

The buildings sector, for example, is the largest energy-consuming sector in Turkey. It offers substantial potential for energy savings, and advanced technology already exists to address that. Massive construction projects geared to the modernization of big cities offer unique opportunities for buildings to be radically optimized and transformed given their long lifetime of 50-80 years; while ambitious renovations can be undertaken everywhere, ensuring that the benefits are fairly spread throughout the country. A more ambitious transformation of the buildings sector could make buildings cheaper to run, provide healthier living conditions, and transform them into resources for the grid.

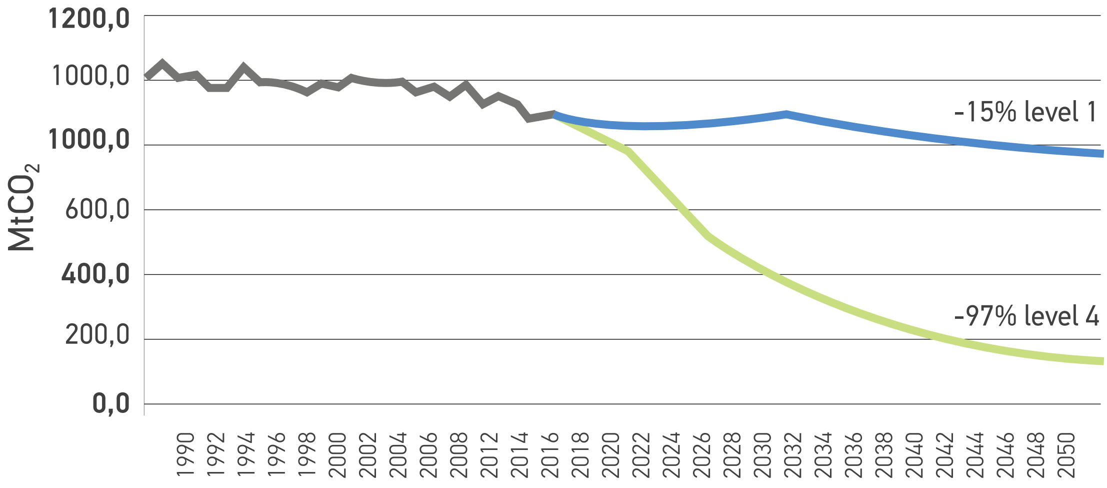
At the EU level, a deep transformation of the buildings sector has the potential to make a major contribution to the EU's overall target of improving energy efficiency by 32.5% by 2030.

Capturing and Maximizing Synergies

The European Commission's newly published European Green Deal aims to set a pathway towards achieving climate neutrality while ensuring a green and inclusive transition. The building sector is a key pillar in that respect, and the European Commission suggests that EU Member States should start a 'renovation wave' to reduce energy consumption, emissions and energy poverty.

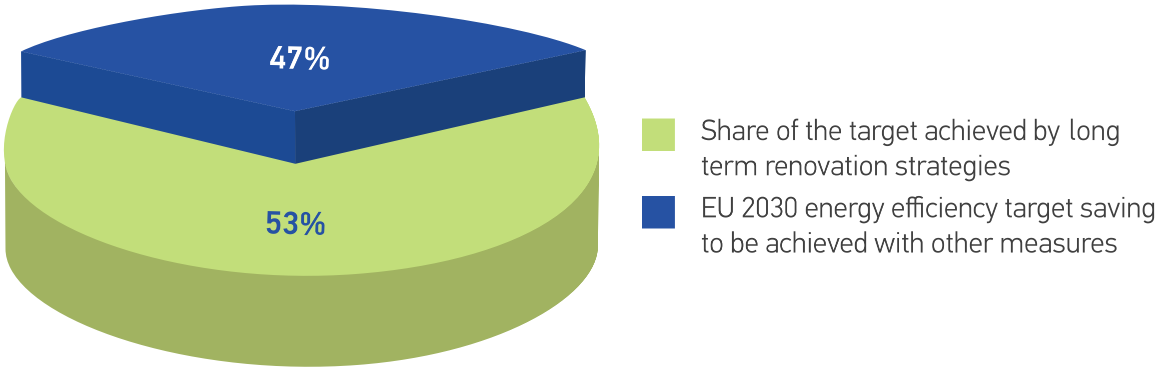
With the help of open-source tools, such as the newly developed European Calculator (EUCalc) model, it is possible to gain better insights into how different sectors could contribute to the reduction of energy demand and GHG emissions towards the long-term horizon of 2050. By exploring the full range of possible policies and measures, their scope and pace of implementation – ranging from little or no effort to reduce emissions and save energy (level 1) to extremely ambitious changes that push towards the physical or technical limits of what can be achieved (level 4) – one can compare the impact of business-as-usual with the most transformative pathways for energy supply and demand, energy security, system costs, etc.

In the case of the buildings sector, in its most ambitious and transformative path it can contribute over 50% of the European Union's overall target of improving energy efficiency by 32.5% by 2030, and reaching full decarbonization by 2050.[8]



CO_2 emissions from space heating, electricity for space cooling and hot water, and district heating in the EU, according to two different levels of mitigation effort (level 1 as little effort and level 4 as most ambitious pathway), using the EUCalc tool

[8] www.european-calculator.eu/wp-content/uploads/2020/04/EUCalc_D2.8_Pathways-explorer-buildings.pdf



Contribution to EU2030 energy efficiency target with the most ambitious pathway (level 4) for transformation of buildings sector, using the EUCalc tool

While the most transformational path for the buildings sector would not be easy to follow, it is nonetheless technically feasible and would yield multiple benefits. It would require the mainstreaming of a combination of policy measures, such as minimum energy performance requirements for existing buildings and advisory tools like one-stop-shops to help citizens in their renovation journey. It would also require exploring industrialized and prefabricated renovation solutions, on the model of the Dutch Energiesprong [9], which would reduce the costs of deep renovations and increase the renovation rate. Achieving an increased renovation rate would also require a significant mobilization of investments through both private and public funds.

The deployment of renewable heat technologies, like the latest generation of district heating and cooling systems or heat pumps, works best with highly efficient buildings. Combining the planning of renovations in buildings and heating systems can avoid unnecessary investments and lock-in effects. [10]

It is important therefore to capture and plan how to maximize synergies.

To understand the full potential for reducing energy demand as a basis for target-setting, detailed data and a better understanding of drivers, historic and future trends, the energy intensity of specific sectors and industrial sub-sectors such as steel, cement etc. would greatly contribute to the public dialogue. While the availability of data and information is the first step to informed policymaking, the mechanisms that encourage such public involvement are also a necessary condition for participatory policymaking and political accountability.

Further, when it comes to energy use, public engagement and understanding are critical to encourage more informed choices about energy efficiency investments on both individual and societal levels.

In an integrated energy system, energy supply and demand sectors interact more closely in order to facilitate a reduced energy demand and the quick scale-up of renewable energy sources.

Based on the interplay of generators and consumers in a well-connected energy infrastructure, inefficient fossil-based technologies and back-up capacities can be phased out more rapidly. An advanced integration of sectors' energy demand prevents the societal costs of stranded assets. It allows for more efficient use of existing infrastructure, harvesting the potential of demand-side response and other flexibility options (CAN Europe, 2020). [11]

[9] www.energiesprong.org

[10] http://www.european-calculator.eu/wp-content/uploads/2020/04/EUCalc_PB_no3_Buildings.pdf

[11] http://www.caneurope.org/publications/submissions-to-consultation/1938-energy-system-integration

CHAPTER III

VIABILITY OF COAL

> *"Today in major markets, including Turkey, new renewables are cheaper than new coal plants. This trend also reflects in the new installed capacity numbers. According to International Renewable Energy Association's capacity statistics, almost three-quarters of new electricity generation capacity built in 2019 uses renewable energy, representing an all-time record.*
>
> *Fossil fuel power plants are in decline in Europe and the US with more decommissioned than built in 2019. While the trajectory is promising, in terms of energy transition, still more is required in order to comply with Paris targets.*
>
> *With increasing numbers of funds moving out of the fossil fuel industry, Turkey needs to focus more on realizing its potential on the renewable energy front rather than investing in coal which is to become stranded sometime soon."*

Faruk Telemcioğlu, Clean Energy Foundation (TEMEV)

Turkey has a substantial coal lock-in outlook as a result of developing the world's third largest coal pipeline, mainly based on exploiting the local lignite resources (Global Coal Exit List, 2019). Turkey's coal imports are currently the eighth highest in the world. Its imports are from Colombia (47%), Russia, South Africa, Australia, the US, Canada, Indonesia and Poland. Turkey plans to create 31,221 MW of new coal-fired power plants (Global Coal Plant Tracker, 2019) through 31 new projects. The official target for scaling domestic coal is 12 GW (Ministry of Energy and Natural Resources, 2019).

Turkey derives 86% of its total energy generation and nearly 56% of its electricity generation from fossil fuels. In its current national energy strategy and related action plans, increasing the share of coal (primarily domestic) in electricity production is prioritized in order to transition the system away from imported natural gas. Current plans for new coal and lignite plants risk locking the country in to carbon-intensive infrastructure for decades. Prioritizing coal poses the risk of widening the gap in climate ambition between Turkey and the EU, which would in turn increase the economic, technological, legal and political risks of significant impacts on exports to Turkey's primary trade partner.

Turkey's coal-based energy trajectory[12] appears to ignore market realities that show a rapid decrease in the price difference between renewable and fossil fuel investments. Its current prioritization of lignite and emphasis on domestic coal resources means it is focusing on adding capacity based on energy independence and security of supply, rather than considering the economics and assessing the impacts of alternative technologies.

Currently, 29 coal-fired power plants are in operation for generating electricity (excluding auto producers and smaller plants below 50 MW), and the total installed capacity of coal-fired power plants in operation is 21.3 GW. Of the 31 coal plants in the pipeline, construction has begun on two with an installed capacity of 1.6 GW; nine have permits, 15 are in pre-permit development, and five others have been announced. Coal consumption is increasing in Turkey, having more than doubled between 1990 and 2012 (Algedik, 2015).

(c) Kerem Yücel, CAN Europe (2015) / Afşin-Elbistan, Kahramanmaraş.

[12]Turkey had the fastest growth of GHG emissions in the OECD (OECD, 2019). Total net emissions increased 161%, and CO_2 emissions of the energy sector increased 172% between 1990-2017 (TUIK, 2019).

Market Dynamics: No Such Things as Cheap Coal

Coal-fired generation is proving increasingly unviable because of its overleveraged and high-priced political and market risks. More importantly, despite its growth in demand and production (Cornot-Gandolphe, 2019)[13] coal is globally losing market share because it is no longer cost-competitive (BloombergNEF, 2019: McKinsey, 2019)[14 15]. Increasing Turkey's reliance on lignite decreases competitiveness with countries that are switching to more cost-efficient and financially viable alternatives.

Financial Instruments

Funding from private banks for fossil fuel projects has increased each year since the signing of the Paris Agreement, totalling $2.7 trillion over the last three years (REN21, 2020). However, there are positive developments from multinational development banks and financial institutions, which have been imposing more restrictions on coal in recent years. Every two weeks a bank, insurer or lender announces new coal restrictions, and vanishing appetite from financial institutions, unfavourable market conditions and increasing government coal phase-out announcements show that what lies ahead is a slow elimination of the coal industry in Europe (IEEFA, 2019).

[13]Cornot-Gandolphe, S. (2019) "Status of Global Coal Markets and Major Demand Trends in Key Regions", Études de l'Ifri, Ifri, June 2019.

[14]Bloomberg New Energy Finance (2019) New Energy Outlook, retrieved from https://about.bnef.com/new-energy-outlook

[15]McKinsey (2019) Global Energy Perspective: 2019 Reference Case

Political Will for Phashing Out Coal

To keep the door open for staying within the Paris Agreement's 1.5°C limit, countries will need to keep 80% of the world's coal underground.[16] This requires planning to retire a large number of existing coal power plants early, reduce the capacity factor of those that remain, and refrain from building new coal capacity. The carbon-intensive energy trajectory of Turkey contradicts[17] the high-level political will set in Paris that favours the uptake of renewable technologies.

There are some signs of action in the sector, providing cause for optimism on the possibility of an accelerated transition away from coal. The number of new coal power plants in the planning pipeline shrank by nearly 75% globally between 2015 and 2019, and several countries and investors have committed to either restrictions or a complete ban on new coal power generation. The capacity factor of the operating coal fleet continues to decline in several countries, affecting coal utilities' profitability and their willingness to invest in coal asset expansion and refurbishment. As a result, coal assets are becoming increasingly vulnerable to market and policy changes around the world.

- Unabated coal-fired power generation globally should be reduced to 80% below 2010 levels by 2030 and phased out before 2040, some 10 years earlier than previous estimates.
- Most reductions in coal in the power sector need to be made by 2030, when the share of coal in electricity generation should not exceed 13% anywhere, and be around 6% globally.
- Between 2030 and 2040 all regions should phase out of coal. The first regions to phase out are the OECD, Eastern Europe and former Soviet Union countries by 2031, followed by Latin America by 2032, the Middle East and Africa by 2034, and finally non-OECD Asia by 2037, completing a global coal phase-out before 2040

(c) Kerem Yücel, CAN Europe (2015) / Afşin-Elbistan, Kahramanmaraş

[16]McGlade, C., & Ekins, P. (2015). The geographical distribution of fossil fuels unused when limiting global warming to 2 C. Nature, 517(7533), 187

[17]According to the official Intended Nationally Determined Contribution (INDC) of Turkey issued on September 30, 2015, with the current policies total emissions will rise to 1,175 $MtCO_2e$ by 2030. In other words, Turkey will see over a 155% increase when compared to 2013 values (UNFCCC, 2015).Nature, 517(7533), 187

EU Coal Phase-out Policies are Spreading Fast and the Trend is Irreversible

In a wave of retirements across the EU and US, 268 GW of coal plants have closed. Another 213 GW are set to retire, and 19 of the world's 80 coal-powered countries plan a complete phase-out of the fuel, including the UK and Germany[18]. Since 2015, 15 national governments in the EU have stated their intention to phase out coal: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Portugal, Slovakia, Sweden and the UK have announced or are discussing plans to ensure no coal is in the electricity mix by 2030. Across Europe, 82 coal-fired power plants have already closed down or had their closure announced.

A total of 72.8 GW of coal power capacity is located in countries which have announced they will phase out coal by 2030 or earlier, putting the coal plants in these countries on a pathway to closure. This corresponds to 40% of Europe's currently operational coal fleet.[19]

Whether driven by economic necessity (e.g. ageing of plants, cost of complying with European directives such as the Industrial Emissions Directive, growing competitiveness of renewable energy), by policies linked with climate change, public health, local controversies, restrictions of financial flows due to new compliance schemes, or other concerns, the phase-out process in Europe offers various lessons on the specific challenges of coal transitions (see Leal Arcas et al, 2020 for an extensive analysis on energy transitions in the EU[20,21]).

The main obstacle is not usually a lack of alternatives to coal. Policy support tools such as the EUCalc offer policymakers, as well as the general public, the opportunity to investigate energy transition scenarios, including the different timings of phase-out and their impact on decarbonization pathways as well as air pollution. Observations from EUCalc and multiple other scenarios and exercises show that national consumption demands can in most cases be met either with zero coal or with minimal amounts of coal, provided that adequate policies are being implemented.

Other obstacles influencing phase-out trajectories – such as institutional barriers, coal-related stakes and employment protection schemes – have been addressed across Europe by putting in place just transition task forces, coal transition commissions and stakeholder consultation platforms to explore options for coal moratoriums. While there is no one-size-fits-all approach to structural change, integrating local stakeholders and civil society into policy planning, as well as open discussion about potential development scenarios in coal-dependent regions and sectors to identify specific regional potentials and locational factors, has been one of the crucial success factors.

This also includes establishing a dedicated policy framework to support a fair transition for impacted constituencies. To facilitate the transition away from coal, in 2017 the European Commission created the Coal Regions in Transition Platform. Its aim is to facilitate the development of projects and long-term strategies in coal regions. It is designed to boost the clean-energy transition in these regions by bringing more focus to social fairness, structural transformation and new skills; and by promoting investment in new technologies and creating new jobs. Similarly, the "leaving no one behind" of the European Green Deal refers to the so-called The Just Transition Mechanism, which is set to provide tailored financial and practical support to help workers and generate the necessary investments in regions most affected by the green transition –moving away from fossil fuels like coal, lignite, peat and oil shale.

[18] www.carbonbrief.org/mapped-worlds-coal-power-plants

[19] https://beyond-coal.eu/wp-content/uploads/2020/03/Overview-of-national-coal-phase-out-announcements-Europe-Beyond-Coal-February-2020.pdf

[20] The Great Energy Transition in the European Union, Volume 2, Eliva Press, 2020; 429 pages; ISBN-13: 978-9975-3417-3-8.

[21] The Great Energy Transition in the European Union, Volume 1, Eliva Press, 2020; 438 pages; ISBN-13: 978-9975-3417-1-4.

Stranded Asset Risk

Stranded assets (Caldecott et al, 2016) are investments that are not able to meet a viable economic return, and which are likely to see their economic life curtailed due to a combination of technology, regulatory and/or market changes. The political will of the Paris Agreement has created a carbon bubble in which fossil fuel companies and their assets are overvalued. The International Energy Agency has warned that, if we are to meet Paris' target of "well below 2°C", 1,715 GW of fossil fuel power generating infrastructure must be shut down before the end of its expected lifetime. With the Paris Agreement having come into effect, the financial risks posed by a limited carbon budget must now be treated as a material risk by big business. The potential for defaults and stranded assets would undermine the Turkish banking sector.

There are some counterarguments on the basis of downward commodity prices based on a potential phase-out. Accordingly, it is argued that abundant resources due to a decrease in demand would keep prices – and energy imports – at lower levels. Another statement is limited exposure to stranded assets based on domestic resources. These arguments are criticized because i) phase-out is a political process that would have binding/restricting impacts at a global level; and ii) market prices rely on several global externalities with which lignite's compatibility would be questionable due to superior competing technologies.

Impacts of Coal

The heavy economic and financial burdens from the coal and lignite sector would be long-lasting, negatively impacting consumers, businesses, the public sector and the power generators themselves. This is true even without factoring in externalities, or taking into account the social and environmental costs of coal mining and coal-fired power plants.

Coal is recognized today for its fundamental limits and the wide range of risks to which it exposes people, the atmosphere and the environment. Policies and incentives that increase the share of coal in electricity generation in Turkey should be critically assessed from the perspectives of combating climate change, building a sustainable energy policy, limiting degradation of natural resources and reducing health and other social costs (HEAL, 2014).

CHAPTER IV

RENEWABLE SOLUTIONS

Due to affordable technology costs, global wind and solar investments are expected to continue in an increasing trend. An energy system that is based on a higher share of renewable energy comes with multiple benefits: improved energy security, better trade balance, increased economic activity, new employment opportunities and a better environment.

Turkey, with its significant resource potential to scale up wind and solar generation, is no exception to this global trend. The use of renewable energy resources, primarily wind and solar, is also expected to grow significantly within Turkey's power system. SHURA's analysis back in 2018 has shown that Turkey can generate 20% of its total electricity from wind and solar by 2026 without negatively impacting the transmission system and planning.

With 30% more investment in transmission capacity and 20% more in transformer substations, it is even possible to triple the installed renewable energy capacity. Such an increase would make solar and wind the largest source of electricity generation in Turkey with a total share of 31%. A higher share of renewables would reduce the electricity provided by thermal generators.

Değer Saygın, SHURA Enerji Dönüşüm Merkezi

Turkey's official projections aim to meet the country's growing energy demand while reducing its dependence on energy imports, which currently make up 75% of the country's primary energy supply. Public authorities see renewable energy as a main pillar – coupled with domestic coal – for overcoming this challenge. Renewable technologies are indispensable for decarbonizing the energy system. There is significant potential for scaling up wind and solar generation in Turkey, and the growing business case combined with the availability of abundant resources close to high demand regions provides an enabling environment.

As previously stated, the total installed electricity generation capacity reached 91 GW in January 2020 (from 85 GW in 2017 and 78.5 GW in 2016): within this total there has been tremendous growth in renewables. Turkey's renewable capacity (excluding hydropower) reached 12,198 MW, the 14th largest in the world. With its new renewable capacity additions of 2,586 MW, Turkey moves to ninth in the world.

Turkey has ambitious renewables targets across sectors – it aims to reach 20 GW of installed wind capacity, 5 GW of solar and 1 GW of geothermal by 2023, as well as 34 GW of hydropower. A boom in unlicensed solar development saw Turkey reach 5 GW installed PV capacity by the end of 2018, well before 2023, due to a generous feed-in tariff. This increasing trend brought Turkey to 6 GW by the beginning of 2020. With one of the highest solar PV potentials among its European peers, and having already surpassed its 2023 targets, Turkey is expected to aim for a higher level of solar energy integration into the electricity market. A recent study from SHURA Energy Transition Center (2020)[22] shows that rooftop capacity provides an expansion opportunity for the solar industry in Turkey. The country's technical rooftop capacity is estimated at 14.9 GW, of which 4.5 GW is financially viable. Accordingly, it is possible to meet 17% of residential electricity demand through the use of rooftop solar PV panels.

Wind energy, with a reported potential of 48 GW, has been steadily growing in Turkey; and the installed capacity had reached 8 GW by the end of 2019. But the 20 GW target – which amounts to 40% of the technical potential – would require the installation of more than 2 GW of additional capacity each year, and policy support has been inconsistent. The site-specific 1 GW RERA auctions have yet to deliver any capacity, with cancelations and delays characterizing the process so far. The FiT is also due to expire after 2020, with no visibility on support for renewables after that point.

With regards to geothermal energy, the 1 GW installed capacity target was already surpassed in 2017, incentivized through a FiT scheme. At a global level, Turkey was the world leader in geothermal expansion (+219 MW) in 2018 (IRENA, 2019).[23]

Market Conditions

Clean energy investment has grown steadily since 2012, with wind leading the investments with $1 billion per annum until 2017 and solar technologies leading the sector since then. Investment in renewable energy has been stalled since 2018 due to uncertainty with the feed-in tariff (FiT) scheme, currency fluctuations and an economic downturn.

The utility scale auctions in 2017 yielded world-record results. Since 2017, the government has conducted five major auctions. The first, in March 2017, awarded 1 GW of solar capacity at an average price of $69.9/MWh. The second, held in June 2017, was a pre-licence auction in which 710 MW of onshore wind was awarded at an average price of $11.5/MWh. The third, in August 2017, awarded 1 GW of onshore capacity at an average price of $34.8/MWh. The fourth, in December 2017, was a pre-licence auction in which 2,110 MW of onshore wind was awarded at an average price of $50.8/MWh. A fifth auction in June 2019 awarded 1 GW of onshore wind at an average price of $39.4/MWh. The auctions have focused capacity installations in areas where the technical potential is the highest.

The government chose to create a general renewables market and develop local value chains, and to recuperate the solar market that was uncredited against the country's resource potential. Other countries have made similar policy choices, but it is important to note that new policies need to be developed as markets and technologies evolve. Current solar investments are exclusively in small-scale (mainly 1 MW) projects. However, Turkey's renewable market has practically stalled due to policy uncertainty and the challenging economic conditions – the solar sector has been particularly impacted.

[22] ASHURA (2020) "Binalarda çatı üstü güneş enerjisi potansiyeli – Türkiye'de çatı üstü güneş enerjisi sistemlerinin hayata geçmesi için finansman modelleri ve politikalar"

[23] IRENA (2019), www.irena.org/newsroom/pressreleases/2019/Apr/Renewable-Energy-Now-Accounts-for-a-Third-of-Global-Power-Capacity

Turkey Renewable Energy Site Auctions

Renewable Energy Resource Areas (RERAs/Yeka) are plots of land allocated by the government for renewable energy generation. The right to develop in these areas is granted through reverse auctions. The first auction for the first 1GW RERA (Karapinar) for PV took place in 2017. Second rounds for both onshore wind and PV were announced in 2018, though the PV round was later cancelled, as was a round for 1GW of offshore wind.

System Flexibility

As renewables' share in the electricity mix increases, more system flexibility will be required. The traditional power system is challenged by the growing demand for electricity, changing load profiles from the introduction of new technologies like electric vehicles, and the rapid penetration of variable renewable sources like solar and wind. An analysis from SHURA Energy Transition Center (2018) shows that the high-voltage transmission grid (including and above 154 kV) can integrate a total installed wind and solar capacity of 40 GW by 2026 without any operational difficulties or further grid investment beyond that already planned by the transmission system operator (Türkiye Elektrik İletim A.Ş., TEİAŞ). Large-scale renewables can be integrated into the power system in a cost-effective way due to the availability of flexible resources such as hydropower plants and combined cycle gas turbines (Turkish Electricity Transmission Corporation, 2017). Tripling the existing solar and wind capacity would imply a negligible cost on system planning and operation (SHURA, 2018). The impact on redispatch (request issued by the transmission system operator to power plants to adjust the real power they input in order to avoid congestion) and curtailment (reduction in the output of a generator from what it could otherwise produce) would be negligible.

Storage

The role of battery storage has been discussed for several years in Turkey. At the end of January 2019, draft legislation on energy storage was released for public consultation. In addition, energy companies are looking into options for investing in battery storage technologies and related business models to operate them. While the issue is attracting much interest, there is a need to better understand the areas in which investments should be directed, to what extent storage capacity should be built up, which technology should be employed for which purpose, and when battery storage makes the most economic sense.[24] Turkey's first pumped hydropower storage project is due to begin this year with a TRY 6.3 billion investment from Kalyon Insaat, Itochu and Toshiba.

[24] For more information on feasibility of different storage technologies, see Saygin et al (2019) On the Way to Efficiently Supplying More Than Half of Turkey's Electricity from Renewables: Costs and Benefits of Options to Increase System Flexibility, https://www.shura.org.tr/wp-content/uploads/2019/04/SHURA_Costs-and-benefits-of-options-to-increase-system-flexibility.pdf

Interconnection

Turkey is synchronously connected with continental Europe through one electricity line to Greece and two lines to Bulgaria. Trade is limited with 550 MW from Bulgaria and Greece to Turkey; and 400 MW from Turkey to Europe via these countries (TEİAŞ, 2014, European Commission, 2019). Network of Transmission System Operators for Electricity (ENTSO-E) signed a long-term agreement on 15 April 2015 providing for the permanent physical integration of the Turkish and EU electricity markets. The integration of the Turkish electricity system and market with those of Europe has hence been taken to a higher level. An observer membership agreement was signed by TEİAŞ and ENTSO-E on 14 January 2016 and TEİAŞ became an observer member of ENTSO-E. Increasing interconnectivity would allow countries to benefit from different energy mixes.

A New Era for Renewable Technologies

The significant fall in the costs of solar, wind and other renewable energy technologies has led to a new era in electricity generation. Since 2012, global net capacity additions in renewables have surpassed those of all other technologies, but the growth trend flattened in 2018 (IEA, 2019). [25]

Many countries have already achieved wind and solar shares above 15% without experiencing major problems. Some countries such as Denmark, Germany, and Spain provide close to or even more than one-quarter of all their output from wind and solar power. Denmark and Germany top the charts for system reliability – in other words, they experience the fewest power outages. In the process, countries have developed their own strategies to ensure a flexible power system to integrate higher shares of wind and solar. Strategies to better integrate high and growing shares of variable renewables include strong transmission grids, flexible generators, interconnector capacity that allows for electricity trade with neighbouring countries, demand-side management strategies, energy storage, and improved techniques for energy planning and forecasting (SHURA, 2019). Global examples are showing that wind and solar shares of up to 25% can be successfully integrated without changing the power system. This can translate into more than 80% of demand at specific hours of the year. Systems in California, Germany and Spain have developed various flexibility options such as strengthening interconnector capacity with neighbouring systems, improving fossil fuel plant flexibility, and allowing for limited curtailment in extreme cases. Some countries have also adapted

[25] IEA (2019), https://www.iea.org/news/renewable-capacity-growth-worldwide-stalled-in-2018-after-two-decades-of-strong-expansion

their market design to address highly variable prices, low utilization rates of fossil plants and the associated investment challenges.

Renewable energy auctions have achieved record prices for large-scale utility projects. Turkey should continue such efforts by considering its resource potential, as well as encouraging project development to ease grid integration. As the costs of renewables go down, Turkey should continue implementing market-based policy mechanisms by making them sustainable and ensuring adequate environmental impact assessment processes (EIA). In order to increase competition in the medium term, it might be beneficial to develop strategies for incentivizing projects of different sizes, from large to medium commercial plants, as part of the framework after the expiry of the current FiT system in 2020. These strategies could also include policy frameworks suited to distributed generation, which has significant potential in Turkey and might yield strong benefits, both by reducing losses in distribution and transmission systems and through local and regional socio-economic value creation. These policies could be complemented with similar instruments and financing for energy efficiency and widespread electrification in the heating, cooling and transport sectors.

The most conservative estimates of rooftop solar PV potential in Turkey add up to 4 GW, around 10% of its theoretical potential of more than 40 GW, with much of that potential being on commercial and industrial roofs (World Bank, 2018). These are the same areas where grids are strong and demand is high. Therefore, the focus should be on also opening a window of opportunity for smaller-scale investors and others to develop business in regions with slightly lower wind speeds and solar irradiation, but where electricity can be fed into the grid without disruptions and can be sold without any major infrastructure investments. This will partly happen through investor initiatives. The new regulatory framework for rooftop solar PV is a good starting point for accelerating the deployment of more distributed capacity that can generate electricity where it will be consumed, thereby reducing stress on grid infrastructure and system operation.

There is broad agreement that a European grid infrastructure will play a key role in providing a secure and stable system that allows for the integration of a high share of renewables and that enables the transition to a decarbonized economy. Turkey is an important asset for an interconnected and decarbonized EU power system due to its abundant renewable resources. Turkey's potential for expanding the EU electricity grid should allow the full integration of renewable energy in line with the regulations and market design promoting EU grid planning and investment. Taking the Energy Union's[26] supply security dimension and the decarbonization of the EU energy mix together, the Energy Union initiative can provide opportunities for the EU to design and balance relations with Turkey as one of the source countries through a renewable European grid interconnection.

[26] The Energy Union is the backbone of the European Union policy on energy and climate. The goal of the Energy Union is to give EU consumers - households and businesses - secure, sustainable, competitive and affordable energy. Achieving this goal will require a fundamental transformation of Europe's energy system.

CHAPTER IV

THE ROLE OF NATURAL GAS IN TURKEY'S LOW-CARBON TRANSITION

Natural gas has been promoted as a so-called 'transition fuel', the bridge to renewable energy. But this belief does not stand up to scrutiny. Fossil gas emits methane, one of the strongest greenhouse gases, and leaking methane along the gas supply chain can only exacerbate the climate emergency we are facing today.

In the context of the Paris Agreement , there is no room for new fossil fuel infrastructure. New natural gas infrastructure would in fact become stranded assets in order to comply with the targets of the Paris Agreement.

It will either lead to a 'fossil lock-in' whereby fossil energy funding commitments inhibit the growth of renewables; or become 'stranded assets' in a decreasing market for gas and concurrent higher demand for clean energy sources like wind and solar.

Food & Water Europe is opposed to natural gas projects in Europe. Working with our allies, we have argued that any new natural gas project will drain EU funds that are vital for the renewable energy transition underlining the Green Deal.

Frida Kieninger, Food & Water Europe

Heavy dependence on natural gas and volatility in global energy prices have increased the vulnerability of Turkey's electricity market. The geographical concentration of gas imports – 70% are from Russia and Iran – poses concerns in terms of its risks at the international political level.

Market Dynamics

Existing natural-gas-powered plants are not profitable because of the oversupply in Turkey's power market and because the operating margins of lower efficiency CCGTs (combined-power cycle plants) are not competitive at current market prices.

Gas power plants have significant exposure to foreign currency loans, and they offer few investment incentives compared to other technologies. The result is that gas generation is being squeezed out of Turkey's power system. The current share of natural gas in electricity generation is 29.9%, but it is expected to decline to 20.7% by 2023 (11th Development Plan).

The major challenge with natural gas investments is the capital-intensity of the infrastructure, especially liquid natural gas (LNG) ports and pipelines. The payback period of such significant investment largely depends on the utilization rate of this infrastructure, which depends on the gas demand and the existence of alternative routes for gas transportation. The current natural gas projects are Baku-Tbilisi-Erzurum Natural Gas Pipeline (BTE), Turkey-Greece Interconnector (ITG), Western Route (Russia-Turkey Natural Gas Pipeline), Blue Stream Natural Gas Pipeline, Iran – Turkey Natural Gas Pipeline, Trans-Anatolian Natural Gas Pipeline (TANAP) and Turkish Stream Gas Pipeline.

Gas demand is expected to drop as a result of the diminishing role of gas in Turkey's power sector and the economic recession. On the supply side, higher imports of Azeri gas through the Trans-Anatolian Natural Gas Pipeline together with higher domestic gas production will eat into the diminishing share of LNG and Russian gas. This raises the risk of Turkish importers struggling to comply with contractual take-or-pay obligations.

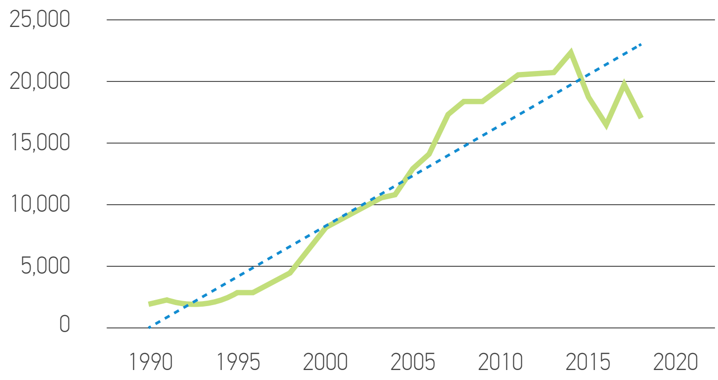
EU Trends Point to a Limited Future for Natural Gas

The IEA predicts an annual average increase in gas demand of 1.5% up to 2040.[27] In Europe, significant investments in new gas pipelines and LNG ports have been proposed, planned and initiated as part of a strategy to increase security of supply, including through accessing alternatives to Russian sources of gas. The overall utilization rate of existing LNG ports is close to 25%, with many ports remaining unused (European Parliamentary Research Service, 2015). If the proposed four gas pipelines (including Nord Stream II) and 39 LNG ports were built, this would increase the EU's gas import capacity by 58% (CAT, 2017). Thirty-two natural gas infrastructure projects of common interest (PCI) combined would cost €29 billion and would add 338 GW capacity to the EU natural gas infrastructure system, which is already approaching 2000 GW of pipeline and LNG terminal capacity. The European Commission's projections currently estimate that achieving the 2030 climate and energy targets will result in a 29% reduction of natural gas, from 415 billion cubic metres (bcm) in 2015 to 297 bcm in 2030. Building the infrastructure to decarbonize the EU's energy system by 2050 through using large amounts of biomethane is projected to be up to 36% more expensive than through energy efficiency and smart electrification (Artelys, 2020).

[27]In the IEA's New Policies Scenario, an increasing global gas demand would mostly be covered by LNG, which would increase its share from 42% in 2014 to 53% in 2040, and lead to projected investments of close to $2.2 trillion in gas transmission and distribution in the period 2016–2040 (IEA 2016c).

A Bridging Role for Natural Gas?

Natural gas is not a long-term solution towards decarbonization, and a low-carbon transition without natural gas is possible. The future of natural gas is limited, even as a bridging fuel (Climate Action Tracker, 2017). Continued investments into the sector risk breaching the Paris Agreement's long-term temperature goal and will result in stranded assets. Energy experts predict a dwindling role for natural gas in the power sector toward the middle of the century, not only to meet the Paris Agreement goals, but also due to increasing competition from renewables. Although the emissions from gas plants can be reduced by up to 90% with carbon capture and storage (CCS), this is not sufficient for full decarbonization. Even if these capture rates could be increased, ultimately the cost of gas with CCS is unlikely to be competitive with renewables and a flexible grid. Investments in gas infrastructure, especially in the exploration of non-conventional and thus more expensive resources, may lead to significant stranded assets in the future if projected demand increases do not materialize. Moreover, there are persistent issues with fugitive emissions during gas extraction and transport (IPCC, 2014). Natural gas only has a very short 'bridge' to renewables. Even if coupled with CCS, current evidence suggests significant emissions would still occur which would require additional abatement strategies or balancing with negative emissions technologies. Additional cost pressures arise from the increasing market share of cheap renewables. Even if gas may play a role in balancing weather-dependent renewables in the short term, there are numerous alternatives to the role of natural gas in increasing the flexibility of the power grid, such as storage, grid development, demand management or flexible renewables.



Historical trends of natural gas demand (thousand TEP) in Turkey (retrieved from Energy Balance Sheets of the Ministry of Energy and Natural Resources)

CHAPTER VI
NUCLEAR ENERGY

Germany used to produce one-quarter of its electricity by operating 17 nuclear reactors. After the Fukushima nuclear power plant accident in 2011, Germany shut down eight reactors amid safety concerns surrounding the technology and announced the vision of Energiewende, the energy transition plan, stressing renewable energy and phasing out completely its nuclear stock by the end of 2022.

What options does Germany have to fill in this void in terms of clean energy capacity? How can this option space be expanded when changes in energy demanding sectors and lifestyle adjustments are included into imagining decarbonized futures?

In the EUCalc project, we argue that for a trusted and credible governance of energy transition aligned with ambitious climate neutrality targets, tools such as the EUCalc Transition Pathways Explorer (http://tool.european-calculator.eu/intro), are needed to help decision-makers recognize and navigate the vast option space and derive transition pathways that are fair, just, publicly acceptable and ultimately sustainable.

The EUCalc tool enables a transparent, evidence-based and participatory approach to energy transition. It provides insights about technology and lifestyle choices that we can take between now and 2050 and their environmental and socio-economic impacts. Such insights are essential for an informed and constructive discussion in society.

Bernd Hezel, Climate Media Factory and European Calculator (Horizon 2020 project)

Turkey has had plans for establishing nuclear power generation since 1970. Recent developments have seen Russia take a leading role in offering to finance and build 4800 MWe of nuclear capacity. The political controversy over Russian collaboration on Turkey's nuclear power plants[28] is a worrying factor due to the political turmoil between the countries in addition to the existing economic, safety and environmental concerns.

[28] See the official gazette on www.resmigazete.gov.tr/eskiler/2010/10/20101006-6.htm

Outlook: Absence of Dialogue and Reassurance

The official projections for 2023 energy targets state nuclear energy installed capacity as 10 GW in operation with a third plant under construction in the following three years. At present, there is no nuclear power plant in operation in Turkey. However, Turkey is considering embarking on a nuclear power programme based on the target and is still planning to install three nuclear power plants, to include 12 nuclear power reactor units. The first nuclear power plant (Akkuyu NPP) is expected to comprise four units of WWER-1200 type reactors; it is planned to be constructed and operated it in Mersin province under the agreement signed with the Russian Federation in 2010. In addition to local controversies at the project site (TMMOB, 2019; Platform Against Nuclear, 2019),[19] the European Parliament recently voted against the construction of the Akkuyu plant, calling for the inclusion of neighbouring countries in the process and pointing out the risks of severe earthquakes in that region. [30]

The second nuclear plant (Sinop NPP) is projected to include four units of ATMEA1 type reactors constructed and operated in Sinop province under the agreement with Japan made in 2013. A Franco-Japanese consortium was expected to build the second nuclear plant, although the project is facing difficulties after the Japanese construction partner withdrew. The government is still planning on its construction, but has yet to announce new partners and funders.

The site selection process for the third nuclear plant is still ongoing. Discussions concerning the plant are underway with Chinese interests.

The construction of the first unit of Akkuyu NPP was formally launched in April 2018 and initiated in the form of land grading. The first unit of Akkuyu NPP is expected to be in operation by the end of 2023. The other units will be put into commercial operation at one-year intervals until the end of 2026. Other NPPs are planned to be in operation by 2035. A small uranium mining project is planned along with these projects.

Name	Installed capacity	Type	Status
Akkuyu 1-4	4800	VVER-1200	Planned, under construction
Sinop 1-4	4600	Atmea 1	Uncertain
Igneneada	5300	AP1000*2 CAP 1400*02	Unkown

Planned nuclear power plants in Turkey (adjusted from World Nuclear Association)

[29] See the constituencies of the Platform Against Nuclear at http://portal.nukleerkarsitiplatform.org/category/s7-nkp-ller

[30] See Resolution 2241 (2018) at http://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=25175

Technology Choices Surrounded by Major Public Concerns over Safety

The technological characteristics of the Akkuyu nuclear power plant have been criticized for being outdated. The VVER-1200 technology – presented as an established technology in Akkuyu NPP's Environmental Impact Assessment Report – is criticized for not having a precedent implementation (TMMOB, 2019). The reactor suggested for the project in Turkey, known as Model 1400, has not been given safety approvals by European institutions.

Earthquake risk. The Akkuyu plant is being built in an area prone to earthquakes. This, along with reports of recurring cracks in the concrete foundation of the site, has further increased concerns about construction management and questions about its safety.

Bloomberg New Energy Finance states a high capital expenditure assumption for Turkey's nuclear energy, at $4.78 million per MW. The levelized cost of electricity range estimates for new nuclear projects is $164-172 per MWh. It is important to note that the purchase guarantees for wind and geothermal projects are lower than the ones provided to the Russian company for the Akkuyu NPP (WWF and BloombergNEF, 2014). Nuclear power plants are not financially viable, and are heavily subsidized. The purchase guarantee for electricity that will be produced by Akkuyu NPP is $12.35 +VAT (Istanbul Platform Against Nuclear, 2019). The Chamber of Electrical Engineers in Turkey estimates the Akkuyu NPP's purchase guarantee to be around $35.5 billion for the next 15 years (Chamber of Electrical Engineers, 2019).

Significant Global Support for Nuclear Phase-out

There is significant political buy-in for phasing out nuclear power plants at the global scale. The heavy burden of nuclear disasters at Three Mile Island (1979), Chernobyl (1986) and Fukushima (2011) has resulted in strong resistance by local communities around the world.

CHAPTER VII

LAND USE, WATER, BIODIVERSITY, AIR QUALITY

We witness the effects of climate changes all around Turkey. There has been an increase in observed flood and drought which affects our lives and causes a great deal of soil and biodiversity loss. A growing population – with almost 75% of Turkish population living in cities – poses additional pressure on our natural assets such as soil, water, air and natural habitats. To secure liveable future we urgently need to direct our collective effort towards sustainable and cleaner modes of mobility, energy supply and energy conservation, improved waste management and making sure that our natural assets are preserved and food systems healthy.

Gaye Kandemir, Seed Association

Climate change is having – and, unless checked, will continue to have – an existential impact on our ecosystems. The effects of climate change are becoming increasingly clear in Turkey and the Mediterranean basin – these include drought, water scarcity, agricultural yield loss, decline of agriculture and tourism revenues, a loss of biodiversity and an increase in forest fires.[31] Precipitation has decreased by 20% in the Mediterranean basin in the last 25 years. Meanwhile average temperatures in the region have already risen by 1.4°C since the pre-industrial era, 0.4°C more than the global average. Even if future global warming is limited to 2°C, as targeted by the Paris Agreement, summer rainfall is at risk of declining by 10-30% in some regions, worsening existing water shortages and reducing agricultural productivity, particularly in southern countries.[32] Under such circumstances irrigation would have to be increased by 4-22%, which would put it in competition with other uses (drinking water, tourism, industry). Turkey is a water-scarce country with a growing population and an increasing demand for water. Water availability is 1.519 m^3 per capita/annum, which poses a challenge. Increasing population and urbanization risk turning Turkey into a water-poor country in the next decade. Turkey lost 1.3 million hectares of wetlands in the last 50 years through excessive water use in agriculture, unsustainable water infrastructure projects, and climate change. The agricultural sector uses 73% of Turkey's freshwater.[30] Large-scale infrastructure projects (highways, urbanization, etc.) and mining activities directly affect freshwater resources, especially wetland ecosystems. Such investments can consume huge amounts of water during their construction and operation phases, or they may pollute water resources. Hydropower investments cause considerable public controversy in Turkey, and there is significant local resistance to them around the country.

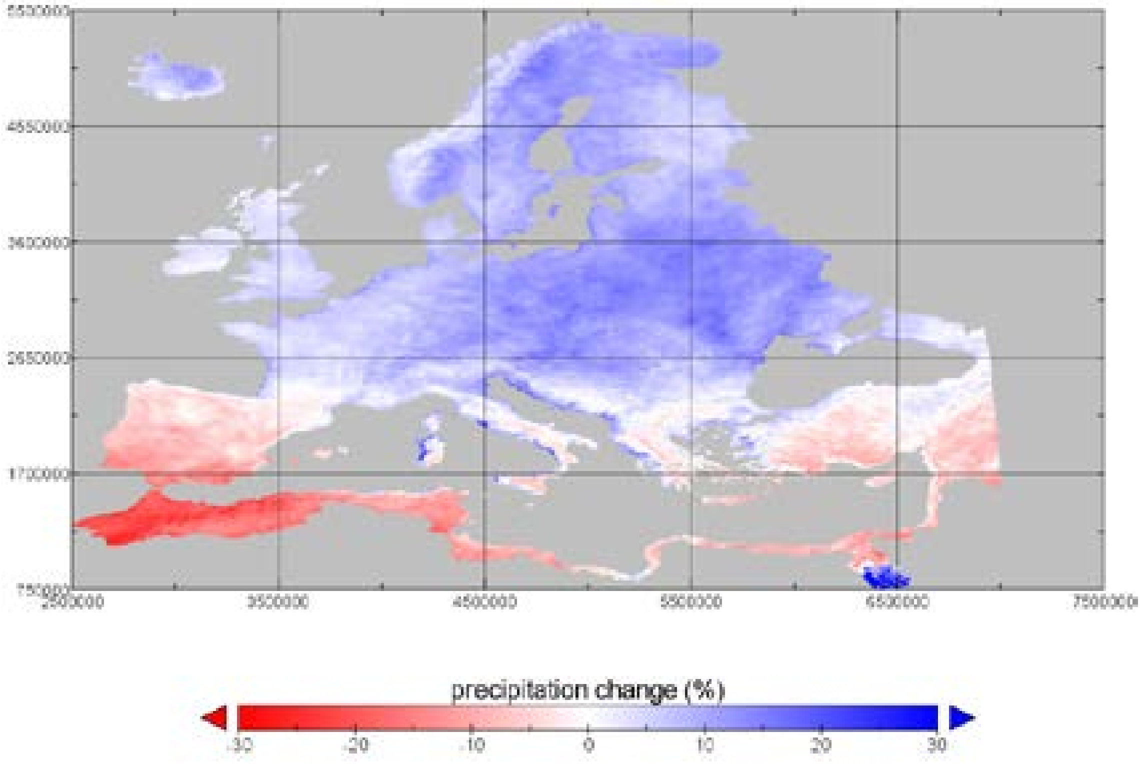
[31]The future total Mediterranean basin averaged sea-level rise has been estimated to be between 9.8 and 25.6 cm by 2040–2050 depending on the scenario (Galassi and Spada, 2014). Warming of the Mediterranean Sea surface is currently estimated at 0.4 °C/decade for the period 1985-2006 (Nykjaer 2009). Concerning future changes, the Balearic Islands, the northwest Ionian, the Aegean and Levantine Seas have been identified as the regions with maximum increase of sea surface temperature (Adloff et al, 2015). Mediterranean Sea acidification is already detectable (Howes et al, 2015).

[32]The Mediterranean basin has been identified as one of the two most vulnerable regions to climate change globally. The IPCC Fifth Assessment Report considers the region as "highly vulnerable to climate change", also mentioning that it "will suffer multiple stresses and systemic failures due to climate changes. In particular, risks associated with increases in drought frequency and magnitude are projected to be substantially larger at 2°C than at 1.5°C.

[33]Irrigation is thought to be economically viable on 8.5 million hectares of the 28 million hectares of agricultural land in Turkey. The State Hydraulic Works has initiated irrigation use on two-thirds of this area (5.7 million hectares). According to official projections, the full irrigation potential will be realized by 2023.

Several studies, including one[34] released by the European Commission's Joint Research Centre (JRC) in 2018, have looked at the impact of the changes in climate, land use and water usage on Europe's water resources.

According to this report, Turkey is among the countries which are projected to face increased water shortages (alongside Spain, Greece, Cyprus and Italy) and a high risk of forest fires (alongside Portugal and Spain) under a 2°C warming scenario. Biodiversity threats also increase due to climate-driven habitat loss.



Projected annual average precipitation changes in Europe at the time when a global average temperature of 2 degrees is reached (average of 11 Euro-Cordex models)

Agriculture and food production will be heavily affected as a result of climate change, particularly because of the changing water supply. Strategic responses to support sustainable land use – which also achieve food and energy security, support health and prosperous lifestyles, and conserve water and biodiversity – are therefore of the utmost importance for Turkey's economy today and in the future. Any planning process that considers either of these elements should be aware of the factors with which they interact, and a careful approach is required to avoid the potential negative impacts of land conversion.

[34] https://ec.europa.eu/jrc/en/publication/impact-changing-climate-land-use-and-water-usage-europe-s-water-resources-model-simulation-study

Coal-fired power plants are among the most polluting industries. The hazardous waste discharged into the environment from coal-fired power plants is comprised of suspended particles, sulphur dioxide, nitrogen oxides, carbon dioxide, carbon monoxide, volatile organic compounds (VOC), dioxins, hydrochloric acid, ash, radioactive materials, and heavy metals (Environmental Health and Engineering, 2011; Sahin et al, 2016; HEAL, 2014). Coal has negative impacts on the natural environment during every stage of its use: from its extraction and transportation, to its preparation (through crushing, sieving and washing) and burning, all the way through to the disposal of the waste produced in each of these stages. It destroys forests, valleys and mountains, while contaminating or depleting ground- and surface-water resources.

In addition to the climate change threat, agriculture is also threatened by Turkey's energy policies that prioritizes domestic coal. Large domestic coal projects (inclusive of coal mining and thermal power plant investments) are being planned within agricultural preservation areas such as Eskişehir, Trakya and Konya Closed Basin. Such projects are not only moving land outside of its designated purpose of agricultural production, but imposing negative externalities on water availability both for agricultural irrigation and freshwater supply. At a larger basin scale, water security is threatened due to dewatering of the area for mining operations and use of water for cooling in thermal power plant operations. Removal of water and land outside the scope of agriculture means removing the population that relies on agricultural activities as well.

(c) Kerem Yücel, CAN Europe (2015) / Soma, Manisa

Villagers collect low-quality waste coal that can't be burnt by the coal power plant to sell.

Coal power plants are a major contributor to air pollution in Turkey, and as such are one of today's most significant public health threats. Exposure to outdoor air pollution is linked to a number of health impacts including higher rates of respiratory and cardiovascular disease. Air pollution has a number of adverse effects on human health: vulnerability to respiratory tract infections, aggravation in allergic respiratory system diseases and chronic obstructive lung disease irritation of the eyes, respiratory system cancers, increases in the prevalence of respiratory and circulatory system diseases, and higher mortality rates. The International Agency for Research on Cancer (IARC) states that outdoor air pollution is one of the leading causes of cancer in humans. Emissions from coal-fired power plants in Turkey contribute significantly to the burden of disease from environmental pollution.

In Turkey coal power is responsible for 2,876 premature deaths, 3,823 new cases of chronic bronchitis in adults, 4,311 hospital admissions and 637,643 lost working days each year. The economic costs of the health impacts from coal combustion in Turkey are estimated to be between €2.9 billion to €3.6 billion per year. These costs are mainly associated with respiratory and cardiovascular conditions, which are two of the leading chronic disease groups in Turkey (HEAL, 2014). This health bill is paid for by individuals, national health care budgets, and the economy at large through productivity losses.

Energy transition can have significant positive impacts on the environment and human health, thanks to the avoidance of emissions and air pollutants that are released during the conversion of fossil fuels into final energy products such as gasoline, diesel, or electricity, as well as the consumption of these products in power plants, transport, and heating or cooking (Saygin et al, 2018).

(c) Kerem Yücel, CAN Europe (2015) / Soma, Manisa

Villagers collect low-quality waste coal that can't be burnt by the coal power plant to sell.

CHAPTER VIII

SOCIAL DYNAMICS OF THE ENERGY OUTLOOK

Community energy has the power to achieve an energy transformation in Europe more quickly, fairly and with added social benefits. Over half of EU citizens – including local communities, schools and hospitals – could be producing their own renewable electricity, meeting 45% of the EU's electricity needs by 2050 as part of a democratized energy system.

The community energy movement received an important boost in 2018 through EU legislation on renewable energy, which gives communities and individuals the right to generate, store, consume and sell their own energy. This gives people a vital opportunity to drive a transformation of energy system and help free Europe of fossil fuels.

An example for the transformation mentioned above can be Troya Renewable Energy Cooperative. In the northern region of Turkey, a group of friends living in Çanakkale, have developed a model of democratic ownership of renewable energy sources as a local response to climate change. By establishing a relationship between the cooperative they established and self-consumption and local development, they started to force the Ministries of Energy, Trade and Agriculture in the field of legislative amendments. By adding energy production regulations that, citizens' energy production is a right, the group have opened the way for other energy cooperatives. Today in Turkey more than 50 energy cooperatives have been established working on different energy sources.

Oral Kaya, TROYA Energy Cooperative

Public Money

Public money is being allocated to high-carbon electricity generation in the form of transfer payments from the Treasury.[35] The capacity payment scheme is instrumental in increasing the viability of these assets, which are struggling as a result of market dynamics. It is generally accepted that fossil fuel subsidies are provided by the government for the purpose of decreasing the cost of energy from fossil fuels, increasing prices paid to producers and decreasing prices paid by consumers. These subsidies can be in the form of direct transfers, cross subsidies, price controls, purchase guarantees, tax exemptions and similar instruments; in order to meet increasing energy demand and to ensure energy security.

As of 2019, when all measurable coal incentives in Turkey are taken into account, their total comes to approximately TRY 232 million excluding transfer payments (Ateş et al, 2019).

The most significant support provided to coal in Turkey is the subsidy scheme for generation, exploration and extraction. On top of the existing financial support, a feed-in-tariff for lignite was introduced in 2017 to secure the financial viability of mining operations. The government offered 35 years of operating rights, a 15-year power purchase guarantee, and exemption from future-proof carbon taxes and fees in order to provide a favourable investment environment. In addition to these measures tax reduction, social security premium support, interest support and VAT exemptions were also introduced. The state puts itself in charge of completing the expropriation, environmental impact assessment (EIA) and zoning permit procedures on behalf of the investor.

[35]The most important support provided to coal is the financial aid given to the hard coal sector through transfer payments from the Treasury. These transfers are mostly used to subsidize hard coal imports, because domestic resources can only meet a small portion of the total demand. Their total value varies from $260 million to $300 million per year.

Coal investments are also subsidized within the frameworks of:

- New Investment Incentives System
- Research and development (R&D) support
- State support for mineral exploration
- Rehabilitation support
- Public expenditure for coal-fired electric power plants.

(c) Servet Dilber, CAN Europe (2018) / Yatağan, Muğla

Toxic lake: the water is contaminated by the ash dam in Yatağan.

Existing Coal Subsidies in Turkey

- Feed-in-tariff for lignite
- Subsidies for generation, exploration and extraction
- Tax reduction, social security premium support, interest support and VAT exemptions
- 35 years of operating rights
- 15 years of power purchase guarantee
- Exemption from carbon taxes and fees
- Completed expropriation, EIA and zoning permit procedures
- Obligations to use 15% of CAPEX sponsored by governmental institutions and organizations

The licence winners will develop the coal mines with proven reserves, build the power plants, and operate them for 30 years with special incentive prices guaranteed to be considerably higher than the spot market price. These newly introduced incentives will increase local production of coal mines, which means the development of new coal mines.
(Acar et al, 2015 and adapted from Presidency of the Republic of Turkey Investment Office Energy Industry Report 2018)

Coal projects in Turkey, starting from their planning, up until licence granting and plant building are not held as participatory and transparent processes, as also indicated in the regional dialogue meetings held during the project activities. The deficiencies and exemptions in the implementation of EIAs can be qualified as incentives.

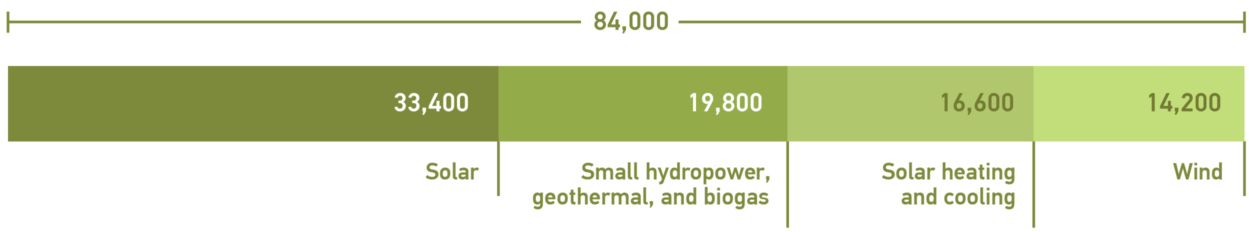
To get a sense of the true cost of nuclear power, one needs to assess not only the cost of power production now, but its intergenerational impacts. Nuclear power entails substantial risks for the environment and human health and generates a long-lasting burden of nuclear waste – one of the outstanding issues with the Akkuyu NPP. The costs of damages to the environment and health are reflected only to a very minor extent in the price of nuclear electricity. These costs have to be covered by the public while permanent disposal of the radioactive waste that nuclear power plants produce has not yet been achieved by any country.

Social Impacts of Decarbonization

Turkey's unemployment rate is 11.43%. This rate is an important reminder to consider the employment aspect of energy policies. There is a clear need to include the well-being of key transition stakeholders in the phasing in and phasing out processes of energy infrastructure. In other words, transitioning to a low-carbon economy needs a strong focus on the employment opportunities offered by renewable technologies, together with careful plans for the future of workers in high-carbon industries.

The entire legacy electricity and gas sector employs a total of 819,000 people, and only directly employs one-third of that number (Turkish Industry and Business Association and the Boston Consulting Group, 2018). Employment in the mining sector has halved in the last 20 years (Avsaroglu, 2018): lignite and hard coal mining currently accommodates 36,000 employees (Directorate General for Mining and Petroleum, 2019). The number of people employed by the mining and quarrying sector is again fairly low, declining from 229,000 people in 1998 to 124,000 people in 2019. The share of the sector in terms of total employment decreased from 1.3% in 1998 to 0.7% in 2013 (Sahin et al, 2016). While the number of jobs at different stages of the coal industry is decreasing, it should be considered that the industry is contributing to the local economy through formal (e.g. regional tradespeople) and informal (e.g. hand-picking and selling of leftover coal) linkages as well. Thus, a transition pathway to a decarbonized economy should also cover the people who are indirectly and even informally linked with the coal sector.

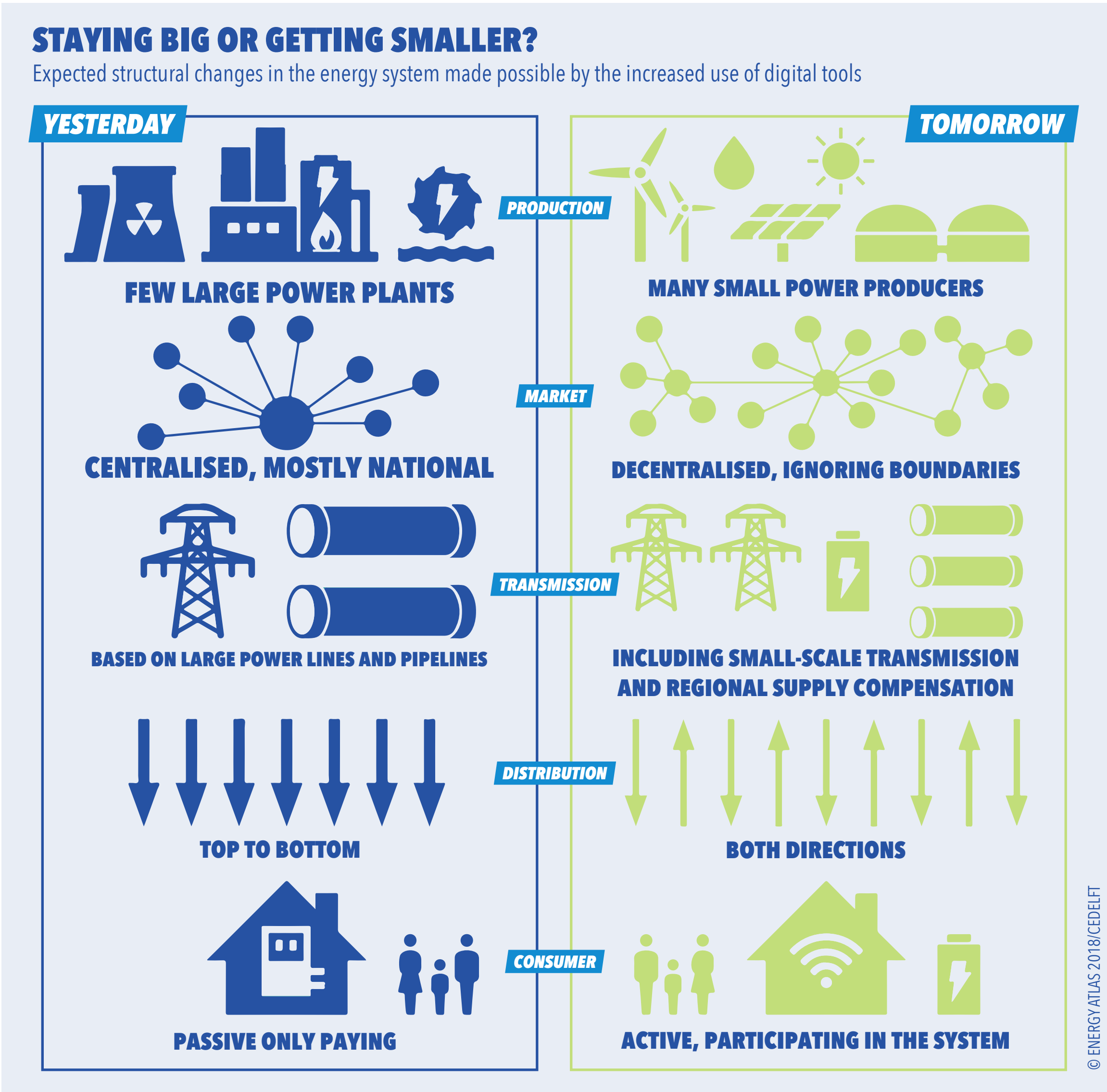
In 2018, the accretion value of mining to GDP (current price) was 0.85% (Presidency of Strategy and Budget, 2019). Informal employment is common in privately owned mines (TEPAV, 2014). On the other hand, renewable energy currently employs 84,000 people in Turkey, out of which 33,400 are in the solar PV sector (IRENA, 2018). In addition to the job creation potential of renewable technologies, measures in energy efficiency and renovation are labour-intensive and may create jobs for 25,000 people (Gul, 2017).



Breakdown of renewable energy jobs in Turkey (IRENA, 2018)

Role of Decentralized Renewable Technologies in Democratization of Electricity Production

Renewable technologies can help to democratize the energy system through decentralized generation and governance dynamics. Decentralized and distributed power transforms not only the source and fuel of generation, but the ownership and governance of the technology.



Structural changes in energy system (Friends of Earth Europe, 2018)

CHAPTER IX

THE SILVER LINING OF TURKEY'S ENERGY TRILEMMA

This report provides a high-level view of some of Turkey's most pressing challenges that are decisive in achieving a low-carbon oriented 2050 vision during the unprecedented post-COVID period in which we are redefining the and disruptions. We tried to summarize the considerations gathered during the project's dialogue meetings and stakeholder consultations about some of the key transformation parameters of long-term decarbonization including technology choices, socio-economic implications and environmental impacts. The European Green Deal is also presented as an exemplary policy framework which aims to transform European economies into net-zero GHG emitters by 2050 without compromising their socio-economic development and environment.

Power sector as the immediate challenge. We focus on the power sector as the most pressing challenge to Turkey's long-term decarbonization based on the contribution of the sector to the GHG emissions of Turkey - the country with the fastest energy demand growth and emission increase amongst the OECD. To meet the challenge of accommodating the demand from local resources, Turkey can either continue its reliance on fossil fuels or it can set an ambitious decarbonization agenda for a sustainable and renewable-based energy system coupled with significant efficiency measures.

The energy transition is a long-term process. If energy and climate consequences of the decisions taken today are to be better understood, there is a need to extend the temporal frame of reference and develop strategic responses that look beyond 2023, in order to avoid the risk of stranded assets.

Improving energy efficiency is achievable and applicable to several sectors in a cost-competitive way. There is potential to increase the security of supply and enhance the overall competitiveness of the economy through efficiency measures. The political willingness to take measures in this direction is, to some extent, in place but the ambition can be set much higher – to seize already tested, transformative demand-management solutions across sectors and bring multiple positive environmental and socio-economic effects.

Current plans for scaling lignite pose the risk of locking in the country to carbon-intensive infrastructure for decades. Coal-fired generation is proving unviable for the high-priced political, market, economic and climate risks. Globally, coal is losing market share because it is no longer cost-competitive. Increasing Turkey's reliance on lignite decreases competitiveness in relation to the EU and countries that are transitioning to more cost-efficient and financially viable alternatives.

Nuclear technology is not sustainable in environmental, social, political and market terms. Energy dependency of the technology, viability in the current market dynamics, risks associated with earthquakes and the intergenerational and interspecies risks that the technology poses to land, water and livelihoods add to the existing drawbacks of the lifecycle of the nuclear technologies in Turkey.

Natural gas is not a long-term solution towards decarbonization. The low-carbon transition without natural gas is possible. The future of natural gas is limited, even as a bridging fuel. Continued investments into the sector - despite gas plants not being cost-competitive to operate at current market prices and the increase in the vulnerability of Turkey's power market - create the risk of breaching the Paris Agreement's long-term temperature goal and will result in stranded assets.

The growing business case and availability of abundant resources provide an enabling environment for Turkey to scale power generation from renewables. Renewable technologies are indispensable for decarbonizing the energy system. The significant decline in the costs of renewable energy technologies has led to a new era in power generation. Availability of abundant resources that are close to high demand regions provides an enabling environment in addition to the viability of PV and wind technologies in the merit order and the interconnection potential to the European grid. Even a significant scale of renewables poses a negligible cost on system planning and operation.

Turkey's freshwater resources, land, air and biodiversity are being negatively impacted by climate change and infrastructures for power generation. A transition planning process must carefully address all of these aspects in order to reverse harmful, negative impacts. Achieving food security, supporting health and prosperous lifestyles, and conserving water and biodiversity – alongside energy security - are of the utmost importance for Turkey's economy today and in the future.

There is a strong need to consider well-being of key transition stakeholders in phasing in and phasing out processes of energy infrastructure. The existing socio-technical regime has negative implications on the livelihoods, communities and the overall economy. Transitioning to a low-carbon economy needs strong attention to the employment opportunities of renewable technologies together with a careful design of the future of workers in high-carbon industries. Decentralised renewable technologies can deliver a more equitable distribution of the benefits of low-carbon transition by democratizing the ownership and governance of power generation. Allocation of public money needs to internalise these crucial aspects and be diverted away from high-carbon power generation infrastructure. Just transition mechanisms implemented across European countries provide important and powerful examples of the kind of policy frameworks that can be set in place to support a fair transition for impacted communities.

A public dialogue on the long-term energy transition – given its far-reaching implications at the technological, economic and societal levels - is a pressing necessity in Turkey. There is a significant need for multi-stakeholder engagement and deliberation around how to accommodate in an equitable way the often competing interests of different industries and technologies, socio-economic concerns and the global commons. This will require a drastic expansion in the number and diversity of spaces for dialogue, engagement collaborations and innovation in Turkey.

Analytical decision-making tools are essential in facilitating multi-stakeholder concerns. Analytical tools that support the decision-making process are vital in inclusion and consensus-building. Developing open-source tools such as the recently developed European Calculator (EUCalc) - based on the 2050 Carbon Calculator approach - can serve to provide a scientific, transparent and comprehensive framework to explore potential decarbonization pathways in different sectors and their implications for the energy system, climate, economy and environment. These decision-making tools are not only instrumental in showcasing the potential and viability of diverse pathways but they also strengthen civic engagement and enable an informed public dialogue. This however highlights a need for better numbers, reporting and monitoring in order to improve, currently patchy and fragmented, understanding of how different policy targets work, including their impacts.

We hope that this publication will serve as a timely, relevant and useful resource to inform and initiate multi-stakeholder platforms to collaborate and take action on a long-term vision toward decarbonizing Turkey's power sector, contributing to a prosperous economy, thriving society and enhanced livelihoods.

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