SHURA
ENERGY TRANSITION CENTER

BATTERY ENERGY STORAGE OPTIONS FOR TÜRKİYE

About SHURA Energy Transition Center
SHURA Energy Transition Center, founded by the European Climate Foundation (ECF), Agora Energiewende, and Istanbul Policy Center (IPC) at Sabancı University, contributes to the decarbonisation of the energy sector via an innovative energy transition platform. It caters to the need for a sustainable and broadly recognized platform for discussions on technological, economic, and policy aspects of Türkiye's energy sector. SHURA supports the debate on the transition to a low-carbon energy system through energy efficiency and renewable energy by using fact-based analysis and the best available data. Taking into account all relevant perspectives by a multitude of stakeholders, it contributes to an enhanced understanding of the economic potential, technical feasibility, and the relevant policy tools for this transition.

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Disclaimer
This report and the assumptions made within the scope of the study have been drafted based on different scenarios and market conditions as of end-2023. Since these assumptions, scenarios, and the market conditions are subject to change, it is not warranted that the forecasts in this report will be the same as the actual figures. The institutions and the persons who have contributed to the preparation of this report cannot be held responsible for any commercial gains or losses that may arise from the divergence between the forecasts in the report and the actual values.

MRC TURKEY

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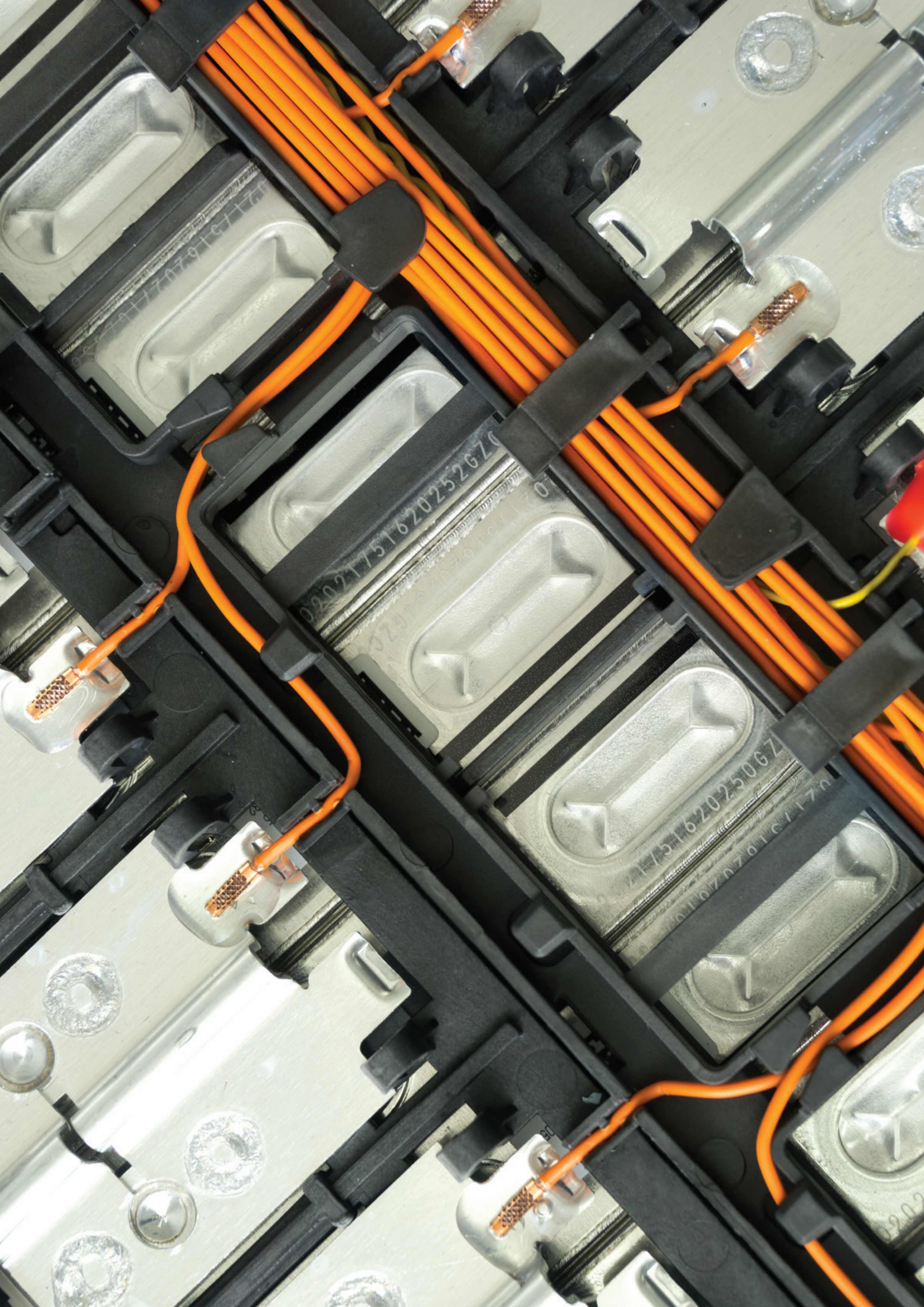


Executive Summary

A. Introduction

The measures introduced to reduce the greenhouse gas emissions that cause climate change, which is recognized as one of the most important global problems of the 21st century, have brought about a significant transition in energy policies. This transition, based on the pillars of energy efficiency, electrification, and renewable energy sources, is critical not only for achieving climate goals but also for the security of energy supplies and affordable access to energy, thanks to the advances in technologies and declining costs that accompany such a transition. As a result, the transition of energy systems with sustainable energy sources is among the priorities of governments and international organizations around the world. Robust renewable energy targets also require increased flexibility in electricity systems, where supply and demand must always be in balance. Flexibility refers to the degree to which a power system can adjust electricity demand or generation in response to both expected and unexpected variations in supply and demand. Large-scale implementation of battery energy storage systems is expected to contribute significantly to this balancing process.

At the 28th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP28) held in Dubai in November 2023, a total of 138 countries committed to working together to triple global renewable energy capacity by 2030[1], in line with the targets set within the Paris Climate Agreement. Parallel to the global developments, Türkiye has committed to achieving a net-zero carbon emissions economy by 2053 and has set ambitious renewable energy targets in line with this goal. On 19 January 2023, the Ministry of Energy and Natural Resources (MENR) published the National Energy Plan (NEP), which aims to increase Türkiye's installed electricity capacity to approximately 190 GW by 2035, with approximately 65% of this capacity coming from renewable energy sources (with solar accounting for 52.9 GW and wind energy providing a further 29.6 GW). The Plan also shows that Türkiye's battery energy storage and electrolyser capacities are expected to reach 7.5 GW and 5 GW respectively by 2035, so as to enhance the flexibility of the electricity system due to the increased capacity of variable generation renewable power plants. Electrolysers can partially reduce the need for batteries, especially since they provide long-term (seasonal) storage[2] by converting excess energy generated from solar and wind power plants into e-fuels. However, to meet

[1] COP28, 2023. Global Renewables and Energy Efficiency Pledge. https://www.cop28.com/en/global-renewables-and-energy-efficiency-pledge

[2] SHURA, 2023. Net Zero 2053: A Roadmap for the Turkish Electricity Sector. https://shura.org.tr/wp-content/uploads/2023/05/Net-Zero-EN.pdf

the shorter-term (hourly) balancing needs of the grid, battery energy storage technologies are expected to play a more central role in Türkiye's energy transition.

According to the results of the report "Net Zero 2053: A Roadmap for the Turkish Electricity Sector" published by SHURA Energy Transition Center in February 2023, the share of renewable energy in Türkiye's installed capacity as well as its share in electricity generation will reach 70% by 2035. It is modelled that the share of variable generation (wind and solar energy) in the total electricity generation will increase from the current level of 17 percent to 44 percent in 2035. In order to increase the share of variable generation in the electricity system to such an extent, it is necessary to introduce grid flexibility options into the system. According to the results of the model, in 2035, Türkiye will need 7.2 GW/28.8 GWh battery storage and 5.5 GW electrolyser capacity.

Currently, with decreasing technology and material costs, battery-based energy storage systems are attracting considerable attention in Türkiye as well as all over the world. Considering the current legislations that define the procedures to install battery energy storage systems in Türkiye, investors planning to build batteries are allowed to build variable renewable energy power plants up to the capacity of the storage facility. Accordingly, the total installed capacity of pre-licenced power plants with battery energy storage systems reached 32 GW, which is almost one third of the current total installed capacity of Türkiye, as of June 2024.

B. Purpose of the Study

Battery energy storage systems provide a number of benefits for both the investors and the grid. From the perspective of the system operators, batteries can be used for frequency control and the management of regional constraints. In the context of frequency control, the use of batteries in ancillary services and balancing power markets can help lower the capacity utilisation rates of thermal power plants in these markets. As a result, total system costs and carbon emissions would decrease. Another important case for the system operators is the management of regional constraints. Considering the Turkish transmission network, there are various systemic constraints, such as the inconsistency between demand and supply in the Northern Marmara region[3]; relatively low demand but high supply due to the hydroelectric power capacity in the eastern regions; and the high wind energy production in the Western Anatolia region. In order to manage such regional constraints, the system operator can issue redispatch instructions in the balancing power market, which in turn would cause additional costs. Positioning the

[3] There is systematically high energy demand but low supply capacity in this region.

battery energy storage facilities in the optimum locations can help ease the management of such constraints encountered in the operation of the system and reduce the costs incurred. From the perspective of investors, battery energy storage technologies have been the focus of the investments in recent years, as such systems can be used both to offset variable renewable energy generation and to generate income through arbitrage opportunities and market participation.

Various electrochemical materials used in battery energy storage technologies offer different advantages and disadvantages depending on their applications. Therefore, it is essential to plan and design battery energy storage systems to meet the needs of the region and to fit the intended purpose (arbitrage, management of generation plant imbalances, frequency regulation, etc.). In this context, the study aims to analyse the spatial distribution of battery technologies across Türkiye, the services to benefit most from their use, and their effects on the transmission grid so that batteries can be utilised efficiently as an instrument to increase flexibility in a wider effort to maximise the use of renewable energy potential in Türkiye.

C. Methodology

Basic assumptions, battery deployment and grid development

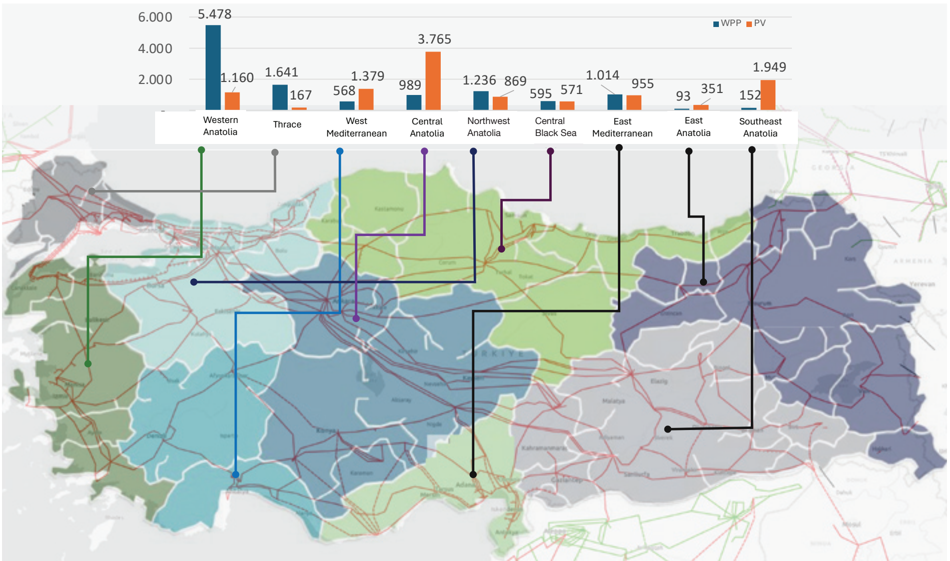
By the end of 2023, the total installed capacities of solar and wind power plants in Türkiye are 11.3 GW and 11.8 GW respectively (Figure 1). The analysis uses the model results of SHURA's net-zero roadmap (NZ2053) for future installed capacity development in all technologies. To assess the regional distribution of future capacity expansions, both the availability of resources and the suitability of land were considered. In this context, priority was given to the capacities that are currently allocated but not yet deployed, as well as ongoing installations. Then, various growth scenarios were created based on technical potential resource maps. Considering the development and distribution of solar power plant capacity over the years, the sustainable urban transformation plan and low carbon targets for buildings, it is presumed that rooftop solar power plant (SPP) installations will increase in and around the city of Istanbul.

Battery energy storage systems, thanks to their short charge-discharge intervals, can be used to reduce the effective load on the transmission lines or to integrate more wind and solar power plant capacity into the system. In this study, locations close to large solar and wind power plants are chosen as the locations with significant potential for battery system development. Following the introduction of the storage systems at these locations, the grid load flow analyses were repeated by gradually increasing the battery storage capacities.

After running these analyses, it was possible to determine the appropriate capacity distribution by optimising the capacity of the battery storage systems at each location while taking into account the grid constraints.

It is assumed in the analyses that 10% of the overall battery energy storage capacity will be installed as behind the meter systems. It is also predicted that the relevant behind-the-meter capacity will be spread evenly over the entire grid. Approximately 30 percent of the battery capacity is distributed to large cities with high energy consumption and regions with high renewable energy capacity. The remaining 60 percent capacity is integrated into the utility-scale renewable energy plants. The detailed capacity allocation is analysed considering the iterative load flow analysis where the grid infrastructure has optimal loads for charging/discharging the batteries. The basic algorithm employed for battery positioning is shown in Figure 2, while regional battery capacity projections are given in Figure 3.

Figure 1. Distribution of installed solar (PV) and wind (WPP) power per regions (MW)[4] – End of 2023



[4] Taken from EMRA Electricity Market Sector Report and Production Licence list.

Figure 2. Algorithm for optimising the capacity and location of batteries

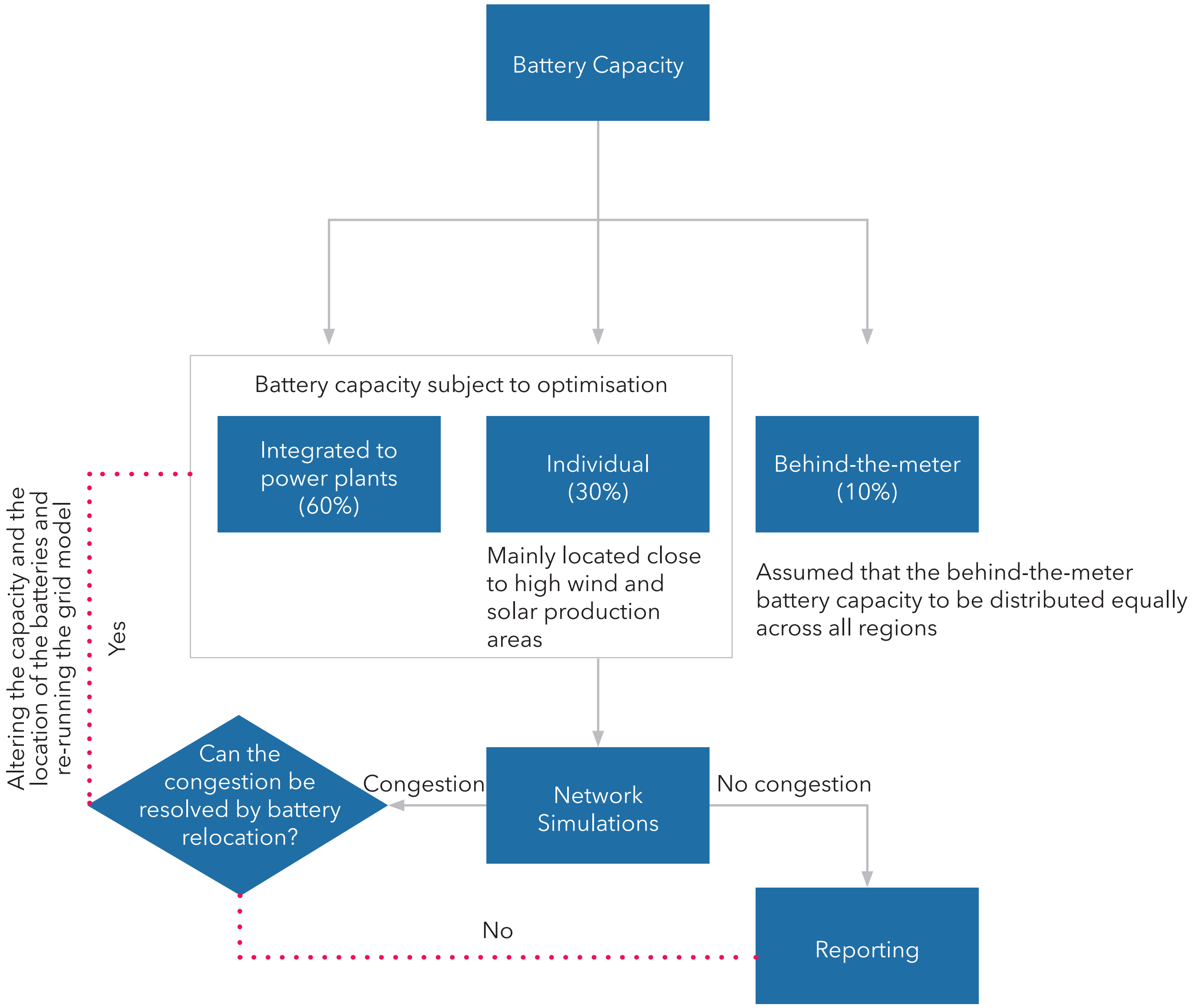
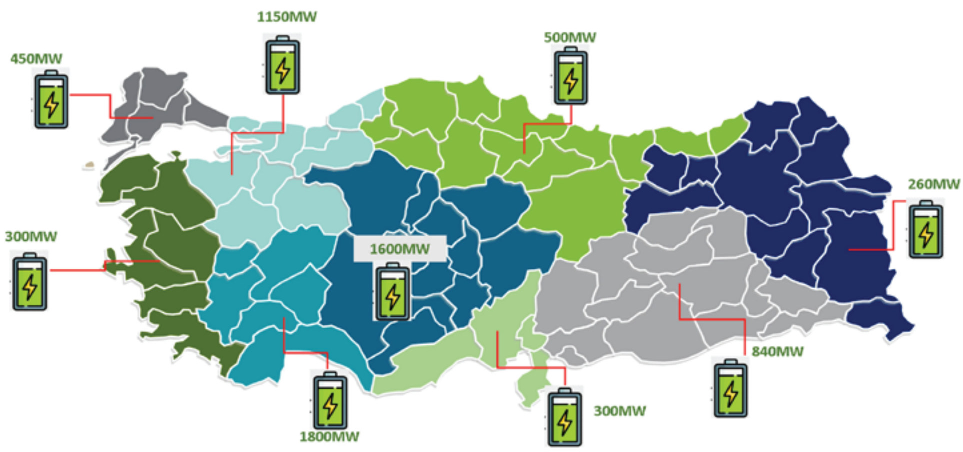
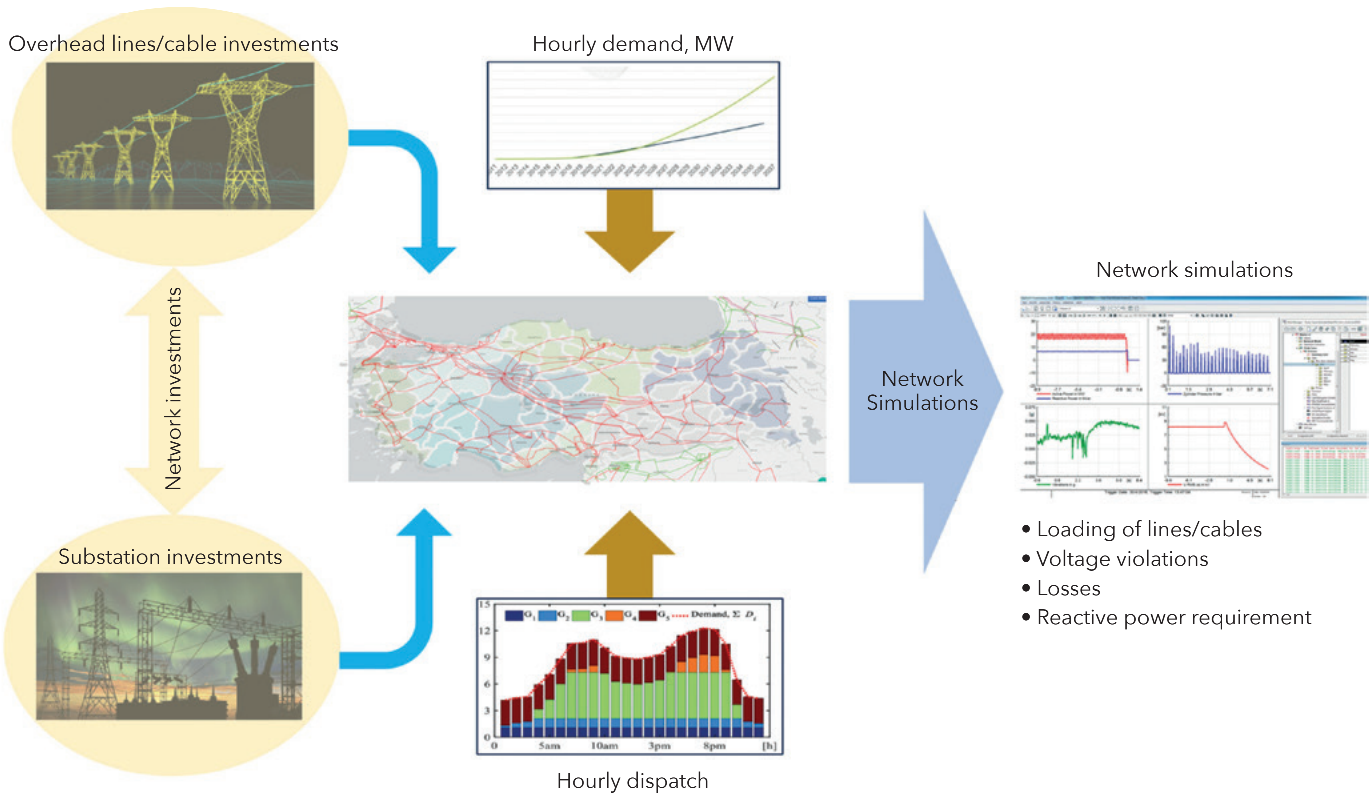


Figure 3. Modelled total battery capacity in 2035 by region (MW)



Existing grid infrastructure and medium- to long-term grid development, load projections, generation profile development, and dispatch projections were used as inputs to analyse the effects of battery energy storage systems on the grid (Figure 4).

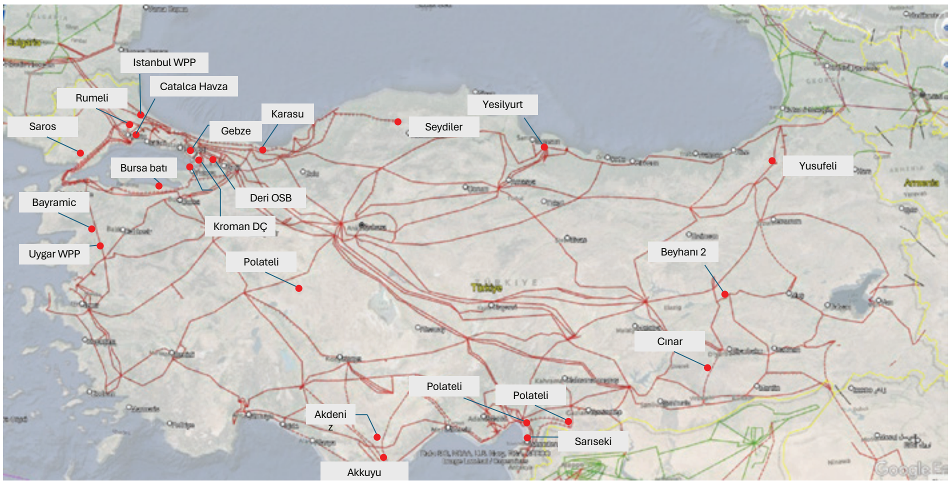
Figure 4. Development of the grid model



Within the scope of the study, the effects of battery energy storage systems on the electricity transmission system were first analysed. In this context, the 154-kilovolt (kV) network of the Turkish electricity system was simplified and merged with the main 400-kV transmission grid in the model. Thereafter, the analyses were carried out over the 400-kV grid. This method made it possible to represent the effects of generation or consumption activities on the 400-kV network and to perform simulations more quickly.

To model the development of the grid in the medium to long term period, macro-level projections and scenarios based on estimated/hypothetical parameters were used. Thus, the overload and/or voltage range violations that may occur in any part of the power grid were analysed with the help of load flow calculations. The as-is model,[5] which represents the existing transmission system, was used for modelling the medium- to long-term grid, while the future investments were projected with reference to publicly available sources such as the investment plans and annual reports of the Turkish Electricity Transmission Corporation (TEİAŞ), and Electronic Public Procurement Platform (EKAP) web portal (Figure 5).

Figure 5. Location of the new 400-kV substations (red) on the grid, which are expected to be commissioned in 2035



Cost-Benefit Analysis

The study also entails an assessment of the battery energy storage technologies that are commercially mature already and their areas of use. In the analyses, lithium-iron-phosphate (LFP), flow, and sodium-sulfur (NaS) battery technologies were assumed to be prominent at the grid scale, whereas lithium-nickel-manganese-cobalt-oxide (NMC) battery technology

[5] As-is: This term stands for the present condition of the grid, indicating that the model used in the analysis reflects the current situation of the network.

was assumed to be prominent as behind-the-meter. The technical parameters of these technologies are presented in Table 1. Cost-benefit analyses were carried out for different services and selected battery technologies. Within the scope of the cost-benefit analyses, it was not aimed to compute the rate of return rates for installing batteries. In the analyses, the economic viability of the annual service costs with respect to the estimated electricity sales prices was examined solely for the relevant years.

Table 1. Technical parameters of the batteries covered in the cost-benefit analyses

Battery Tech	Cycle Count	Capacity (hours)	Loss Rate (AC/AC)	Reaction Time
LFP	5,000	4	12%	Milliseconds
NMC	2,000	4	14%	Milliseconds
Flow Battery	15,000	20	32%	Milliseconds while the pumps run. Otherwise ~10 seconds
NaS	4,500	6	22%	Milliseconds

The battery unit investment cost projections used in the cost-benefit analyses are based on the BloombergNEF (BNEF) study.[6] The cost items other than the battery pack (e.g., project development, engineering-procurement-construction (EPC), transformer, energy management system installation) are also added to the total cost. However, the extra 30% customs duty imposed on LFP batteries imported from countries other than the European Union, South Korea, and Singapore, which entered into force on 1 January 2024, is not included in the calculations. Finally, due to economies of scale in the cost-benefit analysis, the unit cost of the behind-the-meter battery energy storage systems is assumed to be 50% higher for households and 10% higher for industry compared to utility-scale batteries.

Within the scope of the cost-benefit analysis, Day-Ahead Market (DAM) prices were estimated on an hourly basis between 2025 and 2035 in order to determine the charging/discharging cycle of the batteries during the day. While establishing future price assumptions for the market, first, demand forecasts were made with reference to factors such as gross domestic product (GDP) development, electric vehicle usage, and the increase in electrification rates. For the supply side, generation resource projections were gathered by considering the installed capacity development per resource (especially the installed capacity for renewable energy), natural gas price projections according to World Bank[7] forecasts, and daily/seasonal capacity factors of

[6] BNEF, 2023. Lithium-Ion Battery Pack Prices Hit Record Low of $139/kWh. https://about.bnef.com/blog/lithium-ion-battery-pack-prices-hit-record-low-of-139-kwh/

[7] World Bank, World Bank Commodities Price Forecast (nominal US Dollars). https://thedocs.worldbank.org/en/doc/ff5bad98f52ffa2457136bbef5703ddb-0350012021/related/CMO-October-2021-forecasts.pdf

power plants. Hourly price forecasts for the points where supply and demand intersect are calculated and used in the model.

The cost-benefit analysis is based on the Market Clearing Price (MCP). In the analysis, regulated tariffs (residential, industrial, commercial, etc.) are not taken into consideration. The assumption that all consumers will qualify as eligible consumers by 2035 and will procure energy through bilateral agreements is the main reason for using this method in the analyses. It is envisaged that the regulated tariffs will thereafter serve only as community tariffs. On the other hand, due to the difficulties in estimating the subsidy levels applicable to electricity prices, the analysis is based on the wholesale electricity market prices. In this context, a margin of 2% for residential consumers and 1% for industrial customers was added to MCP as the supplier profit margin. Electricity prices include 10% Value Added Tax (VAT) and 5% Electricity Consumption Tax (ECT) or municipal consumption tax for residential consumers and 1% ECT for industrial customers. However, the extra 30% customs duty[8] imposed on LFP batteries imported from countries other than the European Union, South Korea, and Singapore, which entered into force on 1 January 2024, is not included in the calculations.

Finally, the following formula was used for the levelized cost of service[9] (LCOS) calculations within the scope of the analysis:

$$LCOS = \frac{Capital\ Expenditure\ (CAPEX) * Return\ on\ Investment\ (ROI) + Operating\ Expense\ (OPEX)}{Amount\ of\ Power\ Discharged\ (MWh)}$$

$$Return\ on\ Investment = \frac{i * (1+i)^n}{(1+i)^n - 1}$$

When calculating the Return-on-Investment Coefficient as part of the formula, the discount rate (i) is assumed to be 7%. Again, in the formula, n denotes the number of years of the assumed total lifetime of the investment.

D. Analysis Results

In the analyses, it is computed that the estimated gross peak load will be approximately 73 GW for the summer of 2035. The analyses also show that batteries will mostly be used to store surplus solar energy generation. Therefore, if the batteries are not integrated with renewable energy power plants, they can increase load on the grid. For example, the peak load

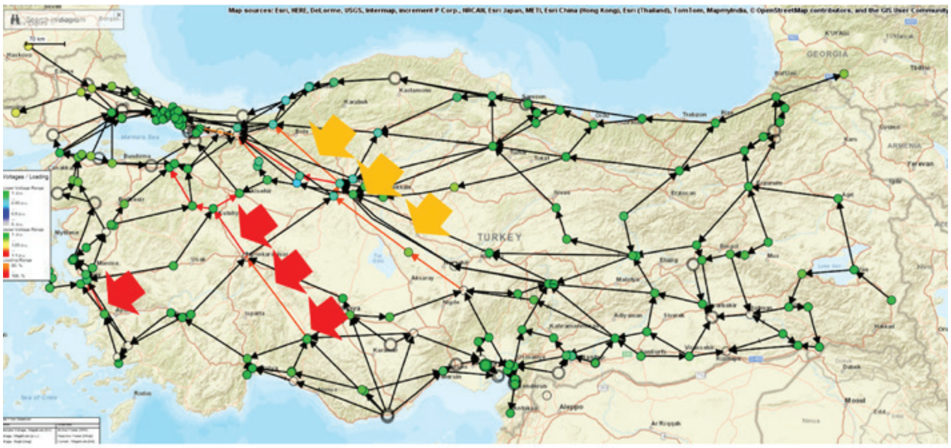
[8] Presidential Decree dated 31.12.2023 and numbered 8044, published on the Official Gazette no. 32416 (3rd issue) dated 31.12.2023

[9] NREL, 2024. https://www.nrel.gov/analysis/tech-lcoe-documentation.html#:~:text=The%20simple%20levelized%20cost%20of,rate)%20%2B%20variable%20O%26M%20cost.

modelling for summer 2035, in the model the storage systems are set to draw energy from the grid (charging mode), while electrolysers (PtX) are assumed to operate at full capacity to balance the excess generation from solar and wind power plants. In such a grid load scenario, various loading violations occur, especially on the older transmission lines with double bundle conductors and smaller capacity (Figure 6).

The red arrows in Figure 6 represent the old binary bundle transmission lines that are loaded beyond their capacity. The yellow arrows, on the other hand, indicate transmission lines that are loaded very close to capacity ratings. Overloading is not a desirable option in grid operations. However, loading close to capacity ratings is also not desirable as it reduces operational flexibility.

Figure 6. Grid loading conditions for summer 2035 – Peak load day



Old low-capacity 2-bundle transmission lines loaded above their capacity ratings

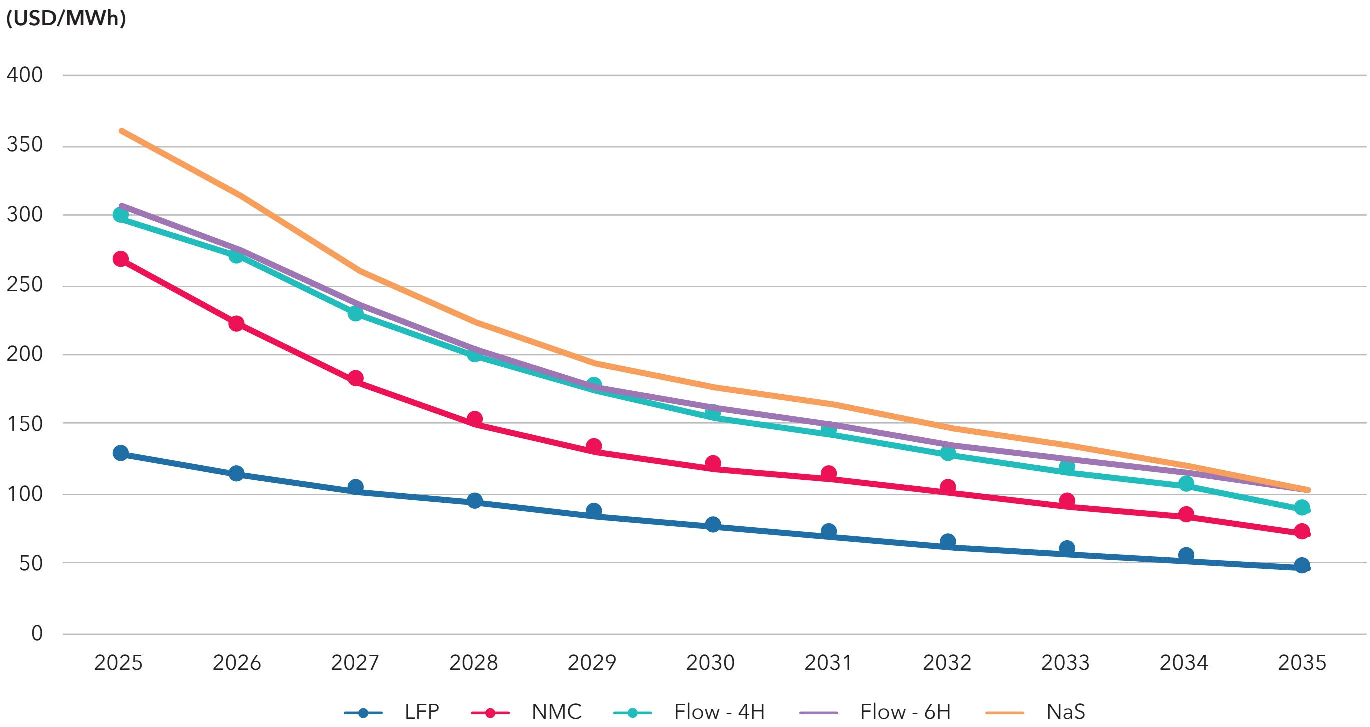
Transmission lines loaded very close to their capacity ratings

In order to minimise the negative effects of this situation on the grid, 500 MW additional storage capacity was moved from Kütahya-Afyon Region to Konya, followed by rerunning the load flow simulation. The analysis showed that increased storage capacity had a positive effect on the line connecting Konya to Afyon region.

Within the scope of cost-benefit analyses, the prominent technologies for the selected areas of use were also evaluated. One case study conducted within the scope of cost-benefit analysis considers a battery energy storage system with an installed capacity of 10 MW/40 MWh (4-hour charge/discharge) integrated with a SPP with an installed capacity of 10 MWp/10 MWe.

Whenever an arbitrage opportunity was available during the simulation period, the battery energy storage system stores either the electricity generated by the SPP or the electricity drawn from the grid, only to discharge it during the hours when the market prices are higher. In case of storing electricity generated by the SPP, no transmission/distribution fees are applicable for the storage system. In the simulation, the storage system is charged by drawing power from the grid in case there is available capacity after storing the power generated in the power plant to which it is integrated. The simulations prepared for this case were run on an hourly basis between 2025 and 2035. The lowest levelized cost of service (LCOS) projected in the context of this service is incurred for LFP batteries (Figure 7).

Figure 7. LCOS projection for storage systems integrated into renewable energy power plants



The analyses predict that a total battery storage capacity of 7.2 GW/28.8 GWh will be reached by 2035. In the analyses, 30% (2.16 MW/8.64 MWh) of the overall storage capacity is assigned to standalone systems, 60% (4.32 MW/17.28 MWh) is integrated into a renewable energy power plant, and 10% (0.72 MW/2.88 MWh) is assigned to behind-the-meter battery systems. As part of the cost-benefit analyses, the total amount of avoided renewable energy generation curtailments was computed if these systems were operated in order to minimise such curtailments. The analysis results show that it is possible to reduce the renewable generation curtailments by

6.9 TWh[10] in 2035. In this way, the reduction of natural gas consumption will be approximately 11.7 TWh.[11] Assuming an average natural gas price of USD 31.4/MWh in 2035, natural gas imports are projected to decrease by USD 369 million[12]. In this context, it is estimated that carbon emissions from natural gas consumption will decrease by 2.3 million tonnes[13] in 2035.

E. Policy Proposals to Accelerate the Deployment of Battery Energy Storage Systems in Türkiye

- New legislation introduced in Türkiye has enabled the investors to install battery energy storage systems integrated to renewable energy power plants. The regulations aim to rapidly increase renewable energy plant capacity to achieve the net zero emission target. However, it is recommended that secondary regulations should be introduced to provide further details on the purpose, technology, and location of battery energy storage facilities.

- In case, the battery energy storage facilities integrated to the power plant will be deployed to manage the imbalance imposed by renewable energy power plants on the grid, it is recommended that imbalance penalties should reflect the actual grid costs, and improvements should be made to ensure that the investor designs the storage facility at a scale and capacity to manage the imbalance of the relevant power plant. Doing so would facilitate the development of projects where the investor would implement the project with a storage capacity other than the specified technical criterion (1 MW/1 MWh) in the regulations to manage such imbalances.

- If the battery energy storage facility integrated to the plant will be operated in order for the renewable energy power plant to operate as a base load power plant, it would be beneficial to amend the regulations to support storage facility designs with a charge-discharge capacity of at least two hours or more. In addition to the improvements in the legislation, providing various relevant financial incentives and tax exemptions to investors will help to increase the battery energy storage investments.

- The benefits of the planned battery energy storage facilities should be evaluated from the perspectives of the system as well as the investors. In cases where the benefits of the batteries to the system are higher than

[10] In the analyses conducted for 2035, it is projected that 2.2 TWh of stand-alone storage systems, 4 TWh of storage systems integrated with renewable energy plants, and 0.7 TWh behind-the-meter storage systems will contribute to the total renewable energy-based power curtailment prevention.
[11] The calculations assume 60% gross efficiency and 1.5% internal consumption rates for combined-cycle natural gas power plants.
[12] Natural gas price calculations are based on Dutch TTF, 2027 Delivery Price (31.4 USD/MWh) (ICE, 2024).
[13] The natural gas emission factor is assumed as 55.4 t/TJ (MENR, 2024).

the total cost of implementing and operating these systems in regards to the selected location and technology, various subsidies and/or incentives should be considered for the investors.

- In order for battery energy storage investments to be deployed in a timely manner, it is recommended to evaluate the investors on both technical and financial terms according to specified criteria. Furthermore, new battery energy storage system capacity to be commissioned will need to be optimally positioned. In this context, a technical roadmap can be created that considers the relevant battery technology and the services to be received from the batteries.

- Virtual Power Line[14] (VPL) installations using battery energy storage systems should be prioritized to reduce the limitations and bottlenecks observed in transmission and distribution lines. Pilot project regions can be selected to test the use of this technology, followed by the widespread implementation of VPL applications.

- Further improvements in wholesale electricity markets may enable battery energy storage facilities to increase their revenues by taking advantage of arbitrage opportunities. The existing maximum and minimum price limits restrict the arbitrage potential of storage facilities. Ensuring that market prices reflect costs and allowing the occurrence of negative prices will increase arbitrage opportunities and encourage consumers to install energy storage systems. To this end, it is also imperative to expand the use of time-of-use tariffs.

- Given the mismatch between the major electricity generation and consumption areas in Türkiye, some regions experience occasional bottlenecks. Regional constraints are expected to increase in the future due to the concentration of variable generation renewable energy sources (wind and solar), which is expected to increase in line with the net zero emissions targets, in certain areas in Türkiye. In that regard, battery energy storage facility installations can be prioritised in regions experiencing bottlenecks, coupled with regional pricing method to manage these bottlenecks. Regional imbalances can be managed through a gradual transition to a regional pricing system that would reflect the physical characteristics of the grid.

- Under the current tariffs, battery energy storage facilities pay transmission/distribution fees for both charging and discharging on the grid. Considering the benefits of battery facilities to the national economy

[14] With VPL, battery energy storage facilities are installed at both generation and consumption points, making it possible to balance out the renewable energy-induced grid frequency fluctuations and loads on the grid.

(reducing renewable energy curtailments, fossil fuel consumption, and the need for grid investments, etc.), a new usage tariff for these systems would be helpful, involving discounts on grid charges compared to the case for other users. As an alternative, battery energy storage facilities could pay grid charges based only on their actual consumption (technical loss) or pay grid charges only for one direction (i.e., either for supply or withdraw).

- Improvements in the ancillary services market would allow for and facilitate the market participation of smaller capacity battery energy storage systems. Under existing regulations, energy storage systems to participate in the ancillary services market must have an installed capacity of at least 10 MW. In the future, this technical criterion may be reduced initially to 1 MW and subsequently to a few hundred kilowatts in order to enable the participation of small-scale behind-the-meter batteries that will increase the possibility of load shifting in the market. Thus, the participation of battery energy storage systems can be facilitated combined with aggregation activities in the market.

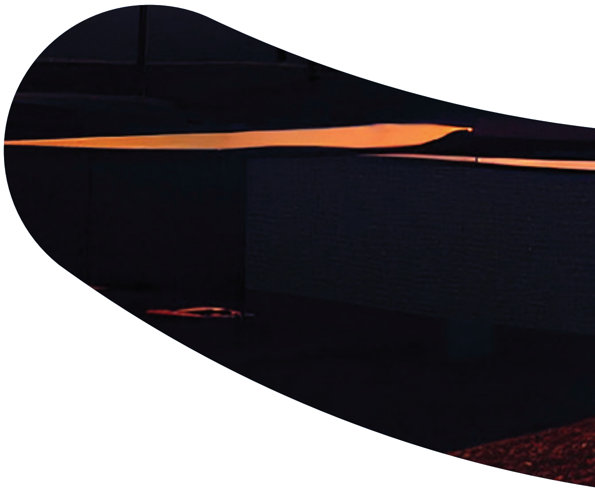
- It is also suggested that after a certain level of renewable energy integration has been achieved, net-billing or buy-all, sell-all pricing models should be adopted instead of the currently available monthly settlement method applied to the unlicensed power plants. With the net-billing or buy-all, sell all schemes, the real cost of the system is reflected to the prosumers, there would be an increase in behind-the-meter battery installations, and the contribution of storage to the system flexibility would become even more evident.

- Various financial instruments such as low-interest loans, tax exemptions, and grants to incentivise energy storage facility installations would be effective. In addition to these direct financial instruments, technology-based incentives or financing can also be utilised. For example, a financial subsidy mechanism can be introduced to compensate for the efficiency losses of batteries during charging-discharging throughout the day, or technical criteria such as meeting certain cycle numbers in line with the services to be provided by the relevant battery can be specified for access to low-cost financing.

About Istanbul Policy Center at Sabancı University
Istanbul Policy Center (IPC) is a global policy research institution that specializes in key social and political issues ranging from democratization to climate change, transatlantic relations to conflict resolution and mediation. IPC organizes and conducts its research under three main clusters: The Istanbul Policy Center–Sabancı University–Stiftung Mercator Initiative, Democratization and Institutional Reform, and Conflict Resolution and Mediation. Since 2001, IPC has provided decision makers, opinion leaders, and other major stakeholders with objective analyses and innovative policy recommendations.

About European Climate Foundation
The European Climate Foundation (ECF) was established as a major philanthropic initiative to help Europe foster the development of a low-carbon society and play an even stronger international leadership role to mitigate climate change. The ECF seeks to address the "how" of the low-carbon transition in a non-ideological manner. In collaboration with its partners, the ECF contributes to the debate by highlighting key path dependencies and the implications of different options in this transition.

About Agora Energiewende
Agora Energiewende develops evidence-based and politically viable strategies for ensuring the success of the clean energy transition in Germany, Europe and the rest of the world. As a think tank and policy laboratory, Agora aims to share knowledge with stakeholders in the worlds of politics, business and academia while enabling a productive exchange of ideas. As a non-profit foundation primarily financed through philanthropic donations, Agora is not beholden to narrow corporate or political interests, but rather to its commitment to confronting climate change.



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