Energy Transition in Turkey
Opportunities & Challenges

International DAAD-TGU Conference on

Economic Dimensions of Sustainability

May 13th,2022 -İstanbul

Alkım BAĞ, Director – SHURA Energy Transition Center

SHURA Energy Transition Center

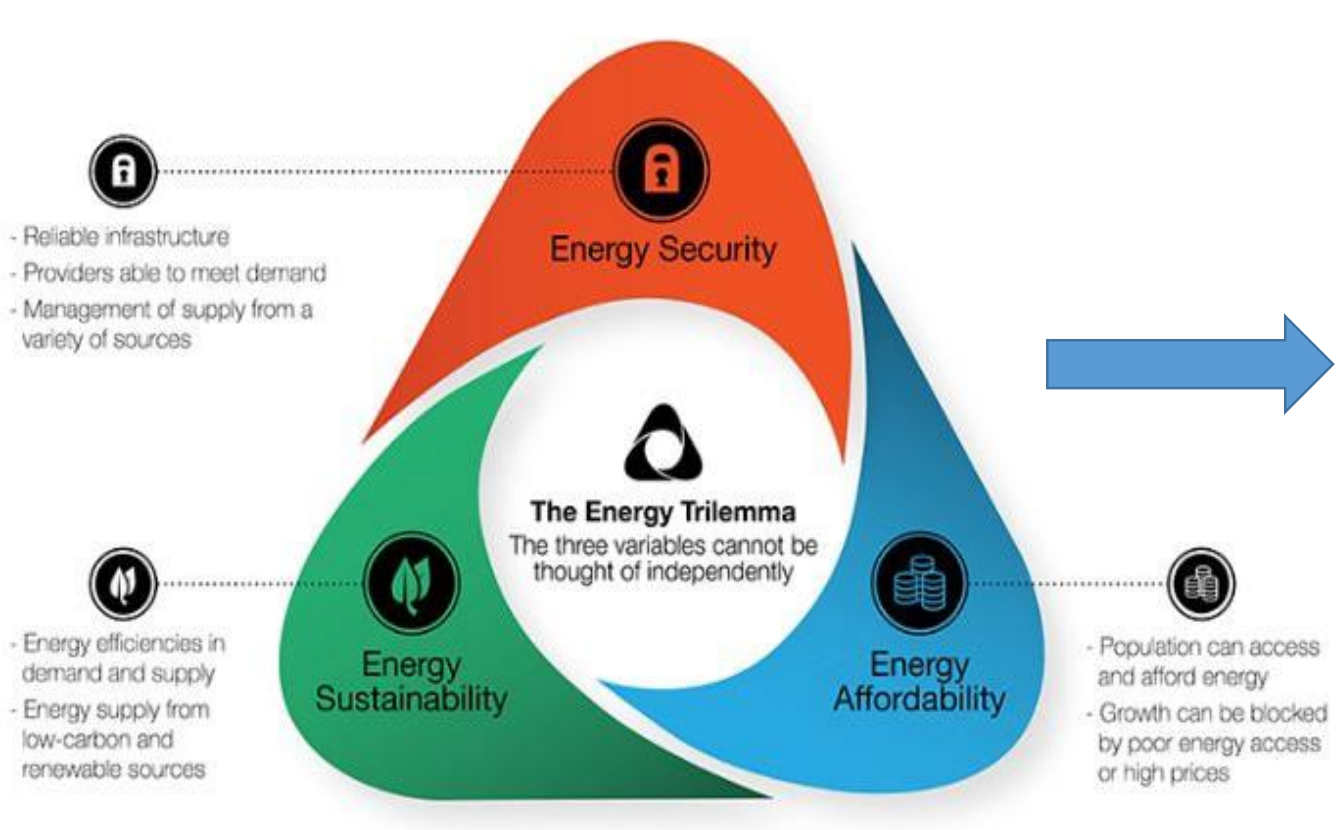
- A **transparent** platform working for Turkey’s energy transition, with Turkey’s priorities
- stimulating discussion on Turkey's energy sector
- **among all interested stakeholders**
- providing fact-based, unbiased and independent research and analysis,
- covering technology, economics and policies
- contributing to the debate on Turkey's energy transition

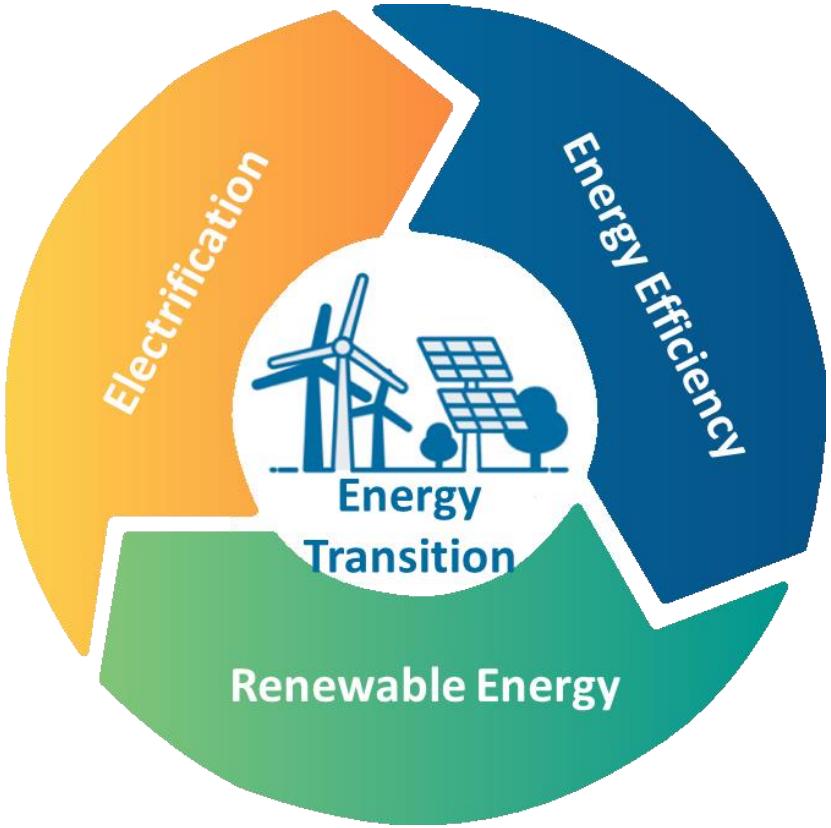
Agora Energiewende

European Climate Foundation

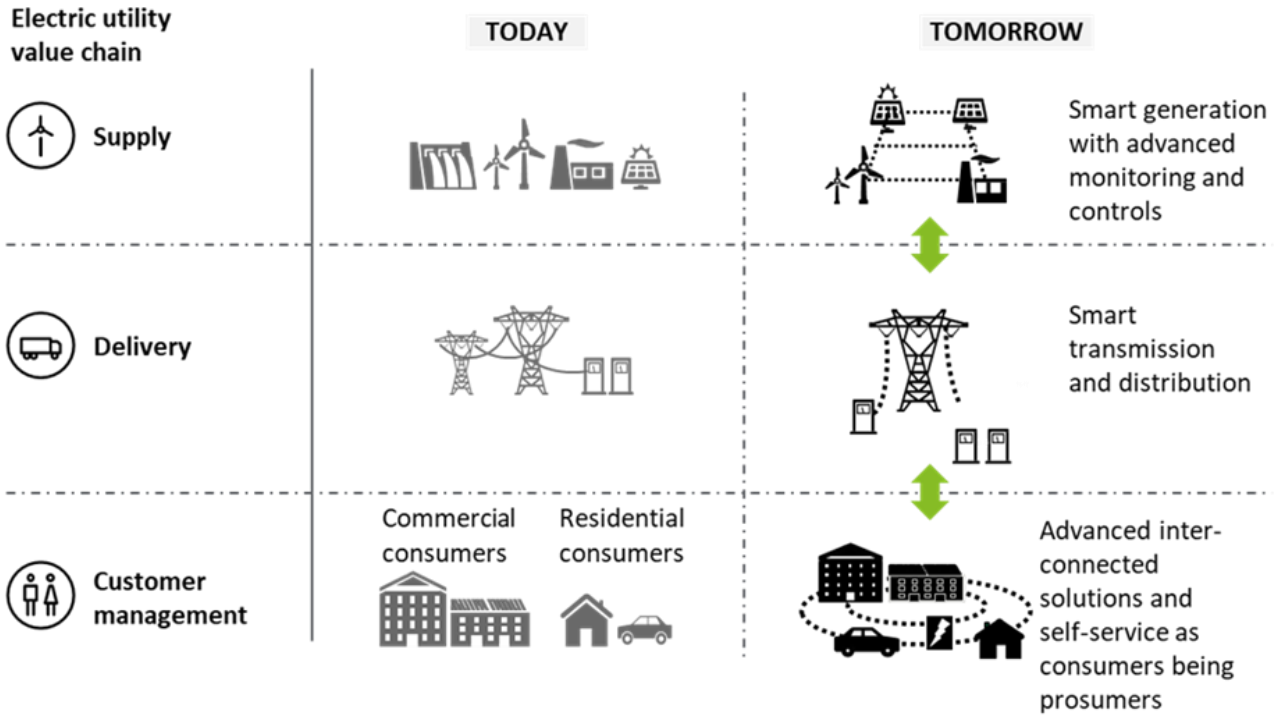
İPM | IPC İSTANBUL POLİTİKALAR MERKEZİ SABANCI ÜNİVERSİTESİ KAMPUSU ISTANBUL POLICY CENTER AT SABANCI UNIVERSITY

Energy Trilemma and Energy Transition



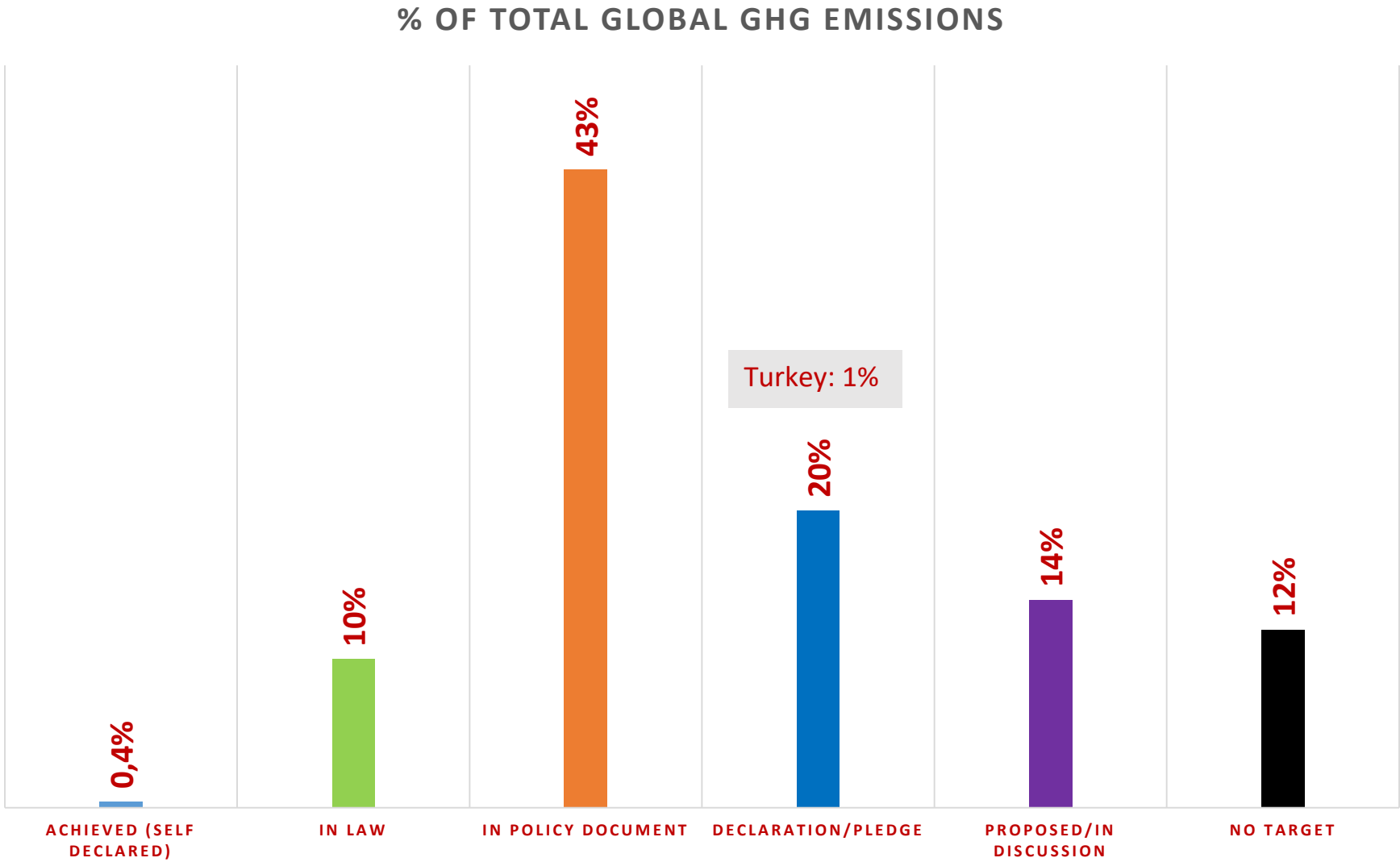


Energy Transition



- Traditionally, electric power systems have been centralized with unidirectional structures organised into generation, transmission and distribution, placing customers at the end of the supply chain.
- Transforming with RE, energy efficiency and electrification, the energy system transforms from a centralized and unidirectional structure to a more distributed and interactive structure, and evolves towards a system where consumers are the focus.

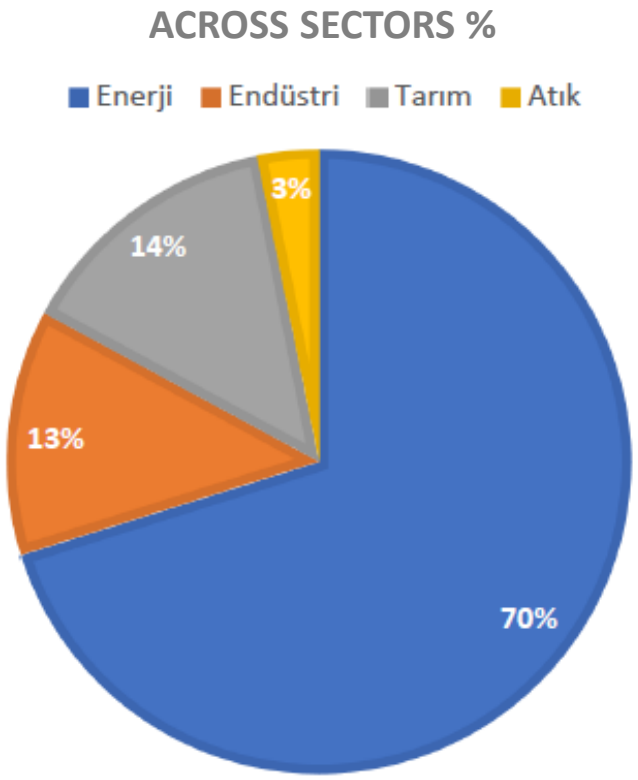
Progress toward net zero carbon by country

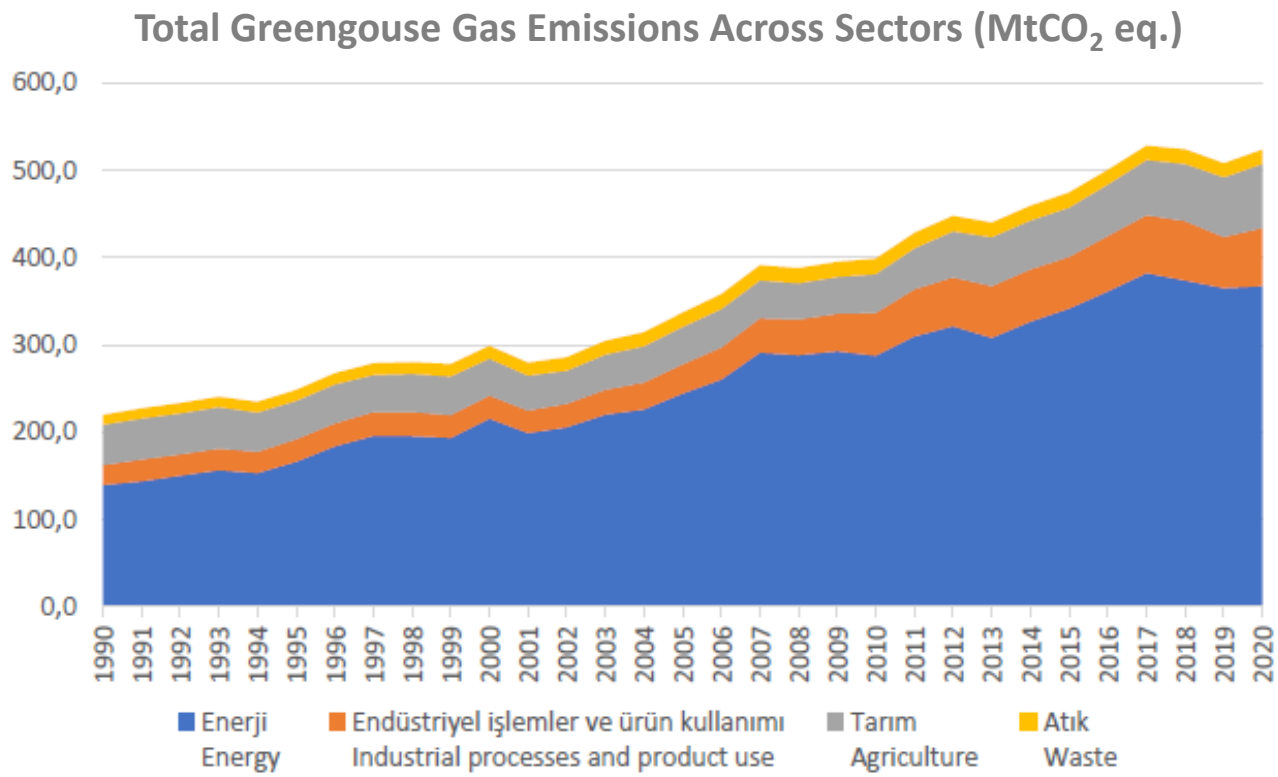


- ✓ **Turkey ratified the Paris Agreement and declared zero carbon target by 2053 in 2021.**
- ✓ **NDC will be revised in 2022.**
- ✓ **Plans and policy documents will be revised in accordance with net zero within the next two years.**

Kaynak: ECIU Net Zero Tracker (2022)

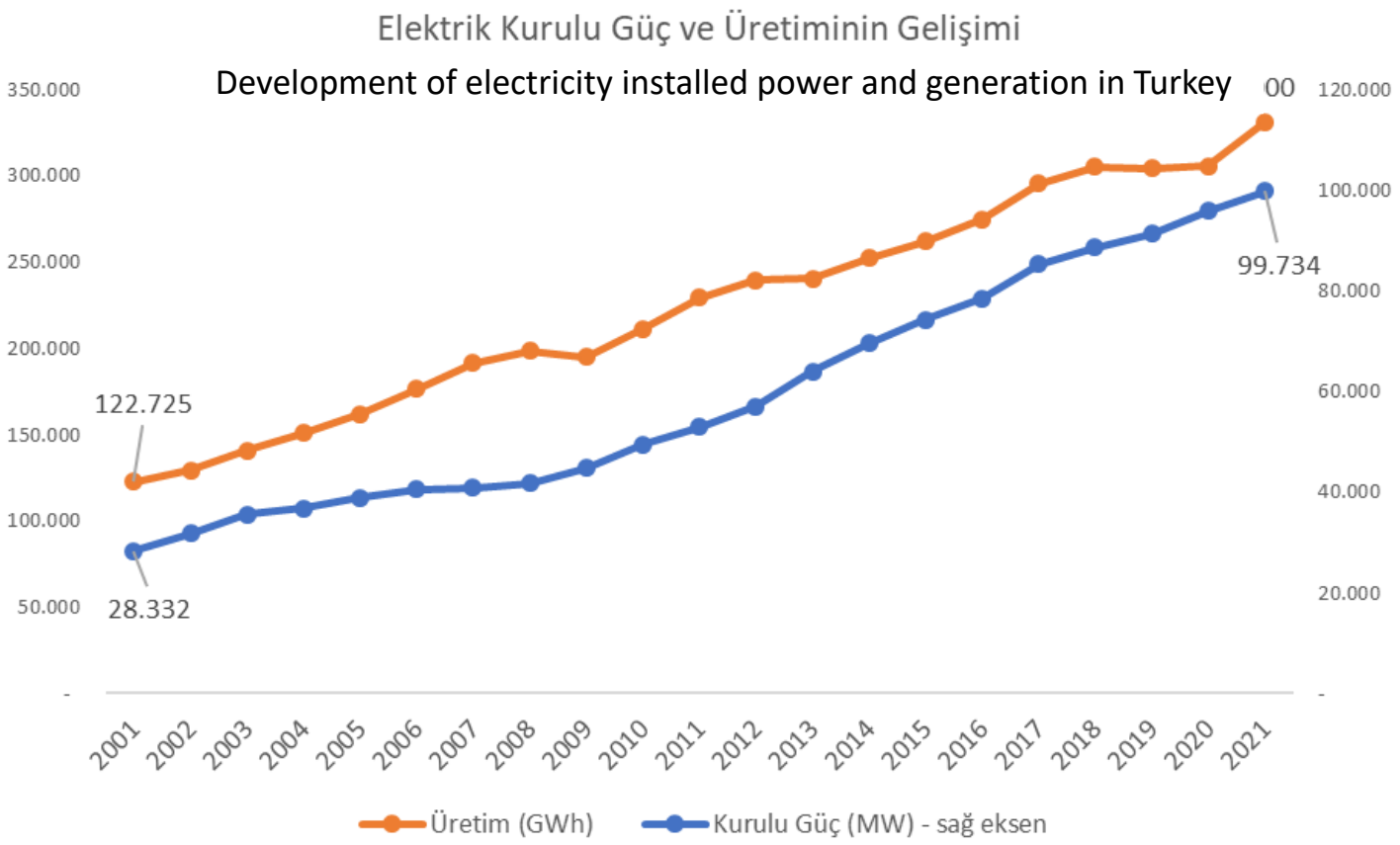
Total Greengouse Gas Emissions in Turkey (1990-2020)





Turkey's emissions increased (excluding landuse) by 134% over the last 20 years to 524 MtCo2. When considered by sectors, increases were largely due to a sustained increase in the energy-related emissions

Turkey - Power Sector (2001-2021)



- Electricity sector share of Turkey's total Co2 emissions originating from the energy sector: 40%
- Significant growth in the electricity sector: Turkey's installed capacity grew by 252 % in the 2001-2021 period while electricity generation increased by 170 %.
- It is critical that the electricity sector lead the energy transition by becoming decarbonized before other sectors. Electrification of end-use sectors, renewable energy, energy efficiency and sector-coupling will play an important role for that.

Energy Transition in Turkey

- **Electrification**

New electrically powered technologies **increase system efficiency by replacing traditional fossil fuel-based technologies**

Electrification also contributes to **accelerating the transformation by meeting electricity demands with renewable energy.**

Energy Transition

- **Energy Efficiency**

Turkey's energy intensity has been decreasing at an average of 1.5% per year since the beginning of the 2000s.

The National Energy Efficiency Action Plan targets a 14% reduction in primary energy consumption in 2023.

- **Renewable Energy**

App 40% of **Turkey's total current electricity demand comes from renewable energy**.
Together with distributed systems, **the share of solar and wind energy varies between 10%-15%.**

SHURA - 2030 Vision

Electrification of end-use	Efficiency gains of 10% compared to the baseline	50% renewable energy share in total output
2.5 million EVs & 1 million charging points + 2 million heat pumps & smart homes + More than 10 GW rooftop solar PV = **7 -9 TWh of additional electricity demand**	17.3 TWh savings in industry + 19.3 TWh savings in buildings + 6.0 TWh savings in the distribution system = **42 TWh of net demand reduction**	Improved market design + 2000 MW energy storage + Demand-side response reduction of peak demand by up to 10 GW + System-friendly wind & solar location + Flexible power plant fleet = **Flexible grid for integration of 30% share in wind & solar**

Increasing the Share of Renewables in Turkey's Power System:
Options for Transmission Expansion and Flexibility

On the way to efficiently supplying more than half of Turkey's electricity from renewables:
Balancing the location of wind and solar PV investments

Lessons from global experiences for accelerating energy transition in Turkey through solar and wind power

On the way to efficiently supplying more than half of Turkey's electricity from renewables:
Opportunities to strengthen the YEKA auction model for enhancing the regulatory framework of Turkey´s power system transformation

Renewable Energy

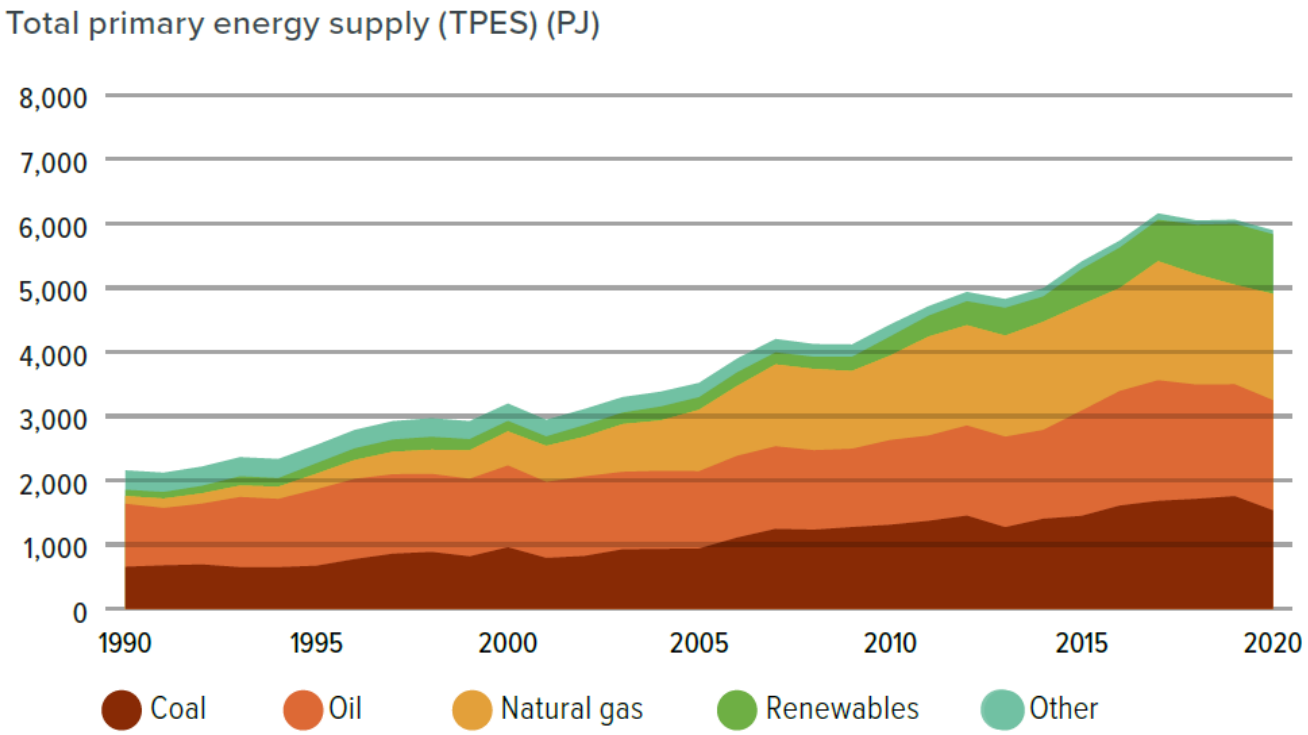
On the Way to Efficiently Supplying More Than Half of Turkey's Electricity from Renewables:
Costs and Benefits of Options to Increase System Flexibility

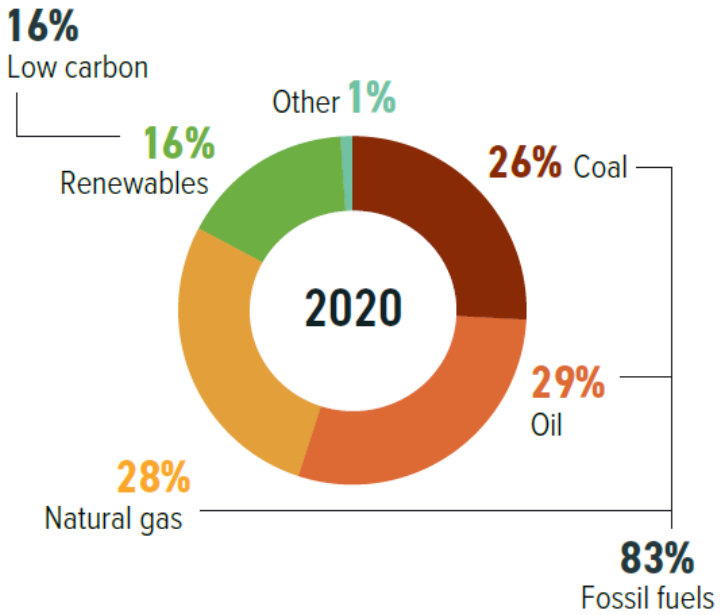
Rooftop solar energy potential in buildings – financing models and policies for the deployment of rooftop solar energy systems in Turkey

Sector coupling for grid integration of wind and solar

Integration of Renewable Energy into the Turkish Electricity System

Turkey - Energy Mix



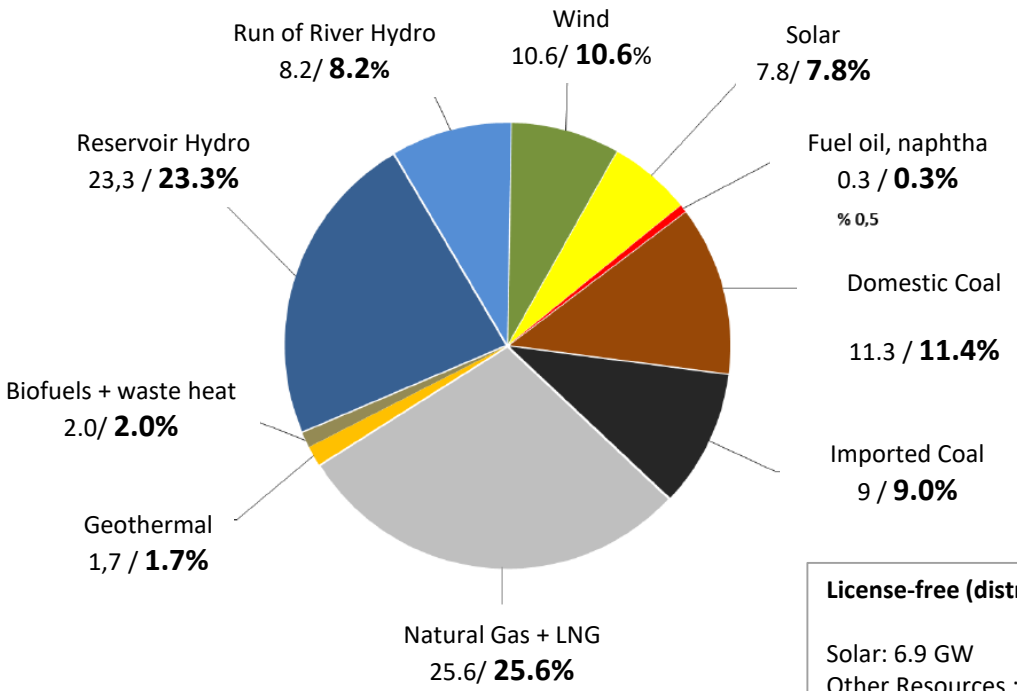


This graph shows the fuel mix for all energy supply, including energy used not only for electricity generation, heating, and cooking, but also for transport fuels. Fossil fuels (oil, coal, and gas) make up 83% of Turkey's energy mix, around the G20 average. The share of renewable energy in the energy mix decreased slightly (0.1%) since 2019 and remains at around 16% of the energy mix. Coal consumption has shown a decreasing trend that reflects the coal phase-out needed for energy decarbonisation.

Enerdata, 2021 *Due to rounding, some graphs may sum to slightly above or below 100%*

Turkey - Power Sector (2021)

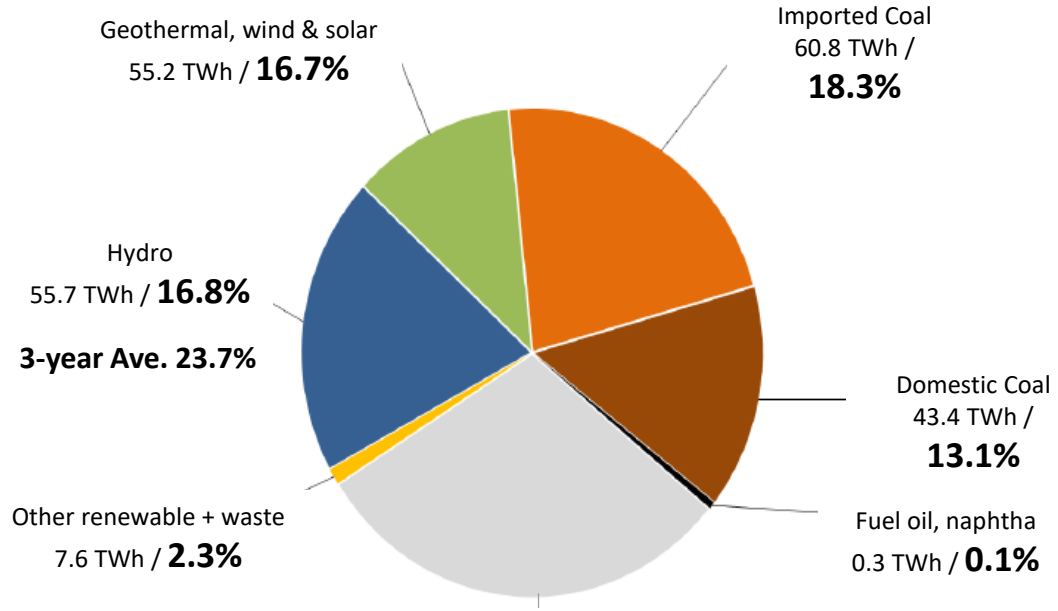
Installed Capacity (99.8 GW)



License-free (distributed): 7.5 GW

Solar: 6.9 GW
Other Resources : 0.6 GW

Total Generation (2021) (331.5 TWh/year)



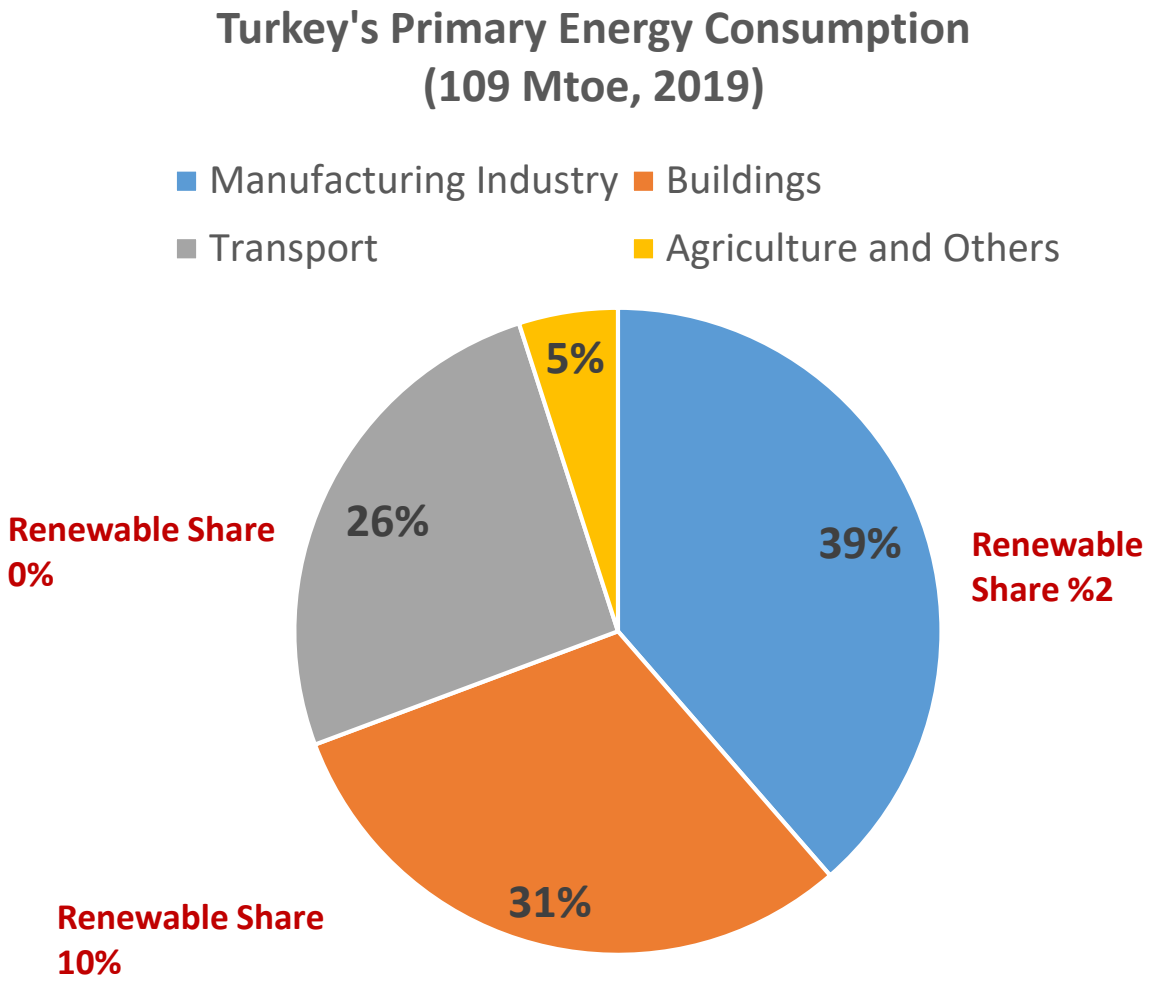
License-free (distributed): 12.2 TWh

Solar: 11.8 TWh
Other Resources: 0.4 TWh

Renewable resources represent more than half of the installed power and 36% of generation. Share of solar + wind exceeds 13 percent.

Source: TEİAŞ, EPİAŞ

End Use Energy Consumption and Outlook for Energy Transition in Turkey

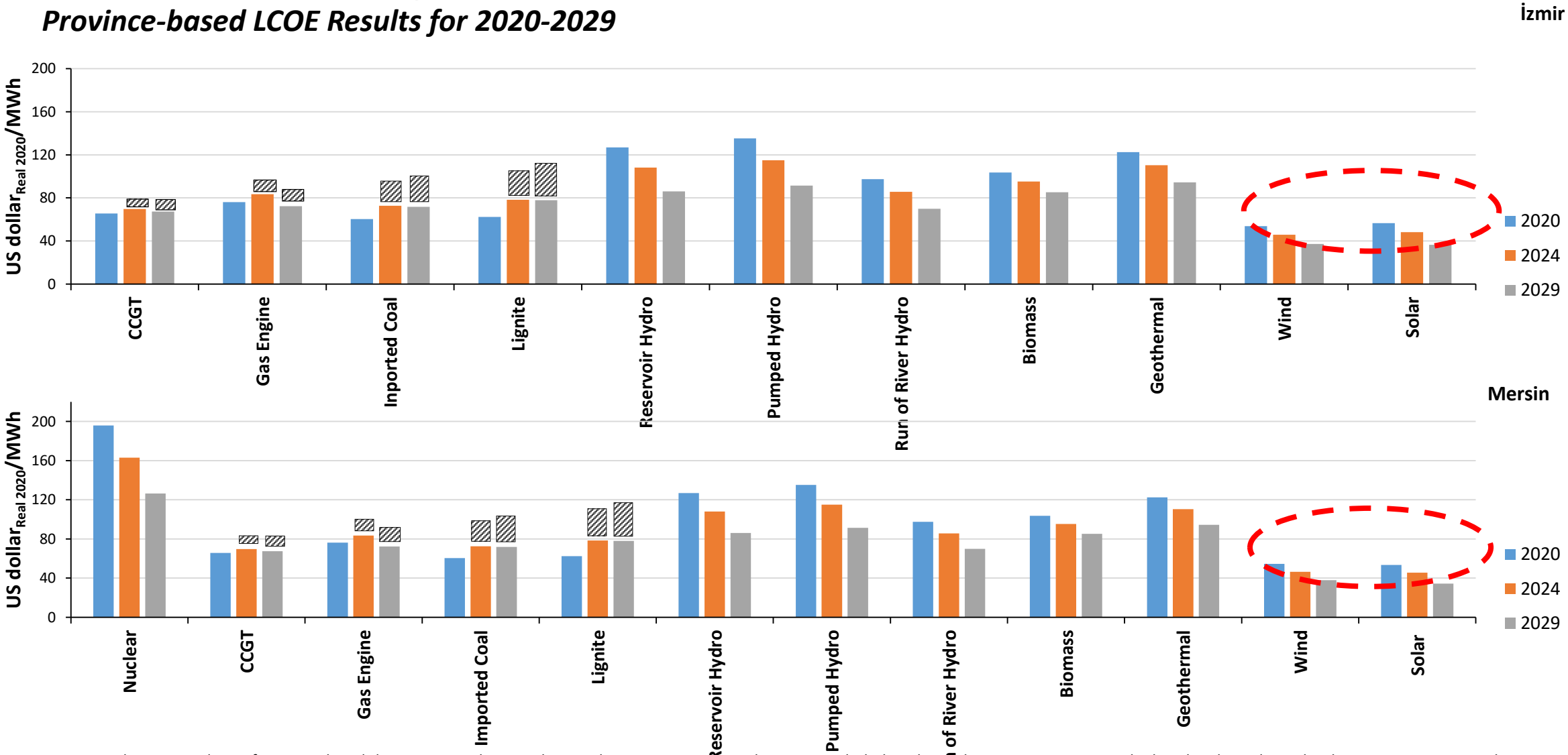


Imported fossil fuels constitute 78% of primary energy supply

- **Power sector transformation underway**
  - ✓ Over 40% renewable share in power generation
  - ✓ Wind + solar share approaching 15%
  - ✓ Renewables constitute most of new generation capacity
- **Manufacturing sector- largest energy user**
  - ✓ Well-developed industrial sector- iron & steel, cement/glass/ceramics, textiles and chemicals/petrochemicals major energy consumers.
  - ✓ Low carbon energy use becoming a major factor for export competitiveness.
- **Buildings- rapidly growing energy consumption**
  - ✓ 9.1 million building stock, over 65% of population active natural gas users
  - ✓ 4 climate zones differing significantly in demand for space heating and cooling
- **Transport- transformative solutions required**
  - ✓ Largest user of oil products, 13 million passenger vehicles and growing
  - ✓ 2030 government vision: 1 million electric vehicles

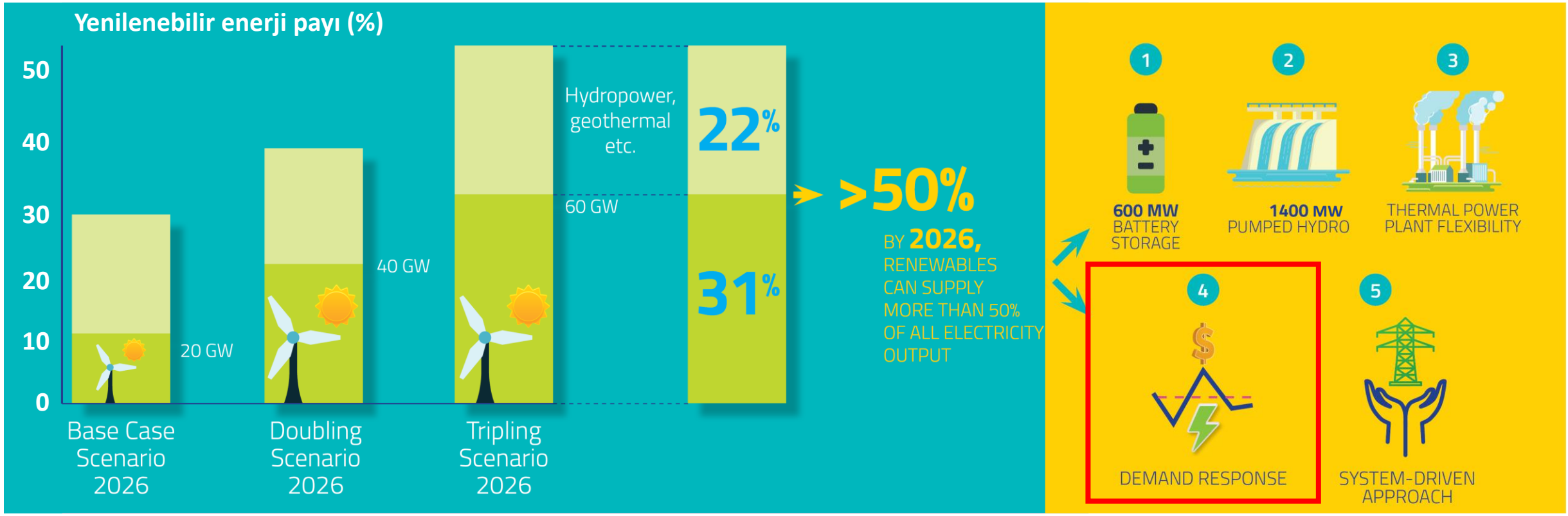
Solar and wind energy came up as the most economical sources of energy in SHURA studies.

Province-based LCOE Results for 2020-2029



Note: The LCOE values of imported coal, lignite, natural gas and natural gas engine power plants are included in the carbon cost amounts applied under the Balanced Policy Action Scenario. The efficiency assumption is taken as 63% for combined cycle power plants, 45% for natural gas engine power plants and 35% for imported coal power plants.

SHURA Study - “Increasing the Share of Renewables in Turkey’s Power System,” (2018)

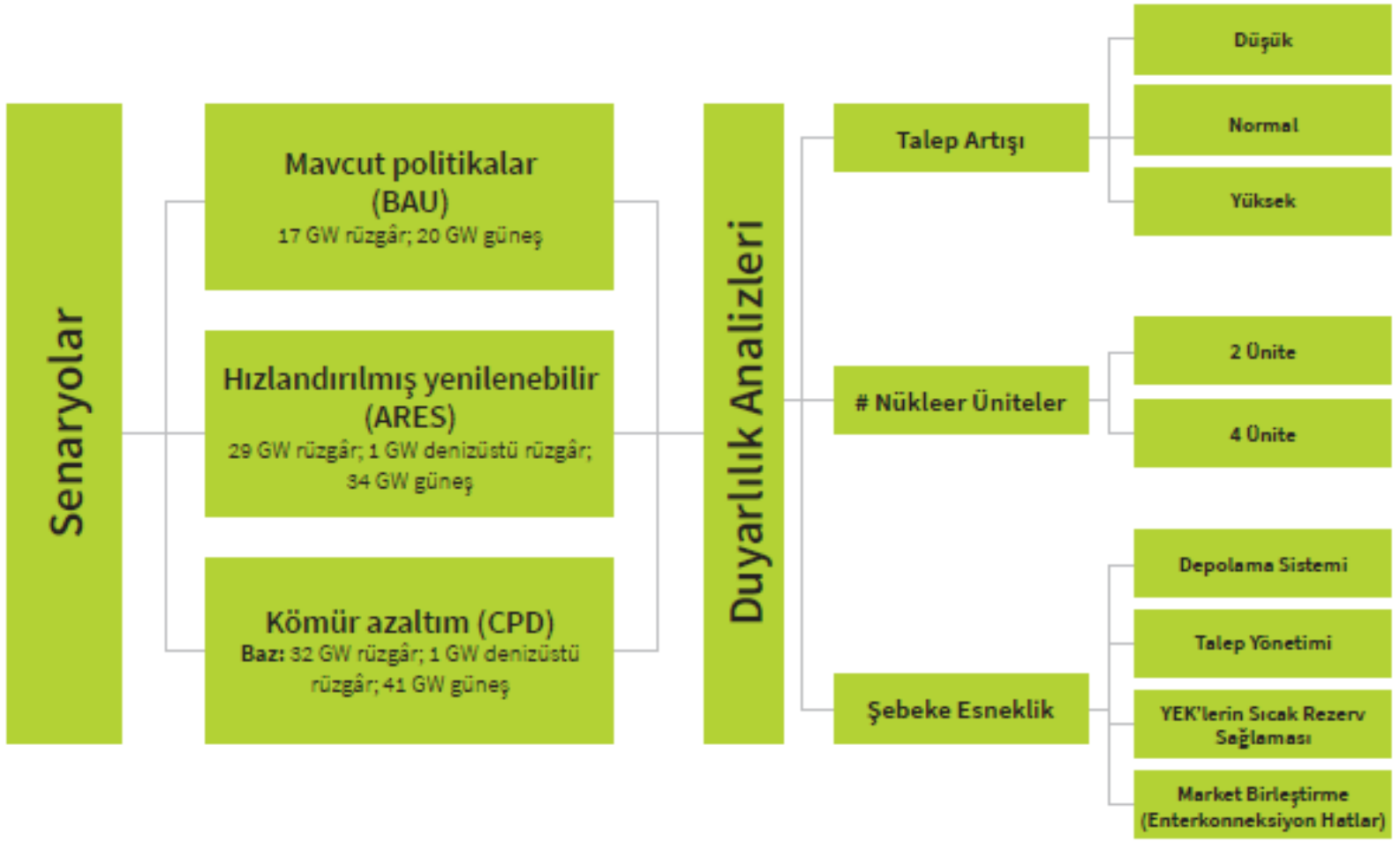


SHURA’s grid integration study “Increasing the Share of Renewables in Turkey’s Power System,” that was released in May 2018 demonstrated the ability of Turkey’s power system to integrate up to 50% renewables at relatively little additional costs until 2026 (including 30% share in VRES, wind and solar energy).

Source: SHURA (2018;2019)

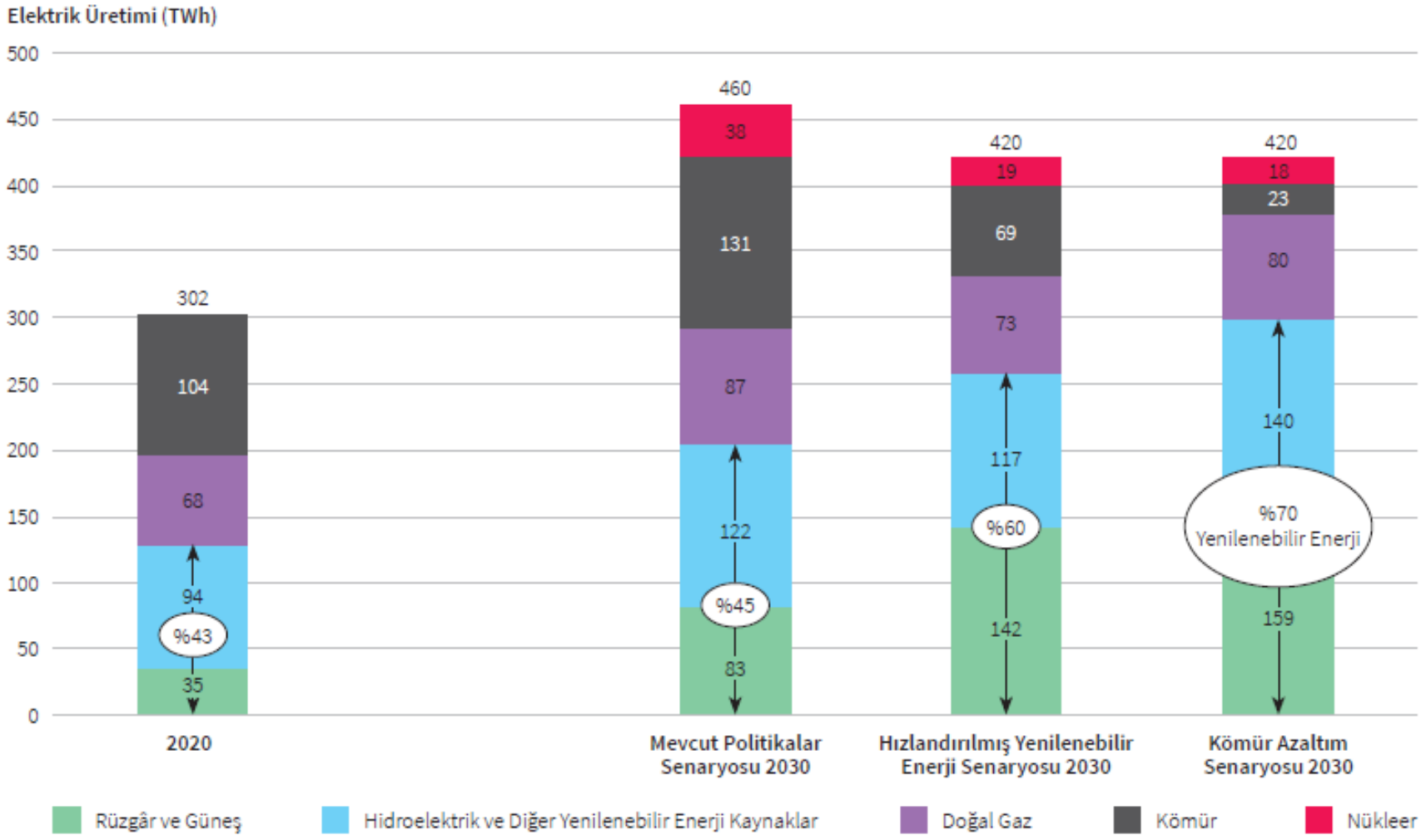
SHURA Study - “Increasing the Share of Renewables in Turkey’s Power System,” (2022)

3 main scenarios and 10 sensitivity analyzes were prepared



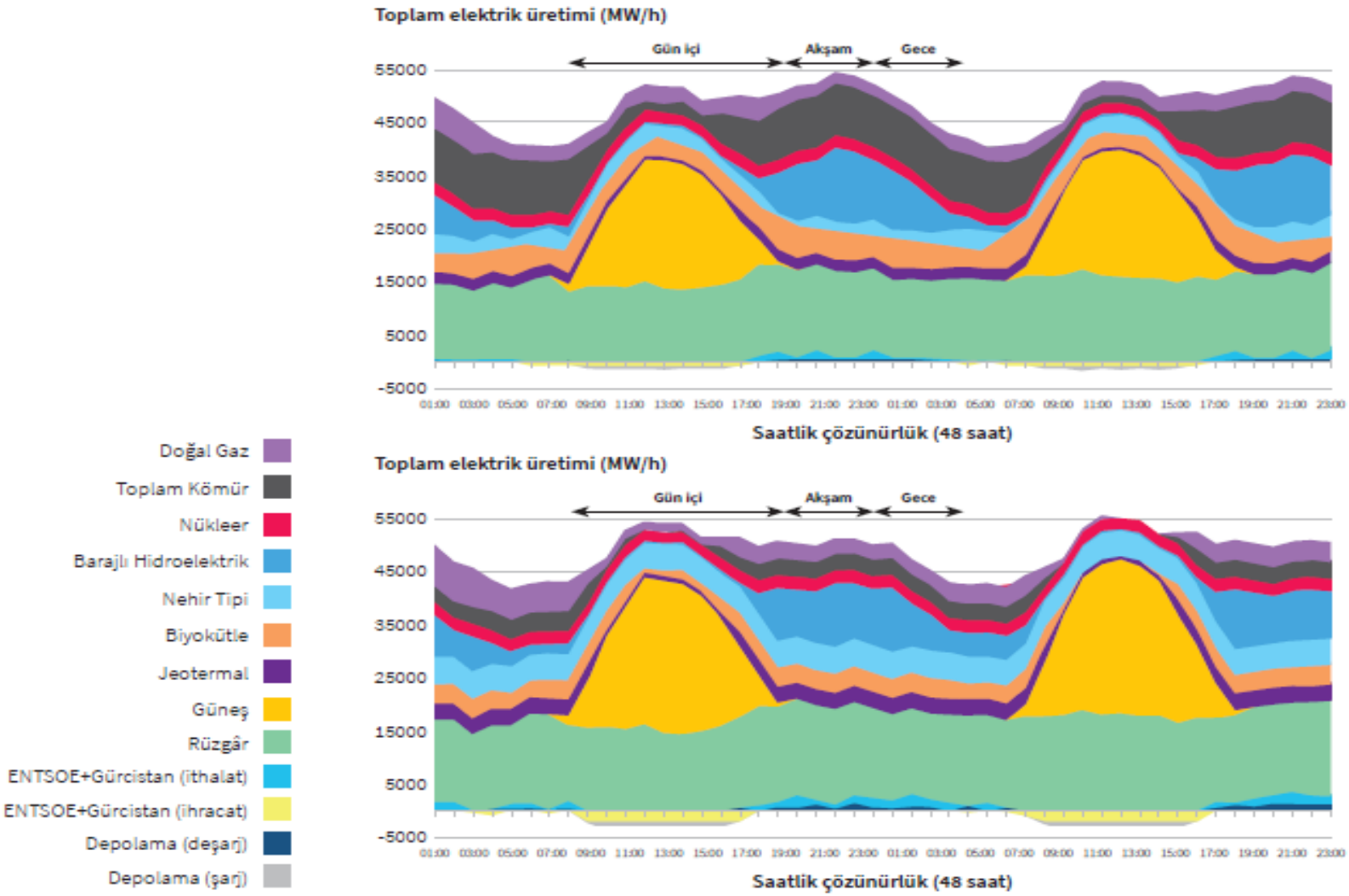
The update of this study, demonstrates **the ability of Turkey’s power system to integrate up to 70% of renewables capacity with relatively acceptable operational challenges** (redispatch and curtailment levels remain well below 5% of annual production) **until 2030 (including 35% wind and solar).** As the share of wind and solar energy in total electricity generation mix grows, the need to transform the power system to embed flexibility options increases

The share of renewables reaches up to 70% in the “Coal Phase Down” scenario in 2030



Through the use of flexibility options, the system reliability can be ensured when the renewable energy generation exceeds the consumption levels.

Electricity generation for a typical 48-hours in the spring during the week days.



ARES

CPD

- 1 GW pumped-storage hydroelectric power plant
- 600 MW/2400 MWh battery energy storage
- Demand-side response
- Renewable energy spinning reserve
- System-driven approach on determination of new power plant locations as well as decommissioning of existing power plants
- Utilization of interconnection capacities with the neighboring countries
- Keeping the existing flexible power plants in the system

Key Messages

- **The current grid development plan provides a solid foundation for the Turkish energy transition.** Until 2030, approximately 800 km/annum of new transmission line investment is foreseen.
- **Parallel to the increase in wind and solar energy, a significant reduction in fossil fuel generation can be achieved without significant additional network investment beyond the planned.** (The amount of load/load and RE generation cut-off in 2030 is less than 5% of total production)
- **For 2030, 60-70% of Turkey's electricity production can be met from renewable energy sources (including 35% share in wind and solar energy**) **while decreasing the share of production from coal power plants to 5%**. In order to reach these rates, it is necessary to make planned investments in the electricity grid and increase the flexibility of the electricity system.
- To integrate more renewable energy power plants to the grid, **pumped-storage hydroelectricity, battery energy storage, demand-side participation, system-oriented approach to determine either commissioning or decommissioning of power plants, interconnection capacity usage between neighboring countries and keeping the existing flexible power plants in the system will be important**.

Renewable Energy in Turkey -Priorities

- Over the last decade renewable energy (mainly solar and wind) capacity has increased considerably in Turkey thanks to USD-based FiT applied until July 2021.
- On the other hand, Turkey has still a significant unutilized potential of wind and solar energy.
- SHURA studies demonstrate that it is both economically and technically viable for Turkey's power system to integrate up to 70% of renewables capacity (including 35% of wind and solar energy) until 2030.
- In order to continue and accelerate the increase in renewable energy capacity installation, however, there is a need to prevent the existing difficulties in financing, ensure continuity in wind & solar tenders (YEKA tenders) andincrease visibility in the market and legislative framework

Energy Efficiency

The Most Economic Solution for Turkey's Power System: Energy Efficiency and Business Models

Role of energy efficiency in electricity sector
Scope of National Energy Efficiency Action Plan 2017-2023

Yatay Eylemler	Binalar	Sanayi ve Teknoloji	Enerji
Y1. Enerji Yönetim Sistemlerinin Kurulması ve Etkinliğinin Artırılması	**B5.** Mevcut Binaların Rehabilitasyonu ve Enerji Verimliliğinin Geliştirilmesi	**S1.** Isı Kullanan Büyük Endüstriyel Tesislerde Kojenerasyon Sistemlerinin Yaygınlaştırılması	**E1.** Kojenerasyon ve Bölgesel Isıtma-Soğutma Sistemlerinin Potansiyelinin Belirlenmesi ve Yol Haritasının Hazırlanması
Y2. Ulusal Enerji Verimliliği Finansman Mekanizmasının Geliştirilmesi	**B6.** Merkezi ve Bölgesel Isıtma/Soğutma Sistemlerinin Kullanımının Özendirilmesi	**S2.** Sanayide Enerji Verimliliği Projelerini ve Çeşitliliğini Artırmak İçin Destek Sağlanması	**E4.** Elektrik Sayaçlarının Okunması ile İlgili Düzenleyici Çerçevenin AB Müktesebatı ile Belirlenen Ana Esaslarla Uyumlaştırılması (Akıllı Sayaçların Yaygınlaştırılması)
Y3. Enerji Verimliliği Projelerinin Enerji Verimliliği Yarışmaları ile Desteklenmesi	**B7.** Mevcut Binaların Enerji Kimlik Belgesi Sahiplik Oranının Artırılması	**S3.** Sanayi Sektöründe Verimliliği Artırmak	**E5.** Transformatörlerde Asgari Performans Standartlarının Uygulanması
Y4. Enerji Verimliliği Projelerinde Teknik, Hukuki ve Finansal Hususları İçeren Kılavuz, Tip Sözleşme vb. Altlıkların Oluşturulması	**B8.** Sürdürülebilir Yeşil Binalar ile Yerleşmelerin Belgelendirilmesinin Özendirilmesi	**S4.** Cihazlarda Enerji Verimliliği Performans Standartları ve Çevre Duyarlı Tasarım, Üretim, Etiketleme Sisteminin Uygulanması	**E6.** Isıtma ve Soğutma Kaynaklı Puant Yükün Yönetilmesi
Y5. Enerji Verimliliği Faaliyetlerinde Kayıt, Veri Tabanı ve Raporlama Sistemlerinin Geliştirilmesi	**B9.** Yeni Binalarda Enerji Verimliliğinin Özendirilmesi		**E7.** Genel Aydınlatmada Enerji Verimliliğinin Artırılması
Y6. Uluslararası Enerji Verimliliği Finansman İmkânlarının ve Etkinliğinin Artırılması, Koordinasyon ve Kontrolü	**B10.** Mevcut Kamu Binalarında Enerji Performansının İyileştirilmesi		**E8.** Elektrik İletim ve Dağıtım Faaliyetleri Verimlilik Artışının Geliştirilmesi
Y9. Enerji Verimliliği Etütleri	**B11.** Binalarda Yenilenebilir Enerji ve Kojenerasyon Sistemlerinin Kullanımının Yaygınlaştırılması		**E10.** Talep Tarafı Katılımı (Demand Side Response) Uygulaması İçin Piyasa Altyapısının Oluşturulması
Y10. Kamuda Sürdürülebilir İşletme ve Satın Alma Yaklaşımının Benimsenmesi	**B12.** Kobi Niteliğindeki Binalara Yönelik Enerji Verimliliği Etüt Programları ve Etütler için Kaynak Tahsisi		
Y11. Enerji Dağıtım veya Perakende Şirketlerine Yönelik Enerji Verimliliği Yükümlülük Programı			

14% savings in primary energy demand through 2023

6 sectors, 55 actions about business models, financing mechanisms, policy mechanisms, regulation

SHURA Study - “The most economic solution for Turkey’s power system: Energy Efficiency and Business Models” (2020)

Energy Efficiency Solutions

Regulation	Market-Based Policy Mechanisms	Business Models	Financing Instruments	System Efficiency
Standards and Certification	Energy Efficiency Obligations	Demand-Side Response and Aggregators	Energy Efficiency Funds	Time-of-Use Tariffs
Energy Efficiency Audits	Energy Efficiency Auctions	Smart Meters	Energy Service Companies (ESCO)	Market and Grid Integration of Distributed Energy Systems
Energy Management	Voluntary Mechanisms		Other Financial Instruments	TSO-DSO Cooperation
				New Business Models for DSOs
				Distributed Generation Models

16 energy efficiency solutions in 5 categories are analysed to realize the energy savings potential for 2030

Role of energy efficiency in electricity sector
Sectoral scope

Electricity generation

- Natural gas
- Coal
- Hydroelectricity
- Solar and wind
- Nuclear
- Biofuels

Target: Renewable energy

Transmission & Distribution

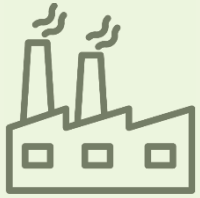
- Peak load management
- Distributed generation
- Demand side participation

Target: Decreasing the losses

Electricity consumption

Industry

- Arc furnaces
- Cement grinding
- Cogeneration
- Process heating



- Basic oxygen furnaces
- Cooling
- Lightening

Others

- Street lightening
- Agriculture and animal husbandry

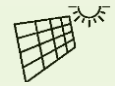
- Electrical vehicles
- T&D losses

Buildings

- Household equipment
- Office equipment
- Lightening
- Smart homes

- Heat pumps
- Cooking
- Micro cogen
- Trigeneration
- Cooling

Distributed generation

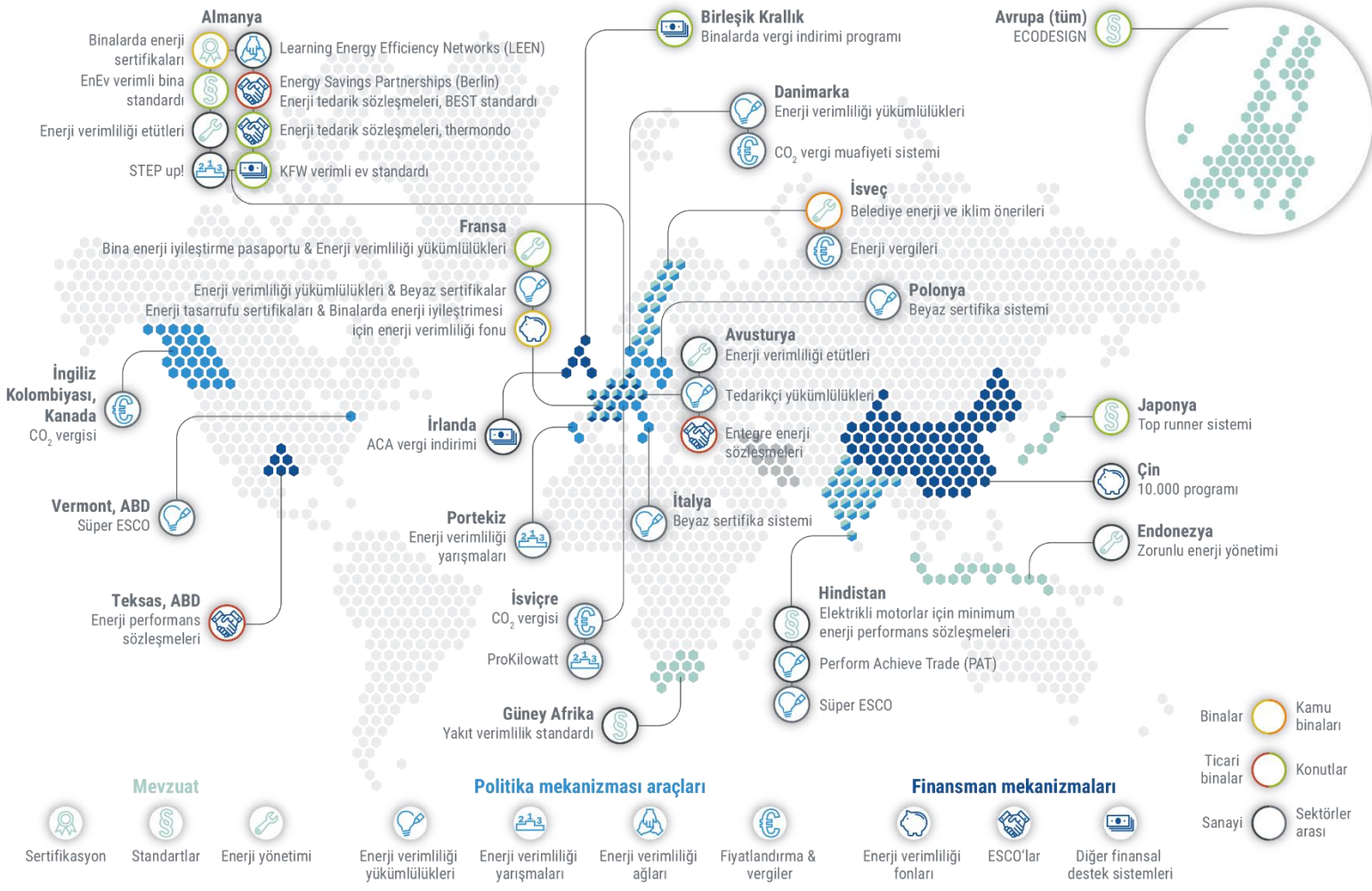


- Rooftop PV
- Cogeneration

Target: Decreasing electricity consumption + distributed energy

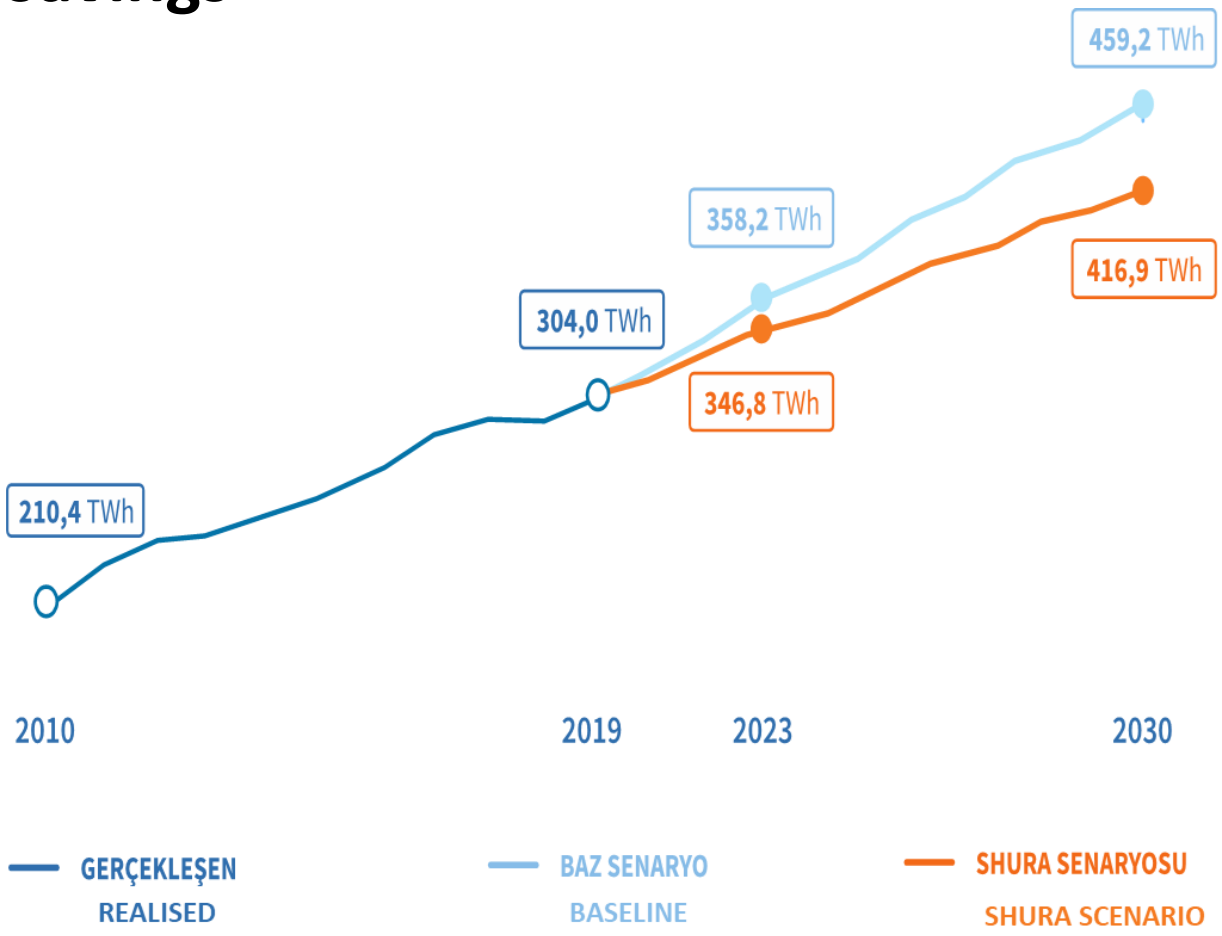
More than 20 end use areas and >100 related technologies are analysed through whole electricity sector
Moreover, savings potential is estimated for generation, transmission and distribution
Analysis is carried out for 2020-2030

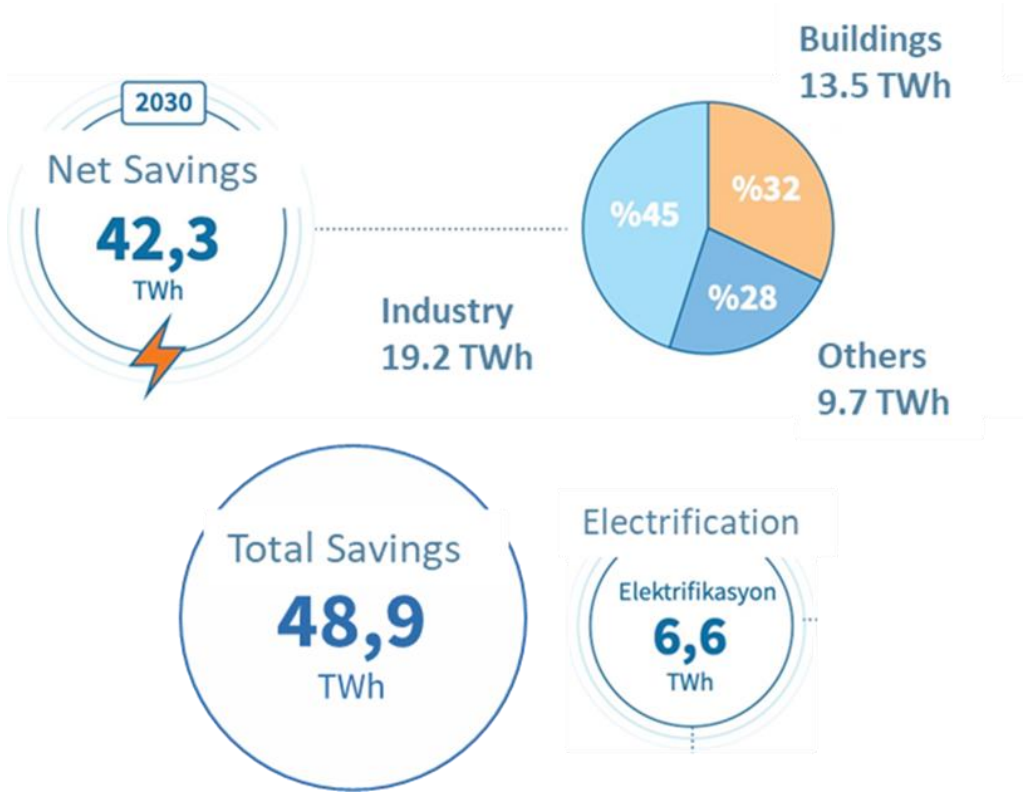
Energy Efficiency Solutions in the Power System



More than 120 world examples were examined for the improvement and design of energy efficiency solutions in Turkey

Potential of energy efficiency in Turkey and the breakdown of savings



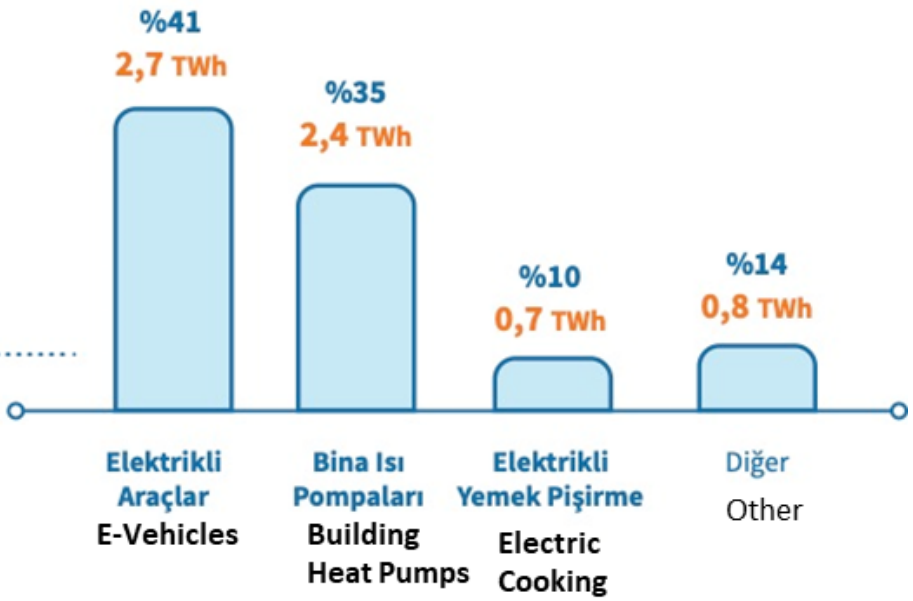


- 10% more energy savings potential compared to Baseline Scenario
- 42,3 TWh/year savings in 2030– equivalent to 18 million household's electricity consumption

The impact of electrification

2030
Electrification
Elektrifikasyon
6,6
TWh

Increased electricity consumption **with electrification** in the SHURA scenario

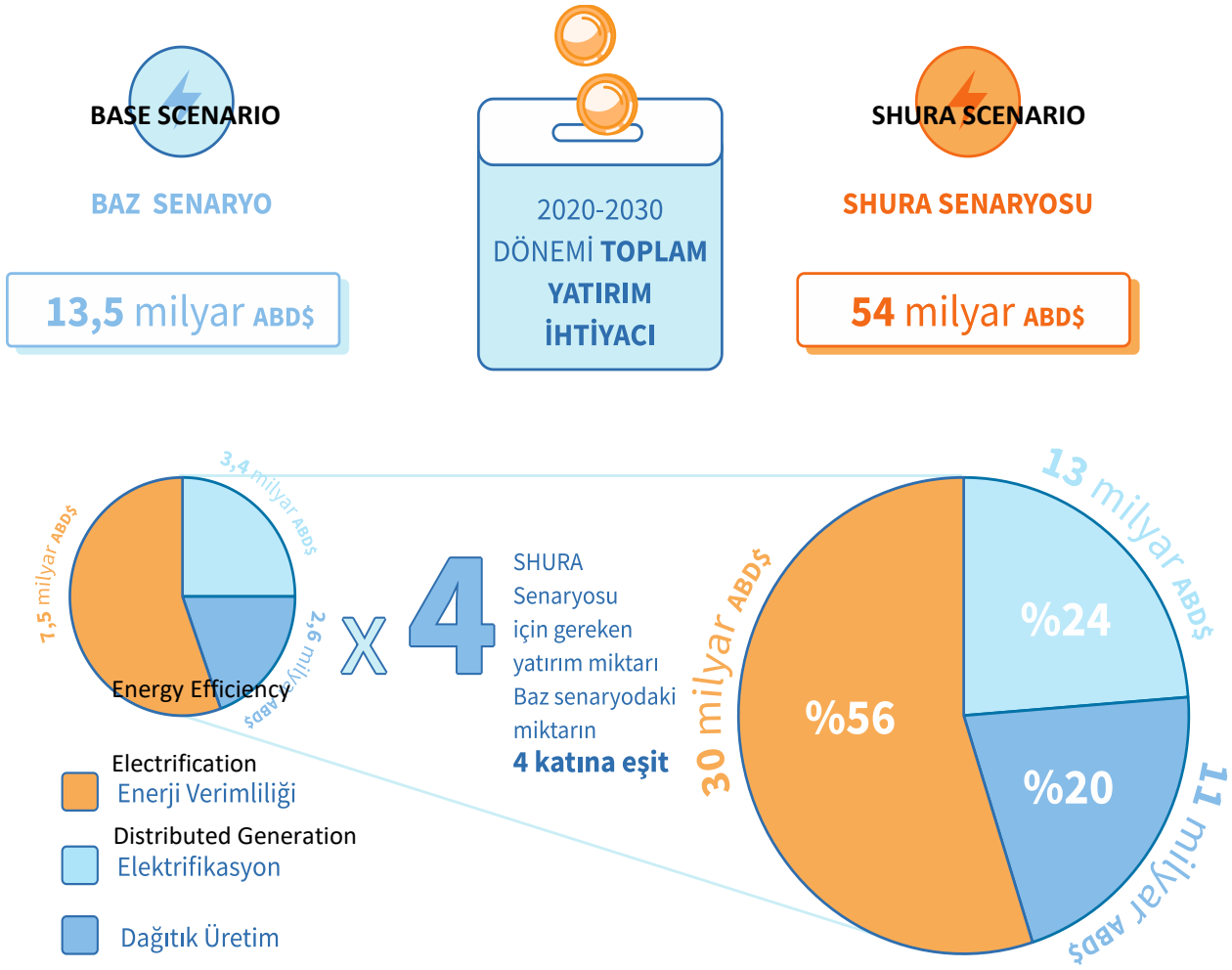


Benefits:

It is a cleaner, more environmentally friendly and efficient technology obtained from new, domestic and renewable resources compared to technologies working with fossil fuels.

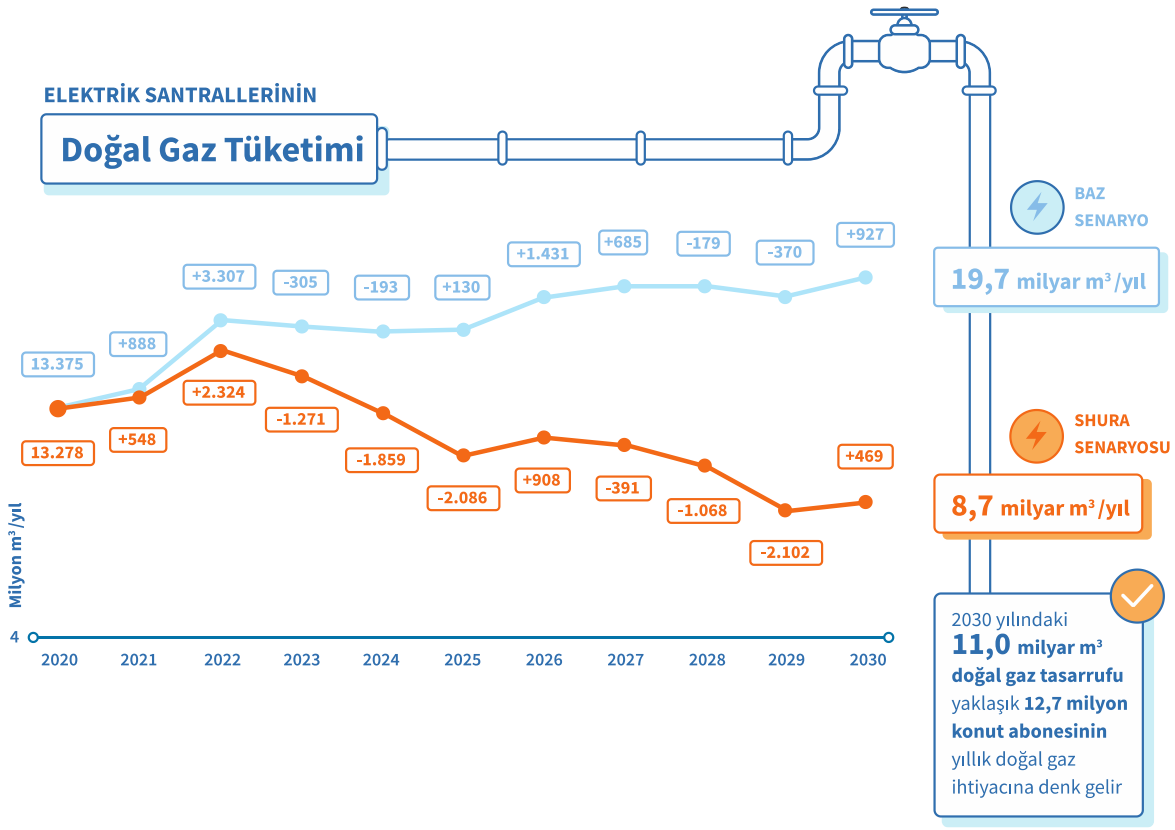
Enables demand-side engagement and load shifting

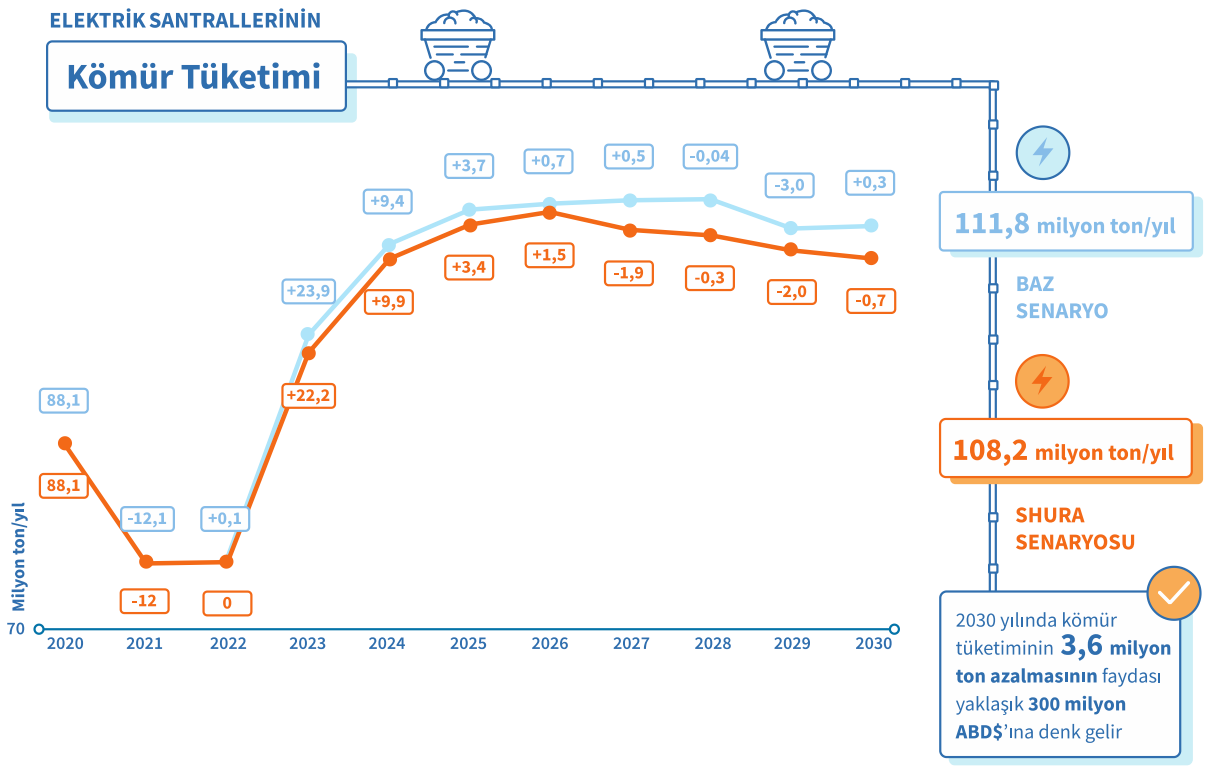
SHURA Scenario: Required Investments



- The investment needed for SHURA scenario during 2020-2030, is 4 times more compared to the Baseline scenario
- Out of the 55 billion dollar investment need, 30 billion dollars is directly related to energy efficiency.
- A net benefit of 1.2-1.5 Euros arises for every 1 Euro spent on expanding the technology portfolio.

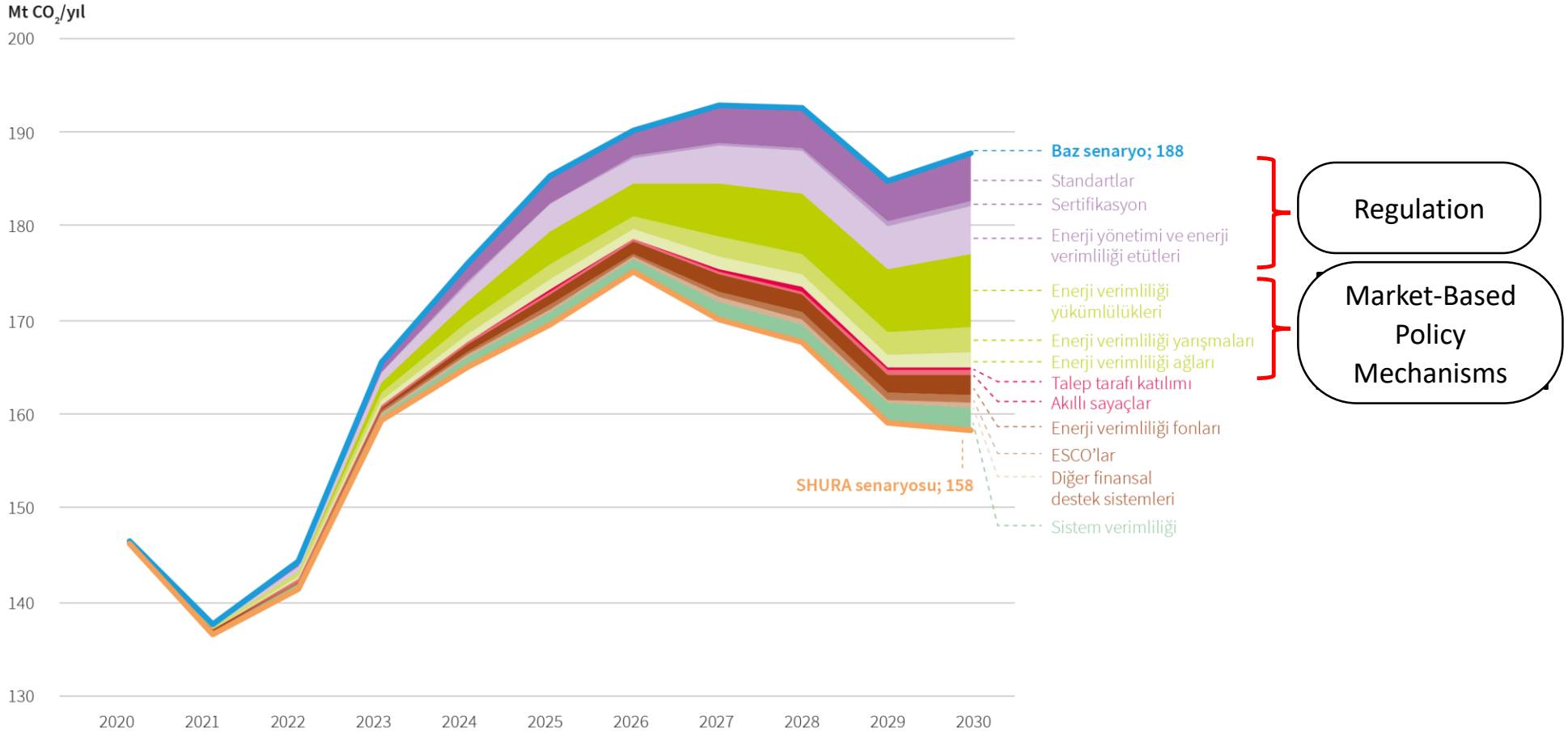
Energy efficiency from public and private perspectives
Cost and benefits





Energy efficiency plays a key role in ensuring energy supply security and increasing the share of renewable energy.

Effects of energy efficiency solutions on CO2 emissions



10% savings limit emissions growth to 5% compared to 2018

The reduction in emissions comes mostly from regulation and energy efficiency obligations

Energy Efficiency-Key Messages & Priority Areas

Energy Efficiency-Key Messages

Compared to Baseline Scenario in 2030

- Savings potential of more than 10%
- 40% of the savings are in industry, 32% in buildings, 28% in other areas.
- 16% less CO2 emissions (25 million tons) in the electricity sector.
- A total investment of 54 billion dollars is required in 10 years to achieve 10% savings potential.
- For every $1 spent on electricity savings, there is a benefit of $1.2 - 1.5
- In addition, energy efficiency provides environmental, social and economic benefits.
- Distribution companies can take an active role, directly or indirectly, in ensuring all these savings.

Energy Efficiency-Priority Areas

- Improving existing practices for energy efficiency and **developing a long-term plan that prioritizes the social and economic benefits of energy efficiency for Turkey**
- Development of **measurement, reporting and verification system**
- Informing industry stakeholders about energy efficiency and energy transition and **raising awareness**
- **Implementing market-based policy mechanism tools** as soon as possible to ensure low-cost and effective technology implementations that support legislation
- Developing and implementing **financing mechanisms and tools that will enable less costly and faster realization of the potential**
- Developing and implementing **business models that can further integrate demand-side and distributed energy resources into the system to increase energy efficiency**
- Implementation of mechanisms and models that will empower the consumer, enable the whole system to work more integratedly and efficiently, and **realize the opportunities arising from distributed energy.**

Socioeconomic Effects of Electrical System Transition in Turkey (June 2021)

Key Findings

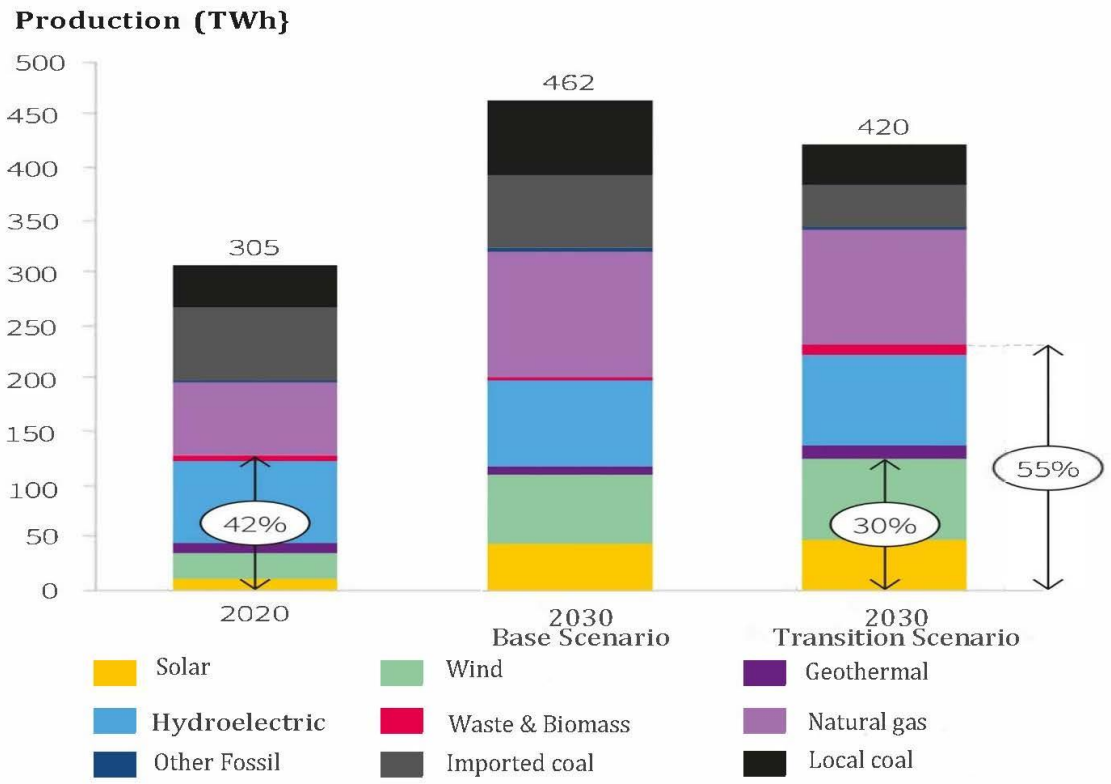
1	With the transition, greenhouse gas emissions will be reduced, economic growth will be strengthened and the foreign trade balance will improve.
2	In addition to achievements in the field of health and the environment, employment opportunities with higher qualifications and higher wage levels are emerging therefore total wage incomes are increasing.
3	the long-term policy vision, including a climate action plan for 2030 and 2050, will provide the necessary ground for achieving the stated benefits.
4	Solutions on a national and local scale will be needed to maximize potential benefits and ensure their fair sharing.

SHURA Electrical System Transition Vision

Transition from an import-based, carbon-intensive structure to an innovative, lower-cost, cleaner and safer low-carbon structure

Electrification of end-use	Efficiency gains of 10% compared to the baseline	50% renewable energy share in total output
2.5 million EVs & 1 million charging points + 2 million heat pumps & smart homes + More than 10 GW rooftop solar PV = **7 -9 TWh of additional electricity demand**	17.3 TWh savings in industry + 19.3 TWh savings in buildings + 6.0 TWh savings in the distribution system = **42 TWh of net demand reduction**	Improved market design + 2000 MW energy storage + Demand-side response reduction of peak demand by up to 10 GW + System-friendly wind & solar location + Flexible power plant fleet = **Flexible grid for integration of 30% share in wind & solar**

Electrical System Transition scenario



- → **Base scenario:** continuation of existing policies in the sectors where renewable energy, energy efficiency and final energy consumption occur.
- → **Transition scenario:** an accelerated transition path focused on the electricity system, renewable energy, energy efficiency and electrification by 2030.
- → **Thanks to energy efficiency in the conversion scenario, annual energy consumption is 10% lower than in the Base scenario.**
- → **In the transition scenario, carbon pricing was applied, which gradually increased until 2030 and reached US$ 25.**

The effect of transition on the socioeconomic well-being is at the level of 1.1% of GDP…

	Base scenario (2030)	Transition scenario (2030)	Effect of transition (Transition- Base)
Milli Gelire Etkisi (Effect on national income)			
Reel GSYil-I	1131,6	1142,6	11,0
As a percentage of the base scenario GDP			***%1,0***
The Impact on the Overall Foreign Trade Balance			
*Balance of Foreign Trade**	-7,8	2,4	10,2
As a percentage of the GDP of the base scenario			***%0,9***
*Net Energy Trade Balance for Electricity Production**	-6,2	-5,2	1,0
As a percentage of the base scenario GDP			*%0,1*
Transition in Industry			
Added Value of the Industry	730,1	770,8	40,7
As a percentage of the base scenario GDP			***%3,6***
Impact on Socioeconomic Well-Being			
Wage Revenues	332,8	341,5	8,7
*Net Energy Foreign Trade Balance for Electricity Production**	-6,2	-5,2	1,0
*Foreign Trade Balance of Net Investment Goods for Electricity Production**	-2,9	-2,5	0,4
*Impact on Health (Air Pollution)***	-2,5	-1,1	1,4
*Impact on Climate Change (Carbon Dioxide (CO2) Emissions) **	-5,1	-3,8	1,3
TOTAL Impact on Socioeconomic Welfare			12,8
As a percentage of base scenario GDP			***%1,1***

Featured effects :

→ Balance of Foreign Trade

→ Industrial Transition

→ Socioeconomic Well-Being

Reducing the foreign trade deficit is one of the most important advantages of the transition

→ In the transition scenario, **energy imports for electricity generation are decreasing by 1 billion US$ annually** compared to the base scenario.

→ Thanks to productivity increases, **the competitiveness of export-oriented sectors is increasing; exports of industrial products are 9% higher** compared to the base scenario.

→ In the transition scenario**, the improvement in the foreign trade deficit is four times higher than in the base scenario.**

→ Energy efficiency and renewable energy will reduce the demand for energy imports and the relative cost of energy, as well as increasing capital accumulation and access to foreign exchange savings.

With the transition, the technology level of production and exports is increasing

→ Transition has a great positive impact on the industry; the size and the direction of the impact differ across sectors

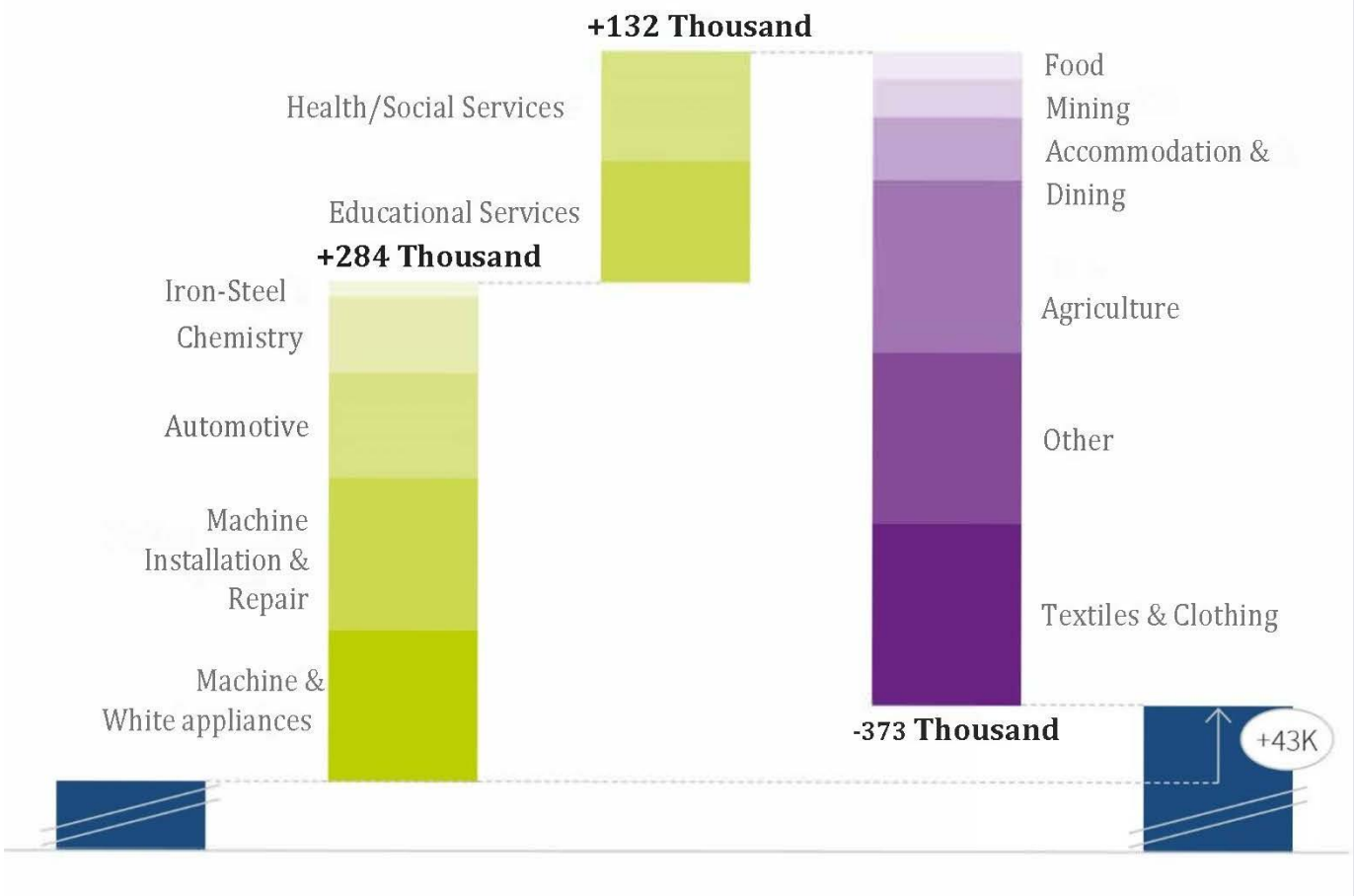
→ **Internationally competitive, export-oriented sectors and some energy-intensive sectors are growing faster** in the Transition scenario than in the Base scenario.

→ **Since mining is linked to fossil fuels, the electricity sector is experiencing a loss of production** compared to the Base scenario due to energy efficiency.

→ **Transition results in the highest growth in the medium-high technology sectors, especially in competitive and export-oriented sectors of automative automotive and Machinery Industry while labor intensive sectors such as Agriculture, Food Processing and Textiles/Clothing grow more slowly**.

→ **Healthcare, social services and education in services are growing faster** in the transition scenario.

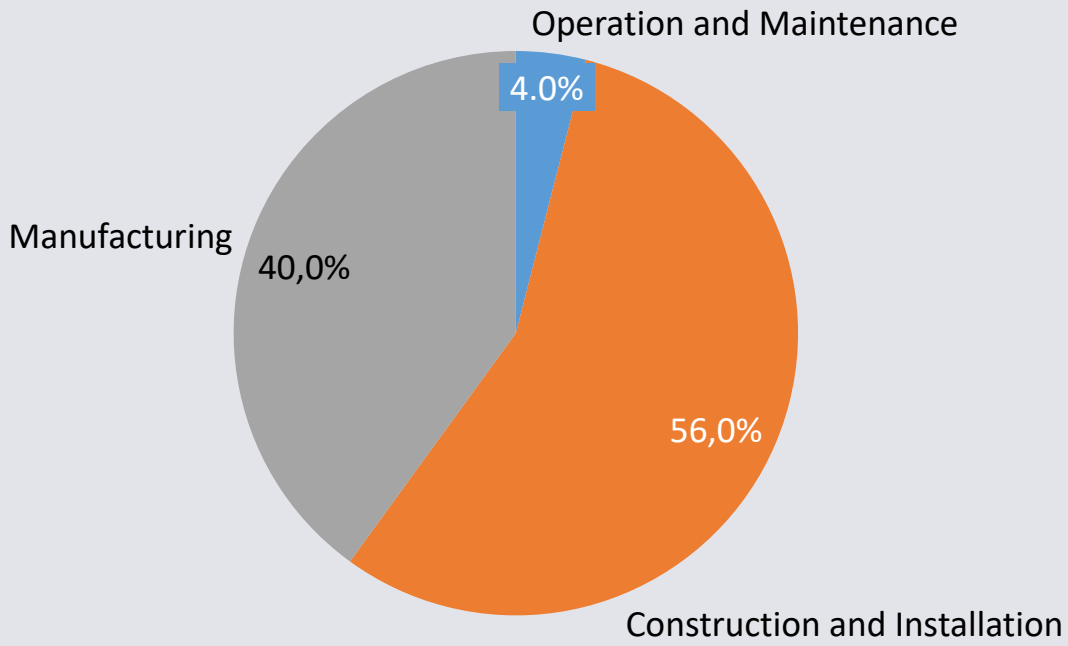
In the transition scenario, a net 43 thousand additional jobs compared to the base scenario



- → An increase is expected in education and social services with sectors that benefit from productivity Dec or provide intermediate goods/inputs for transition.
- → Lower employment is expected in sectors linked to electricity generation from fossil fuels and in labor-intensive sectors that benefit less from productivity growth.
- → 80% of net additional employment is attributed to energy efficiency and electrification.
- → Distributed energy, storage and digitalization can create additional employment potential.

Renewable energy investments and efficiency create new employment opportunities

Distribution of New Employment Created by Wind and Solar Energy Investments

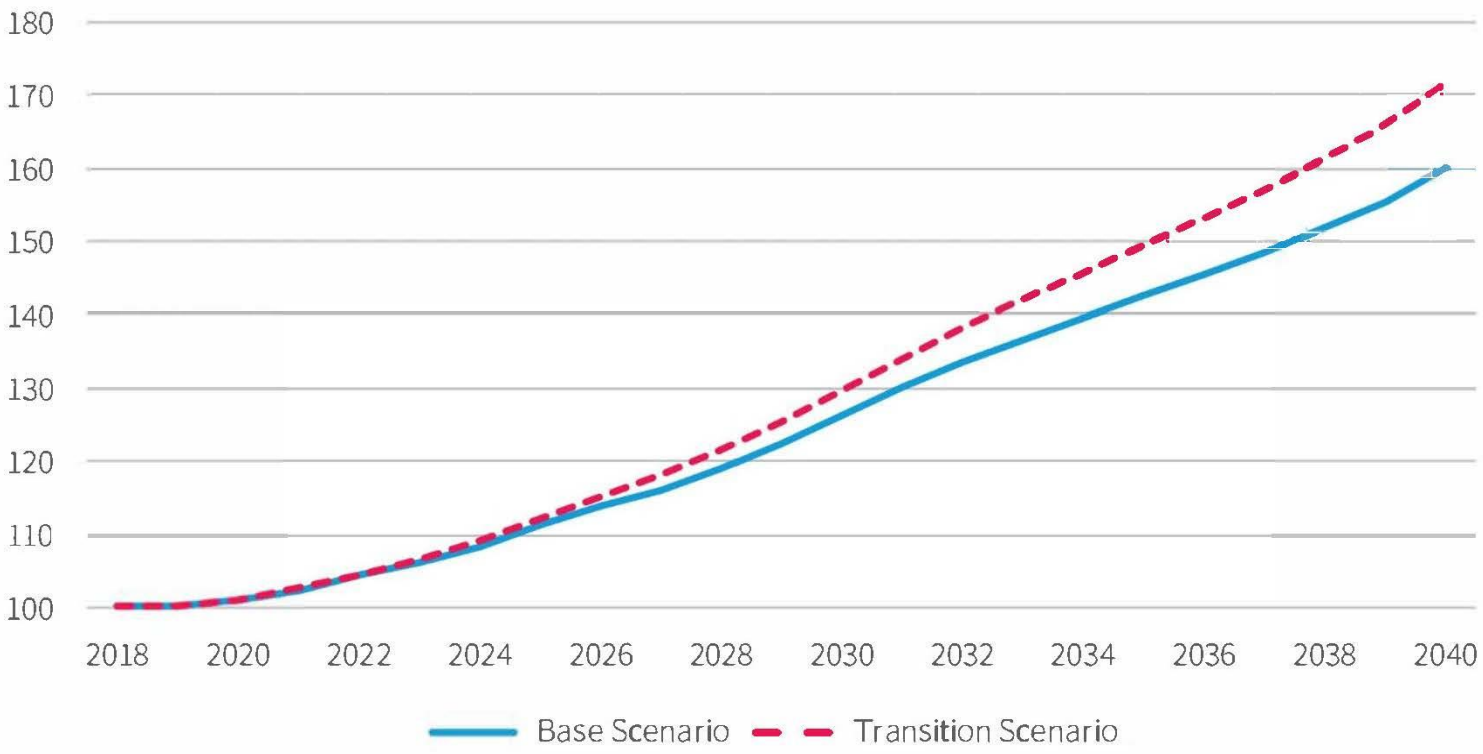


- → the total employment figure for the period 2018-2030 is increasing by 4.2 million and reaches 32.9 million in 2030.
- → It is calculated that renewable energy investments will create 520 thousand new jobs in the base scenario and **590 thousand in the Transition scenario.**
- → Most of these job opportunities will be in construction/installation and manufacturing areas.

Transition scenario creates a significant increase in real wages and total wage incomes

Real Wage Indices in the base scenario and in the Transformation scenario

(Billion US$, 2018 Fixed Prices)

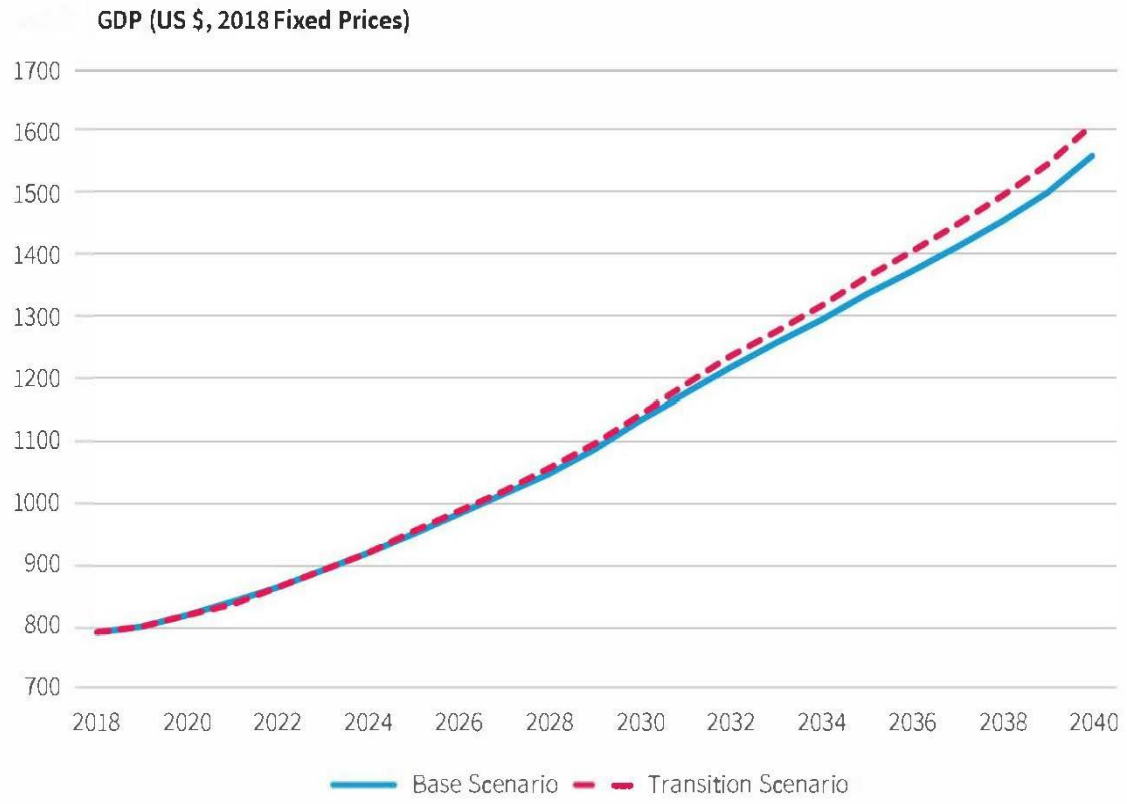


With the achievements in the field of health and the environment, high-skilled and higher-wage employment opportunities increase social welfare.

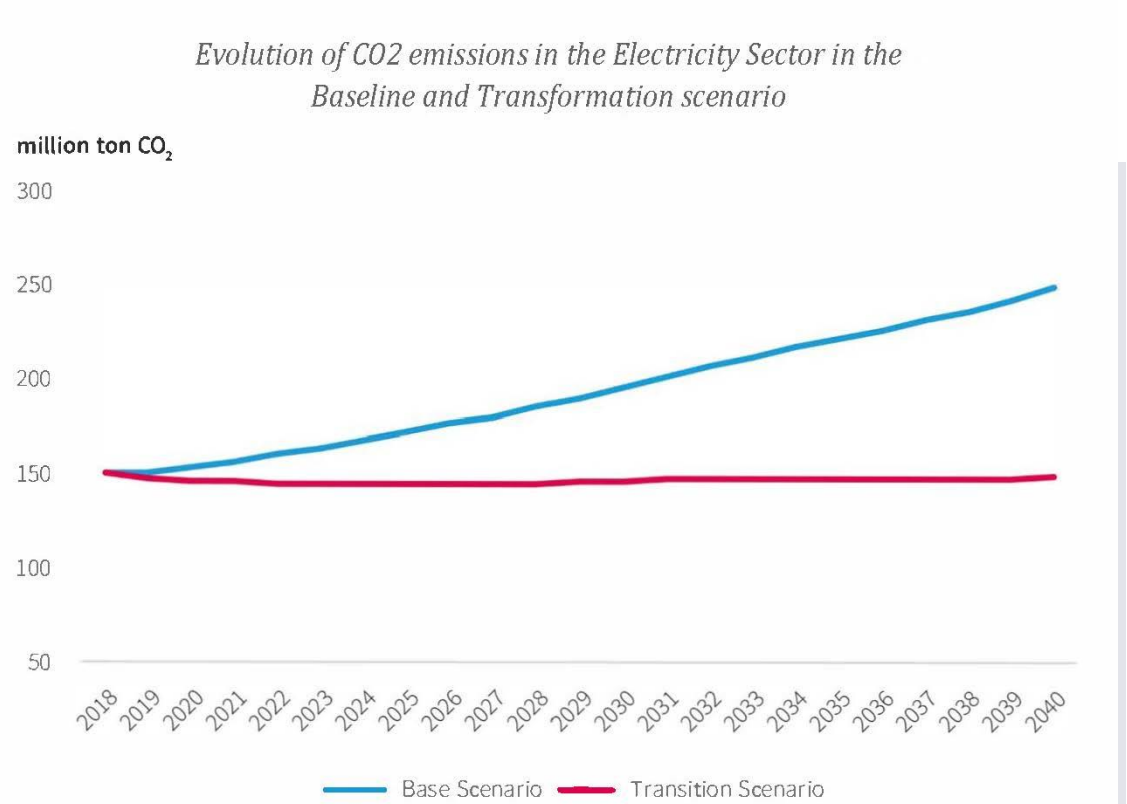
- average wages in 2030 are 2.7% higher compared to the base scenario.
- wage revenues in 2030 are 8.7 billion US$ per year higher than in the base scenario.
- The increase in wage incomes also has a small but positive effect on the functional income distribution.

With the transition, carbon emissions are falling compared to the base scenario and the , GDP is rising

GDP (billion US$, 2018)



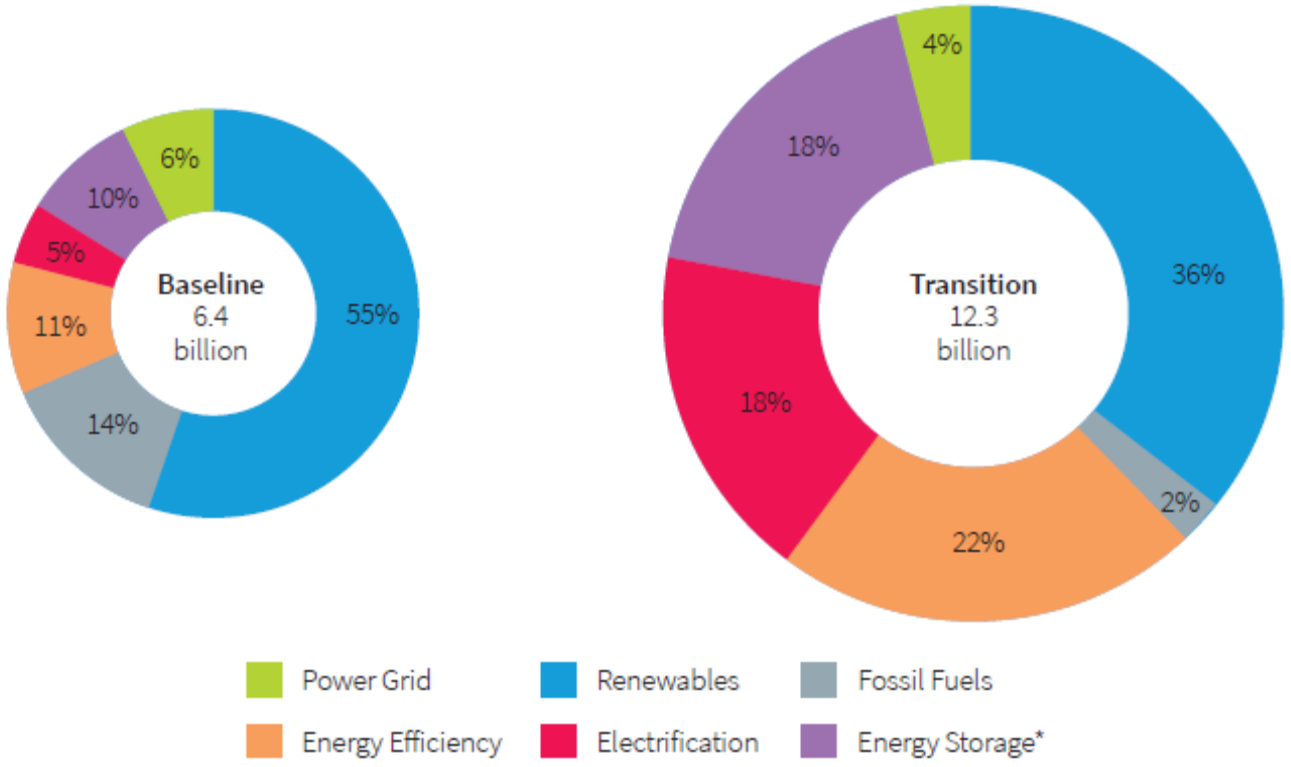
Total CO2 emissions (million tons)



- ✓ **The transition scenario stops the growth in power sector carbon emissions.**
- ✓ To approach net zero carbon, **a new national vision with clear targets for 2030 and 2053** covering all consumption areas **is needed**.
- ✓ Global **green deal and green recovery** will form the basis for the new vision.

Cost-benefit of the transition; challenges and opportunities

Average Annual Investment Requirement (US$)



** Note: Energy Storage includes both electric vehicles and power grid energy storage.*

- ✓ **Investment and financing needed for transition will be twice the level in the baseline.**
- ✓ **Estimated additional annual cost of the transition is 4 billion US$, compared to 12-13 billion US$ economic benefit.**
- ✓ **Policy predictability will be key to securing the necessary financing.**

Source: SHURA 2020 (Energy Efficiency, Optimum Capacity Mix); SHURA 2021

What should be done to pave the way for investments?

→ **Carbon pricing mechanism and trading system should be implemented**

→ **Renewable energy incentives should be maintained in accordance with market-based mechanisms**

→ **Incentives for fossil-fueled power plants should be reviewed and those that are not efficient should be terminated**

→ **Long-term planning and market-based policies should be implemented to ensure energy efficiency.**

What should be done for a fair and effective transition?

- a long-term policy vision should be established, including a climate action plan for 2030 and 2050
- Policies that pave the way for investments should be implemented
- National and local solutions should be developed to minimize the negative effects in sectors that will experience employment and production losses through transition

Thank You!

Alkım Bağ (alkim.bag@shura.org.tr)

@shuraedm

@company/shura