Unlocking demand-side response in Turkey: A white paper

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 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 Turkey'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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Acknowledgements

SHURA is grateful to Bram Claeys, Andreas Jahn, Deborah Bynum (RAP), Philipp Godron (Agora Energiewende), Mert Kekevi (Energy Pool), Hasan Aksoy, Değer Saygın and Ayşe Ceren Sarı (SHURA Energy Transition Center) who provided valuable review and feedback to the report.

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Design

Tasarımhane Tanıtım Ltd. Şti.

ISBN 978-625-7329-23-1

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This report and the assumptions made within the scope of the study have been drafted based on different scenarios and market conditions as of the end of 2020. Since these assumptions 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.

Key Messages

- Demand-side response offers a great potential in decarbonising the power system at minimum cost. Pricing reforms will boost demand-side response benefits in Turkey's power system.
- Demand-side response plays a key role in transforming the power system along with energy efficiency, distributed energy resources and battery storage, as other flexibility tools.
- A fast and reliable communication system between smart technologies will help consumers switch to smart meters to play an active role in demand-side response.
- Restructuring the power system regulations considering consumers, independent aggregators, digitalisation and flexibility, will accelerate the proliferation of demand-side response in Turkey.

Introduction

Turkey's energy system has enormous potential for renewable energy integration and smart-tech innovation, both of which are crucial to achieving energy decarbonisation, improving efficiency and ensuring resilience. To realise this potential, policy makers will need to boost clean-tech investment by maximising the value of renewables, while mitigating adverse consequences for the grid and consumers. This paper explains why demand-side response (DSR) is key to achieving these objectives and provides practical recommendations through a six-point plan for implementation.

Part one: Meeting Turkey's future energy system needs through flexibility

Turkey's clean energy vision

Of the total 305 terawatt-hours of electricity generated in Turkey in 2020, coal's share was 34.8%, hydropower 25.6%, natural gas 22.7%, wind, solar, geothermal and other renewables 16,8%.[1] Going forward, Turkey has made a robust commitment to reduce imported fuel and to increase renewable energy systems (RES) share for power system decarbonisation, having already comfortably surpassed the Eleventh Development Plan target of 38.8% share of renewables in Turkey's total electricity demand by 2023.[2] Recent analysis released by SHURA Energy Transition Center indicates that it is technically and economically feasible for wind and solar penetration to reach 30% by 2030, with a further 20% provided by other renewable energy resources. There is however a consensus that this potential is well achievable and it will not be the limit for both wind/solar and RES potential in 2030. Achieving this potential would require up to 60 GW total installed wind and solar capacity by the same time, depending on electricity demand growth.[3]

In turn, electricity demand growth depends on the net outcome of two important trends: (1) **electrification** of the heating, cooling and transport sectors, which will inevitably increase electricity demand; and (2) **energy efficiency** measures, designed to reduce electricity demand. Anticipating the challenges of electrification and managing these with energy efficiency and DSR are increasingly essential for keeping system disruption to a minimum and enabling higher shares of renewable generation to be integrated. These factors are explored in more detail below.

[1] https://enerji.gov.tr/eigm-raporlari
[2] https://www.shura.org.tr/wp-content/uploads/2020/09/ExecutiveSum.pdf
[3] https://www.shura.org.tr/wp-content/uploads/2020/08/ExecutiveSum.pdf

Heat pumps: SHURA's 2030 scenario envisages a significant roll-out of heat pumps as one of the pillars of the energy transition. SHURA's Electrification scenario envisages 50% of new buildings and 10% of the existing stock adopting heat pumps, totalling 1.9 million heat pumps deployed across Turkey, thereby increasing their share from 1% to 19% of the stock. Such a heat pump roll-out is projected to augment the electricity requirement for heating in 2030 from a baseline of 4 GW to around 18 GW.[4]

Electric Vehicles (EVs): Approximately 1,000 EVs are currently driven In Turkey, 2,000 including plug-in hybrid EVs (PHEVs). With the increasing ownership of cars and a growing population, there is significant potential to increase EV use. The Ministry of Energy and Natural Resources (MENR) envisages the possibility of 1 million EVs on Turkey's roads by 2030.[5] However, according to SHURA's 2019 report on EVs, it is well feasible to integrate 2.5 million EVs, with an annual electricity demand of 4 TWh, into Turkey's distribution grid by 2030, provided that policy strategies to enable smart charging are successfully deployed.[6]

Energy Efficiency: Turkey's National Energy Efficiency Plan[7] **(NEEAP)** for 2017-23 aims for a 14% reduction in total primary energy demand by 2023, compared to 2017 levels. The NEEAP suite of efficiency measures comprises 55 actions to drive energy efficiency, with 31 targeting different stages of the electricity sector. The SHURA Energy Efficiency study[8] revealed that, compared with baseline projections, an additional 10% reduction in electricity demand is possible with a suite of cost-effective efficiency options. This includes not only buildings and industry but also other end-use areas such as street lightening and T&D network efficiency, resulting in approximately 48.9 TWh electricity gross savings per year by 2030, 42.3 TWh net savings, factoring in electrification.[9] SHURA estimates that, for each €1 spent for the deployment of the technology portfolio, net benefits of €1.2-1.5 are stimulated, underlining the importance of energy efficiency in playing a central role in the energy transition, including in informing resource adequacy planning.[10] Such investment will be critical because without intervention, Turkey's electricity demand is expected to increase by 50% from 2019 to 2030.[11]

Nearly 10-15 GW of the 60 GW potential relies on consumers providing distributed energy resources (DERs) including roof-top solar PV systems, according to SHURA's study on rooftop solar potential in Turkey.[12] This represents a significant leap from today's situation, with roof-top solar PV systems constituting less than 1 GW in early 2020[13], though this has picked up in spring 2021, with TEIAS reporting around 400MW of (mostly rooftop) PV added between January and April[14]. To bridge this gap and maintain recent momentum, policy action is needed to optimise the value of renewable generation, both on-site and at scale.

[4] https://www.shura.org.tr/wp-content/uploads/2021/05/Sector_coupling_for_grid_integration_of_wind_and_solar.pdf
[5] https://www.aa.com.tr/en/economy/turkey-expects-1-million-electric-cars-on-roads-by-2030/1704467
[6] https://www.shura.org.tr/wp-content/uploads/2019/12/Transport-sector-transformation.Integrating-electric-vehicles-into-Turkey%E2%80%99s-distribution-grids.pdf
[7] https://enerjiapi.enerji.gov.tr//Media/Dizin/EVCED/tr/Raporlar/Ulusal%20Enerji%20Verimliliği%20Eylem%20Planı/20180102M1_2018_eng.pdf
[8] https://www.shura.org.tr/wp-content/uploads/2020/10/SHURA_Ana-Rapor-1.pdf
[9] https://www.shura.org.tr/wp-content/uploads/2020/10/SHURA_Exum.pdf
[10] https://www.shura.org.tr/wp-content/uploads/2020/10/SHURA_Exum.pdf
[11] https://www.shura.org.tr/wp-content/uploads/2020/10/SHURA_Exum.pdf
[12] https://www.shura.org.tr/rooftop-solar-energy-potential-in-buildings-financing-models-and-policies-for-the-deployment-of-rooftop-solar-energy-systems-in-turkey-2/
[13] https://www.shura.org.tr/rooftop-solar-energy-potential-in-buildings-financing-models-and-policies-for-the-deployment-of-rooftop-solar-energy-systems-in-turkey-2/
[14] https://www.pv-magazine.com/2021/05/10/turkey-hits-7-gw-milestone/

Current barriers to the transition

Solar and wind generation provide the enormous social benefit of producing clean electricity at near zero marginal cost, with low operating costs and no fuel price risk. However, their intermittency means that they also create significant imbalance costs, which ultimately makes the system less efficient and more costly for consumers.

Delivery of power from any source is also impacted by physical system constraints, i.e. where the power lines are at capacity, requiring generation to be stopped (curtailed) in the congested area, and increased in another area, to ensure that power can flow to the area of demand. The higher the peak demand, the more infrastructure required and the greater the cost overall, because the physical network must be built out to accommodate the highest demand spikes and to alleviate network congestion. Increased share of DERs in the system also causes voltage deviations in networks, which were designed for the traditional one-way flow of centralised power from high voltage transmission lines to lower voltage distribution networks. SHURA's Market and Grid Integration of Distributed Energy study[15] identified nine key areas of focus for addressing challenges associated with DER integration in Turkey. These include measures to increase cost-reflectivity, transparency and accountability in charging mechanisms, including network tariffs and imbalance costs, as well as technical solutions to improve DER visibility and therefore integration.

A coherent DSR policy strategy would significantly enhance these recommended measures, to ensure the most efficient solution. Unless Turkey's renewable power effort is supported by a growing market for DSR, higher levels of wind and solar will result in increasing amounts of renewable energy being curtailed and more network upgrades will be needed, while fossil fuel peaking plants continue to be kept on stand-by to provide back-up power when the renewables are not operating. This will increase cost for consumers, who ultimately pay for the doubling-up of generation and the extra network infrastructure required. It also prevents full system decarbonisation.

To overcome these barriers, renewable generation intermittency needs to be managed at a system-wide level. In a truly efficient market, network operators would have a full range of capacity options available to them, not only calling upon the supply-side to ramp up generation but also calling upon consumers providing DSR services during times of system stress or imbalance. Such services would compete on an equal footing, to provide the least-cost solution. Balancing the electricity system through DSR rather than by increasing generation would also reduce network losses, as a certain amount of electricity is inevitably wasted when it is conveyed over long distances. In 2019, transmission losses were 1.9% and distribution losses 8.8% on average in Turkey, compared to 6% in central Europe.[16]

A diverse energy mix, comprising both supply and demand-side resources, is essential for system resilience. During the extreme weather of the 2014 Polar Vortex event in New York, coal stocks froze and gas stations ran out of fuel, while DSR helped to "keep the lights on"[17]. Conversely, the events in Texas in February 2021, which saw similar

[15] https://www.shura.org.tr/wp-content/uploads/2021/05/Yenilenebilir_Dagitik_Enerji_Uretiminin_Sebeke_ve_Piyasa_Entegrasyonu.pdf
[16] TEİAŞ - Türkiye Elektrik Enerjisi Üretim Tüketim ve Kayıplarının Yıllar İtibariyle Gelişimi (1993-2019). This figure includes both technical and non-technical losses (e.g. theft)
[17] https://www.pjm.com/~/media/markets-ops/rpm/rpm-auction-info/2016-2017-base-residual-auction-report.ashx Ayrıca bakınız: https://www.nrdc.org/experts/john-moore/polar-vortex-and-power-grid-what-really-happened-and- why-grid-will-remain

failures of gas supply and power plants leading to extended outages, were perpetuated by the absence of fit-for-purpose DSR products.[18] A similar pattern is emerging within Europe. For example, during the January 2021 system split, transmission system operators (TSOs) in France and Italy called upon interruptible load capacity from industrial DSR consumers, which provided 1.7GW to enable frequency stabilisation.[19] Turkey should take stock of the difficult lessons learned by other countries and ensure that DSR readiness is part of its energy resilience planning now.

The power of a flexible demand-side

DSR is about consumers changing their demand patterns, within a specific time-period, in response to market signals. This can be achieved through either manual actions or automated processes, using smart energy technology. By becoming demand-flexible, consumers can reduce their electricity demand at peak times and instead move usage to cheaper, off-peak times, such as when renewable power is plentiful. Where the regulatory regime facilitates it, demand capacity can be traded in the same way as generation capacity.

Broadly, there are two types of DSR actions:

- **Explicit DSR:** Sold as an explicit product (volume) in specific market segments, or as network related services to system operators. For example, sale of balancing energy to the TSO or distribution system operators (DSOs) and services for grid congestion management purposes; energy in the day-ahead and intraday markets and capacity mechanisms. To sell explicit demand response, an explicit control and verification of the load is typically required.

- **Implicit DSR:** Utilised to enable the customer or their balance responsible party (BRP) to optimise their network costs, energy costs or imbalance charges. For example, optimisation of imbalances against the imbalance settlement price or optimising network costs against dynamic network tariffs. Implicit DSR can either be facilitated via price signals to the customer, such as time-of-use (TOU) retail pricing and dynamic network tariffs, or by an explicit control and change of the load.[20]

Long before the large-scale deployment of renewables, DSR was already an essential economic efficiency measure, for both network operators managing grid congestion and energy-intensive industries keen to keep production costs to a minimum. However, with the introduction of smart meters, settlement reform and affordable smart home technology in some markets, DSR is rapidly becoming an accessible tool for other categories of cost-conscious and environmentally aware consumers, including small businesses and households.

[18] https://www.euractiv.com/section/electricity/opinion/real-life-drama-lessons-for-europe-from-a-texas-tragedy/
[19] https://eepublicdownloads.azureedge.net/cleandocuments/Publications/Position%20papers%20and%20reports/entso-e_CESysSep_interim_report_210225.pdf
[20] CEER Principles for Valuation of Flexibility Paper 2016
https://www.ceer.eu/documents/104400/-/-/4a605bcf-9483-d5a0-67fb-368e75af30cd

The NEEAP represents Turkey's action plan to recreate this DSR boom in Turkey. Action E10 is to "Build a market mechanism for demand response". There are two explicit DSR ancillary services in existence in Turkey today, which cover consumers providing services directly but not third party aggregators:

- **Demand Side Reserve:** This is a new scheme, which will be procured through tenders by the TSO rather than on a continuous basis. Access to DSR is therefore dependent on the TSO deciding to run a tender. The detail of pre-requisites, such as minimum bid size, capacity duration requirement and advanced notification before being called upon, are yet to be determined and will be specified by the TSO as part of the tender process. It can be assumed that consumers will need to have a meter that records data in less than hourly intervals, as the load reduction orders may be for less than an hour duration. To be eligible, consumers must have an annual electricity consumption of at least 10,000 MWh and be connected directly to the transmission network, which excludes residential and smaller business consumers.

- **Interruptibility Scheme:** Interruptibility schemes are mechanisms by which TSO can call upon large industrial consumers to reduce their demand in scarcity situations. In Turkey's interruptibility scheme, consumer's demand must be able to be interrupted in relays of 15 minutes and they must be connected directly to the transmission grid. The minimum bid size is 1 MW and there is currently no role for independent aggregators in the regulation. These factors together exclude residential and smaller business consumers.

Even if the TSO were already regularly running tenders for these DSR services, they would still only be available to the largest industrial consumers, which are able to meet the eligibility and entrance criteria and engage with the tender process on their own, without needing an aggregator. Part Two sets out how these opportunities could be opened up to the entire DSR sector.

Smart meter access is another key requirement for scaling up DSR in Turkey, necessary not only for participation in explicit DSR schemes but also implicit DSR via retail time-of-use and dynamic tariffs. Action E4 of the NEEAP is to "Harmonise the legislative framework on electric metering with the EU aquis" in order to scale up smart metering in Turkey. This does not mandate a national smart meter roll out, but does commit to a cost-benefit analysis on smart meters, which implies that smart metering systems could be scaled up, using targets similar to those contained in EU legislation. Focus groups of consumers have been identified for priority access, including industrial facilities, commercial buildings and hotels. The NEEAP also articulates the need to identify infrastructure needs, calculate costs and evaluate the total impact on electricity bills.

Better together: Creating a suite of complementary demand-side tools

The growth of the "prosumer", i.e. consumers that produce their own energy such as on-site solar or wind power, via DERs, combined with developments in behind the meter battery storage, is changing the traditional top-down energy supply model. SHURA envisages total supply-side storage capacity (including pumped storage) exceeding 2GW by 2026 (including approximately 600MW distributed battery storage). This figure could be significantly higher if the true system value of behind-the-meter storage were captured through cost-reflective charging. From the perspective of the network operator, a consumer switching to on-site DERs or a battery "behind the meter" is the same as true load shifting. EVs also represent significant, inherently flexible storage,[21] the growth of which would benefit greatly from opportunities to lower operating costs to offset higher upfront cost, and to minimise the need to build and recover the costs of new grid infrastructure. The SHURA study on Sector Coupling for Grid Integration of Wind and Solar (the SHURA Sector Coupling study) revealed that the combination of space heating, space cooling and smart EV charging could reduce peak demands in summer and winter by up to 10 GW by 2030 in Turkey.[22]

Energy efficiency greatly increases the flexibility of buildings, and therefore DSR value potential. A well-insulated building will stay warm or cool for longer. This not only optimises the ability of electric low-carbon heating and cooling systems to integrate with variable renewable energy resources through thermal energy storage, it also increases the period in which the consumer can avoid using the grid, without compromising comfort levels.[23] In other words, DSR customers can deliberately pre-heat or pre-chill an energy efficient space before the peak period, with confidence that an acceptable temperature will be maintained.

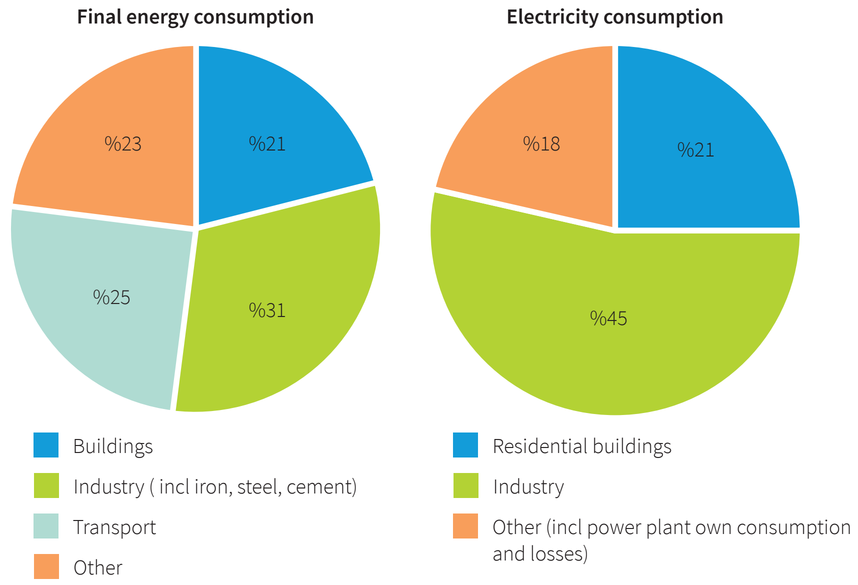
In summary, DSR is particularly valuable when combined with DERs, storage, EVs and energy efficiency measures, to create a dynamic suite of flexible, local, customer-controlled demand-side resources. These empower customers to make the best use of any on-site resources, while avoiding using the wider network when prices are highest. SHURA estimates that, compared with the baseline scenario total potential electricity savings in Turkey's industry and buildings sectors are 19.2 TWh and 16.6 TWh per year by 2030, respectively. This indicates that majority of the new total savings potential exists in buildings. Almost 50% of the projected industry sector savings came from motor systems. LED lighting systems also have a high energy savings potential with a similar contribution among all the different technology types that have been assessed. Distribution network losses could be reduced by 7.2 TWh in 2030 compared to the baseline scenario due to energy efficiency, DER deployment and DSR.[24]

[21] https://www.raponline.org/wp-content/uploads/2019/03/rap-start-with-smart-ev-integration-policies-2019-april-final.pdf
[22] https://www.shura.org.tr/wp-content/uploads/2021/05/Sector_coupling_for_grid_integration_of_wind_and_solar.pdf
[23] Rosenow, J., and Lowes, R. (2020). Heating without the hot air: Principles for smart heat electrification. Brussels, Belgium: Regulatory Assistance Project.
[24] https://www.shura.org.tr/wp-content/uploads/2020/10/SHURA_Exum.pdf

Realising Turkey's DSR potential through sector coupling

In 2019, 31% of Turkey's final energy consumption[25] came from the industrial sector, which includes intensive industries such as iron, steel and cement. 21% of consumption was from residential, commercial and public buildings and 25% from the transport sector. Taking a closer look at electricity consumption, the share of electricity consumed in residential buildings corresponded to 19% of total consumption, industrial electricity demand just over 40% representing the highest demand sector, commercial services 26%, agriculture 3%, transportation only 0.4% with network losses just under 11%.[26]

Figure 1: *Turkey's final energy and electricity consumption*



*Source: TEİAŞ Energy Balances Data**

Integration of the power sector with energy-consuming sectors is known as **sector coupling**. The SHURA Sector Coupling study[27], revealed that marrying the power system with electrified heating (and to a lesser extent cooling), transport and industry sectors has the potential to provide considerable flexibility to Turkey's power system. The study assessed both the technical and economic potential for DSR utilisation, when deployed alongside, or in competition with other flexibility options, in the scenario of 30% wind and solar energy share in total power output. It determined that activating the full techno-economic potential of DSR options could reduce peak demand by 10 GW by 2030, with nearly 6 GW of net peak demand reduction coming from **flexible space heating** and **smart EV charging**, enabling net system benefits. The largest system benefits from activating DSR potential were derived from the avoidance of constructing new generation and distribution network capacity, which would be otherwise needed to cover the growing peak demand driven by electrification. SHURA calculated that successful DSR activation could lead to operational efficiency savings of up to €122 million per year through reduced generator fuel use and redispatch requirements, while savings due to avoided capacity expansion of generation and distribution networks reach to nearly €500 million per

[25] Excluding non-energy uses of fossil fuels for the production of chemicals and plastics.
[26] Energy Pool calculations using TEİAŞ data. The self-consumption of power plants is an added factor, not transparent in the data, due to net metering. Network losses include non-technical losses.
*TEİAŞ - Türkiye Elektrik Enerjisi Üretim Tüketim ve Kayıplarının Yıllar İtibariyle Gelişimi (1993-2019)
TEİAŞ - Electricity Production, Consumption and Losses by Year in Turkey (1993-2019)
[27] https://www.shura.org.tr/wp-content/uploads/2021/05/Sector_coupling_for_grid_integration_of_wind_and_solar.pdf

year. Total costs were assessed at €72 million, indicating net benefits of €550 million per year in 2030.

Summary of Part One

DSR, as part of a suite of demand-side flexible tools including energy efficiency, DERs and storage including EVs, is the lynchpin in the pursuit of power system decarbonisation at the lowest cost to consumers.

As seen above, DSR improves overall system efficiency in a number of vital ways. The diagram below categorises these into broad themes for ease of referring to them in the next section. In reality, the categories are interrelated and together form a total system "efficiency first" approach.

DSR and Energy Efficiency	• Improved thermal storage of buildings • Longer time window for load shifting • Value optimisation of EE upgrades
DSR and Economic Efficiency	• Investment reduction/deferral in network upgrades and new generation • Reduced network losses • Total system efficiency-across supply chain
DSR and Renewables Integration Efficiency	• Reduced curtailment of renewables • Reduced balancing costs associated with intermittency • Higher overall % renewables enabled in power mix
DSR and Consumption Efficiency	• Customers empowered to exploit their flexibility and save money through EV smart charging, onsite DER and TOU/ dynamic tariffs and load shifting

However, innovation does not happen in a vacuum. The benefits of DSR will not materialise without a strategic policy approach to flexibility. The SHURA Sector Coupling study concluded that two essential missing factors were dynamic market regulation and innovative business models, which recognise and reward DSR services and climate-tech investment. It is imperative that Turkey now develops an integrated power system strategy that includes electrification and sector coupling. This will enable the power system to access higher shares of wind and solar energy, while maintaining a well-managed distribution grid and efficient use of power at the end-use side. The strategy must have flexibility at its heart.

To ensure that consumers have confidence in the emerging sectors and are protected from exploitation and unequitable outcomes, the implementation strategy should be complemented by social policies, including consumer and environmental protection. For Part Two, a fifth pillar of "Complementary Social and Environmental Policies" has been added to the list above, to form a colour coded guide to the recommendations.

Complementary Social and Environmental Policies

Part Two of this White Paper sets out a six-step plan, to act as a blueprint for Turkey's flexible energy transformation.

Part 2: Six point plan for scaling up DSR in Turkey

1. Use regulatory standards to get technology, buildings and grids DSR-ready

DSR and Energy Efficiency	DSR and Renewables Integration Efficiency
DSR and Consumption Efficiency	Complementary Social and Environmental Policies

Consumers require both flexible capital and access to the appropriate technologies to respond to market signals through DSR. Grid infrastructure must also be future-proofed for the smart energy era. New business models are evolving in the dynamic market for smart charging, particularly in the EV sector. These use smart technologies with automation to optimise charging and deliver maximum economic benefits to consumers and the grid. The regulatory framework must evolve with them.

As a baseline, all consumers should have the right to adopt a smart meter (at their own cost) with at least hourly resolution, and a reliable, rapid communication system, to record and reward DSR actions. Higher resolution (such as 15 minutes) will be necessary for those providing ancillary services, e.g. the interruptibility scheme.[28] The national smart meter policy under the NEEAP should not set the pace for all customers. Those with EVs, other flexible assets, or simply a desire to participate in DSR should be empowered to be early adopters. **Customers should also have the right to request a flexibility assessment from their supplier or an independent aggregator (IA), ideally with shadow billing available or another method of estimating DSR savings, on the basis of certain tariff and usage assumptions. Point 2 below covers tariff design.**

We recommend mandating that all new EV charging environments include smart functionality and making compulsory the use of technology that enables dynamic tariffs. Legislation should support the deployment of automation technology to enable smart charging.

Building codes are an important catalyst for raising energy efficiency standards and transforming heating into a low-carbon and flexible sector. Several European countries, including Belgium, Denmark, Germany, Ireland, the Netherlands, Norway and the UK, have taken steps to ban gas and/or oil boilers or gas connections for new buildings, while Poland has ruled to phase out coal boilers in new and existing buildings.[29] **We recommend regulation to phase-out fossil fuel heating systems, at least for new buildings, with incentives for retro-fits to increase energy efficiency and to enable electrification of existing building stock, especially for buildings not connected to the gas grid. Like EVs, heat pumps should ultimately be required to be DSR-ready. Standardisation of terminology and clear labelling rules would also help consumers to compare and choose between different providers.**

[28] https://www.shura.org.tr/wp-content/uploads/2021/05/Sector_coupling_for_grid_integration_of_wind_and_solar.pdf
[29] https://www.raponline.org/wp-content/uploads/2020/03/rap-rosenow-lowes-principles-heat-decarbonisation-march-2020.pdf

The invisibility (and therefore unpredictability) of behind-the-meter generation to grid operators is a problem for system management everywhere. In Turkey, this issue is perpetuated by DER net-metering and high levels of solar. SHURA Energy Transition Center's report on "Market and Grid Integration of Distributed Generation" explores case studies in Australia, Germany, the UK and US, where dynamic solutions are being explored to address these challenges. The report recommended the following actions to address DER invisibility:

- **Put in place a system for collection of statistical data of distributed generation installations in Turkey**

- **Create capacity hosting maps for potential DER investors, containing information about the hosting capacity of the existing network and the connection points of the network (need for network improvement, etc.).**

- **Roll out smart inverters as a priority - in addition to the rapid adoption of smart meters (see above) - to ensure visibility and controllability of DERs. To support timely implementation, determine the regulatory framework and responsible parties for smart metering infrastructure installation, with an incentive mechanism to accelerate the development of business models to build the necessary installment capacity.**

Figure 2: *Smart technology is required to make the most of smart pricing and smart infrastructure*

Source: RAP, Designing retail electricity tariffs for a successful Energy Union

2. Ensure price signals reflect cost to support efficiency

Having laid the foundations of flexibility through standard-setting, it is essential to provide clear, cost-reflective price signals. These incentivise consumers and other market actors to act in the most efficient manner.

We recommend:

- **Volumetric network tariffs that reflect peak:** the volumetric element of the tariff should reflect the cost of conveying energy within the network (cost reflectivity), and - whenever possible - consumer contribution to peak grid capacity; this is, for example, supported by simple dynamic volumetric tariffs that coincide with peak, and may be particularly suited for the short term when the extent of EV and electrification remains relatively low. These may vary by consumer groups (below).
    - **Small industrial and commercial consumer groups:** a volumetric TOU tariff should be set as the default option, updated sufficiently regularly to ensure overlap with peak. If smart technology is available, critical peak pricing and dynamic pricing pilots could be explored.
    - **New controllable load groups:** with significant potential to flexible consumption (such as EVs and heat pumps) should have volumetric TOU tariffs, with smart meters in place, preferably with locational signals.[30]
    - **Other residential consumers:** network tariff design should be based on a simple volumetric charge, with the option to choose a TOU or dynamic tariff. As smart and automated controls, and metering and billing become more widespread, the roll-out of such tariffs can be expanded further.
- **Cost-recovery in network tariffs:** supplementary tariffs to ensure cost-recovery of the network (beyond peak and energy charges) should be designed to minimise distorting incentives, and especially as the energy transition gathers pace in presence of net metering, should be made “hard-to-avoid”, for example placed on fixed demands where consumers could otherwise dodge these without lowering system costs.
- **Energy costs in regulated retail tariffs:** should be linked to the actual economic costs of generation (and the value of energy during scarcity: see value of loss load in section 4), through a link to dynamic wholesale prices or TOU blocks. Ideally hidden costs relating to environmental damage should be accounted for (see next point).
- **A carbon pricing mechanism:** The implementation of a carbon pricing mechanism in the electricity market and the application of these prices to electricity generation facilities that cause greenhouse gas emissions will provide benefits in combating climate change and improving local air quality, while allowing these costs to be reflected in electricity prices.

[30] https://www.raponline.org/wp-content/uploads/2019/03/rap-start-with-smart-ev-integration-policies-2019-april-final.pdf

In addition, it should be noted that:

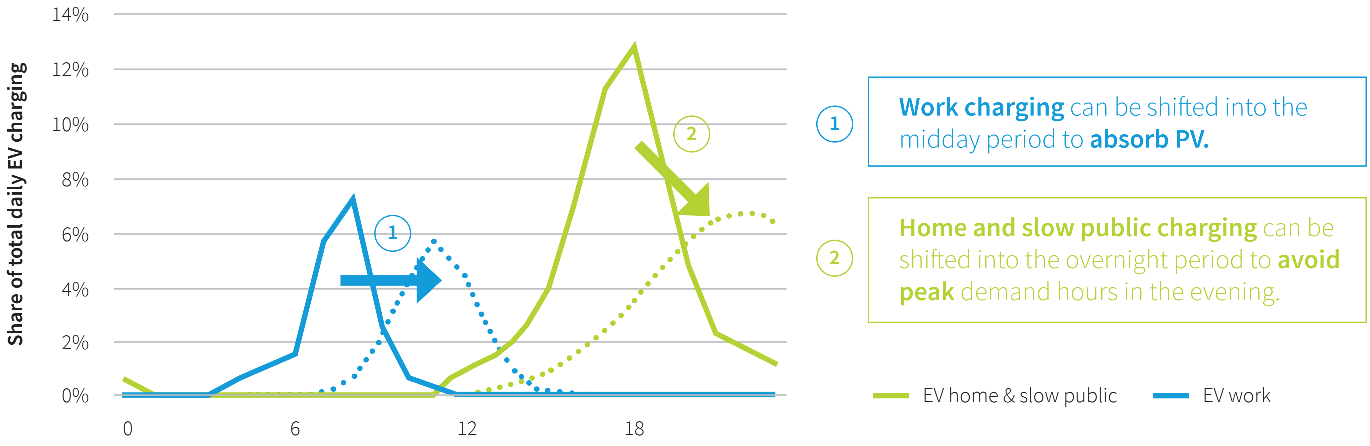
- in TOU design, ensuring coincidence of peak tariffs with system peak is crucial (whether network or with respect to wholesale in context of regulated retail tariffs), which suggests devising the shortest and most focused peak period feasible, in turn meriting regular assessments and updates.
- after reaching a certain level of distributed generation, it is important that net metering[31] implementation is replaced with other remuneration approaches, such as net-billing[32] or buy-all sell-all[33], where the real costs of the system will be reflected on the prosumers. This will incentivize load shedding and load shifting together with the use of behind-the-meter battery storage for consumers.
- the **gradual removal of regulated retail tariffs** will support the transition of consumers to the market and allow market forces to unlock demand side flexibility. This transition can build on the tightening requirements for eligibility to avail of regulated tariffs, combined with incentives for consumers to move away from regulated retail tariffs (except in the case of vulnerable consumers on social tariffs). The latter will entail embedding cost reflectivity in regulated retail tariffs – including YEKDEM costs[34] – complemented by building in "headroom". Headroom protects the ability of efficient and innovative independent retailers and other service providers to lure customers away from regulated tariffs, and is part of the design of regulated retail tariffs in Britain for example.[35]
- an assessment of the pro's and cons of moving from a national to a zonal or even nodal (local) pricing regime can be carried out in the mid to long term, including an impact assessment on cost-reflectivity, congestion and protections from market abuse.

The Shura Sector Coupling study concluded that wind and solar should be co-located with flexible demand, to minimise grid constraints. **The regulatory regime for grid and generation planning, including the availability of dynamic tariffs, should encourage co-location where possible.** This should include:

- Offsetting summertime cooling demand with rooftop solar PV systems where at least a total potential of 15 GW exists.[36]
- Offsetting peak PV generation with daytime (workplace) EV charging of as many of the 2.5 million EVs (in total) by 2030 as is possible.[37]

[31] On-site electricity generation system users connect to the distribution grid and receive premiums for their production surplus. Net metering generally applies to systems with a certain capacity upper limit, and billing periods may vary from hours to months.
[32] Surplus electricity production is sold to the grid at a different rate (real-time) than retail tariff price.
[33] The customer agrees to sell all electricity generated by their PV system to the utility at a set rate and to continue to buy all of the electricity they will consume from the utility.
[34] Regulatory and market disharmony in the Turkish electricity industry, Koksal et al, Utilities Policy, 2018
[35] "We include an additional headroom allowance, over and above our estimate of efficient costs and profit" Decision, default tariff cap, Ofgem, 2018. This supports the needs identified in legislation, including to support incentives to switch and to enable competition.
[36] https://www.shura.org.tr/wp-content/uploads/2020/12/Rooftop-solar-energy-potential-in-buildings-financing-models-and-policies-for-the-deployment-of-rooftop-solar-energy-systems-in-Turkey.pdf
[37] https://www.shura.org.tr/wp-content/uploads/2019/12/Transport-sector-transformation.Integrating-electric-vehicles-into-Turkey%E2%80%99s-distribution-grids.pdf

Figure 3: *Smart EV charging can avoid peaks and lower system costs for consumers*



*Source: SHURA**

3. Give DERs non-discriminatory access to markets and products

DSR and Renewables Integration Efficiency	DSR and Consumption Efficiency
DSR and Energy Efficiency	DSR and Economic Efficiency

Individual consumers, IAs and all other DERs must be able to access the full value chain, to enable them to compete with supply-side generation and provide the most efficient system solution. Turkey's current market design provides limited opportunities for the integration of distributed generation.[38]

We recommend that clear rules be put in place to grant non-discriminatory access for DERs (including individual or aggregated DSR) to balancing, intraday and day-ahead markets, as well as redispatch and any capacity mechanisms. Any capacity mechanisms that remain in place must give equal access to DSR and energy efficiency resources.

This requires more than notional eligibility for markets or competitively auctioned revenue streams. A DSR mechanism that is on the statute books but never utilised by TSO (or DSOs) is of no use to consumers and will not provide the wider system efficiencies. As mentioned in Part One, in the (non-guaranteed) event that the TSO decides to run a tender, the current DSR schemes in Turkey are still only accessible to large industrial consumers, connected to the transmission network. Even these consumers may struggle to participate without the option to go through an IA (see point 5).

[38] https://www.shura.org.tr/wp-content/uploads/2020/10/SHURA_SistemVerimliligi.pdf
* https://www.shura.org.tr/wp-content/uploads/2021/05/Sector_coupling_for_grid_integration_of_wind_and_solar.pdf

Growing a reliable and dynamic DSR market requires enough advanced notice of regular tenders, with product and eligibility criteria known in advance, to boost investor confidence that there will be an opportunity to get a return on upfront business and equipment costs.

In order to enable participation of all DSR customers, in addition to facilitation of IAs, platforms and products themselves must be free from both:

- Direct discrimination, such as limiting the contribution of certain technologies, or allocating different contract lengths to different technologies without an objective justification; and

- Indirect discrimination, such as designing tender exercises, auctions and energy or capacity products in an inherently generation-centric manner.

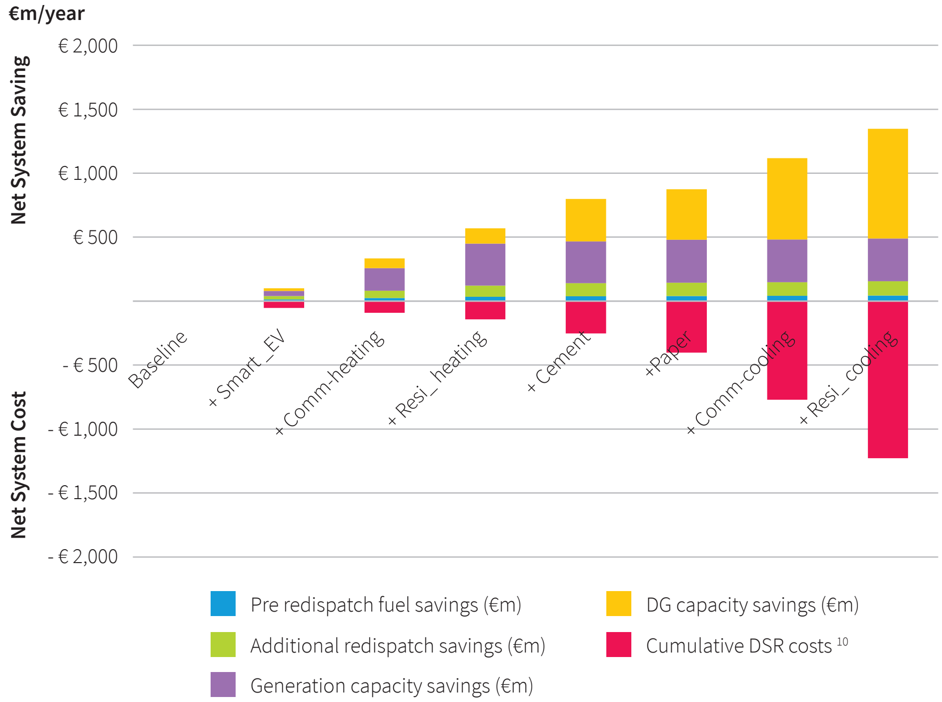
Indirect discrimination is more difficult to detect and address because, on the surface, the same rules apply to everyone and so the policy design may seem fair. However, in practice such rules can play out in favour of larger, centralised generators and other incumbents while throwing up barriers to new entrant innovators. **For this reason, it is especially important that DSR, RES and other DER, and consumer group stakeholders are included in the process of policy development, and that their concerns are listened to.**

Minimum size thresholds are a classic example of a condition which can be met by large generators but not DSR. Minimum bid size for ancillary services in Turkey is currently 30 MW. This essentially rules out all DSR load shifting and other DERs, even with aggregation. To put this into perspective, Article 8 of EU Electricity Regulation 2019/943[39] requires that minimum bid size for day ahead and intra-day markets be 500 kW or less. The PJM capacity market and the New England Independent System Operator ('ISO-NE'), which are widely acknowledged as being successful in bringing forward DSR capacity, both have a threshold of 100 kW. This is much lower than the ancillary services threshold in Turkey. **We recommend reducing the threshold to 500 kW or less, with an intermediate step of 1 MW if necessary.** DSR/DER testing can be used to reassure authorities that distributed resources are capable of delivery when needed. This will help to deliver the aspiration in Action E10 of the NEEAP, to create a flexible consumption portfolio of large industrial consumers, with flexible consumption, such as cement, iron and steel. The potential for industrial DSR in Turkey is depicted in the chart below.

Action E10 also refers to assessments being made to *"include other consumers including residential ones in the implementation. To that end, demo areas will be created in the scope of micro grids, smart city, smart grids by supporting the scaling up of smart meter and pilot schemes."* **Such demonstration projects should be prioritised, with the inclusion of IAs.**

[39] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0943&from=EN

Figure 4: Potential value of unlocking DSR value in Turkey - greatest for heating, cement, paper and EVs



*Source: SHURA**

4. Remove, or at least reduce, market interventions that dampen price signals for DSR

DSR and Energy Efficiency

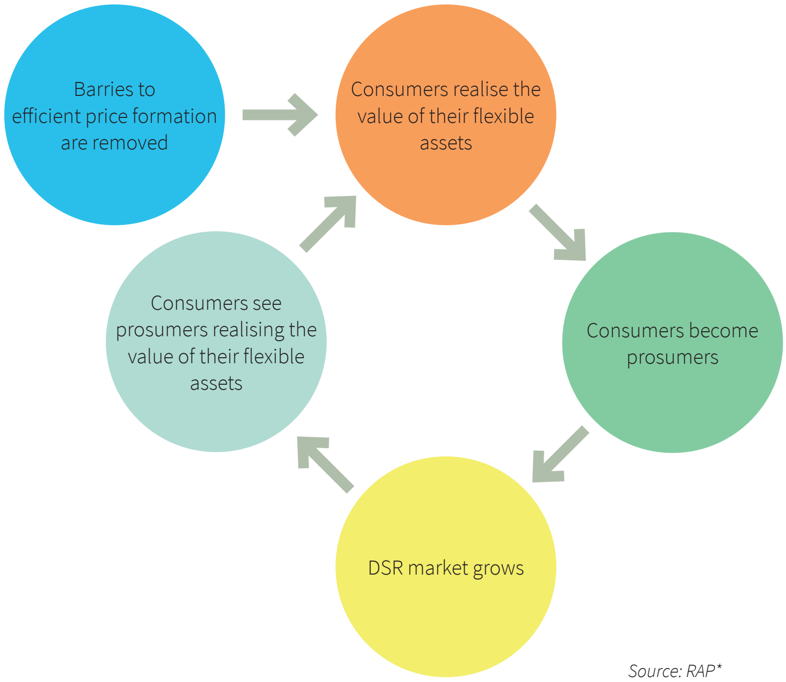
Interventions such as price regulation and capacity mechanisms usually have laudable social policy aims, but they also reduce or remove market signals for scarcity pricing, by compressing wholesale prices. Revealing the true marginal value of energy through efficient price formation is essential for incentivising DSR investment and business model development. Interventions not only prevent consumers from realising the value of their flexible assets, they also mask the true cost of inflexible generation. As the DSR market grows, consumers will be increasingly able to respond quickly to price volatility, reducing demand peaks and creating a virtuous cycle, which should achieve the policy objectives of current interventions, such as resource adequacy and lower bills, in a more efficient manner.

We therefore recommend a comprehensive review of current market interventions, to critically assess whether they continue to serve consumers amidst the changing landscape of Turkey's energy system. As a minimum, the following policy actions should be considered (with the usual impact assessments undertaken) to make the market more cost-reflective. These actions are explored in more detail in Shura's Wholesale Market Report[40], which also examines case studies in the British, PJM and Australian markets.

[40] To be published in September 2021.
* https://www.shura.org.tr/wp-content/uploads/2021/05/Sector_coupling_for_grid_integration_of_wind_and_solar.pdf

- Reform electricity balancing prices with a view to transitioning to a single imbalance price, which is marginal, pay-as-clear, free of caps and monitored for abuse of power. Such change could be accompanied by shortening the current settlement period from 1 hour to 15 minutes.
- Phasing out the capacity market for lignite, or at least allowing it to expire in 2024.
- Phasing out lignite purchase guarantees, or at least allowing them to expire in 2027.

Figure 5: *Effective price signals can help kick-start a DSR virtuous cycle*



*Source: RAP**

5. Establish a regulatory framework for independent aggregators and other innovative business models

DSR and Consumption Efficiency

Aggregation, in the DSR context, is the combination of multiple customer loads, for the purpose of selling to a BRP, DSO or TSO. For the full potential of Turkey's demand-side to be realised, smaller industrial and commercial loads, and in particular the residential sector, will need to be aggregated by entities capable of acting on consumers' behalf to deliver energy services at a scale.

Electricity suppliers can provide DSR aggregation services in principle; yet, experience from more developed DSR markets suggests that without external competitive pressure, incumbent electricity suppliers will not develop the timely, creative combinations of commodities and services needed to access the untapped flexibility embedded in the demand-side. Most respond only when pressed by competition from innovators, if at all. Therefore, for these services to enter the market, there is a need to "unbundle" flexibility services from supply and to clarify the relationship between energy services entities or aggregators and incumbent energy suppliers or retailers.[41]

[41] https://www.raponline.org/wp-content/uploads/2016/05/rap-bakerhogankeaybright-eucodes-may2015.pdf
* https://www.raponline.org/wp-content/uploads/2019/03/rap-start-with-smart-ev-integration-policies-2019-april-final.pdf

IAs provide a gateway to DSR services, which many customers would otherwise not be able to easily access. Through aggregation, IAs can meet minimum bid size thresholds for DSR services in energy, balancing and capacity services, though high thresholds still represent a barrier. IAs interact with the market, usually via the TSO, on behalf of customers. By pooling flexible resources, IAs can maximise availability of DSR across different time periods, while limiting risks to customers. They may also meet the upfront equipment costs of making customers DSR-ready. IAs pass on the value to customers, retaining a profit margin for themselves. Healthy competition in the IA market is therefore important for ensuring that DSR customers get the best return on their flexibility.

We recommend establishing comprehensive regulatory framework for IAs and flexibility services,[42] which is distinct from the underlying energy supply.

This should include the following features as a minimum:

- The DSR actions contained in Action E10 of the NEEAP should equally apply to IAs.

- No supplier veto. Suppliers may be permitted to engage in flexibility services, but must not have a monopoly over their customers, who should be permitted to contract with an IA, without suffering any discrimination from their supplier.

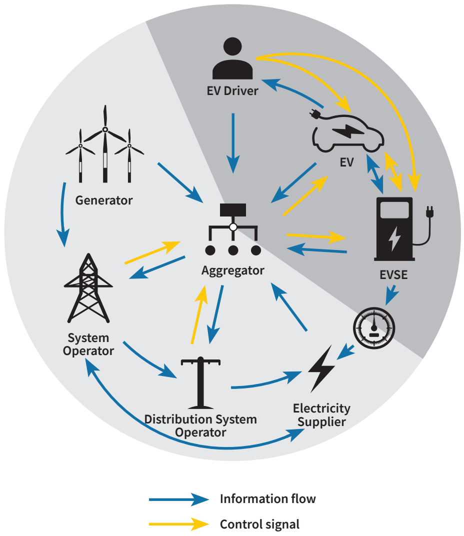
- Free access to end-customer data. IAs should be able to obtain consumer data, with consumers' consent.

- Provisions to enable IAs and customers to become balancing service providers (BSP), providing balancing services to the system operator.

- An imbalance adjustment mechanism, to make sure that the imbalance position of a BRP (e.g. the supplier) is not aggravated by the actions of an IA. The compensation provisions should enable suppliers to recover their costs (including of energy purchased but not used) as a result of IA intervention, but should not extend to compensation for lost profit.[43] The current DSR legislation includes an adjustment mechanism for individual consumer participating in DSR, but this needs to also be part of the new IA regulatory framework.

[42] For an evaluation of the development of IA regulatory frameworks across the EU, see also https://smarten.eu/wp-content/uploads/2020/11/FINAL_smartEn-EMD-implementation-monitoring-report.pdf
[43] https://www.raponline.org/wp-content/uploads/2016/05/rap-bakerhogankeaybright-eucodes-may2015.pdf

Figure 6: *Aggregators can optimise multiple loads for consumer and overall system benefit*



*Source: Element Energy**

6. Regulate for consumer protection and energy equity

Complementary Social and Environmental Policies

Consumers stand to benefit significantly from greater flexibility and digitalisation. However, responsible regulation is needed to ensure that such benefits are not distributed in an inequitable manner, to the detriment of disadvantaged groups, including lower-income consumers or those with lower levels of digital literacy. In addition to the wider issues associated with digitalisation, such as cyber security, consent and data protection, DSR brings new challenges.[44]

Lower-income consumers are less likely to be early adopters of flexibility-enhancing assets, such as smart meters, EVs, electric heat pumps and energy efficiency upgrades. They are therefore less able to access value from TOU tariffs. Ensuring an equitable outcome, however, is more complicated than simply exempting certain consumers from TOU tariffs. If Turkey's gas infrastructure becomes less used due to electrification of heat, lower income customers risk being left to pick up legacy costs. Therefore, an integrated system approach is needed, to ensure energy justice.

The CEER-BEUC 2030 Vision for Energy Consumers[45] provides a useful blueprint for consumer-centric policy in the digital age. Their "ASPIRE" framework is based on the principles of Affordability, Simplicity, Protection, Inclusiveness, Reliability and Empowerment.

We recommend a review of Turkey's energy regulation, particularly regarding consumer protection and vulnerable consumers, to determine whether it remains fit-for-purpose in the context of digitalisation and flexibility. This should be framed around a set of energy justice principles, such as the ASPIRE principles.

[44] https://www.ceer.eu/documents/104400/-/-/3b167ae3-9a7a-fd36-a02e-c64ad7595a51
[45] https://www.ceer.eu/ceer-beuc-2030-vision-for-energy-consumers
* https://www.shura.org.tr/wp-content/uploads/2021/05/Sector_coupling_for_grid_integration_of_wind_and_solar.pdf

Figure 7: *The CEER-BEUC "ASPIRE" principles can guide DSR consumer protection in Turkey*

- A — **A**ffordability - fair distribution of costs, access to benefits of energy efficiency
- S — **S**implicity - clear, trustworthy and easy to understand information
- P — **P**rotect - laws against unfair practice, redress, data protection, cyber security and crisis management
- I — **I**nclusion - new policies do not enhance gaps within society and integrate consumers in transition
- R — **R**eliability - the overcharching framework should support consumer access to secure supplies
- E — **E**mpowerment - consumers should enjoy equivalent protections and be able to contribute to the transition

Source: https://www.ceer.eu/documents/104400/-/-/2d2b1ed9-9dab-b418-ed4b-29c19bd88659

ANNEX: Summary Table of Recommendations

Action Point	Key Recommendations
1. Use regulatory standards to get technology, buildings and grids DSR-ready DSR and Energy Efficiency DSR and Renewables Integration Efficiency DSR and Consumption Efficiency Complementary Social and Environmental Policies	Consumers should have the right to adopt a **smart meter** and request a **flexibility assessment** from their supplier or an independent aggregator (IA). All new **EV charging environments should include smart functionality** and enable dynamic tariffs. **Fossil fuel heating systems** should be phased out at least for new buildings and existing buildings not connected to the gas grid, with renovations to electrify heating incentivised in other housing stock. Heat pumps should be required to be DSR-ready. Introduce new measures to mitigate the consequences of **DER invisibility** arising from net metering, including collection of statistical data on DER installations, network capacity hosting maps for new investors and adoption of smart inverters (alongside smart meters), with incentives for new business models.
2. Ensure price signals support efficiency by embedding cost-reflectivity DSR and Economic Efficiency DSR and Consumption Efficiency Complementary Social and Environmental Policies	**Network tariffs should be volumetric and reflect peak.** Volumetric TOU tariff should be default option for **small industrial and commercial consumer groups.** TOU signals should also be included for **new controllable load groups** with such as EVs and heat pumps. For **other residential consumers,** network tariff design should be based on a simple volumetric charge, with the option to choose a TOU or dynamic tariff. **Energy costs in regulated retail tariffs:** should be linked to dynamic wholesale prices or TOU blocks. **Introduce a carbon pricing mechanism:** to allow environmental costs to be reflected in electricity prices. **Replace net metering with other more cost reflective approaches such as buy-all sell-all and net-billing.** **Carry out impact assessment on moving from national to nodal (local) pricing** where this better reflects congestion. **Gradually remove regulated retail tariffs.** **Sector coupling: the regulatory regime for grid and generation planning should encourage co-location where possible.** This should include: • Offsetting summertime cooling demand with rooftop solar PV systems. • Offsetting peak PV generation with daytime (workplace) EV charging.[46]

[46] https://www.shura.org.tr/wp-content/uploads/2019/12/Transport-sector-transformation.Integrating-electric-vehicles-into-Turkey%E2%80%99s-distribution-grids.pdf

3. Give DERs non-discriminatory access to markets and products DSR and Economic Efficiency	Establish clear requirements for **non-discriminatory access** for DERs (including individually or aggregated DSR) to **balancing, intraday and day-ahead markets, as well as redispatch and any capacity mechanisms.** Any capacity mechanisms that remain in place must give equal access to DSR and energy efficiency resources. Ensure that DSR, RES other DER and consumer group stakeholders are properly included in the **consultation** process of **policy development.** **Reduce the minimum size threshold** for all balancing, intraday and day-ahead markets and other ancillary services to **500 kW or less,** with an intermediate step of 1 MW if necessary.
4. Remove, or at least reduce, market interventions that dampen price signals for DSR DSR and Consumption Efficiency	**Review current market interventions** assess whether they are necessary and fit for purpose. Consider the following actions: • **Remove the price floor,** adopt a system value of lost load and gradually **raise current the price cap** towards that level. • Reform electricity balancing prices with a view to transitioning to a **single imbalance price.** Consider **shortening settlement period from 1 hour to 15 minutes.** • **Phase out the capacity market for lignite** in the absence of a resource adequacy concern. **Also phase out lignite purchase guarantees.**

5. Establish a regulatory framework for IAs and other innovative business models DSR and Consumption Efficiency	Introduce a **comprehensive regulatory framework for IAs** and flexibility services, distinct from the underlying energy supply. This should include an **expansion of the DSR actions in Action E10 of the NEEAP to IA and contain the following features:** • **No supplier veto** on customers, must be permitted to contract with an IA, without suffering any discrimination from their supplier. • Free **access to end-customer data** for IAs, with customer consent. • Provisions to **enable IAs and customers to become BSPs,** providing balancing services to the system operator. • An **imbalance adjustment mechanism** that applies to IAs rather than just individual DSR customers.
6. Regulate for consumer protection and energy equity Complementary Social and Environmental Policies	Review Turkey's energy regulation, particularly regarding **consumer protection** and vulnerable consumers, to determine whether it remains fit-for-purpose in the context of digitalisation and flexibility. Consumer protection provisions relating to DSR services should be framed around a set of **energy justice principles,** such as the EU CEER-BEUC "ASPIRE" principles of **A**ffordability, **S**implicity, **P**rotection, **I**nclusion, **R**eliability and **E**mpowerment.

About Istanbul Policy Center at the 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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