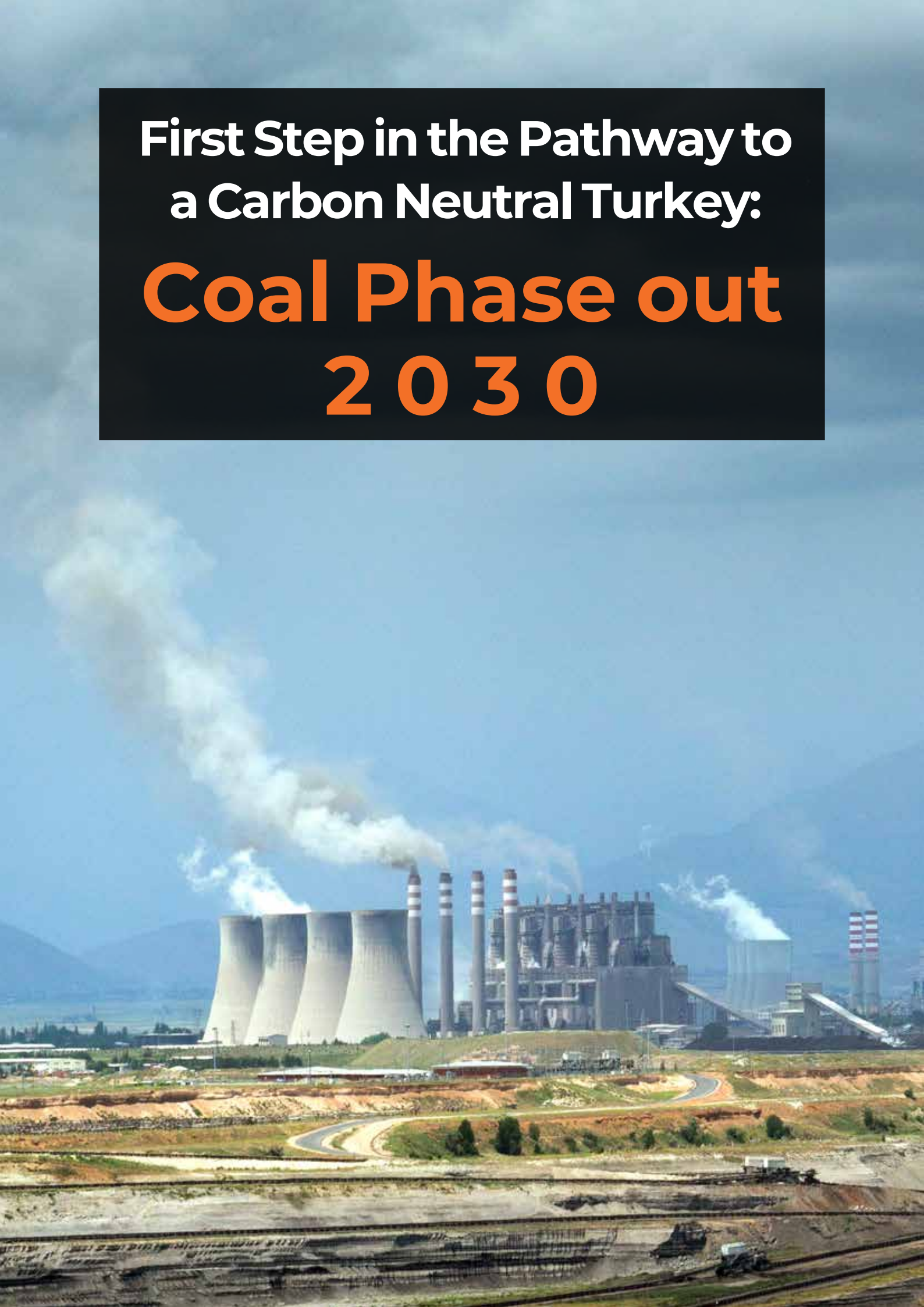
First Step in the Pathway to a Carbon Neutral Turkey:

Coal Phase out 2030



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EXECUTIVE SUMMARY

Coal is the source of 46% of global greenhouse gas emissions that cause climate change, and 72% of greenhouse gas emissions from the electricity sector. With the negative effects of climate change manifesting themselves more severely, and international efforts to mitigate climate change intensifying, the role of coal in the energy system is being questioned. Following the Paris Climate Agreement, many countries accelerated their climate change mitigation policies and set targets for a complete exit from coal. In line with calls for an immediate limit on emissions, a lot of countries have set their coal phase out target for 2030 or before. The use of coal is decreasing on a global scale due to negative externalities of coal use, cost reductions observed in areas such as renewable energy and energy storage, and the need for flexibility in energy markets. This trend is expected to accelerate in the coming years.

The Carbon Border Adjustment Mechanism, proposed to be put into use at the reporting level in 2023 and implemented as of 2026 within the scope of the European Green Deal, would also provide an economic incentive for countries trading with the European Union to abandon their coal policies. Turkey has implemented policies to support coal energy over the past decades, and as a result, in the 1990-2020 period, coal-fired electricity production increased by 459%, while the greenhouse gas emissions of the electricity sector increased by 323%. Among the country's current energy plans, there are still goals to open new reserve areas to coal mining and increase domestic coal-based electricity generation. Currently, these plans do not seem feasible for both environmental and economic reasons.

The continuation of practices promoting coal energy in Turkey is also inconsistent with the country's recently announced climate targets. The ratification of the Paris Climate Agreement by the Grand National Assembly of Turkey in October 2021 was a turning point for Turkey. The announced 2053 net zero emission target also indicates that Turkey has entered a new and ambitious process in terms of emission reduction policies.

Fundamental changes in the country's energy policy are required in order to meet the announced climate target. In this context, it is essential to set updated energy targets for Turkey and to create a comprehensive and realistic strategy. Ending the existing incentives for coal energy, developing policies that will pave the way for renewable energy sources and a flexible energy system, making the necessary changes to market regulations to keep up with the energy transformation that is advancing all over the world, and developing measures and policies that will ensure that this transition takes place in a way that no one is left behind will form the foundations of this plan.

It is clear that coal energy is no longer a viable option. As an important part of the new energy strategy that Turkey will create, it is necessary to determine a coal phase out date. Exiting coal in electricity generation will also be the first step towards the 2053 net zero emissions target and will facilitate the establishment of a more flexible and efficient energy system. Upon the implementation of policy changes, exiting coal energy in electricity generation by 2030 is a realistic and feasible goal for Turkey.

This report aims to contribute to the creation of a roadmap for Turkey to completely phase out coal in power sector by 2030. To that end, three scenarios covering the period 2021 to 2035 were created. In light of this modeling effort, the probability and possible consequences of Turkey's exit from coal in 2030 were examined. Modelled results include outputs such as overall system costs, total investment requirements, production development with resource-based installed power, and amounts of carbon emissions.

Within the scope of this study the following scenarios were examined:

Business as usual scenario: This scenario aims to show the probable situation that will be reached if the current energy policies continue. In this context, the purchase guarantee and capacity mechanism payments for domestic coal power plants are assumed to continue in their current form. No carbon pricing mechanism is applied during the scenario period. It is assumed that the Akkuyu nuclear power plant will gradually be brought into operation starting from 2025.

Coal phase out scenario: This scenario aims to show the situation in which the existing coal incentives are removed, the capacity mechanism payments for coal power plants are cancelled as of 2022, and the goal of existing coal by 2030 is achieved as a result of the introduction of a fixed carbon price. As in the business as usual scenario, it includes the assumption that the Akkuyu nuclear power plant will be operational by 2025. In addition, it is assumed that offshore wind and battery installation applications will be put to use within the scope of the scenario through various incentive mechanisms.

Nuclear-free coal phase out scenario: Within the scope of the scenario, Akkuyu nuclear power plant is not brought online, and the possibilities of a coal phase out in a situation where nuclear energy is not utilised are examined. The assumptions on issues such as carbon price and incentive mechanisms applied for coal etc. are accepted in the same way they are under the coal phase out scenario.

The result of the study shows that a coal phase out by 2030 is a realistic target. A summary of the modeling outputs are as follows:

The study's main findings can be summarised as such:

- **If certain policy tools such as carbon pricing and elimination of coal subsidies are implemented, a coal phase out by 2030 at the latest is a realistic and achievable target.** In line with the 2053 net zero target, Turkey's current Nationally Determined Contribution, which estimates a doubling of its emissions by 2030, should be updated. In this respect, the coal phase out plan stands out as the first and easiest step on the way to the net zero carbon target for 2053. As a result of the changing policies under the coal phase out scenario, carbon emissions from the electricity sector decreased by 82.8% in 2035 compared to 2021, and emissions in 2035 decreased to 27.6 million tons of CO_2. On the other hand, the results of the business as usual scenario indicate that if current policies are followed, there will not be a significant change in Turkey's emission level until 2035 and it will become very difficult to reach the 2053 carbon neutral target.

- **In the event that the costs of coal, which can be categorised as negative externalities, are undertaken by polluters, namely coal power plant operators, the use of coal for electricity generation will no longer be a rational choice for any parties, and a coal phase out will be the natural outcome.** This can be achieved through carbon pricing mechanisms, such as a carbon tax or a carbon market. It has been understood that the carbon pricing option, which has been discussed within the scope of this model, will be an effective method in ensuring the exit from coal.

- **In light of serious concerns over climate change and the environment, it is vital that Turkey take serious steps in pricing its carbon emissions.** Taking into consideration the possible costs arising from a Carbon Border Adjustment Mechanism, if a national carbon pricing mechanism is not implemented, a significant financial resource from Turkey will be transferred abroad through carbon taxes at the border. Thus, additional costs will occur on exports to the EU, which is an important trade partner to Turkey.

Results	Business as usual scenario	Coal phase out scenario	Nuclear-free coal Phase Out scenario
Total installed capacity at the end of 2035 (MW)	147.615	168.657	174.781
Battery installed capacity at the end of 2035 (MWh)	-	136.000	136.000
Total wind and solar installed capacity at the end of 2035 (MW)	60.254	101.154	112.078
Share of sun and wind in electricity generation in 2035 (%)	%28,8	%51,7	%56,4
Share of renewable energy in electricity generation in 2035 (%)	%49.4	%73,6	%78,4
Share of local sources in electricity generation in 2035 (%)	%59,2	%73,6	%78,4
Greenhouse gas emissions from electricity generation in 2035 (million tons of CO_2 equivalent)	139,42	27,63	33,62
Average electricity generation unit price between 2022-2035 ($USD_{Reel\ 2021}$/MWh)	50,39	59,08	62,76
Total investment needs between 2022-2035 (billion $USD_{Reel\ 2021}$)	68,46	118,24	88,74
Amount of carbon revenues collected between 2022-2035 (billion $USD_{Reel\ 2021}$)	-	24,8	30,3

- **Turkey's first step towards exiting coal is the cancellation of existing policy mechanisms that provide incentives for coal use.** Incentives given to the coal industry through practices such as domestic coal purchase guarantee and capacity mechanism negatively affect the functioning of the free market as it supports this inefficient energy source to remain in the system. At the same time, it prevents the reduction of the country's carbon emissions and delays the benefits that come with the energy transition, such as new jobs and investments in new technologies, especially given Turkey's high renewable energy potential.

- **The study shows that the energy transition will not burden Turkey's national budgets with high system costs.** The cost reductions occured in renewable energy sources such as wind and solar as well as in storage technologies in recent years which are expected to continue in the future play a decisive role at this point. Today, renewable energy and storage technologies have become low-cost compared to fossil fuels without the need for any incentives. The difference between the business as usual scenario and the exit coal scenario between the years 2022 and 2028, when the coal phase out is realised, is 26.7 billion USD. If the investments to be made in the transmission system are included, this difference rises to 28 billion USD. It is possible to realise the coal phase out scenario if only 0.5% of the country's current gross domestic product is transferred annually to new energy investments in the coming years.

- **The impact of a coal phase out on electricity generation costs will not be high in the long run.** Although there is a significant difference in the electricity generation costs between the business as usual scenario and the coal phase out scenario, in the middle of the simulation period, this difference is gradually decreasing thanks to the high renewable energy capacity made possible under the coal phase out scenario. In 2035, the electricity generation cost in the coal phase out scenario was only 2.5 USD/MWh higher than the business as usual scenario. The revenue from carbon pricing and the savings from removing coal subsidies show that a resource can be created to cover this cost of change without being reflected in end-user tariffs.

- **The results of the study indicate that a coal phase out will yield positive results in terms of energy security and independency targets.** Due to their high marginal costs, in the case of a carbon pricing mechanism,

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imported coal-fired thermal power plants are the first to become obsolete in the system. In the coal phase out scenario, in the period between 2021 and 2035, the share of domestic resources in electricity generation increases from 51.3% to 73.6%, which is entirely made up of domestic and renewable resources. In the scenario where nuclear energy is not included, the same figure is 78.4%. In the business as usual scenario, however, the share of domestic resources – renewable and domestic coal – can only go as high as 59.2% in 2035.

- **The current global fuel price crisis shows how risky fossil fuel-based energy production is and how it makes economies vulnerable to external shocks.** From this point of view, the rapid increase in the use of renewable energy sources is also important in order not to be exposed to global price shocks.

- **Based on the results of the study, the importance of flexibility in energy systems is even more grave for the upcoming period.** As the proportion of intermittent resources in the system increases, the demand for storage technologies such as batteries, which are gradually decreasing in cost, or the demand for applications such as demand-side participation increases. At this point, besides technological solutions such as batteries or hydrogen, market architecture changes that can increase system flexibility will also play an important role. Energy system architecture should be evaluated separately within the framework of a long-term energy transition strategy.

- **Comparing the nuclear-free coal phase out scenario and the coal phase out scenario, it can be seen that coal phase out is possible even if nuclear energy is not put to use.** It is noteworthy that the system cost of putting nuclear energy to use is quite high. Between the years 2022 and 2029, when the coal phase out takes place, the difference in investment requirements between the nuclear-free coal phase out scenario and the business as usual scenario is only around 1.1 billion USD. This shows that if the resources to be spent for nuclear energy investment are directed to renewable energy, coal phase out can be realised with an additional cost of only 1.1 billion USD over eight years. Considering the high cost and risks of nuclear energy, these results also indicate that Turkey's current nuclear energy policies should be reviewed.

- **The results of the model show that the share of electricity generation from fossil gas is gradually decreasing.** In the coal phase out scenario, the share of fossil gas power plants in total energy production in 2035 decreases from 31.5% to 17.7% while the former figure is projected for 2021. In the business as usual scenario, this value is 20.4%. Even in the absence of the nuclear power plant, the share of fossil gas remains around 21.6% in 2035. Because of the need for flexibility in the electricity system, the model is expected to keep fossil gas in the system, but it is foreseen that the technological developments to be experienced by 2030 will primarily ensure that the electricity system is free of fossil gas. In addition, factors such as lifestyle changes are likely to affect the estimates for electricity demand growth. Thirdly, it is expected that future carbon prices will be much higher than those predicted by the model. All these developments will enable fossil gas to exit the system faster than expected following the coal phase out.

- **While the energy transition creates new possibilities and development opportunities – as does every major process of economic change – an unplanned transition carries the risk of leaving behind economies and regions that depend on fossil fuels.** To address potential damage, achieve climate justice, and sustain support for climate policies in the public sphere, the coal phase out plan should also include the design of a just transition mechanism that will create new local economic opportunities, and decent, inclusive employment opportunities. A portion of the revenue from carbon pricing can be used for this purpose. ■

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