Renewable Energy in Romania
Roadmap to 2030

MAY 2023

Romanian Wind Energy Association

Romanian Photovoltaic Industry Association

Scope of Work and Limitations

The main objective of the study – Developing a 2030 roadmap for the renewable energy sector in Romania (two scenarios), including:

Pathway towards 2030:

- Presenting the most recent economic and regulatory developments concerning the EU energy sector;
- An overview of the evolution of energy production costs from conventional and renewable sources, with emphasis on wind and photovoltaic technologies;
- An assessment of Romania' s potential for renewable energy – update with offshore;
- The electricity demand evolution in Romania towards 2030 – update and impact of COVID-19 for the long-term evolution;
- New capacity potential for 2030 (retirement, increased demand, repowering etc.) and cost-benefit analysis of available options;
- Investment costs necessary to achieve the 2030 target;
- Analysis of and comparison between Romania's reference energy use growth scenario for 2030 (based on the country's actual NECP) and an updated scenario(s) proposed by the study, based on achieving the renewable potential;
- Analysis of the opportunities created by the three indicative benchmark years (2023, 2025 and 2027) and the associated intermediary targets.

Roadmap of policies and market design measures:

- Grid constraints, Flexibility and Adequacy of the system – the actual situation, solutions for short and medium term, implementation timeline and estimated costs (based on data availability);
- Impact of balancing costs on today's profitability (if possible) and ways to decrease it (short and mid-term) – (based on data availability);
- Economic and social impacts of an increased share of renewables, including investments and job growth
- Environmental impact assessment of an increased share of renewables in terms of reducing the carbon footprint of electricity production in Romania, as well as mitigating harmful air pollutants such as NOx, SOx, and PM – update;
- Presentation of the key legislative and regulatory barriers that need to be overcome for enabling the transition towards reaching the entire renewable potential of Romania;
- Pathways for accelerating renewable uptake through specific support mechanisms and market design (for example CFDs, PPAs);
- Sector coupling potential through decarbonisation of transport and heating in 2030 and use of green H2 – (based on data availability)

Information Sources

Main data sources include market data, historical / statistical and forecasted data using the PRIMES model in relation to the key energy sector drivers.

Limitations

The study covers only the scope previously mentioned.

The information, data and analysis presented were based on market data, historical / statistical data (publicly available) and forecasted data using the PRIMES model developed by E3M; for each figure and table presented, the source is mentioned; therefore, although Deloitte endeavors to provide accurate and up-to-date information, it does not guarantee that such information is accurate as of the date of publication of the study, or that it will continue to be accurate in the future.

The information and data contained in this study is selective and can be subject to update, expansion, revision and amendment. The study does not claim to contain all of the information that any interested third party may require. Any statements, estimates and forecasts contained in this report reflect various assumptions of the expected results, assumptions that may or may not prove to be correct.

Contents

Glossary

Bn.	Billion
CBA	Cost-Benefit Analysis
CCGT	Combined Cycle Gas Turbine
CO_2	Carbon Dioxide
CfD	Contract for Difference
DAM	Day-Ahead Market
E3M	E3 Modelling company
EC	European Commission
EGD	European Green Deal
ETS	Emission Trading System
EU	European Union
EV	Electric Vehicle
GHG	Greenhouse Gas
GW / GWh	Gigawatt / Gigawatt hour
INSSE	National Statistics Institute
IRENA	International Renewable Energy Agency
JTF	Just Transition Fund
kW / kWh	Kilowatt / Kilowatt hour
LTS	National Long-Term Strategy
Mil.	Million
Mt	Million tones
MW / MWh	Megawatt / Megawatt hour
NECP	National Energy and Climate Plan
NRRP	National Recovery & Resilience Plan
NES	National Electricity System
NTC	Net Transfer Capacity
OPCOM	Power & Gas Market Operator
PPA	Power Purchase Agreement
PV	Photovoltaic
RED	Renewable Energy Directive
RES	Renewable Energy Sources
RES-E	Renewable Energy Sources in Electricity Generation
RES-T	Renewable Energy Sources in Transport
RES-H&C	Renewable Energy Sources in Heating & Cooling
RFNBO	Renewable Fuels of Non-Biological Origin
TSO	Transmission System Operator

Executive Summary

Study Context & Methodology

Why was the study commissioned?

To address the market & industry context

- Considers current market and industry drivers, including carbon pricing, energy supply pressures, current generation mix
- Responds to industry needs and growth strategies

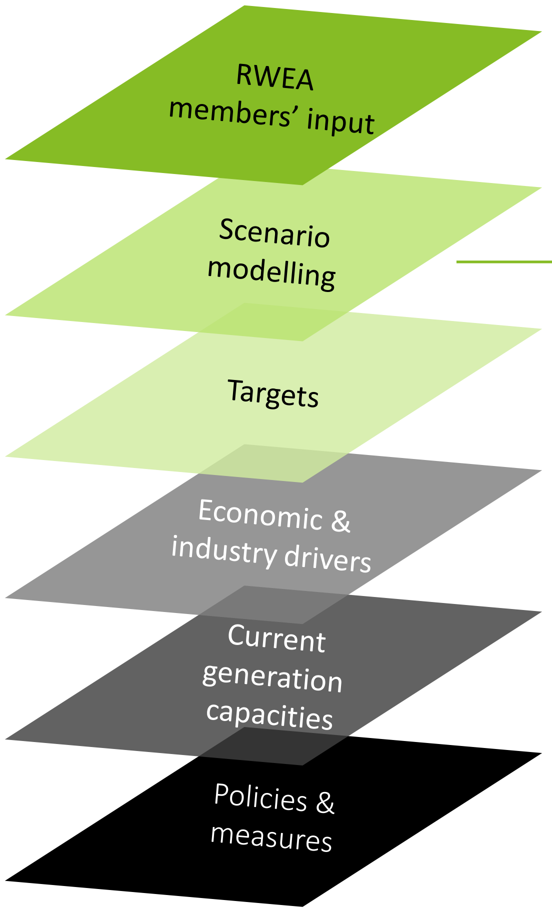
To address RO & EU RES targets

- Provides 2030 projections based on current path assumed by Romania
- Highlights the gap that Romania will have to close in order to reach REPowerEU targets: **42.5% RES at EU level (+2.5% top-up)**

To provide an action plan for Romania

- Aims to raise awareness among authorities and industry leaders on key investment areas
- Outlines necessary policies and initiatives for closing the gap

How was the study developed?



Instrument used by the EU Commission in developing **FitFor55** projections

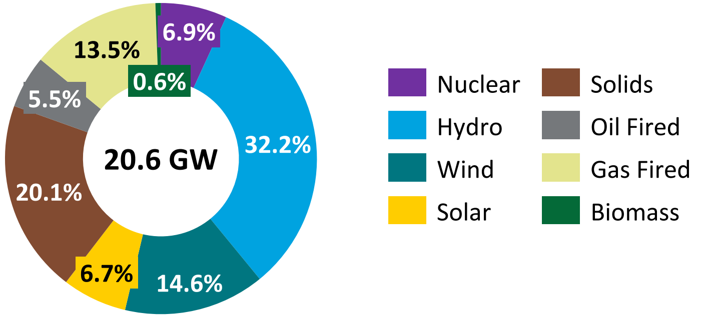
E3Modelling Energy Economy Environment

Two scenarios

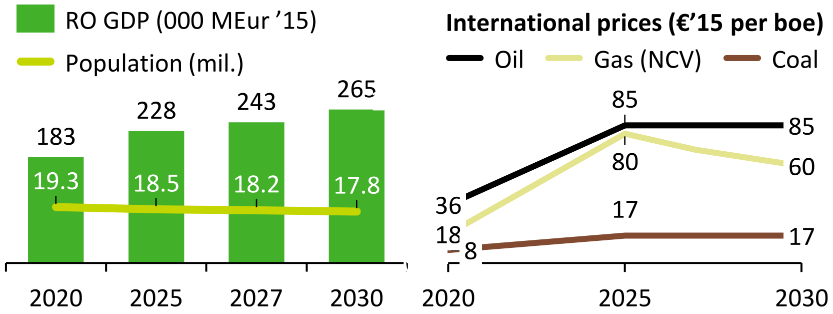
- **As-Is Scenario**: projections based on implemented policies and measures
- **REPowerEU Scenario**: a top-down approach in order to achieve REPowerEU targets at national RO level

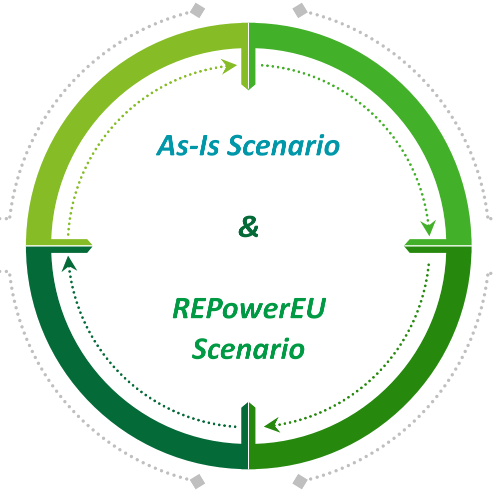
Main Assumptions & Drivers

Installed capacities, 2020



Economic Context



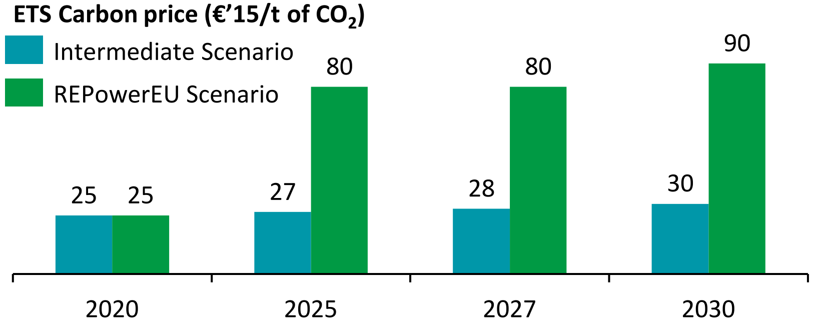


Policies & Targets

	RO NECP	REPowerEU / RED III
RES 2030	**30.7%**	**45% ***
RES-E	49%	Set based on other RES
RES-T	14%	≈29% 5% RFNBO
RES-H&C	33%	+1.3 p.p./a

- No additional nuclear is considered by 2029
- Gas & Hydro power evolution based on known plans (2022)
- Coal-based capacities evolution based on CEO Restructuring Plan
- Wind & Solar develop to cover electricity demand

Carbon Pricing

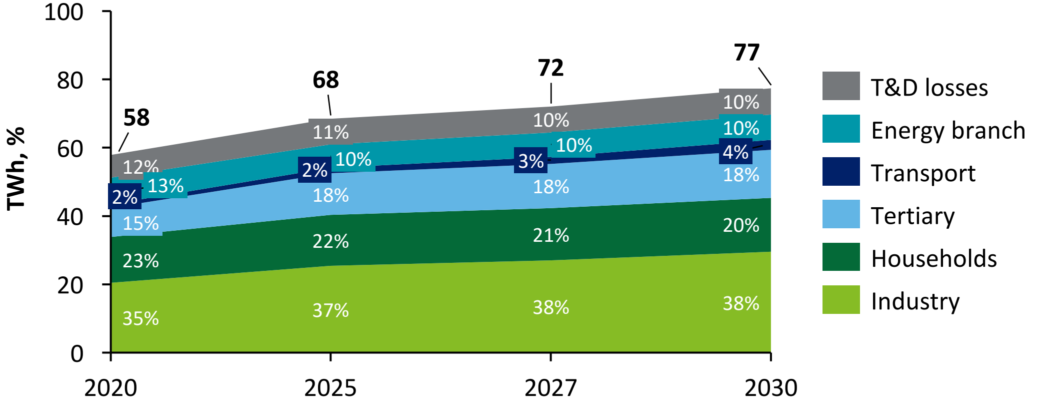


* 42.5% target plus 2.5% top-up

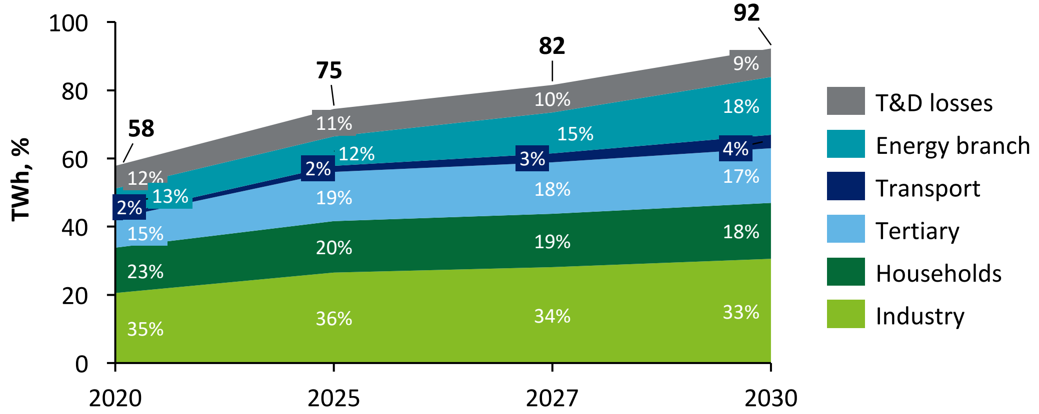
Source: ANRE, NECP, EU Commission, E3M Primes model

Study Results – Gross Electricity Demand

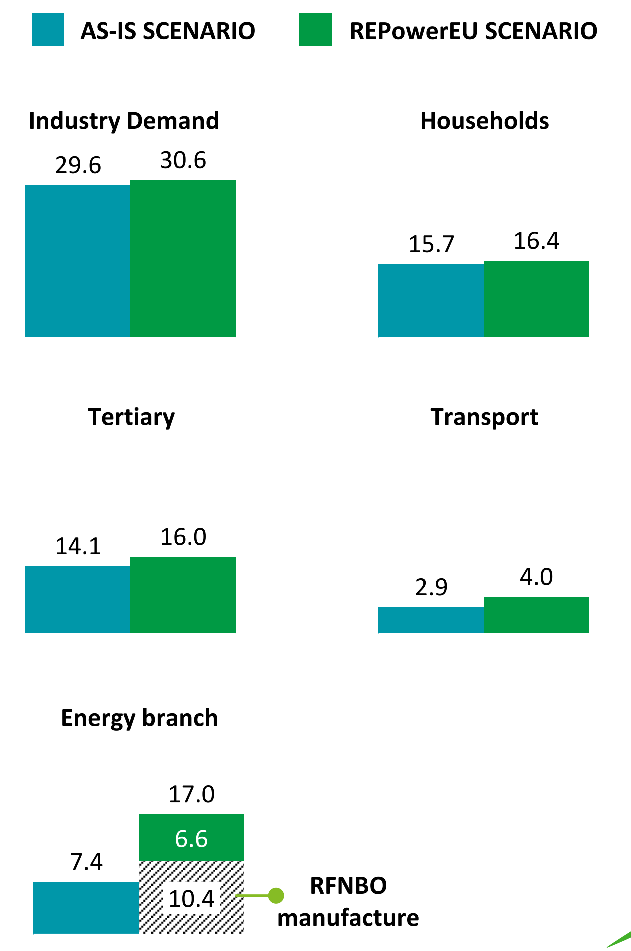
AS-IS SCENARIO



REPowerEU SCENARIO



SCENARIO COMPARISON 2030, TWh

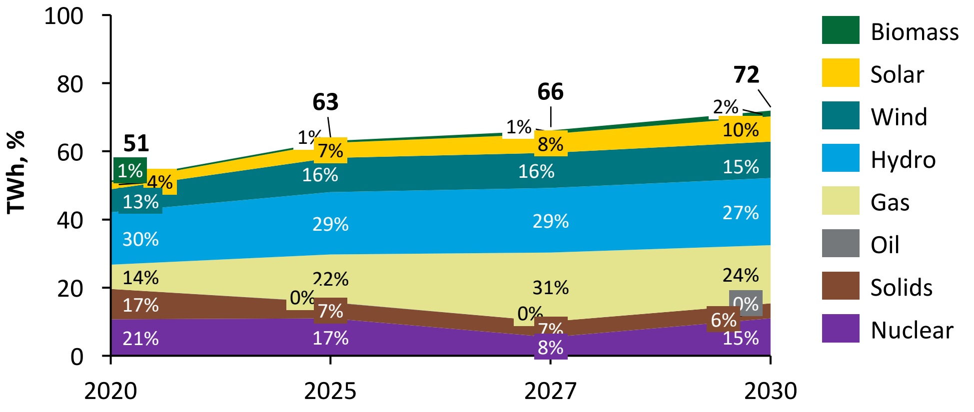


- Electricity demand is **set to increase in both scenarios**, in line with projected economic context (+**60%** in 2030 vs. 2020 for the REPowerEU scenario)
- Electricity demand is higher across all economic sectors in the REPowerEU scenario vs the As-Is 2030: +**20% overall**
- **Key demand difference** results from consumption for RFNBO production (H_2 electrolysis mainly) in the REPowerEU scenario (**+5.4GW/10 TWh**)
- Annual growth rates of electricity demand are highest in transport

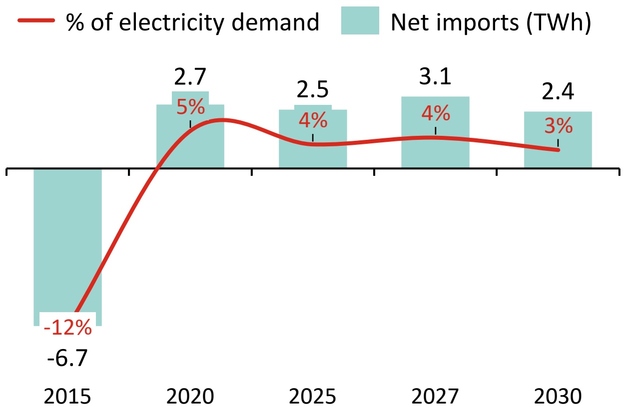
Source: E3M Primes model

Study Results – Electricity Supply (1/2)

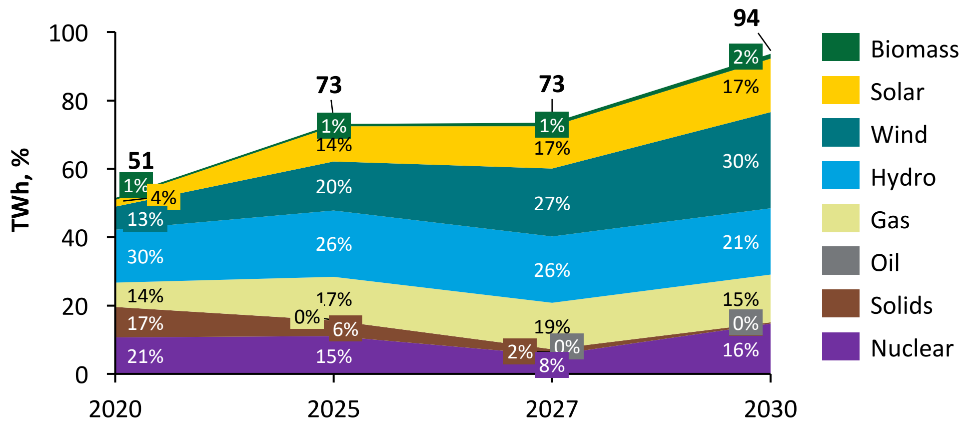
AS-IS SCENARIO – Generation Mix



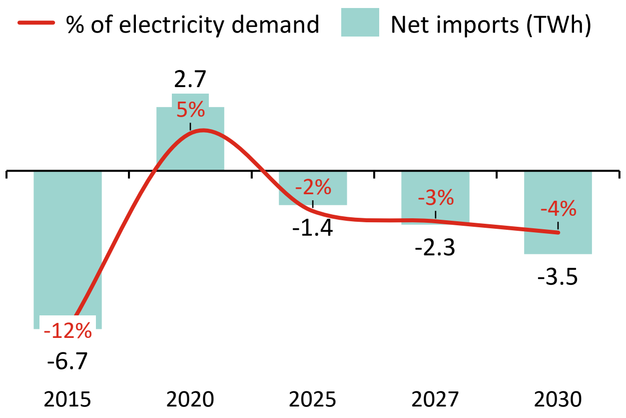
AS-IS SCENARIO – Net Imports



REPowerEU SCENARIO – Generation Mix



REPowerEU SCENARIO – Net Imports

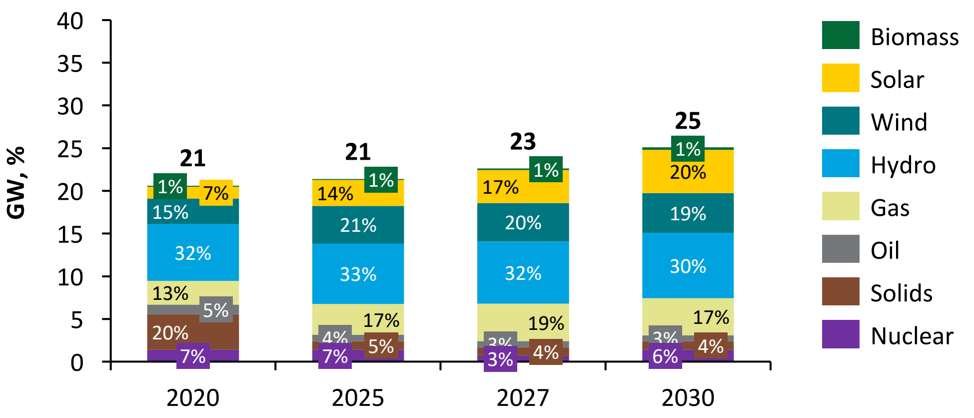


- In both scenarios, the increasing demand of electricity is driven mainly by investments in new RES and natural gas capacities, resulting in **increases of relative shares for Wind, Solar and Gas**
- If Romania follows the **REPowerEU** scenario setup, it will once again **become a net exporter of electricity**
- In the **As-Is** scenario, Romania would still **depend on electricity imports** to cover demand

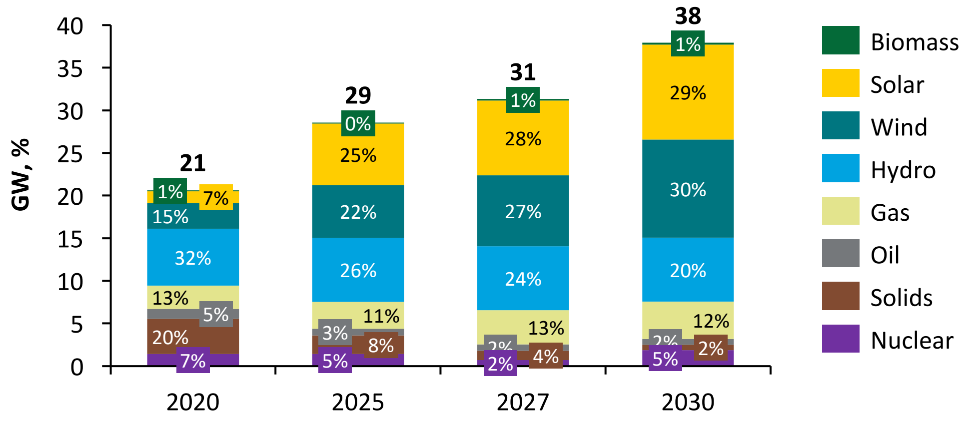
 Source: E3M Primes model

Study Results – Electricity Supply (2/2)

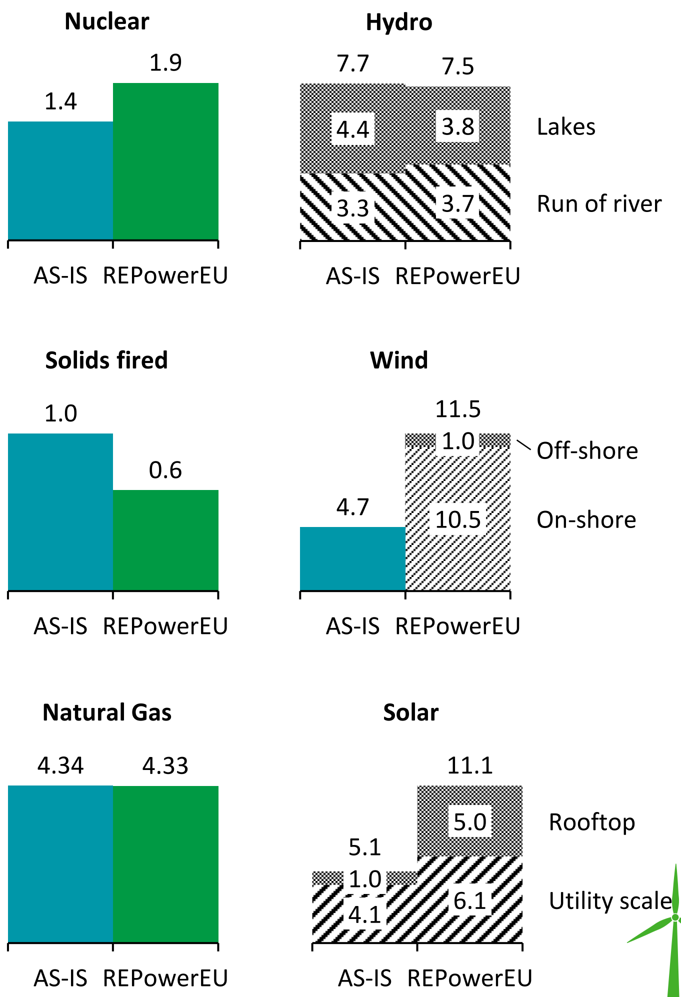
AS-IS SCENARIO – Operating Capacity



REPowerEU SCENARIO – Operating Capacity



SCENARIO COMPARISON 2030, GW



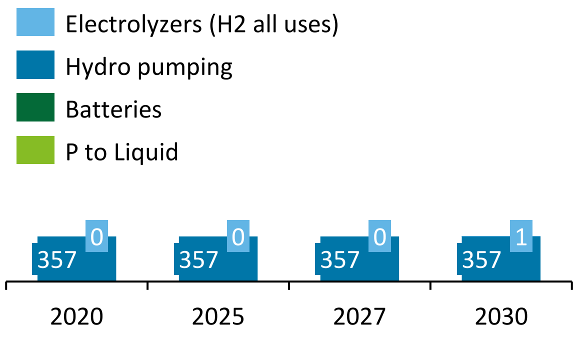
- New investments in CCGT units increases the weighted utilization rate of gas plants in both scenarios, paired with Black Sea natural gas extraction
- Coal / lignite capacities decrease by 76% and 85% (REPowerEU) 2020-2030. Coal-phase out requires additional natural gas to cover the demand for heat/steam
- No nuclear capacities commissioned by 2029 inclusively (except for reactor 1 modernization); reactor 3 commissioning expected no earlier than 2030
- Note the high uptake of Wind (emerging off-shore) and Solar (rooftop) in REPowerEU vs As-Is 2030

 Source: E3M Primes model

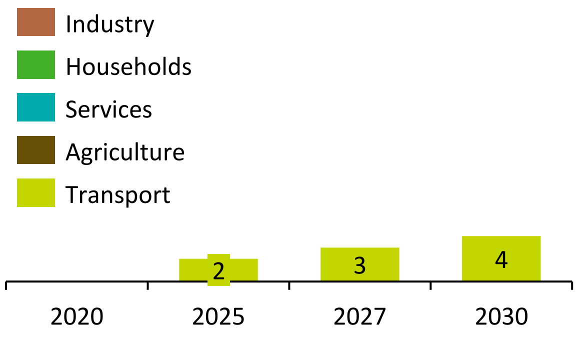
Study Results – Storage Capacities & P2X

AS-IS SCENARIO

Installed Capacity of Storage and Fuel Production *(MW-elec or MW-output fuel)*

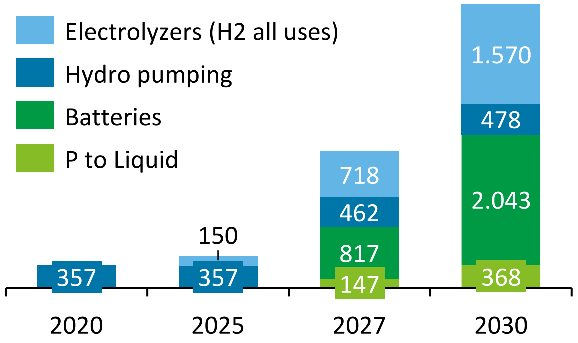


Final Energy Demand of P2X *(GWh-fuel)*

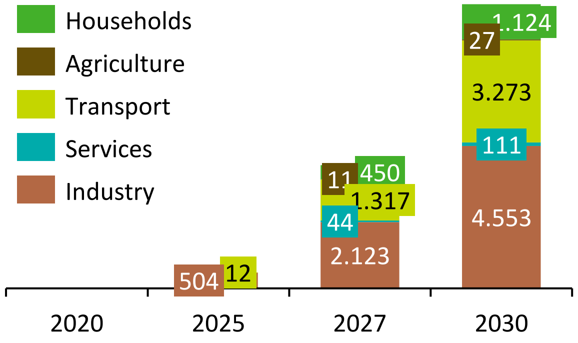


REPowerEU SCENARIO

Installed Capacity of Storage and Fuel Production *(MW-elec or MW-output fuel)*



Final Energy Demand of P2X *(GWh-fuel)*



- The **As-Is scenario** does not foresee mainstream uptake of storage capacities and P2X demand, whereas the **REPowerEU scenario** assumes great uptake of battery storage and electrolyzers for H_2 production
- Battery storage becomes key to ensuring grid balance
- Final Energy Demand in transport in the REPowerEU scenario is mainly comprised of H_2 (10%) and clean hydrocarbons (i.e. synthetic (P2X) Gasoline, Kerosene and Fuel Oil)

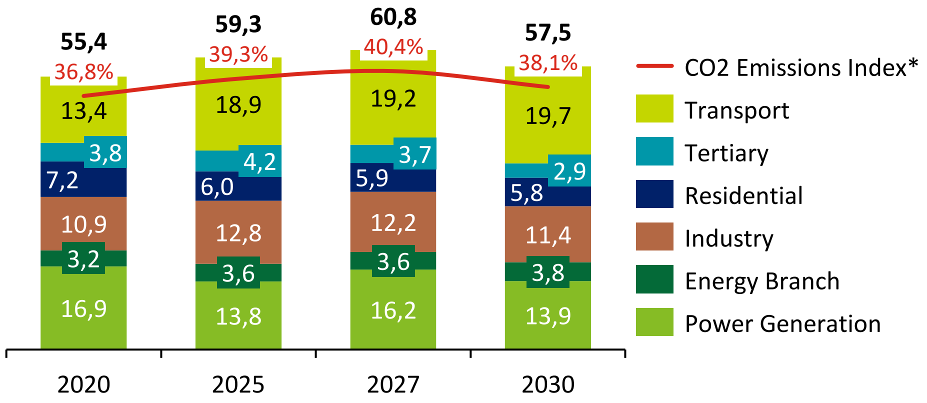
 Source: E3M Primes model

Study Results – Renewables Shares

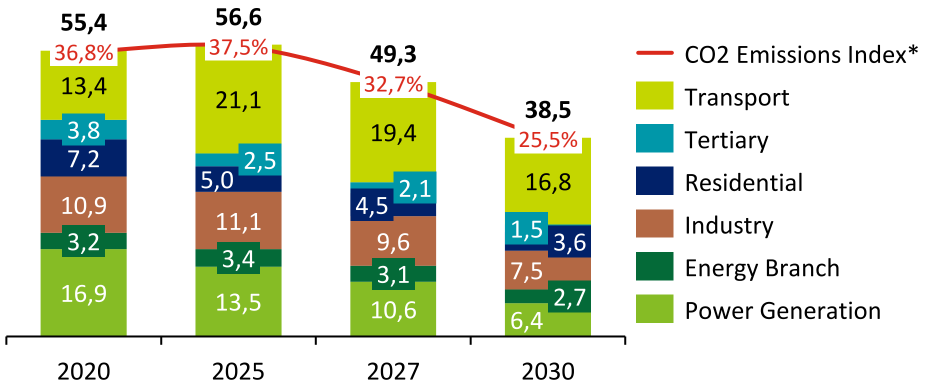
2030 RES Projections, %

	AS-IS	REPowerEU
Overall RES	**31.7%**	**44.4%**
RES-H&C	33.5%	47.3%
RES-E	51.7%	66.9%
RES-T	14.7%	24.6%
RFNBO in Transport	0%	5.4%
RFNBO in Industry	0%	50.5%

AS-IS SCENARIO Emissions (Mt CO_2)



REPowerEU SCENARIO Emissions (Mt CO_2)



*) Refers to the CO2 emissions % compared to 1990 (1900=100)

- Overall RES share growth is significant in the **REPowerEU** scenario, thus reaching EU intended targets. Penetration of mainly Solar and Wind capacities is a key driver in this evolution
- The **As-Is scenario** shows moderate increase, but higher than NECP target
- The higher RES share of the **REPowerEU scenario** is directly related to the lower emissions figures 2020 vs 2030 – the transport sector is the only sector with higher emissions, mainly due to increasing activity

Source: E3M Primes model

Key takeaways

NECP update by 2024

- Upcoming NECP update should follow REPowerEU targets

- Communication & consultation

- Integrate with other strategies (LTS, H_2, mitigation & adaptation, biodiversity)

- Intergovernmental approach & governance

Taxation & Incentives

- Enable merchant based projects
- Competitive state aid

- Support investments through taxation and incentives

- Build value chain & industrial ecosystems around new investments

- Ecosystem mapping and value chain creation in Romania

Legal Framework

- Permitting
- Enable Fit for 55 framework
- Predictable

- Fast permitting
- Smart transposition and implementation of Fit For 55

Study Context & Objectives

Study context

The energy sector was significantly affected by the pandemic and by recent geopolitical challenges, therefore EU and national strategies evolved, increasing ambitions related to decarbonisation and renewables transition

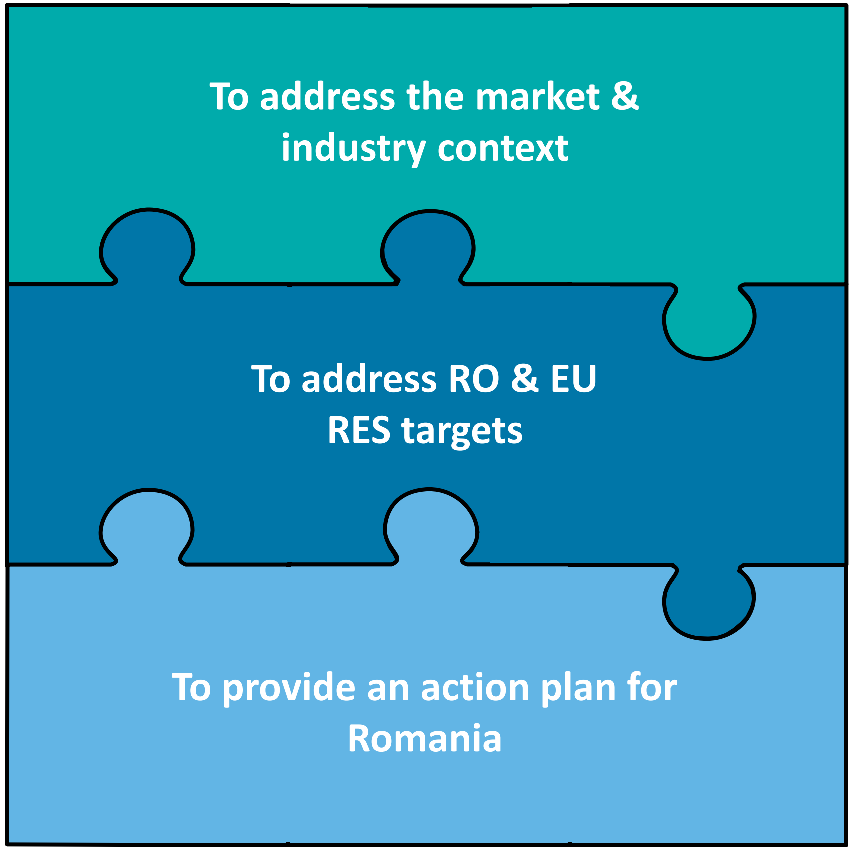
Study rationale

- A scenario-based study was necessary to highlight the outlook of the Romanian energy sector, based on current national strategies versus an ideal path that ensures the Romanian energy sector follows EU strategies and fulfils EU targets & obligations

Energy market developments

- The global pandemic of COVID-19 and related lockdowns have created supply and demand shocks in the fuels markets, resulting in supply bottlenecks; EU's response was the Next Generation EU Plan which in turn was designed to support the Fit for 55 package, which aimed a minimum 55% reduction of net greenhouse gas emissions by 2030
- The invasion of Ukraine in February 2022 determined EU Member States to reduce their energy imports from the Russian Federation, driving prices of commodities higher and highlighting the fact that EU needs to decrease its dependency of imports; as such, the Commission has proposed the REPowerEU, which builds on Fit for 55 and aims to increase the velocity of EU's decarbonisation

Study objectives



Study context – Policy & targets

The latest version of the Renewable Energy Directive (RED III) provides for higher RES targets across all sectors

- REPowerEU scenario follows RED III targets. Should the scenario transform into reality (not only in Romania, but also in EU and worldwide), the following narrative will apply:
- Driven by EU stimulus, sector coupling has been successful. Public and private investments into renewable energy technologies and smart infrastructure have brought down the cost for these technologies, which led to a widespread adoption of renewables as an energy source for electricity generation and green hydrogen production. Political consensus and customer involvement in providing flexibility from the demand side has enhanced the coordination across the European power grid. Targets assumed through RED III were met (see table with currently agreed upon targets).
- On the market side, incentives for the supply of energy, capacity and system services are established. All in all, this concerted European effort led to the Union meeting the 2050 climate goals.

		RED II	**RED III**
	Status	In force	Council & Parliament
Overarching EU target		**32%** (cumulative impact of all NECPs: 33.1-33.7% RES share)	**42.5%** + 2.5% indicative top up
RES-E		Not specified by RED. Each country decides to use RES-E to close the whole gap to overarching target or do more in RES-H&C and RES-T than specified by RED.	
RES-H&C	**H&C– overall**	Indicative +1.3 p.p./a (baseline RES H&C 2020); Indicative +1.1 p.p./a for MS not using waste H&C	**+0.8 p.p./a** (2021-25), **+1.1 p.p./a** (2026-30) binding, with indicative top-ups for MS
	District H&C	+1.0 p.p./a (baseline RES H&C 2020) avg. for 2021-2025 and for 2026-2030	+1.3 p.p./a (baseline RES H&C 2020) avg. for 2021-2025 and for 2026-2030
RES-T	**Transport Fuels**	RES share target: 14%	GHG intensity **-14.5%** (or **29%** RES share)
	2nd Gen. biofuels sub-target	3.5% with double-counting	**5.5%** with double-counting
	RFNBO in transport	Not specified	**5.5%** binding Minimum 1% of RFNBOs
Buildings (NEW)	**Overall share**	Not specified	**49%** indicative RES share
Industry (NEW)	**Overall share**	Not specified	**+1.6 p.p./a** indicative
	RFNBO in industry	Not specified	**42%** in 2030 **60%** in 2035

Study context – Policy & measures

To achieve targets, specific measures need to be implemented immediately, such as faster permitting

REPowerEU main implications & measures

- EU considers that permitting for new renewable energy projects must be streamlined. As such, the Council adopted Council Regulation (EU) 2022/2577 of 22 December 2022 laying down a framework to accelerate the deployment of renewable energy. It aims to accelerate permit-obtaining processes. It entered into force on 30 December 2022 and is applicable for 18 months from the entry into force with a review clause in order to extend its validity if necessary. The Regulation states that renewables projects should be presumed to be "in the overriding public interest". Examples of tightened deadlines include maximum 6 months for repowering renewable energy projects, maximum 3 months for solar energy equipment and co-located energy storage assets and maximum 1 month for the installation of solar energy equipment (including renewables self-consumers) with a capacity of 50KW or less.
- Solar energy also receives more attention and improvements with the EU solar strategy proposed under REPowerEU. The strategy proposes three main initiatives: (1) the European Solar Rooftops Initiative – aiming to accelerate the underutilized potential of rooftops by e.g. gradually introducing the obligation to install solar energy in buildings, (2) the EU large-scale skills partnership – addressing the skills gap in the workforce in the solar energy sector and (3) the EU Solar PV Industry Alliance – aiming to provide a forum for stakeholders in the sector
- The Commission promises to support Member States to aggregate public resources via potential Important Projects of Common European Interest (IPCEI) in order to promote innovation along wind, heat pumps and solar value chains
- The REPowerEU plan proposes to increase the headline target of the Energy Efficiency Directive from 9% to 13% reduction of energy use compared to the baseline scenario in 2030
- Additionally, the Commission introduced a proposal for a gradual solar rooftop obligation (installing solar panels on buildings)

Study context – Technology costs

Cost-competitive renewables are leading the pathway to net zero

Global weighted average total installed costs per technology, EUR/kW

	Solar PV	On-shore wind
2010	4,065	1,727
2020	767	1,140
2021	725	1,120
2021 vs. 2020	↘-3%	↘-2%
2021 vs. 2010	↘-82%	↘-35%

Note: Exchange Rate EUR/USD: 1.1827

- The global weighted average cost of newly commissioned solar PV and onshore wind projects fell in 2021. This was despite rising material and equipment costs as there is a significant delay in the transition to total installed costs
- The 2010 – 2021 period has witnessed an increase in the competitiveness of renewables. Cost-competitive renewables provides the most compelling path to decarbonizing the future global energy system and achieving the 1.5°C target
- Increasing competitiveness, and thus price pressure, has been far greater in the global PV market than in on-shore wind for the past decade. PV module costs have driven the overall reduction in average total installed costs by 82% reaching 725 EUR/kW in 2021
- The weighted average total installed cost for on-shore wind fell by 35%, from 1,727 EUR/kW in 2010 to 1,120 EUR/kW in 2021, driven by wind turbines costs reduction and technology improvements

Source: IRENA Renewable Technology Innovation Indicators 2022 Report, IRENA 2022 Report regarding Renewable Power Generation Costs in 2021

Study objectives

The Study aims to inform industry stakeholders not only on the challenges of achieving the targets, but also on the potential that Romania needs to unlock in order benefit from the energy transition

The objectives of the Study

To address the market & industry context

- Considers current market and industry drivers, including carbon pricing, energy supply pressures, current generation mix, latest policy implications
- Responds to industry needs and growth strategies

To address RO & EU RES targets

- Provides 2030 projections based on current path assumed by Romania
- Highlights the gap that Romania will have to close in order to reach REPowerEU targets: **45% RES at EU level**

To provide an action plan for Romania

- Aims to raise awareness among authorities and industry leaders on key investment areas
- Outlines necessary policies and initiatives for closing the gap

Methodological Approach

Methodological Approach

The study assumed a tailored methodology that enabled developing a robust renewables roadmap with a 2030 horizon

	Approach	Deliverables
1. Objectives alignment & project launch	• Assess initial assumptions & inputs based on 2030 NECP guidelines & targets • Align on main objectives & hypotheses the modelling process should focus on, in line with the EGD targets, elaborate & align on necessary changes & variables to be considered in the modelling process	• Confirmed project scope and objectives • Finalized team structure • Scheduled steering committee meetings & jour fixe • Detailed work and project communication plans (including precise timeline)
2. Data collection & scenarios modelling	• Collect all relevant data for scenarios modelling, run the modelling process, based on approved assumptions, developing two different RES Roadmap scenarios; • Assess scenarios based on CBA & potential impact, align upon main indicators to be highlighted, interpreting the results	• RES target scenarios • Cost-benefit analyses and impact assessments • Optimum scenario outcomes
3. Elaborate policies and measures	• Identify main technical, legislative and regulatory barriers that need to be overcome for enabling the transition towards reaching an increased RES share • Elaborate a comprehensive package of policies and measures that are designed to facilitate the increase of the RES share	• Comprehensive package of policies and measures
4. Final report validation and results presentation	• Elaborate updated “RES in Romania: Roadmap to 2030” report, validate in Steering Committee, present main result of re-modelling process to internal stakeholders, obtain & integrate feedback • Hold keynote presentation of the methodology and main findings	• Updated “RES in Romania: Roadmap to 2030” report (EN) • Executive summary of the report (EN and RO) • Keynote presentation of the methodology and main findings (EN and RO)

Data collection & scenario modelling

The PRIMES model enabled the Study to deliver rich perspectives on the future of Renewables in Romania

Modelling process activities

A. Collect all relevant data for the scenarios modelling, such as global trends in new technologies and RES costs, most recent EU policy and developments in the energy sector, theoretical RES potential in Romania, electricity demand evolution towards 2030 and impact of COVID-19 on energy consumption, an updated new capacity potential for 2030, cost-benefit analysis of available options, updated EU and National environmental goals for 2030 and 2050

B. Run the modelling process for developing **two different RES roadmap scenarios** starting from Romania's reference energy use growth scenario for 2030 (NECP) and new EU emissions' reduction targets for 2030, using the **PRIMES energy system assessment tool**. Outputs include: Total Final Energy consumption, Electricity Demand, Generation Mix, Fuel input in Power Generation, Net Imports, Operating Capacity, Capacity Investments, Heat-Steam Demand, Electricity Prices, RES Shares and Emissions

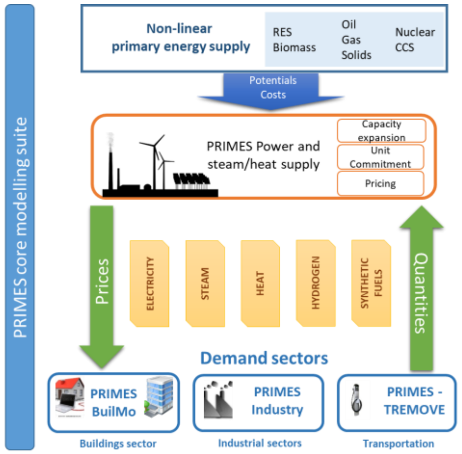
C. Assess the opportunities created by the three indicative benchmark years (2023, 2025, 2027) and the associated intermediary targets

D. Evaluate the defined RES scenarios by elaborating an updated socio-economic & environmental impact assessment, focusing on: 1) Economic and social impacts of an increased share of renewables, including job growth and 2) Environmental impact of an increased share of renewables in terms of reducing carbon footprint of electricity production in Romania and mitigating harmful air pollutants based on agreed baselined pollution emission / country specific emission factors

E. Align upon the main indicators to be highlighted in the final report and final presentation

Overview of the PRIMES Model

The PRIMES energy system model represents all demand and supply sectors in separate modules.



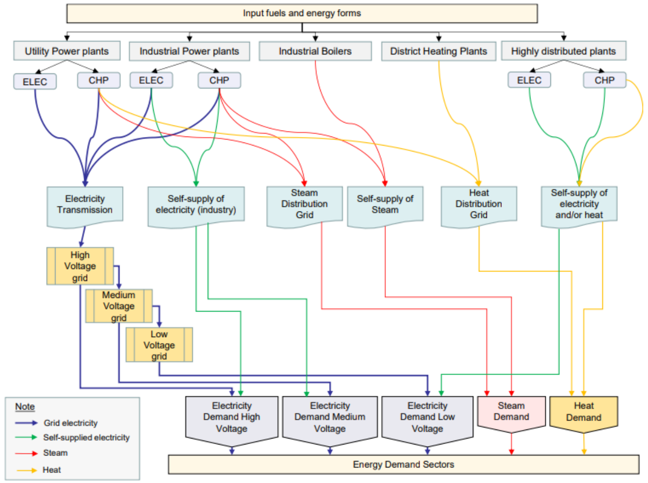
Temporal resolution: to 2070, in 5-year steps

Geographic resolution: EU27+UK+10 European non-EU countries

Mathematically: concatenation of mixed-complementarity problems with equilibrium conditions and overall constraints (e.g. carbon constraint with associated shadow carbon value)

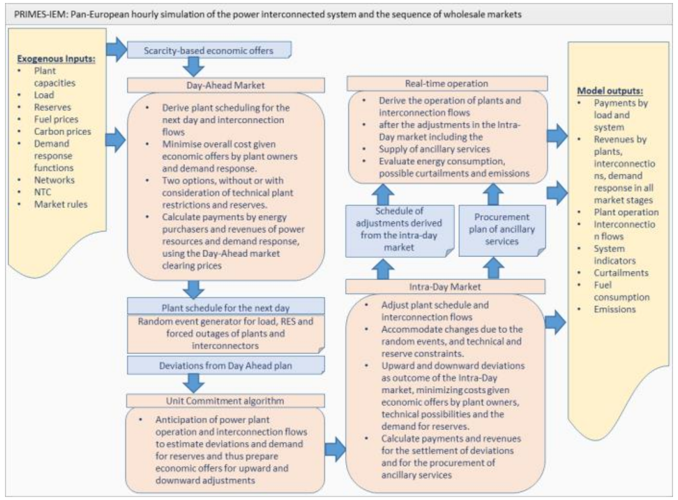
PRIMES Power & Heat Model

It is a stylized network for handling demand, supply and exchanges of power, heat and steam simultaneously



PRIMES Internal Electricity Market Model

Simulates the sequence of wholesale markets at a pan-European scale, together with power exchange flows



Scenarios used in modelling

Two scenarios have been developed to highlight the impact of REPowerEU on the Romanian renewables industry

The "As-Is" Scenario

- **Models the Romanian energy sector up to 2030** based on the known policies, measures and RES targets of the NECP, as well as known funding sources such the Recovery & Resilience Plan, also assuming the continuation of policies that stimulate the decarbonisation of the economy
- **Considers the evolution of the power Generation Mix** based on current available capacities and known development plans (e.g. CE Oltenia, Nuclearelectrica, Hidroelectrica); includes a realistic take on the feasibility of implementing capacity development projects by 2030

Main baseline assumptions

- CO_2 pricing
- RES targets and RFNBO share in industry & transport
- Macroeconomic context and energy prices (past and projections)
- RO installed generation capacities
- EU and RO energy strategy & policy framework

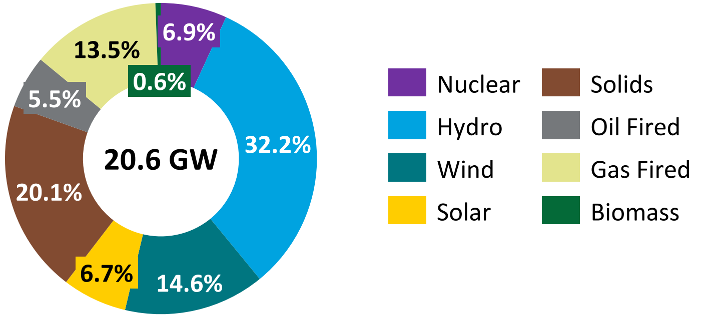
The "REPowerEU" Scenario

- **A top-down accelerated policy Scenario to 2030** in which the Generation Mix is modeled as per the needs for achieving the overall RES target for Romania based on the more ambitious REPowerEU targets (amending FitFor55 targets)
- **Broadly aligned with the MIX Scenario** of the EU's FitFor55 package (with increased targets) and revisions of the RED III Directive
- **Compares the results with the "As-Is" Scenario** in order to identify and analyze the gaps to 2030 in terms of installed capacity, GHG emissions reduction, required investments and RES share

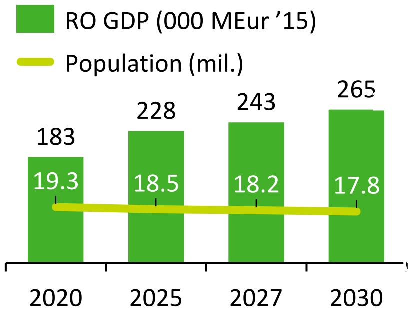
Main Assumptions & Drivers

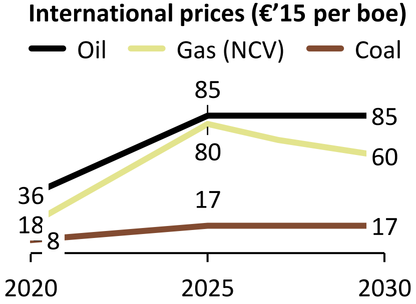
Significant developments in RES have taken place in the last years, mainly driven by policy and available funding

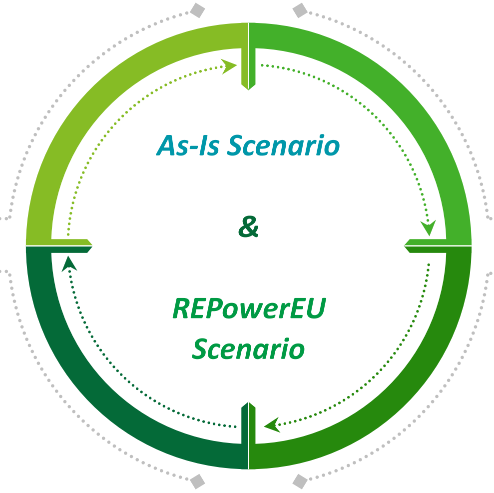
Installed capacities, 2020



Economic Context







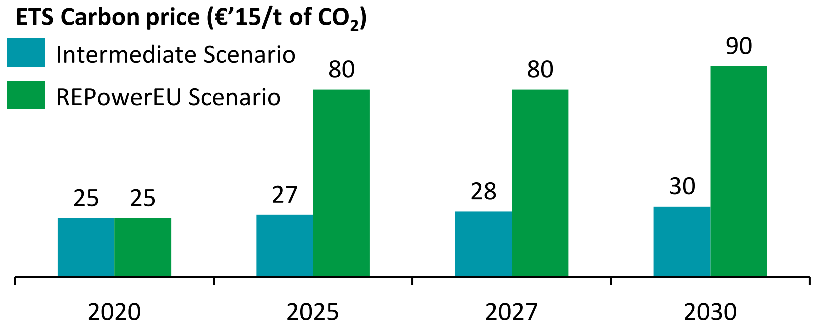
Policies & Targets

	RO NECP	REPowerEU / RED III
RES 2030	**30.7%**	**45% ***
RES-E	49%	Set based on other RES
RES-T	14%	≈29% 5% RFNBO
RES-H&C	33%	+1.3 p.p./a

- No additional nuclear is considered by 2029
- Gas & Hydro power evolution based on known plans (2022)
- Coal-based capacities evolution based on CEO Restructuring Plan
- Wind & Solar develop to cover electricity demand

* 42.5% target plus 2.5% top-up

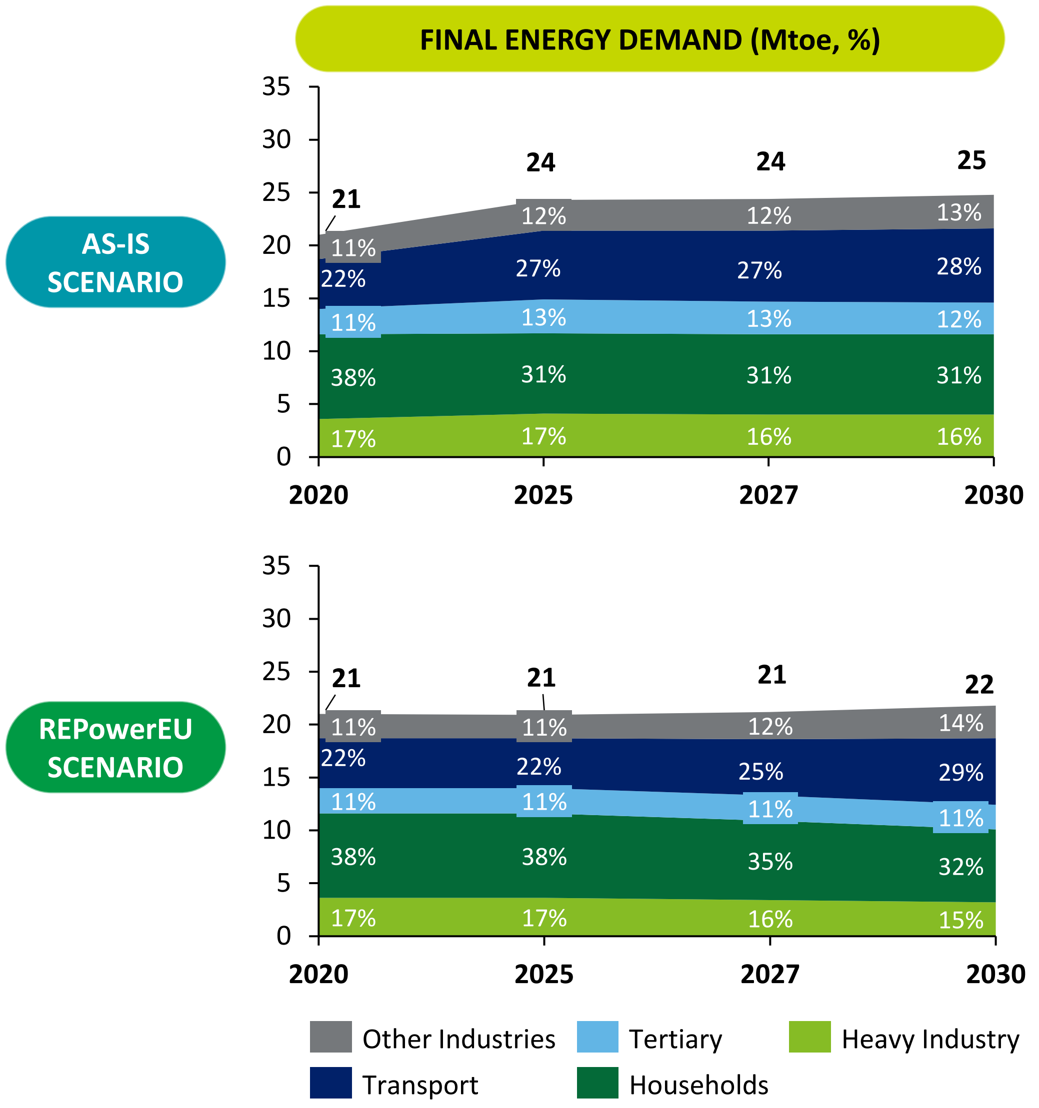
Carbon Pricing

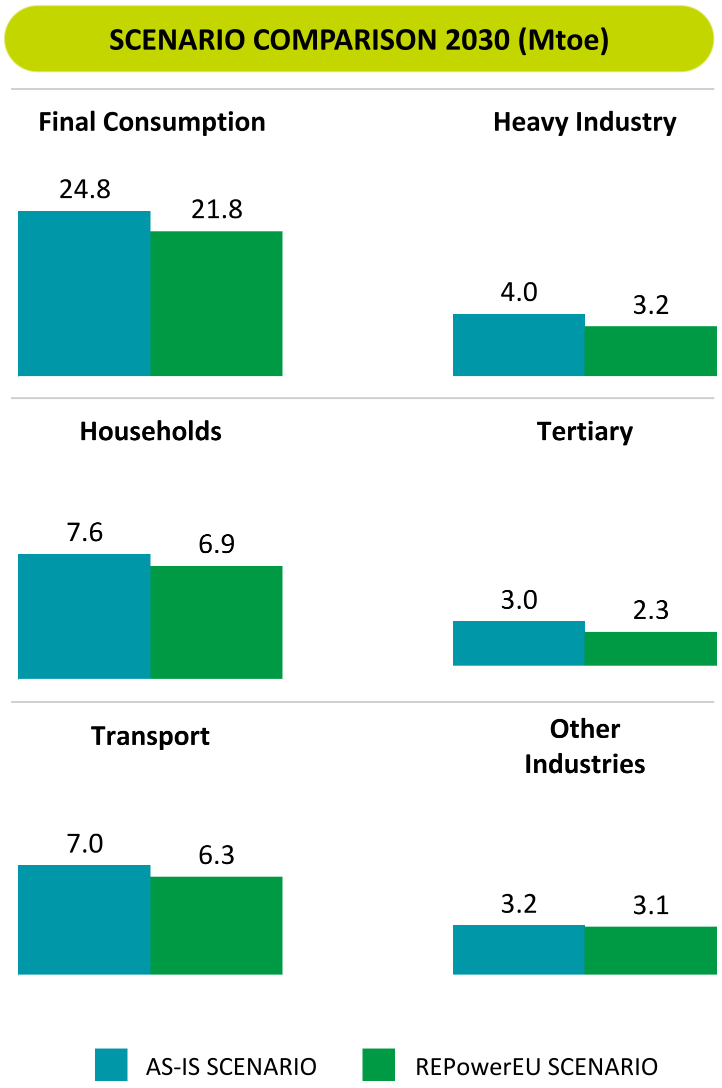


Source: ANRE, NECP, EU Commission, E3M Primes model

Scenario Results & Comparative Analysis

Scenario Results – Total Final Energy Demand by Sector (1/2)



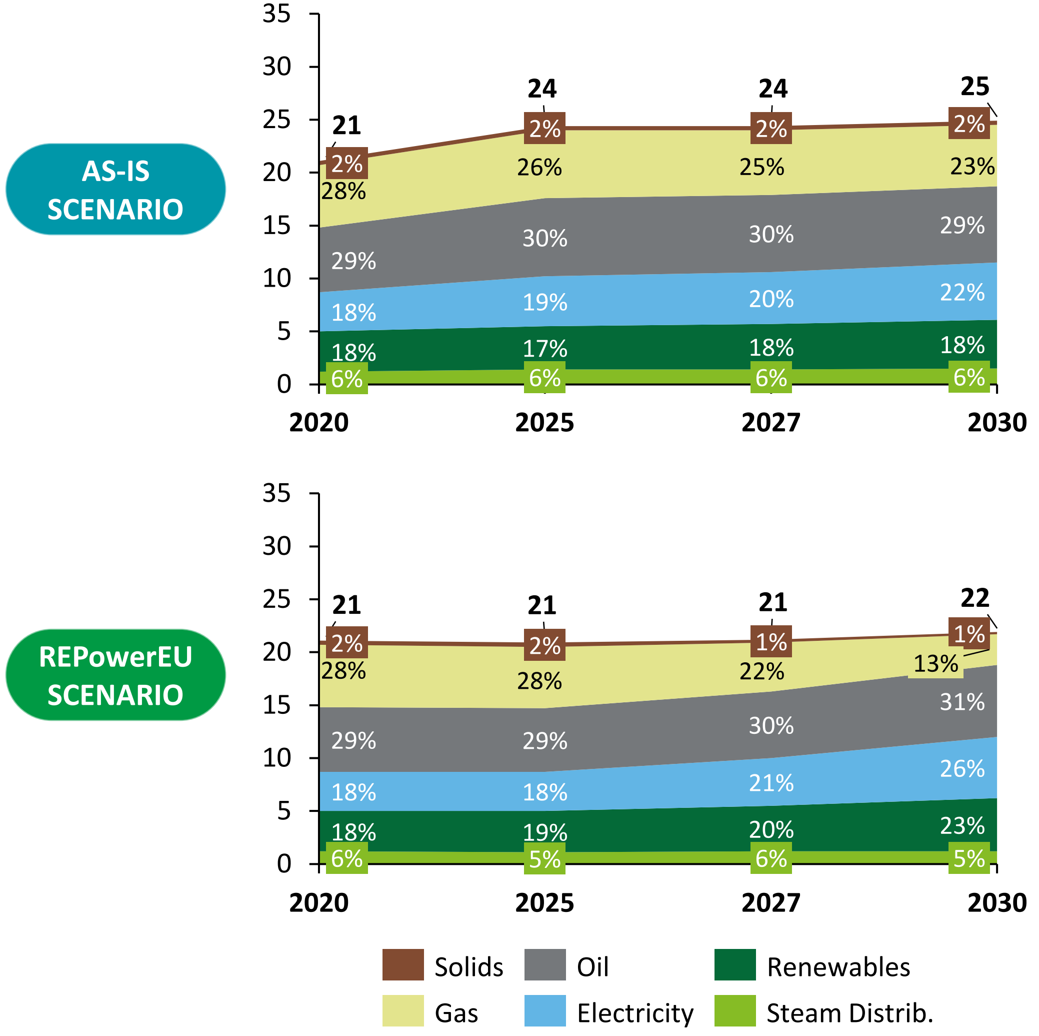


- **Overall final energy consumption is expected to be greater in 2030** in the As-Is Scenario (24.8 Mtoe) compared to the REPowerEU Scenario (21.8 Mtoe)
- Although economic grown is assumed to increase the same in both scenarios, **a stable final energy consumption in the REPowerEU Scenario results from investments in energy efficiency** measures across the economy
- **The most significant decrease in 2030**, between the 2 Scenarios, **is expected to occur in the Heavy Industry Sector** (0.8 Mtoe), whereas all other sectors decrease by approximately 0.7 Mtoe

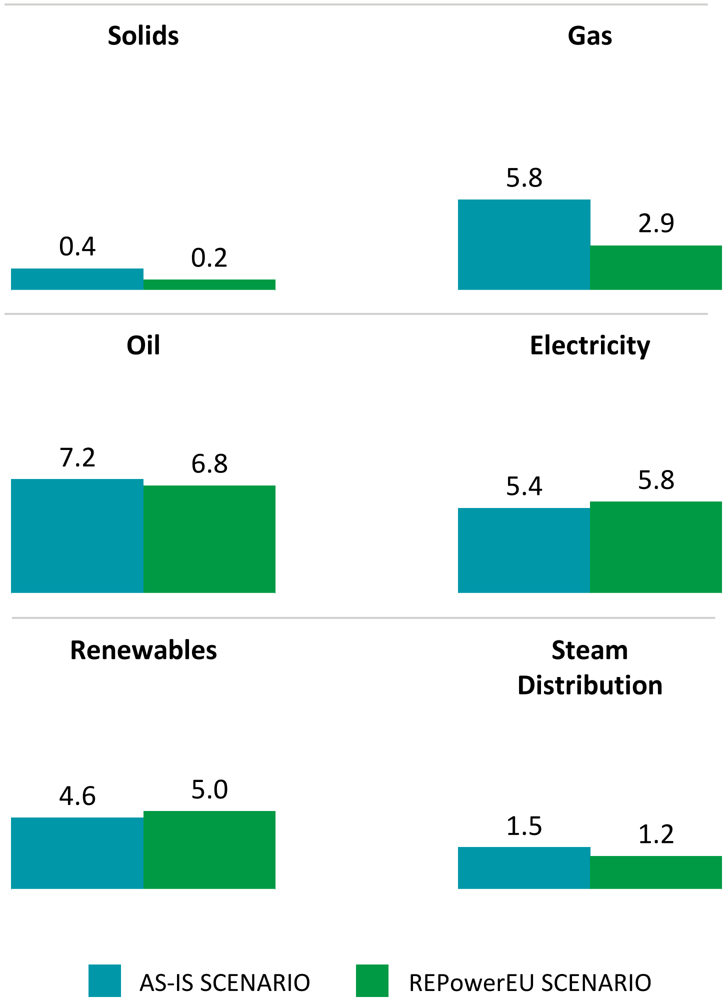
Source: E3M Primes model

Scenario Results – Total Final Energy Demand by Fuel Type (2/2)

FINAL ENERGY DEMAND (Mtoe, %)



SCENARIO COMPARISON 2030 (Mtoe)

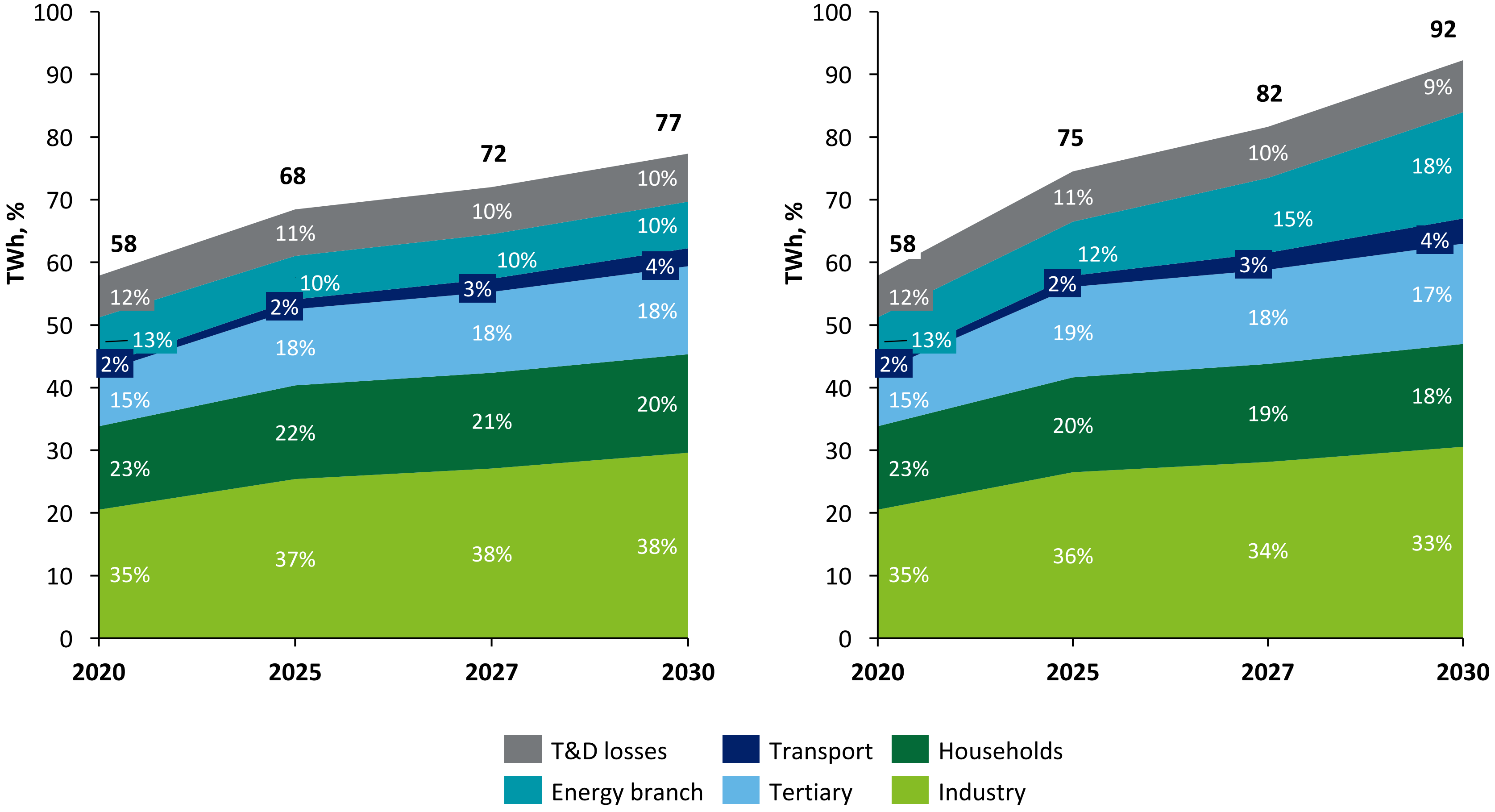


- Considering final energy consumption by fuel type, compared to the As-Is Scenario, **the REPowerEU Scenario shows less reliance on fossil fuels** (expressed in absolute values) **with considerably less on Natural Gas** by 2030 - a reduction of 2.9 Mtoe. This is in line with the overall objectives of the REPowerEU package.
- However, when expressed in % shares, the REPowerEU Scenario sees a slight increase in Oil, compensating for the decrease in Natural Gas share. On the other hand, **Electricity and Renewables shares are expected have a steeper growth** of 8% and 5% between 2020 and 2030 in the REPowerEU Scenario

Source: E3M Primes model

Scenario Results – Gross Electricity Demand (1/2)

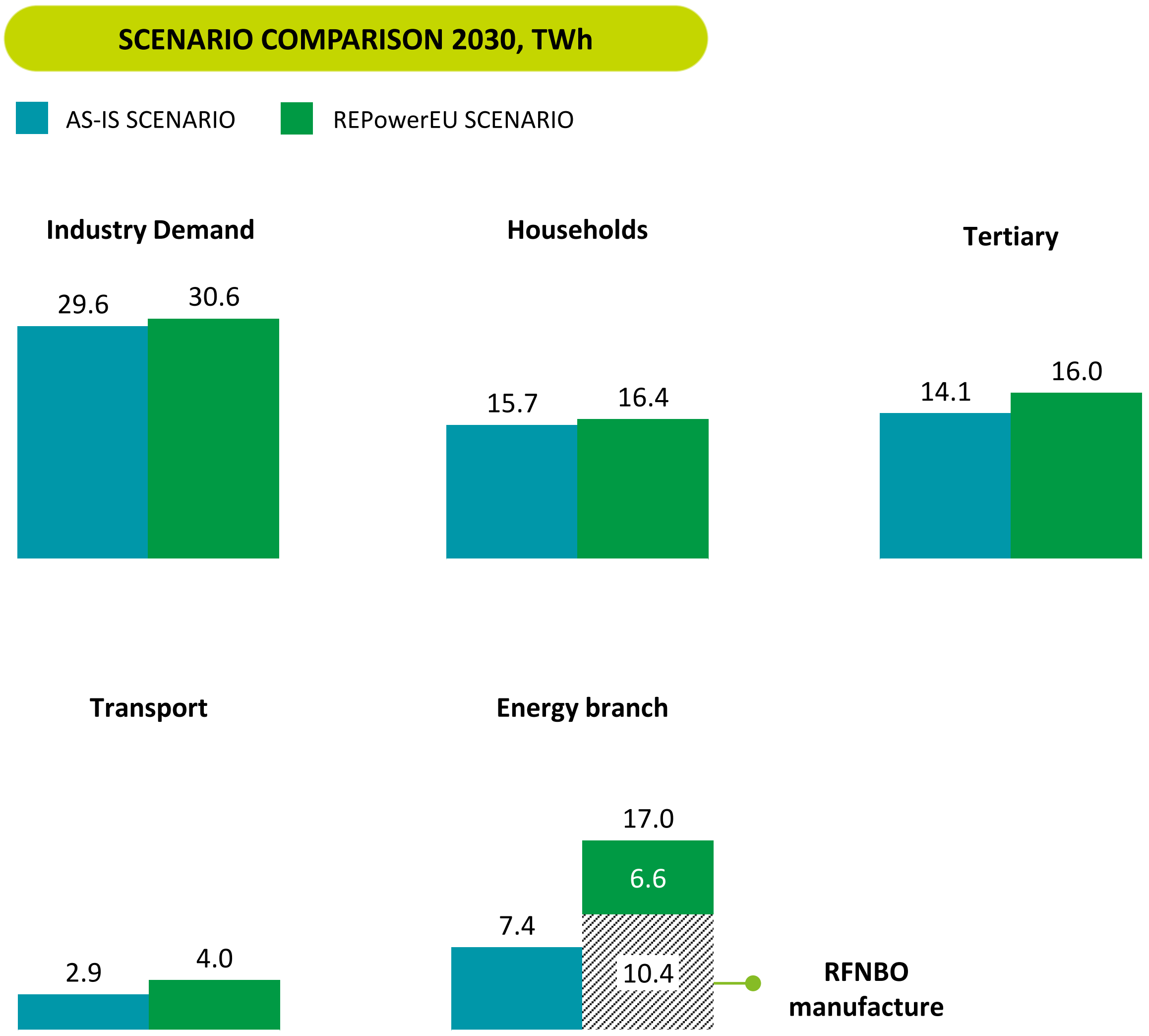
AS-IS SCENARIO – Gross Electricity Demand | **REPowerEU SCENARIO – Gross Electricity Demand**



- **Electricity demand is set to increase in both scenarios**, in line with projected economic context (+**60%** in 2030 vs. 2020 for the REPowerEU scenario)
- Based on the switch to a less carbon-intensive economy and the wider adoption of renewables, **electricity demand** is higher across all economic sectors in the REPowerEU scenario vs. the As-Is 2030: +**20% overall**
- Although not evident, **annual growth rates of electricity demand are highest in the Transport sector** (approx. +300% between 2020 and 2030 in the REPowerEU Scenario), followed by the Energy branch (+120%) mainly due to demand for RFNBO production

 Source: E3M Primes model

Scenario Results – Gross Electricity Demand (2/2)

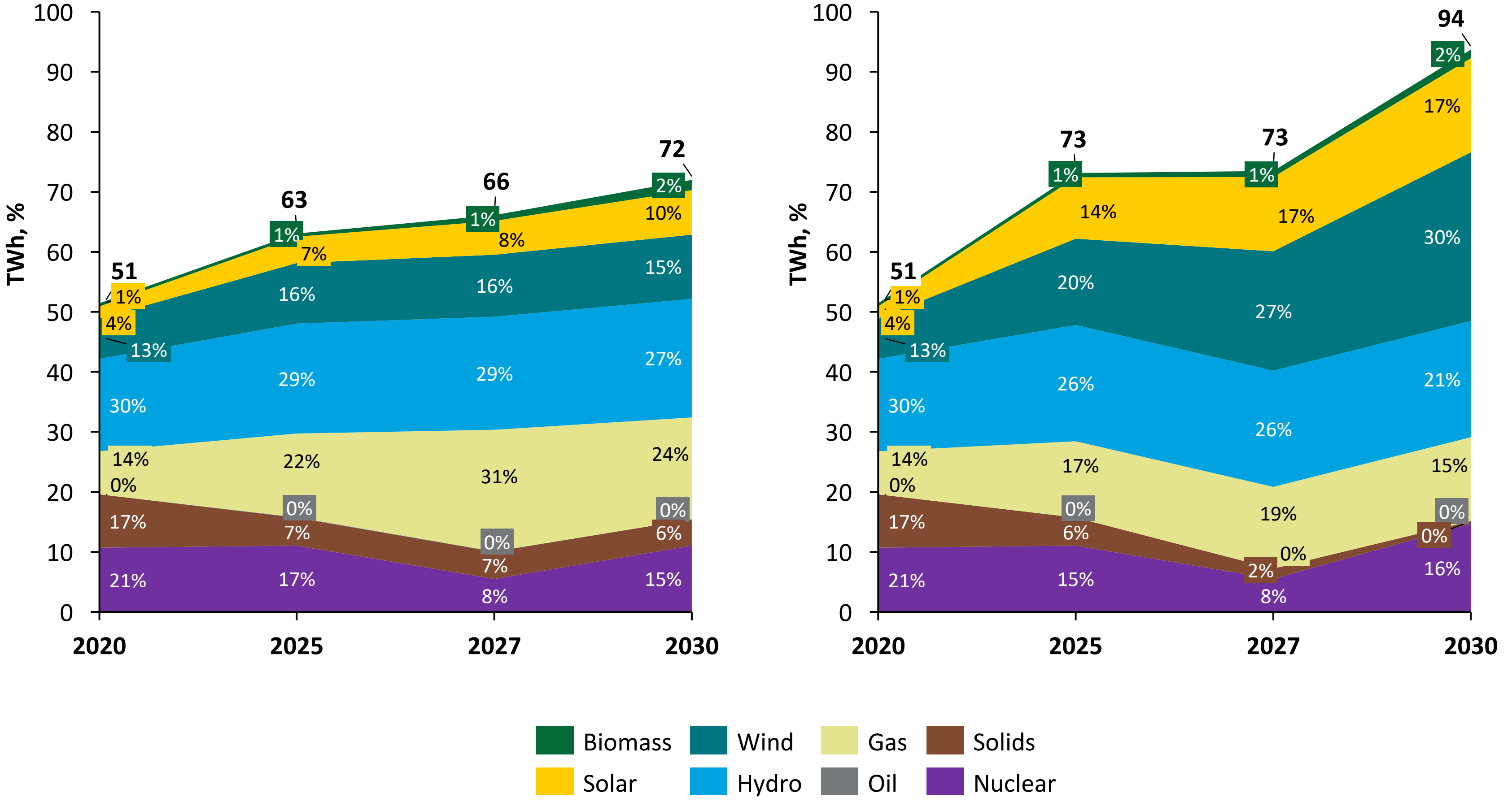


- **Key electricity demand difference results from consumption for RFNBO production** (H_2 electrolysis mainly) in the REPowerEU scenario (**+10 TWh);** considering standard capacity factors of renewables, this equates to an additional requirement of approx. **5.4 GW** of installed RES in 2030 in the REPowerEU scenario compared to the As-Is
- Green H_2 is a **key enabler for the decarbonisation** of hard-to-abate sectors, such us steel and aluminum smelting

Scenario Results – Electricity Supply (1/3)

AS-IS SCENARIO – Generation Mix

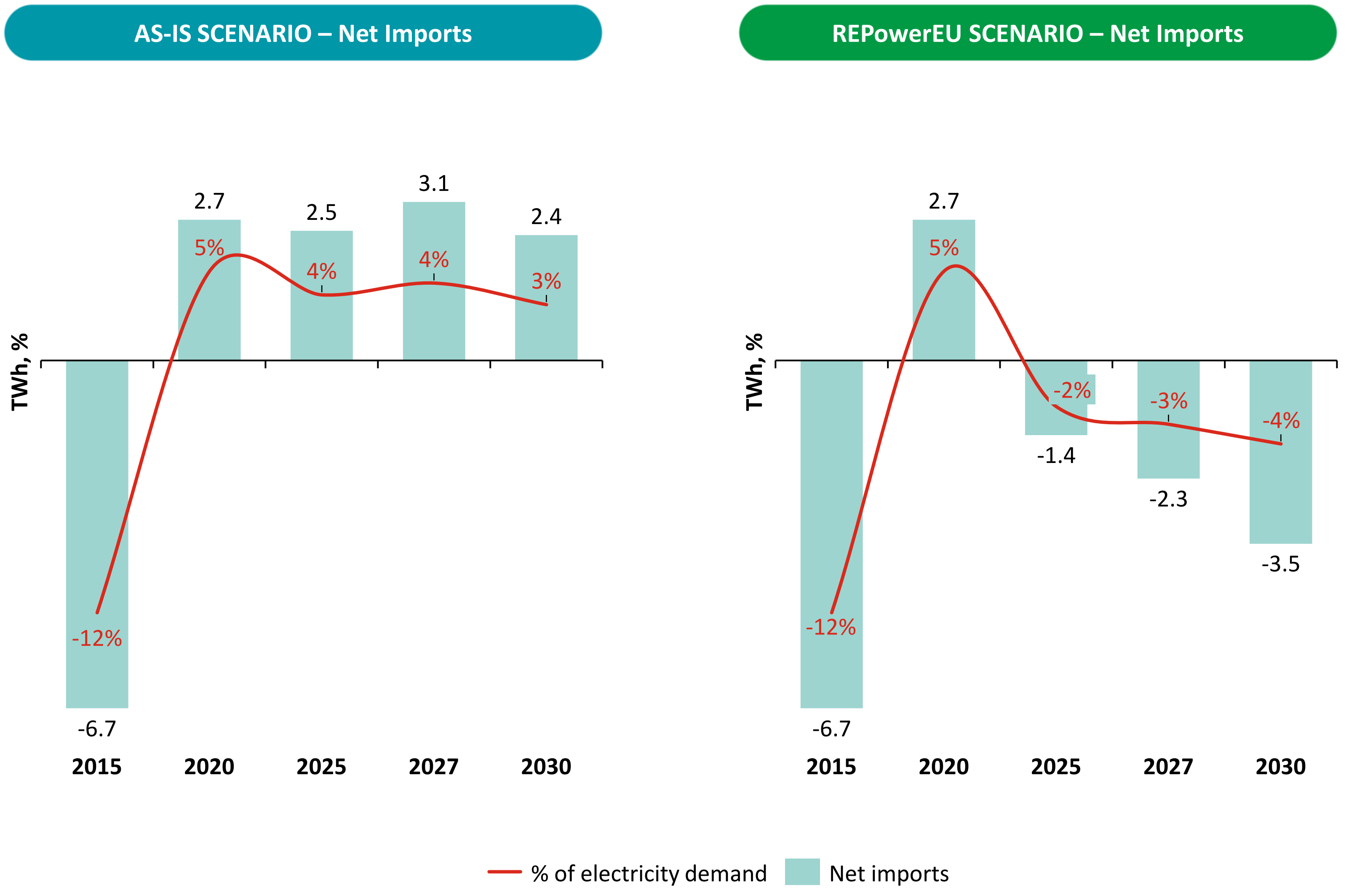
REPowerEU SCENARIO – Generation Mix



- In the As-is scenario, the increasing demand of electricity is covered mainly by investing in new RES and natural gas capacities. As such, the most significant **increases in the relative shares** are expected to be generated from **wind, solar and natural gas,** whilst hydro and natural gas will have the largest overall shares by 2030
- The **REPowerEU scenario** expects an exponential increase in the generation mix of **solar** (17% in 2030 from 4%) and **wind** (30% in 2030 from 13%) production capacities, compensating both the extra demand and the **wind-down of production from solid fuels** and a **stagnating share of natural gas**

 Source: E3M Primes model

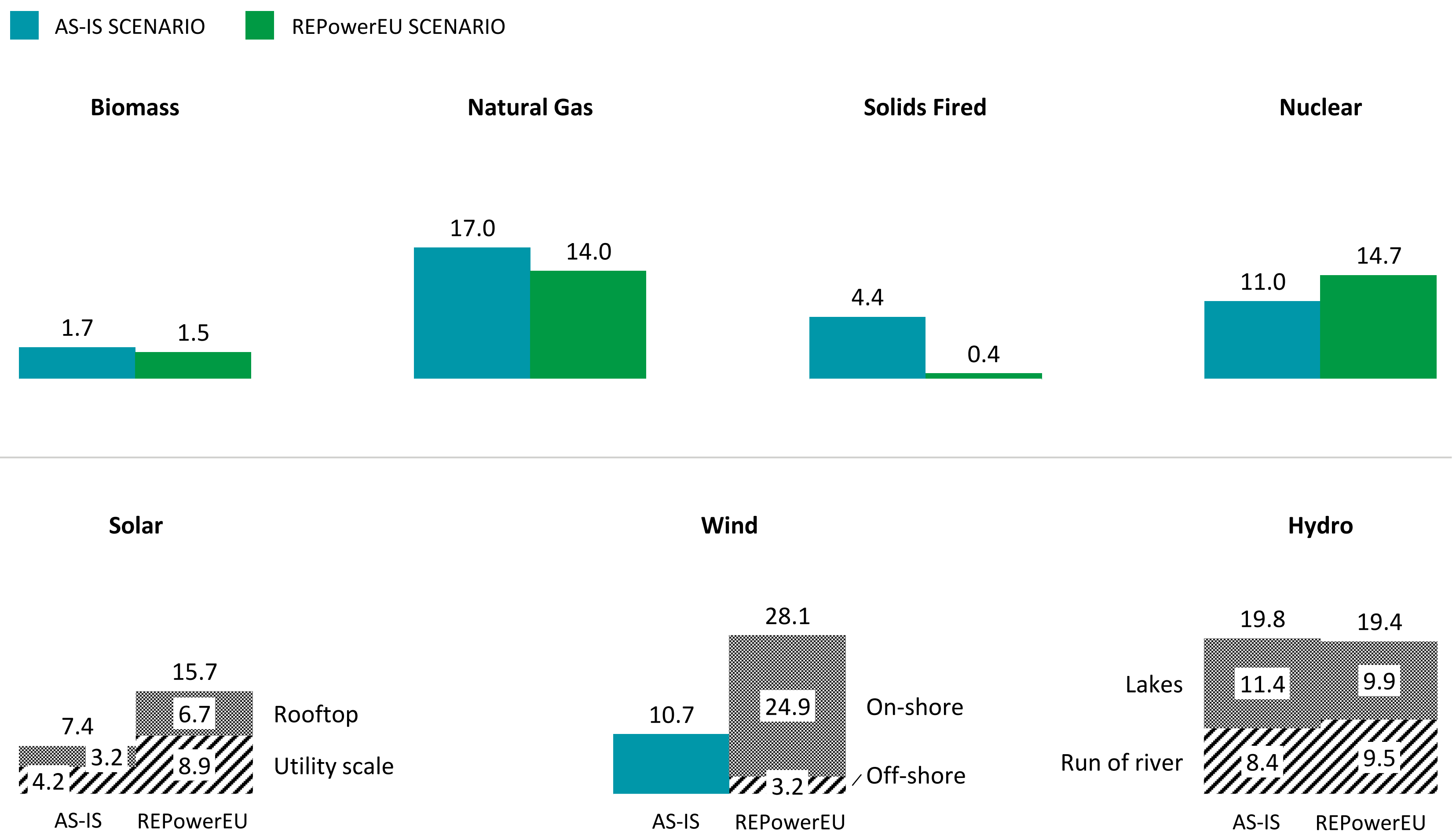
Scenario Results – Electricity Supply (2/3)



- **In the REPowerEU Scenario, Romania would, once again, become a net exporter of electricity before 2025**, following the early decade where demand can be covered only through net imports of electricity
- In the **As-Is** scenario, **Romania will maintain its reliance on electricity imports** to cover internal demand

Scenario Results – Electricity Supply (3/3)

SCENARIO COMPARISON 2030 – Generation Mix, TWh



- In the **REPowerEU scenario, solid fuels and natural gas have a smaller % share in the generation mix, being replaced mainly by solar and wind energy**; it is further assumed that Reactor 3 of the Cernavodă Nuclear Plant will be commissioned no earlier than 2030

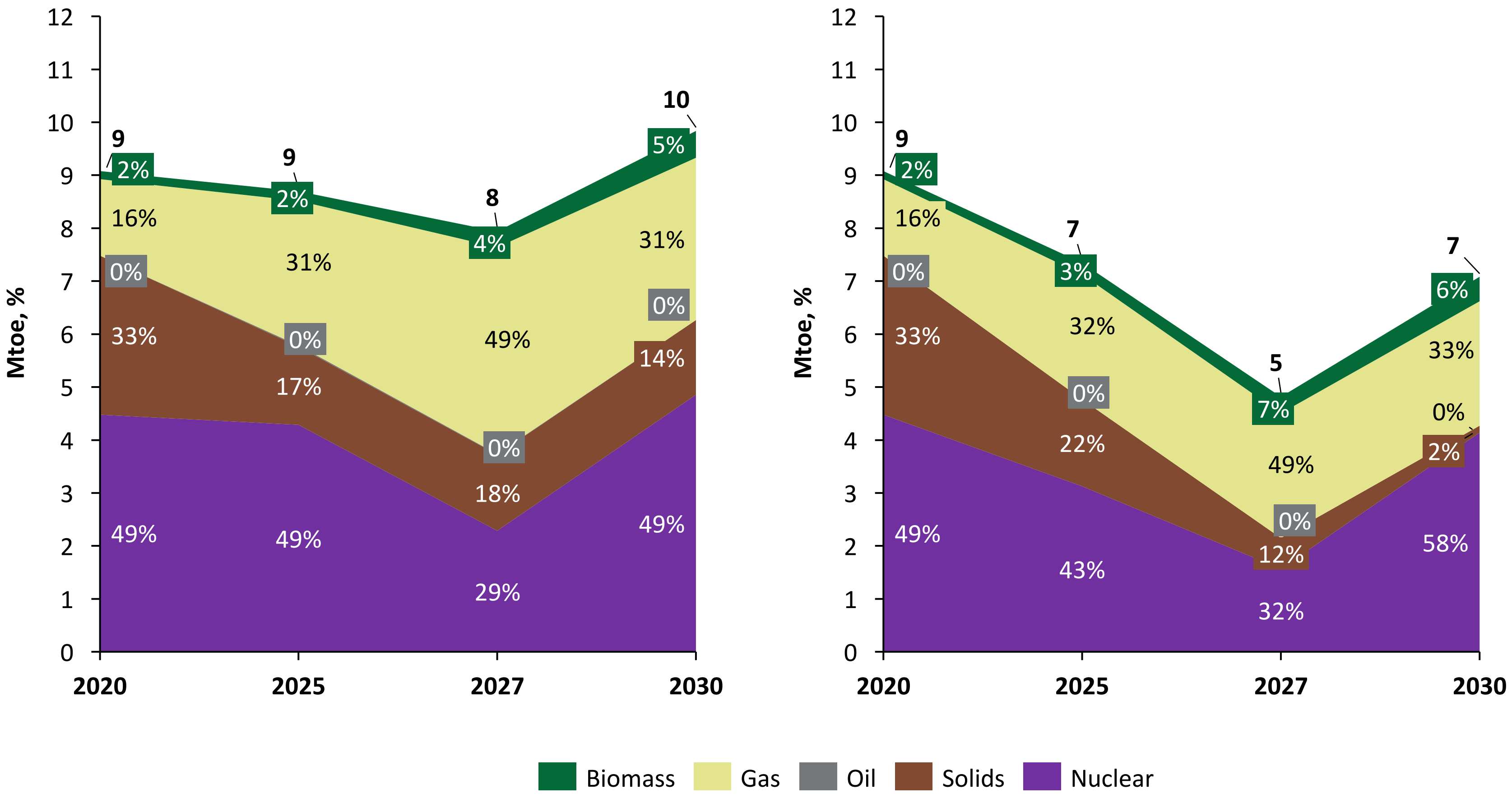
- Significant investments will be directed to renewables, leveraging the EU and national funding available and **doubling the output of solar** installations (notice upscale of Rooftop PV) **and tripling it for wind energy** (first off-shore wind projects are to be commissioned by 2030) in the REPowerEU scenario

Source: E3M Primes model

Scenario Results – Fuel input in power generation (1/2)

AS-IS SCENARIO

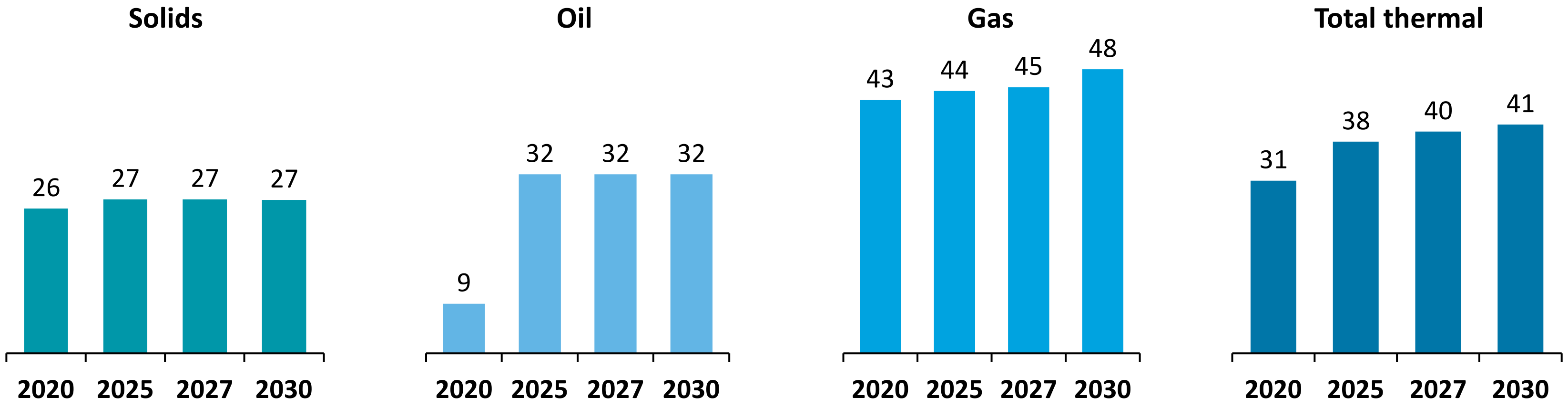
REPowerEU SCENARIO



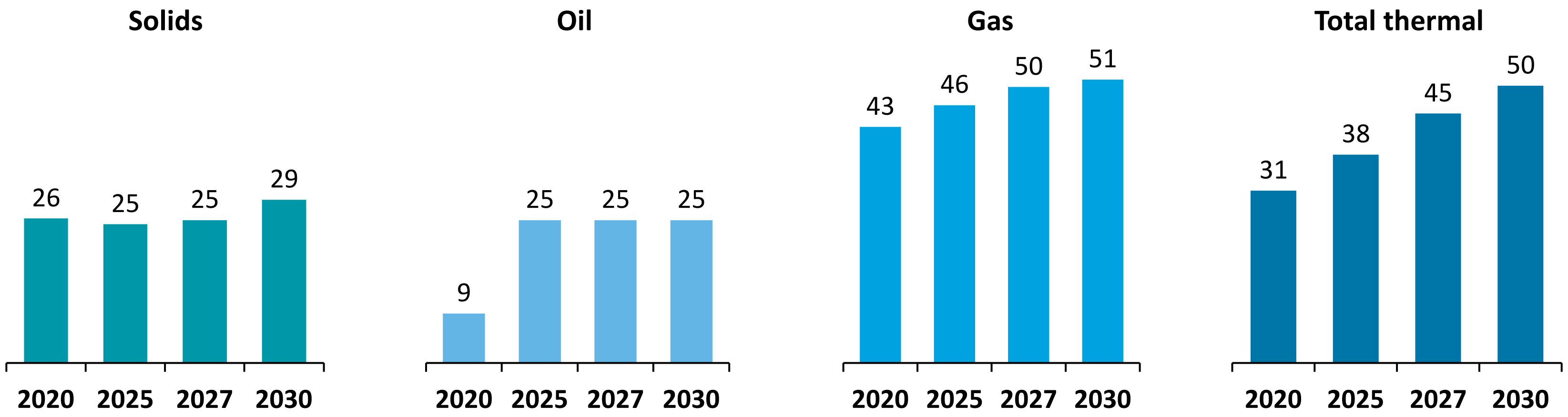
- As renewables are expected to replace fossil fuel-based energy, **carbon intensive fuel input in power generation is expected to decrease significantly in the REPowerEU scenario** – yielding thus 7.1 Mtoe in total vs 9.8 Mtoe in total in the **As-Is**
- Nuclear share sees a decline in 2027 in both scenarios due to taking offline Reactor 1 of the Cernavodă Nuclear Plant for refurbishment purposes

Scenario Results – Fuel input in power generation (2/2)

AS-IS SCENARIO – Efficiency of net thermal electricity production, %



REPowerEU – Efficiency of net thermal electricity production, %



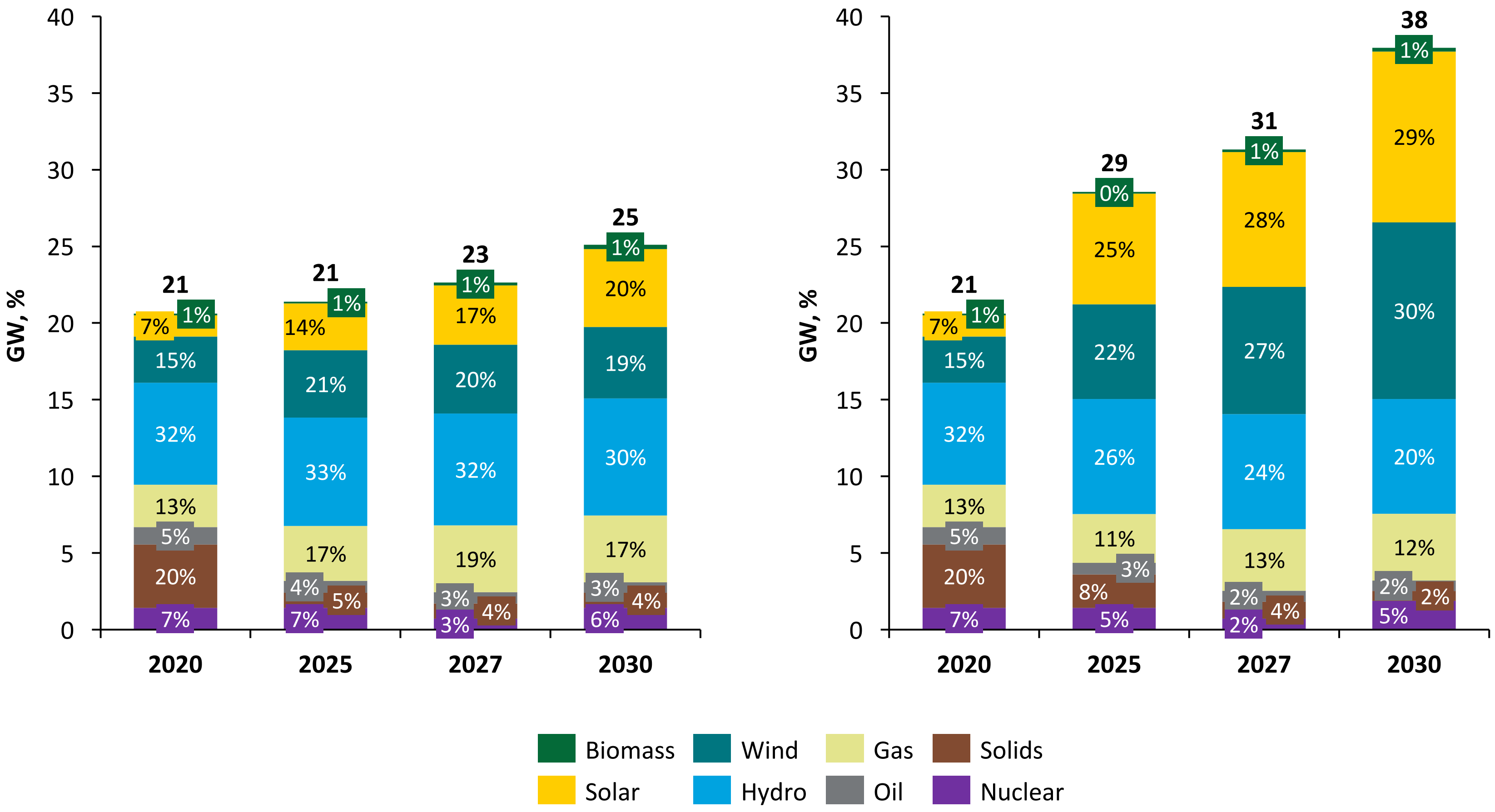
- Overall efficiency of thermal electricity production is expected to increase more abruptly starting with 2027 in the **REPowerEU scenario**, differing from 41% to 50% in 2030
- Significant differences in efficiency can be expected in the REPowerEU scenario resulting from the **disposal of capacities using oil**, as well as **investments in new gas-fired co-generation plants**

 Source: E3M Primes model

Scenario Results – Operating capacity (1/3)

AS-IS SCENARIO

REPowerEU SCENARIO

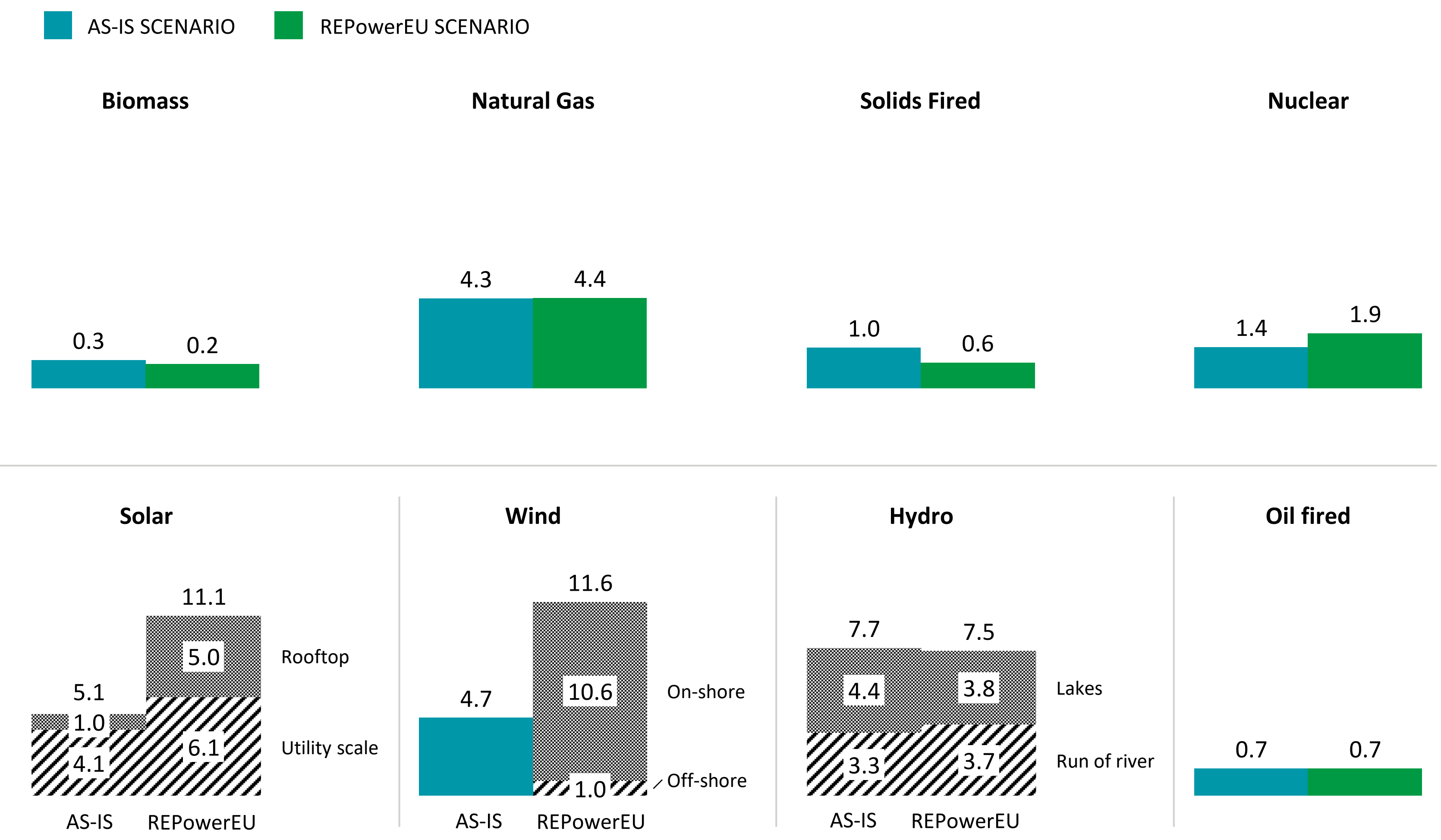


- New investments in CCGT units increases the weighted utilization rate of gas plants in both scenarios, paired with Black Sea natural gas extraction
- **Coal / lignite capacities decrease by 76% and 85% (REPowerEU) between 2020 and 2030**. Coal-phase out requires additional natural gas to cover the demand for heat/steam
- Once more, the overall share of renewables is considerably greater in the REPowerEU scenario, where almost **60% of the installed operating capacity in 2030 will be comprised of wind and solar capacities**

 Source: E3M Primes model

Scenario Results – Operating capacity (2/3)

SCENARIO COMPARISON 2030, GW

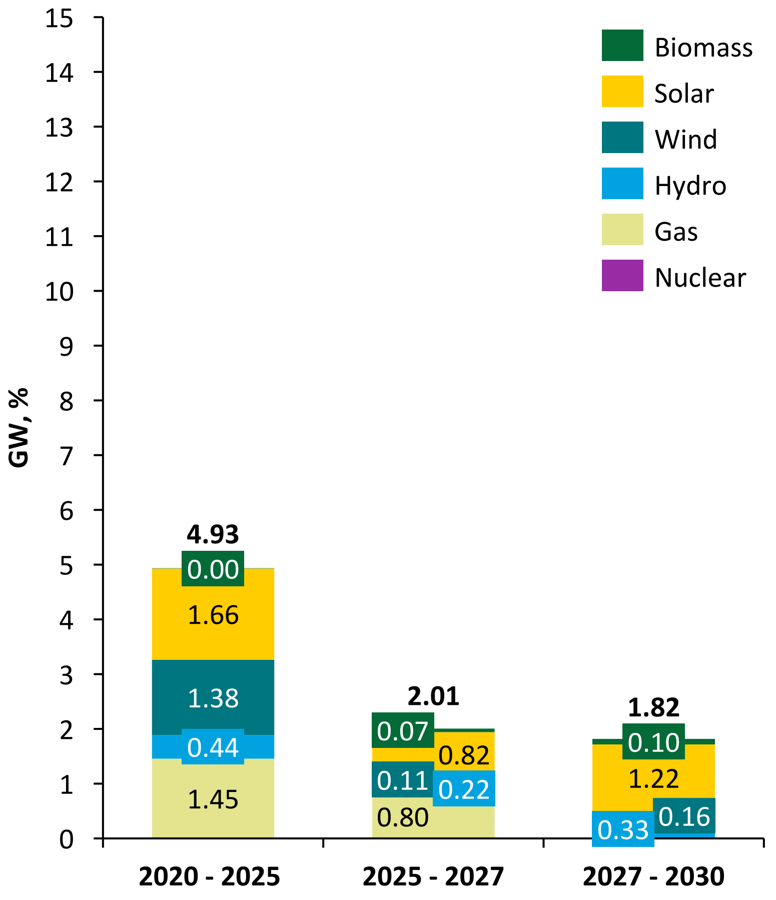


- Main difference between the two scenarios consists in the higher uptake of Wind capacities (emerging off-shore and utility-scale projects) and Solar (note the emerging rooftop PV market) in REPowerEU vs As-Is until 2030
- At 2030 level, out of the total additional renewable capacity required (**12.7GW**) in the REPowerEU scenarios vs the As-Is, **5.4GW** are needed in order to reach the RFNBO targets
- Operating capacity of Nuclear in 2030 increases in the REPowerEU scenarios vs base case due to the commissioning of Reactor 3 from Cernavodă

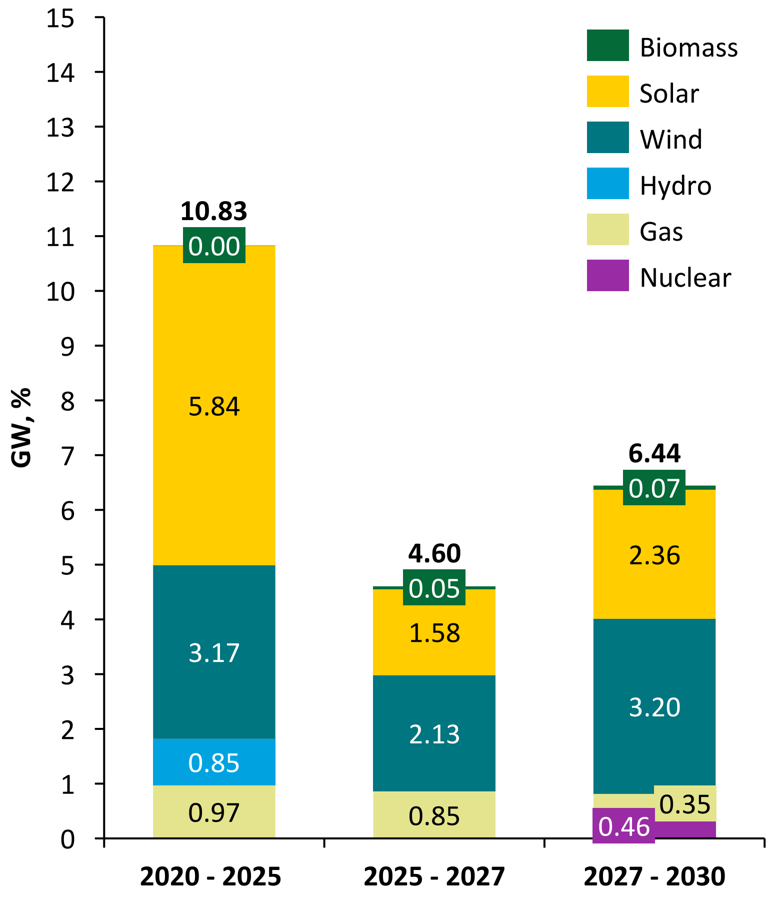
 Source: E3M Primes model

Scenario Results – Operating capacity (3/3)

AS-IS SCENARIO – additional capacities by period



REPowerEU SCENARIO – additional capacities by period

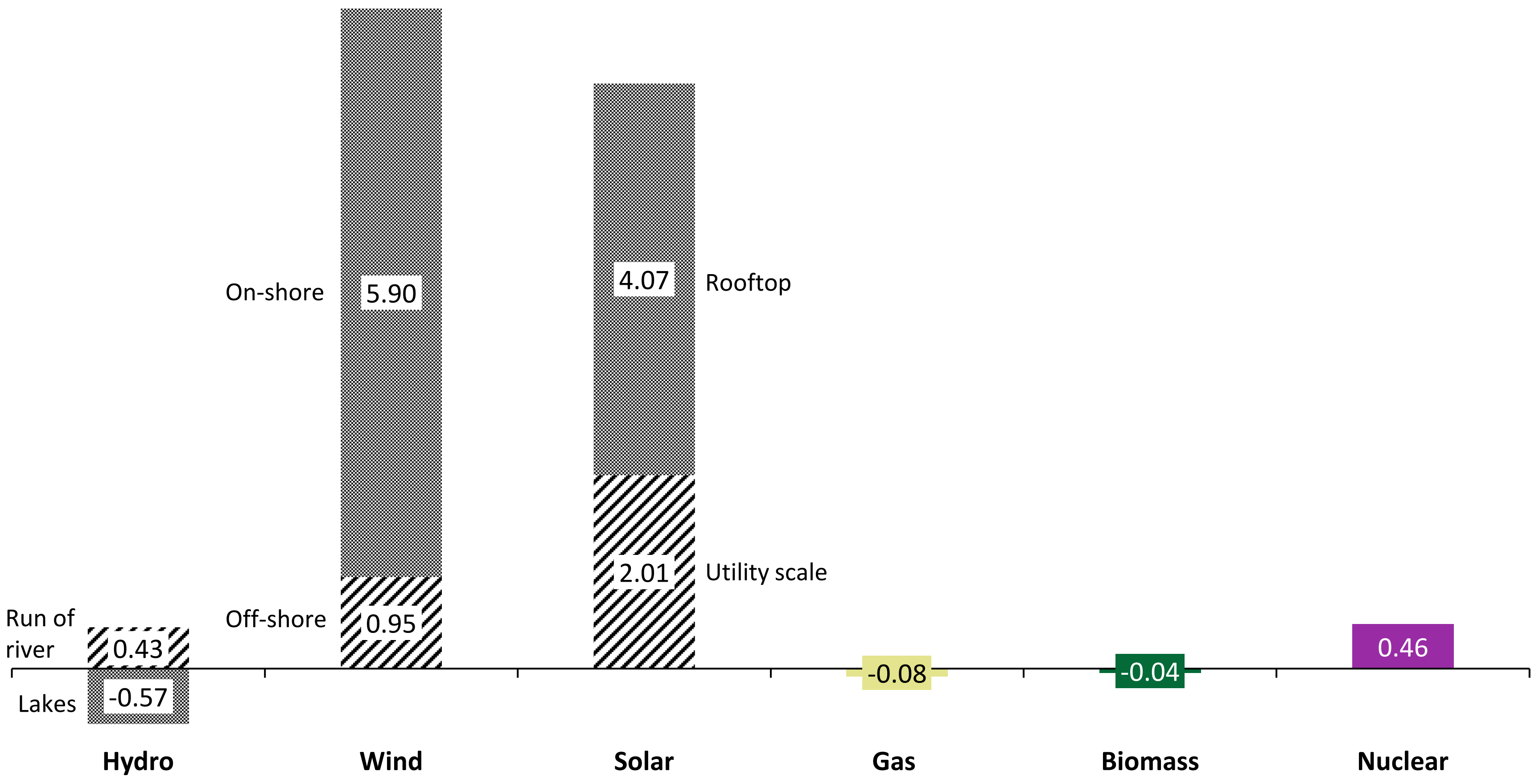


- In the **AS-IS scenario**, solar and gas assume the largest share of capacity investments, cumulatively estimated at 3.7 GW and 2.25 GW by 2030
- In the **REPowerEU scenario**, investments in new capacities are expected to be directed mainly towards rooftop (5 GW) and utility scale (4.8 GW) solar installations, as well as on-shore (7.5 GW) and off-shore (1 GW) wind turbines

 Source: E3M Primes model

Scenario Results – Additional NET capacities in the REPowerEU Scenario

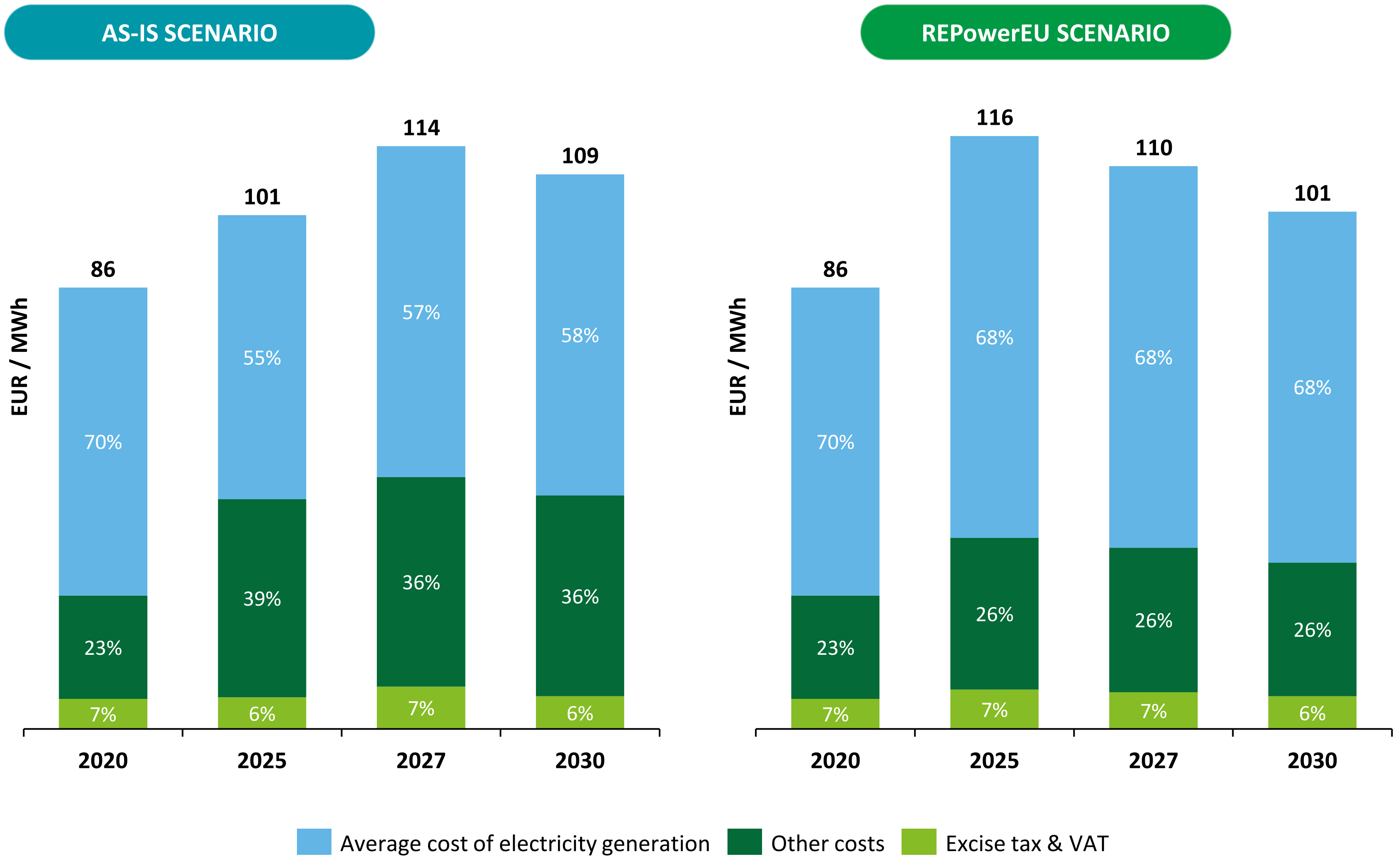
Additional NET Capacity 2020-2030 REPowerEU Scenario compared to the AS-IS, GW



- In the **As-is scenario**, investments in gas, biomass and lake hydropower capacities are expected to increase, with the latter representing the most significant difference, due to the environmental impact of such projects
- On- and off-shore wind as well as utility scale and rooftop solar projects are expected to be additionally funded in the **REPowerEU scenario**

 Source: E3M Primes model

Scenario Results – Electricity Prices



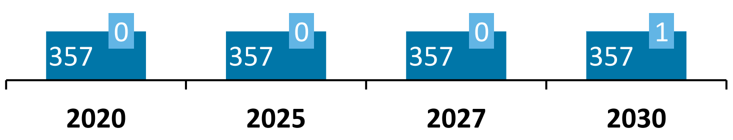
- In 2025, final electricity prices are higher in the **REPowerEU scenario** than in the **As-is scenario** due to increased fuel costs (tax and ETS auction payments), corroborated with higher capital costs driven by additional investments and fixed costs
- In the 2027-2030 period, even though capital costs will continue to increase, final electricity prices will decrease by 4 and 8 EUR/MWh respectively in the **REPoweEU scenario** compared to the **As-is scenario**
- At 2030-level the decreases in final electricity prices are driven by decreases in fuel and supply costs as well as in taxes and ETS auction payments

Source: E3M Primes model

Scenario Results – Storage Capacities

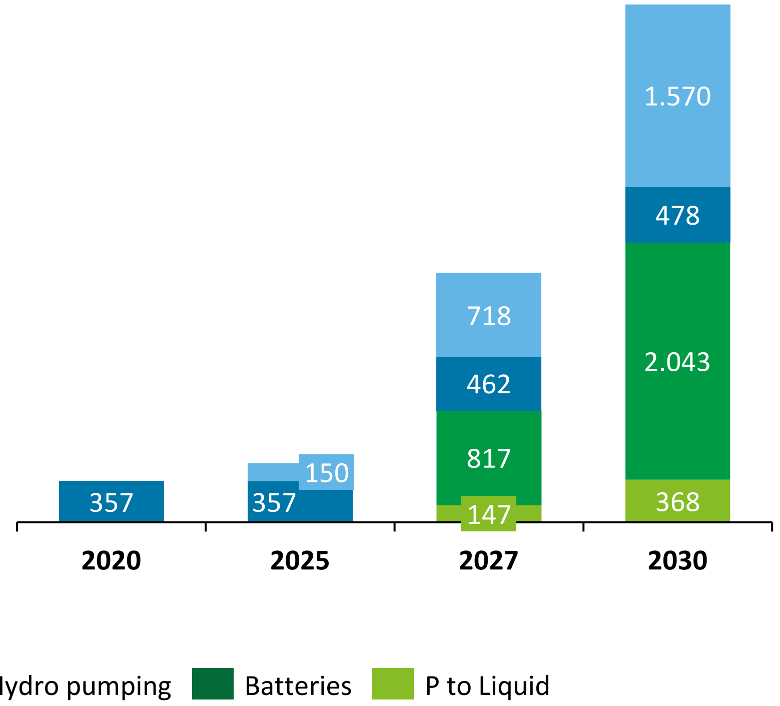
AS-IS SCENARIO

Installed Capacity of Storage and Fuel Production
(MW-elec or MW-output fuel)



REPowerEU SCENARIO

Installed Capacity of Storage and Fuel Production
(MW-elec or MW-output fuel)



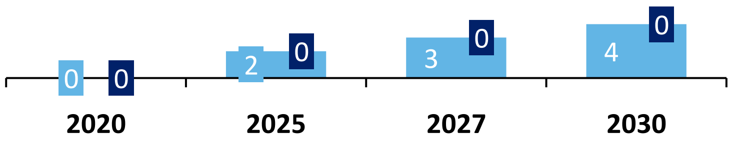
- The **As-Is** scenario does not foresee a large uptake of storage capacities and renewable fuel production
- In the **REPowerEU scenario**, it is assumed that a significant uptake of battery storage and electrolyzers for H_2 production will occur
- In a network with every increasing renewable generation capacities, battery storage becomes key to ensuring grid balance

 Source: E3M Primes model

Scenario Results – Power2X

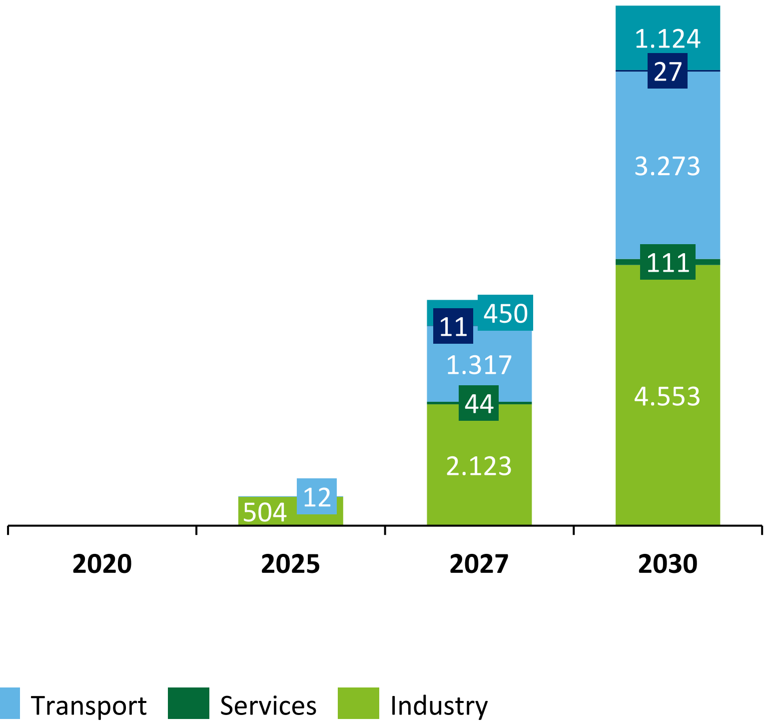
AS-IS SCENARIO

Final Energy Demand of P2X (GWh-fuel)



REPowerEU SCENARIO

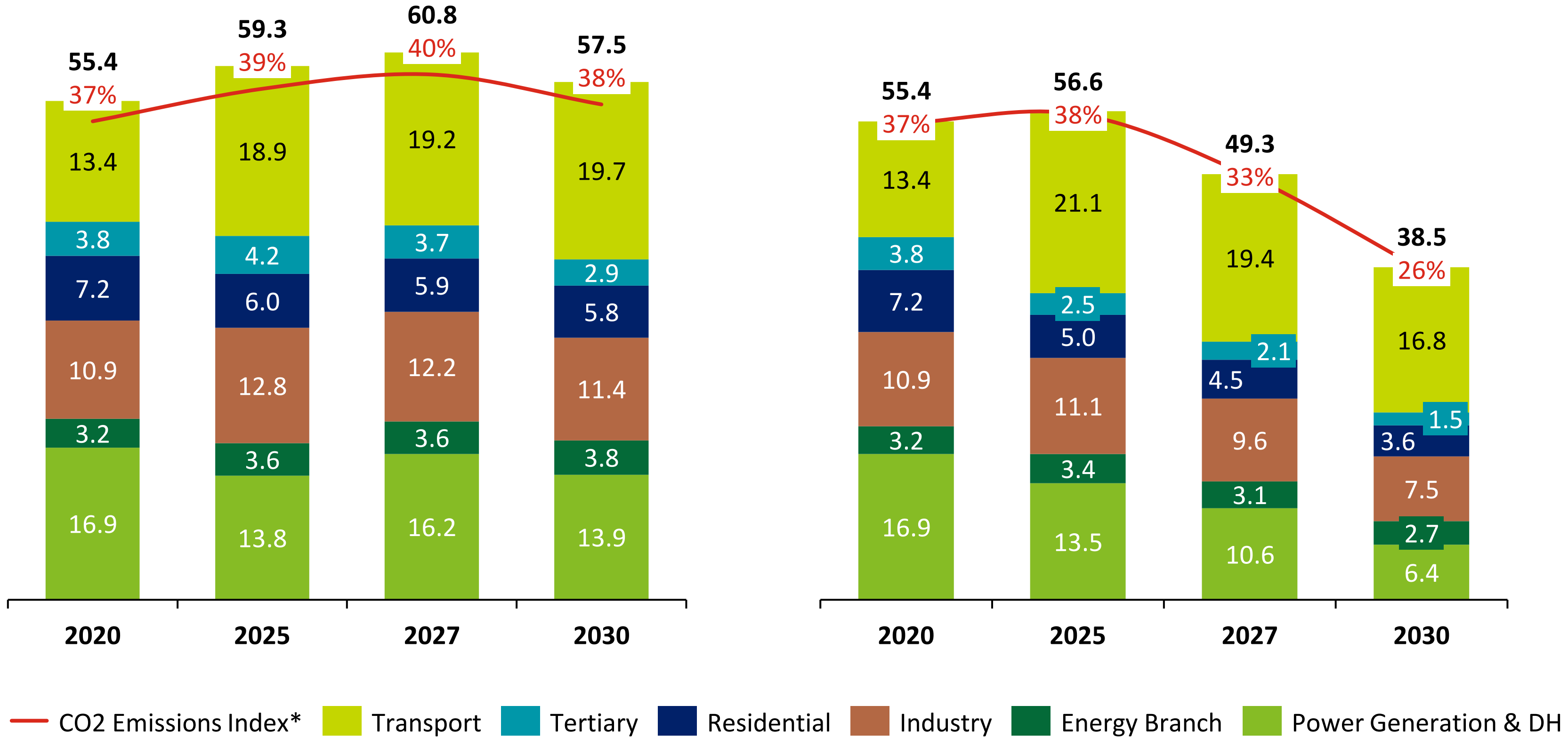
Final Energy Demand of P2X (GWh-fuel)



- Power to Product (P2X) refers to a number of electricity conversion, storage and reconversion technologies that use surplus electricity, usually during periods where fluctuating renewable energy generation exceeds network demand, to produce (for example) other chemicals (e.g. H_2)
- P2X demand is virtually non-existent in **As-is scenario**, only with very small amounts in the transport sector
- Final Energy Demand in transport in the **REPowerEU scenario** is mainly comprised of H_2 (10%) and clean hydrocarbons (i.e. synthetic (P2X) Gasoline, Kerosene and Fuel Oil)

Scenario Results – CO_2 emissions

AS-IS SCENARIO, Mt CO_2 | **REPowerEU SCENARIO, Mt CO_2**



- Overall emissions from 2025 and onwards are significantly decreased in the **REPowerEU scenario** compared to the **As-is scenario**
- The largest differences between scenarios can be found in **Power Generation & District Heating** (-7.5 Mt CO_2-eq) and Industry (-3.9 Mt CO_2-eq)

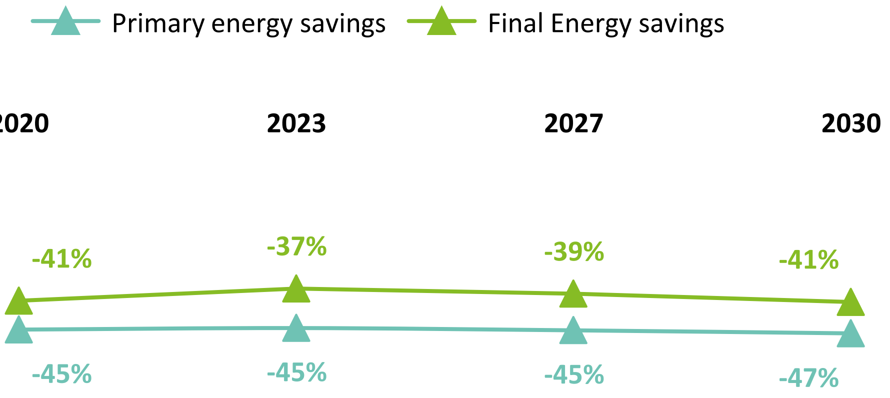
*) Refers to the CO_2 emissions % compared to 1990 (1990=100)

Scenario Results – Renewables Shares

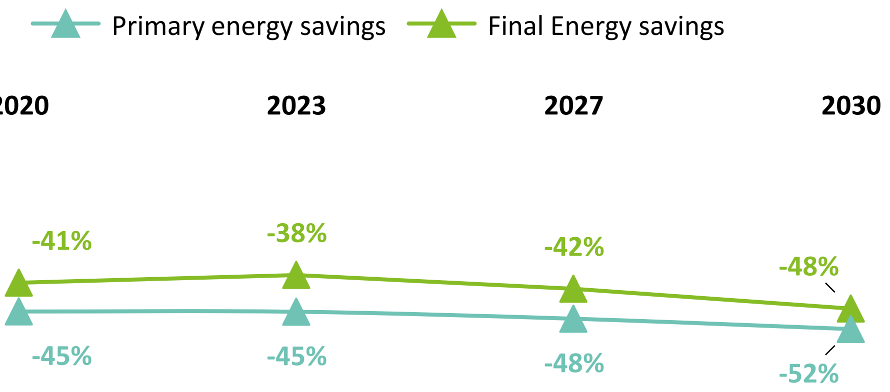
2030 RES Projections, %

	AS-IS	REPowerEU
Overall RES	**31.7%**	**44.4%**
RES-H&C	33.5%	47.3%
RES-E	51.7%	66.9%
RES-T	14.7%	24.6%
RFNBO in Transport	0%	5.4%
RFNBO in Industry	0%	50.5%

AS-IS SCENARIO – Energy Savings, %



REPowerEU SCENARIO – Energy Savings, %



- Overall, RES share growth is significant in the **REPowerEU** scenario, thus reaching EU intended targets. Penetration of mainly Solar and Wind capacities is a key driver in this evolution
- The **As-is scenario** shows moderate increases in RES shares, but in line with the NECP targets

Source: E3M Primes model

Socio-Economic Impact

Framework and methodology of socio-economic impact analysis

Impact analysis framework

1 **Aim of the analysis**

Outlining the socio-economic benefits of the REPowerEU Scenario

2 **Assessment methodology**

Assessing the impact of the additional RES investments in the REPowerEU Scenario compared to the AS-IS Scenario with more limited RES development

3 **Analysis outputs**

Economic output gains: potential additional GDP gains
Employment: potential additional job creation

4 **Analysis limitation**

Static analysis (no wage-response, no price-response or trade impacts are considered); does not consider the impact of government spending on private sector spending

Economic output and employment impact calculation

Calculating **additional required investments** in power generation in the REPowerEU Scenario versus in the AS-IS

	2025	2027	2030
Mil. €	793	1,079	1,718
% GDP	0.3%	0.43%	0.63%

Calculating the **output** and **employment Leontief multipliers** for 2015 – 2030 in five-year time steps using Input-Output (IO) table

To calculate **economic gains** of the RES development, two cases were designed:

- **Loan-based**: additional funds (compared to the AS-IS Scenario) are made available
- **Self-financing**: No additional funding available, new investment IRR must outperform other investments in other sectors of the economy

The use of output multipliers implies that RES investment were decomposed:
PV: 40% demand, 16% construction demand, 44% other services & products.
Wind turbine: 69% demand, 10% construction, 21% other services & products

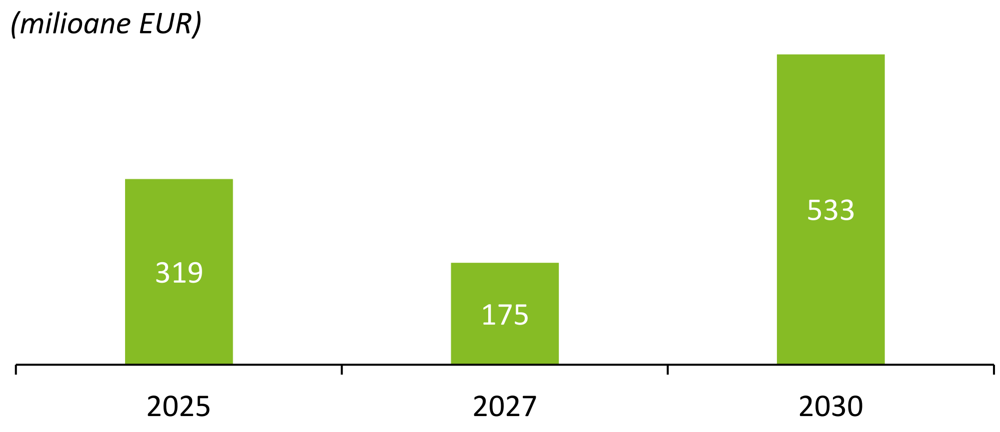
For calculating the **employment impact**, two approaches were used:

- Analysis using the **Leontief Employment multipliers** derived by the IO table (jobs/Euro)
- Analysis using **literature/bottom-up info.** (jobs per MW installed). Assumption: specificities of local labour market not considered

The main caveats of static Leontief approach: i) No feedback loops from the economy are accounted for, ii) No substitution effects, iii) Assumption of abundant resources, iv) No price effects

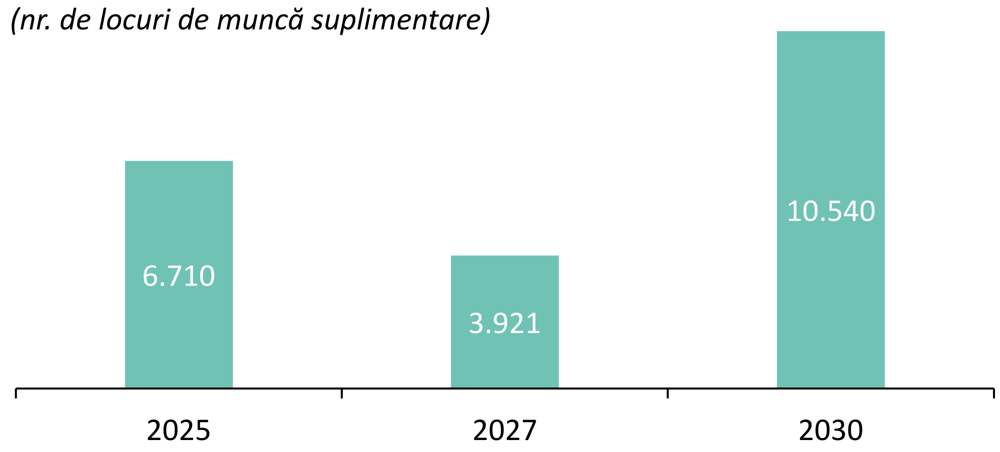
Ar putea fi obține câștiguri economice anuale între 180 – 520 mil. EUR și 4-10.000 de locuri de muncă

Câștiguri totale ale producției economice *(pe bază de împrumuturi)*



- Investițiile suplimentare în generarea de energie, în principal bazate pe SRE, au potențialul de a crește producția economică globală a țării - în medie, pentru fiecare 1 € investit producția economiei crește cu 1,3 € (un câștig net de 0,3 €)
- Câștigurile provenite din producție depind de mixul de investiții și sunt proporționale cu nivelul investițiilor întreprinse (adică, un nivel mai ridicat de investiții duce la beneficii economice mai mari)
- Analiza ia în considerare interconexiunile sectoriale și specificațiile regionale pentru România
- Principalele beneficii (directe) provin din creșterea activității în sectorul construcțiilor și a serviciilor (de exemplu, servicii financiare, suport tehnic), prestatorii fiind în principal companii naționale
- Beneficiile (directe) pentru sectorul de producție sunt de așteptat să fie mai mici ca amploare, deoarece echipamentele SRE sunt în principal importate
- Notă: aceasta este o analiză statistică și nu ia în considerare efectele de excludere

Câștiguri totale din modificarea locurilor de muncă *(pe bază de împrumuturi)*

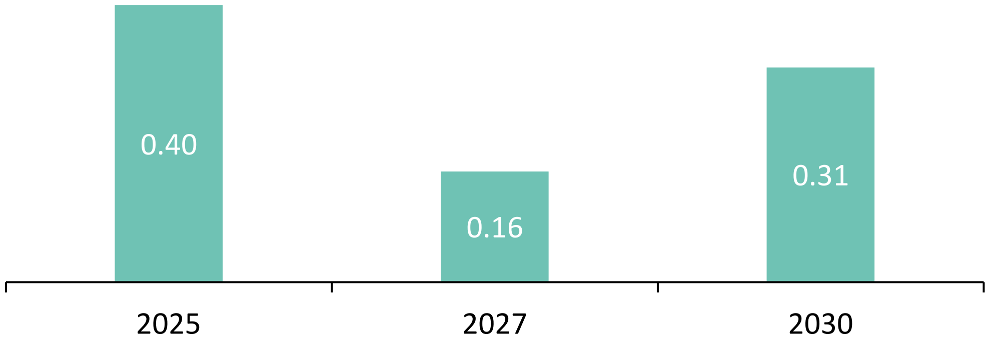


- Investițiile suplimentare în generarea de energie, în principal bazate pe SRE (a se vedea rezultatele modelării sistemului energetic), au potențialul de a adăuga locuri de muncă în economie.
- În medie, investițiile suplimentare generează 6,1 locuri de muncă per milion € investit
- În anii în care au loc cele mai mari investiții, se creează și cele mai multe locuri de muncă
- Analiza ia în considerare faptul că prestatorii de servicii din sectorul construcțiilor se află în România, în timp ce producția se va desfășura cel mai probabil în afara țării
- Notă: aceasta este o analiză statistică și nu ia în considerare efectele de excludere

Output multipliers show the net effect of the RES investments

Economic Multipliers *(loan based)*

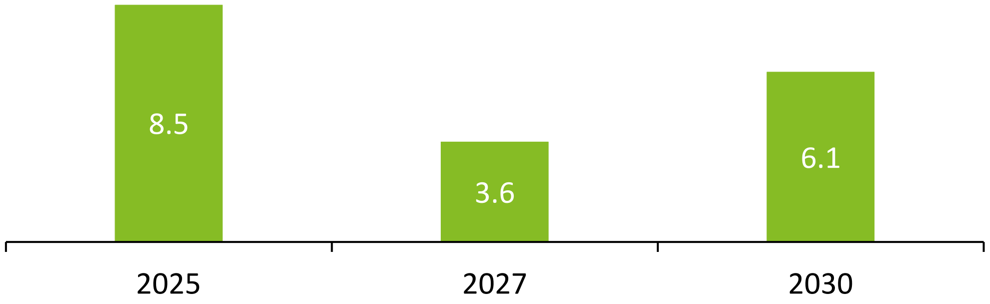
(additional euro per euro invested)



- Output multipliers (type I) show by how much the total production of the economy will increase for each € spent on power generation facilities
- The 0,7 multiplier indicates that for each € spent on power generation 0,7 cents are generated in the rest of the economy

Employment Multipliers *(loan based)*

(additional jobs per euro invested)



- Employment multipliers derived from the Romanian IO table show how many jobs are generated for each million € spent
- There is no distinction between short term and permanent jobs (i.e. full time equivalent)

Source: E3M GEM-E3 model

Relevant tables and input used for socio-economic impact calculation (1/2)

IO table

Jobs per MW	Construction (Rutovitz, 2015)	Manufacturing (Rutovitz, 2015)
Wind	0.5	4.7
Photovoltaics	6.4	6.7
Large hydro	7.4	3.5
Biomass	14	2.9
Coal fired	11.2	5.4
Oil fired	1.3	1
Gas fired	1.3	1
Nuclear	11.8	1.3

Investment matrix – power generation

	Gas fired	Biomass	Hydro	Wind	Solar
Gas	0.0				
Power Supply	0.2	0.1	0.0		1.2
Ferrous metals	0.2				
Metal products		32.5			
Computer electronic & optical prod.		2.4	1.3		4.1
Electrical equipment	15.1	7.6	1.4	7.8	12.9
Machinery and equipment	60.2	15.2	15.3		
Other Equipment Goods					10.5
Construction	14.8	14.4	52.6	10.4	15.5
Financial services	5.5	10.7	9.1	3.8	3.9
Other Market Services	4.0	17.1	20.3	8.5	12.2
Equipment for wind power technology				69.4	
Equipment for PV panels					39.9
Equipment for CCS power technology					
Total	**100**	**100**	**100**	**100**	**100**

Source: Panagiotis Fragkos, Leonidas Paroussos, Employment creation in EU related to renewables expansion, Applied Energy, Volume 230, 2018, Pages 935-945, ISSN 0306-2619, https://doi.org/10.1016/j.apenergy.2018.09.032.

Relevant tables and input used for socio-economic impact calculation (2/2)

Investment matrix – rest of the economy

Agriculture	0.03
Wheat Cereal Grains Sugar cane sugar beet	0.01
Ferrous metals	0.00
Non-ferrous metals	0.00
Metal products	0.18
Chemical Products	0.00
Rubber and plastic products	0.00
Paper products publishing	0.02
Non-metallic minerals	0.06
Computer electronic and optical products	3.64
Electrical equipment	3.15
Machinery and equipment	35.63
Transport equipment (excluding EV)	7.41
Other Equipment Goods	0.80

Consumer Goods Industries	0.01
Air transport	0.00
Water - Freight transport	0.00
Warehousing and support activities	0.07
Construction	40.08
Trade	0.81
Recreational and other services	0.03
Education	0.00
Other Market Services	5.84
Other Non-Market Services	0.00
Research & Development	1.52
Road-Freight transport	0.58
Rail -Freight transport	0.12
Total	**100**

Source: Panagiotis Fragkos, Leonidas Paroussos, Employment creation in EU related to renewables expansion, Applied Energy, Volume 230, 2018, Pages 935-945, ISSN 0306-2619, https://doi.org/10.1016/j.apenergy.2018.09.032.

Key Takeaways of the Study

Key takeaways of Study results

2030 Projections	AS-IS	REPowerEU
Final Energy Demand	25 Mtoe	22 Mtoe (-3 Mtoe; -12%)
Gross Electricity Demand	77 TWh	92 TWh (+15 TWh; +20%)
Electricity Supply	72 TWh	94 TWh (+22 TWh; +30%)
Operating Capacity	25 GW	38 GW (+13 GW; +52%)
Electricity Storage Capacity	358 MW-elec / MW-output fuel	4,459 MW-elec / MW-output fuel
CO_2 Emissions	57.5 Mt CO_2	38.5 Mt CO_2 (-19 Mt CO_2; -33%)
Overall RES %	31.7%	44.4% (+12.7%)
Additional Investment	To achieve the REPowerEU Scenario, 0.5% of GDP must be spent on average in addition to the As-Is	

Key takeaways

- Whereas the basis of economic growth applies to both Scenarios of the study, which further translated into an increase of final energy demand, the higher assumed energy efficiency measures in the REPowerEU Scenario generates a much more moderate final energy demand increase compared to the As-Is. Corroborated with investments in the renewables sector, the REPowerEU Scenario is less reliant on fossil fuels (and considerably less on Natural Gas) by 2030.
- On the other hand, electricity demand in the REPowerEU scenario will be 20% higher than in the As-Is, mainly due to additional demand required for RFNBO production. Therefore, 40% of Romania's final energy demand will be covered by electricity supply.
- The Romanian transport sector will see the highest increase in electricity demand out of all economic sectors (+300% by 2030), although in absolute numbers it will still be the least consuming sector. 1/3 of electricity consumption will originate from the industry
- The generation mix and operating capacity in the REPowerEU Scenario assumes an exponential increase of solar energy (+9.8GW installed capacity 2020 vs 2030; 45% rooftop and 55% utility scale in 2030) and wind energy (+9.5 GW installed capacity 2020 vs 2030; 91% onshore and 9% off-shore in 2030). As such, this will compensate both the extra demand for electricity and the wind-down of production from solid fuels. In this context, Romania would once again become a net exported of electricity before 2025, compared to remaining a net importer by 2030 in the As-Is Scenario
- The year 2030 also finds Romania with an additional 4GW of energy storage capacities to balance network demand, comprised of 2GW battery storage capacity and 1.5GW in electrolyzes for H2 production
- In terms of investments, the socio-economic impact of the REPowerEU Scenario yields that for every 1 € invested, the output of the economy increases by 1.3 € (a net gain of 0.3 €), whereas each 1 mil. € invested in power generation creates on average 6.1 jobs

Unlocking the Potential

Opportunity Analysis

Unlocking the Potential of renewable energy

Bringing down legislative barriers and designing a robust market framework will enable and encourage development of RES capacities, providing predictability for investors and security of supply for consumers

Legislative Barriers

- Permitting time and bureaucracy is the most significant legislative barrier, hampering the ability of developers to react quickly to market demand and address capacity deficits
- Multiple legislative changes were undertaken, severely affecting market predictability and therefore investments, while not addressing fully the issues regarding permitting
- Romania, as well as the EU, require a robust supply chain to reach intended goals, thus a legislative framework that supports domestic production
- The main challenge for Romania to develop a domestic RES capacity production industry is the lack of skilled workforce and a lack of predictable installation timeline for wind/PV projects

System Adequacy & Flexibility

- Transelectrica, the national transport system operator, plans to allocate EUR 1.4 billion in its most recent TYNDP, a 44% increase compared to the previous version of the Plan
- The adequacy analysis of the NES indicates a minimal risk of failing to cover demand through domestic production and imports if by 2030 certain investments (including RES) are on the market
- The current state of the NES presents significant risks, due to imports covering an important part of the net domestic consumption, as the power deficit approaches the NTC maximum limits considered for import / export

CfDs and PPA Frameworks

- Not addressing relevant barriers/risks can slow down the adoption of CfDs and by consequence, the uptake of new renewable energy, hampering the desire of generators and investors to make offers and adopt CfDs.
- CfDs are increasingly used across Europe, providing protection to consumers, while avoiding ex-post governments interventions in the energy market
- The PPA market is currently accessible only to large players and few transactions have been closed, due to the uncertainty of electricity price development and nationally-driven regulatory changes
- PPAs can mitigate short term price volatility, but also lock-in a price for the long-term

Sector Coupling

- The combination of end-use sector coupling, renewable H_2 and P2X solutions may reduce the overall energy system decarbonisation costs
- Sector coupling can contribute to the cost-efficient decarbonisation of the energy system by taking advantage of synergies between different parts of the energy system, while improving the efficiency and flexibility of the energy system as well as its reliability and adequacy
- For the greater European energy market, sector coupling would ensure security of supply for net importing countries, while ensuring short-term network robustness and long-term price stability

Unlocking the Potential

Main Legislative Barriers

Unlocking the potential – first step: remove legislative barriers

Background

- Romania's current performance with regards to photovoltaic and onshore wind energy permitting must be improved. It is indicated that the permitting process in Romania takes significantly longer than the RED II limits. The prolonged duration of permitting is caused by barriers within the underlying legislation
- As such, the Romanian government has tried to address many of the legal and administrative barriers blocking renewables development in the previous decade.
- However, new barriers have appeared and the ability to address the capacity deficit is held back

Main legislative barriers

- Key barriers within the administrative authorization and grid connection permit stages were identified in the RES Simplify project (a report on the simplification of permitting and administrative procedures regarding RES installations). Other barriers include bureaucratic burden and lack of legal coherence
- Last summer, Law 254/2022 was amended. The change was meant to simplify permitting procedures for renewable projects developed on surfaces of a maximum of 50 ha (approximately 42MW of solar power). However, the effect was stopping all projects developed on surfaces larger than 50ha because of the Ministry of Agriculture and Rural Development's interpretation of this amendment to the law. Because of this limitation, it is unfeasible cost-wise to connect projects to the 220 or 400kV transport infrastructure, significantly increasing the cost of electricity which could have been brought to market
- Although a further simplification of the permitting process has been attempted through Law 21/2023 (which, for some investment projects, allows construction on the basis of a building permit and the approval of the land use change, without the requirement for a prior approval of a Zoning Plan (PUZ)) and other legislative proposals are currently under discussion, it is still unclear if the interpretation issues restricting projects over 50ha have been resolved. Additionally, Law 21/2023 does not provide transitional rules for projects already in the authorisation phase (i.e. projects for which planning certificates have already been issued or which are undergoing PUZ authorisation procedure)
- GEO 119/2022 introduced a 100% tax for the revenues of renewable generators that exceed 90 EUR/MWh. This GEO also failed to recognize the financial transactions or hedging costs of renewable operators. This contradicts EU market design principles and causes existing renewable generators that have hedging contracts to lose money for each MWh they produce and sell. The effect of this is decreased financial stability for such companies and the discouragement of investments
- GEO 153/2022 then tried to address the problems posed by GEO 119, but effectively re-established a regulated energy market in Romania until 2025. Although both existing and future renewable generation capacities are exempted from the centralized purchasing mechanism imposed by this GEO, the fact that this was the fourth major legal change to the sector in under a year, caused severe regulatory disturbance in the energy market

 Source: RES Simplify - Eclareon, The Institute for Applied Ecology, Study coordinated and published by the European Commission; EPG Study

Unlocking the potential: encourage domestic production to avoid supply chain bottlenecks

Romania should develop a strong supply chain for renewable generation capacities

EU level

Renewables supply chain is struggling. Inflation, challenging access to raw materials, the lack of a clear project pipeline and increasing competition from non-European manufacturers and markets are all putting pressure on the industry. The EU, including Romania, needs to develop a strong renewables supply chain in order to avoid having to rely in imports from third countries. Recognizing the status of wind energy as a sector of strategic importance is key. Otherwise, dependence on Russian fossil fuels will be swapped for other dependencies, Europe might lose its position as a leader in the wind industry and the energy transition might risk being unattainable

Component Manufacturers → Distribution & Delivery → Development → Construction → Electricity Generation → Operation & Maintenance → Repowering

Opportunities in Romania

- There are local production sites for bearings, forgings, generators and electrical control systems for turbines. Additionally, the wind turbine technician training center in Constanta is a valuable resource. It has produced experts covering the needs of multiple regional markets. It is already preparing onshore technicians.
- Components manufacturers can take advantage of the transportation and shipping opportunities of Constanta Harbour for consistent development of onshore wind. The integration of new renewable energy presents opportunities for developing clean transport, the charging infrastructure and energy storage. This will allow the battery and hydrogen value chains to be developed nationally and can also apply to the decarbonization of heavy industrial processes.

Romania

There are opportunities for a strong local supply chain. Significant resources (financial, technical, human) are required to install new capacities which Romania does not currently have. The production of components for wind turbines or PV panels, software or storage equipment constitutes a possible course of action. This can contribute to the development of the country's economy.

Attracting new manufacturers & service providers

- Efficiently promoting the timely opportunity for the RES supply chain in Romania to domestic and foreign players (e.g. through programs such as RESInvest)
- Reliably forecasting the needed volumes of equipment and services, creating long term visibility for investors
- Providing a national incentive framework (e.g. green financing, instruments, minimum local content, tax incentives)
- Providing training & recruitment programs to expand the available talent pool

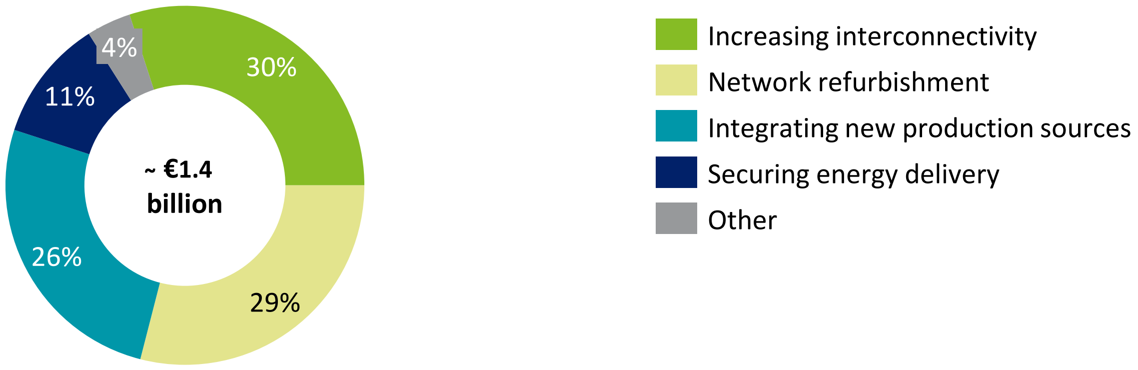
Unlocking the Potential

System Adequacy & Flexibility – Main Technical Barriers

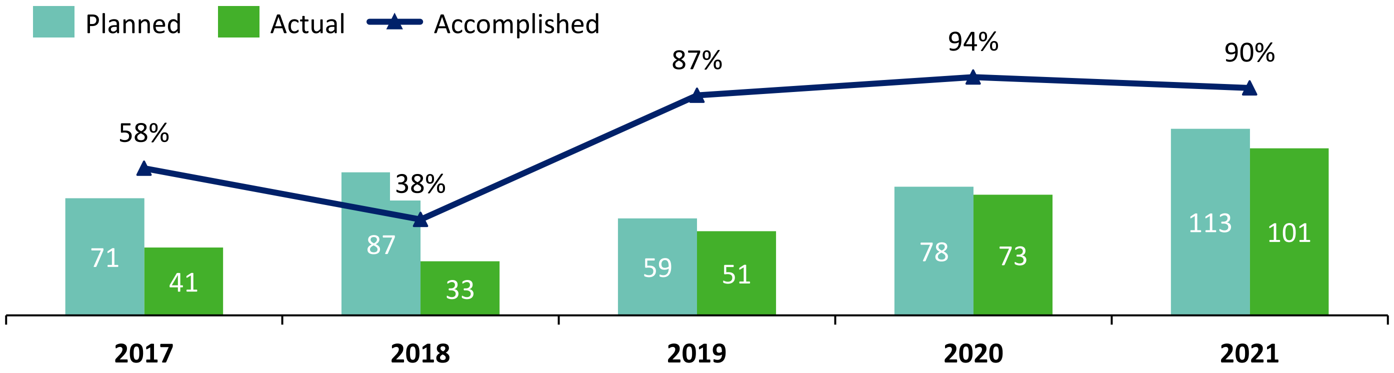
Transmission System Operator – Overview and investment plan

Transelectrica's Network Development Plan enables market participants to better assess opportunities

Transelectrica network development plan 2022 – 2031 *(%)*



Transelectrica yearly planned vs. actual investments *(mil. EUR, %)*



- Forecasted investments for the updated 2022 – 2031 TSO development plan amount to approximately **EUR 1.4 billion**, an increase of **+44%** compared to the 2020 – 2029 version
- Transelectrica allocates more than half of its total investment budget for 2022 – 2031 towards integrating new production sources (RES) and network refurbishment with the aim to secure an appropriate adequacy and flexibility of the national energy system.
- **Main risks** affecting the TSO's yearly investment plans:
  - External: legal notices and approval delays (e.g. environmental approvals), delays induced by contracted parties
  - Internal: delays caused by failing to initiate public procurement procedures in a timely manner, dependability of new projects on the status of ongoing projects

Note: Exchange rate RON/EUR: 4.9315

Source: Transelectrica's annual reports 2017, 2018, 2019, 2020, 2021, Transelectrica's Network Development Plan 2022 – 2031

Transmission System Operator – Current view on 2030's national energy system adequacy

Transelectrica's adequacy analysis, MW

	2027	2030
Net production capacity	20,115	22,769
Unavailable power	14,920	16,665
Actual available power	**5,195**	**6,104**
Net domestic consumption at peak load	10,680	10,945
Remaining capacity in NES	**-5,485**	**-4,841**
Simultaneous import/export capacity	5,500	6,250

- Transelectrica adequacy analysis indicates that the risks of not covering domestic consumption with the generation capacities available in NES plus import are minimal
- Covering an important part of the net domestic consumption through import involves major risks; thus, new production plants are needed
- The power deficit approaches the NTC maximum limits considered for import / export

Source: Transelectrica's Network Development Plan 2022 – 2031

Unlocking the Potential

CfDs, PPA & State aid Frameworks

Unlocking the potential - Market design is essential for investors and consumers

Market design must enable investors to have access to a mix of long-term contract options they can combine to incentivize renewable deployment at scale - e.g. CfDs, PPAs, forward contracts

From the market design perspective, Romania must consider coordinated actions and measures to unlock the full potential of renewables. Combining market based instruments (PPAs) with state support (CfD, demand response) is a key prerequisite for a market that provides value for all stakeholders – authorities, investors and consumers.

PPA

- Assess current barriers for PPA such as the credit risks of buyers
- Promote State-supported schemes that can be combined with PPAs
- Facilitate cross-border PPAs

CfD

- Enforce CfD framework to provide public support for new investments in infra-marginal and must-run renewable and non-fossil electricity generation
- Define different contract types of CfD to match each technology's characteristics
- The design of CfD tenders should allow the participation of projects in the auction that intend to cover part of their production with a PPA or other market-based mechanisms

National Energy System flexibility and adequacy

- Introduce new support schemes for demand response and storage by enabling the TSO procure demand reduction at peak hours to increased NES flexibility
- Expanding the scope of system needs assessment to have a 'whole system' perspective
- Reviewing the governance arrangements to conduct the system needs assessment

Source: EU 2023 Staff working document regarding EU market design, Eurelectric 2022 Electricity market design Report, Deloitte analysis

Contracts for Difference – state of play

CfDs are key policy instruments which incentivize price stability for final customers

- Contracts for Difference involve a two-way support payment as difference between the strike price and market reference price: the generator will be paid by OPCOM when the market reference price is below the strike price. Conversely, the generator pays OPCOM when the market reference price is above the strike price
- The CfD mechanism does not guarantee the sale of the electricity produced. It is aimed at providing stability and certainty of revenues for generators by guaranteeing the sale of electricity at a minimum price (and protecting them against price volatility)
- CfD payments will be funded by the Modernisation Fund and will take place monthly based on the generation weighted monthly average DAM price (reference price). No cumulation of aid is possible and there is no obligation to enter into a PPA. The CfD Payment Differences will be collected in the CfD Liquidity Fund
- Applicants can apply from the minimum capacity of 5MW up to the maximum capacity for a single bid/bidder specified in the Auction Initiation Order

NRRP milestone Q2 2023

- In addition to the transposition of European legislation into national legislation, NRRP includes the reform for a new energy law with milestone Q2 2023 leading to:
  - Introduction of CfDs, as the main support mechanism for investments in RES generation capacities
  - Establishing the possibility of direct negotiation of PPA's (power purchase agreements) by all RES generation capacities

1st auction process

- Separate for onshore wind and solar PV (assets with integrated storage facilities are not Eligible)
- Eligible commissioning years (2025, 2026) earlier than 30 June 2026
- Bidders cannot apply for a CfD to deliver a project in phases but can apply for only part of their planned capacity or build a larger capacity than originally applied for

New legislation will entry into force

- Acc to NRRP, after the entry into force of the new energy law and related secondary legislation:
  - Following the first round of competitive procedures/auctions CfD will be signed until Q4 2023, for at least 1,500MW installed capacity;
  - Following the second round of competitive procedures/auctions until Q2 2025, CfDs will be signed, of at least 2,000 MW of installed capacity

Source: Ministry of Energy , National Recovery and Resilience Plan, Deloitte analysis

Contracts for difference – risks & recommendations

Although CfDs can be useful instruments for providing certainty for renewables developers and for consumers, there are risks if not implemented and designed correctly

- The energy crisis has shown that renewable support schemes with uncapped upside revenues in the case of high prices may not be resilient and could trigger future policy interventions. This is because of perceived 'windfall profits' and the need to raise money to finance consumer protection, which can lead MSs to intervene and create policy or regulatory uncertainty
- If CfDs are implemented, it is important that they should not distort short-term prices. CfD designs in which the CfD is decoupled from the dispatch decision of the asset are key to ensuring this
- Technologies subject to CfDs could include wind, solar, run-of-river hydro or other renewables or low-emission technologies
- Such contracts need to be designed in such a way as not to distort investment and operational efficiency

Risks

- It should not be possible for Romania to impose two-way CfDs by regulatory means on existing generation capacity
- An overly strict application of the competition law and of rules such as the rules on double funding etc.
- The design of CfDs is technology-dependent

Impact

- It might slow down the adoption of CfDs and by consequence, the uptake of new renewable energy
- This might disincentivize generators and investors from making offers and adopting CfDs
- It may hamper incentives to adopt more efficient and innovative technologies

Recommendations

- Develop guidance on best practices for the design of CfDs (and possibly for other public de-risking contracts)
- CfD design should consider product type (e.g. purely financial or physical delivery), time horizon, counterparty (e.g.: public entities, public companies), contractual conditions (including termination) amongst other things

Benefits

- CfDs help protect consumers and are use across Europe increasingly
- Two-sided CfDs could avoid ex-post interventions of governments especially in countries where it is likely that the need to further protect consumers will appear

Source: EC 2023 Staff working document regarding EU market design, Eurelectric 2022 Electricity market design Report, Deloitte analysis

Power purchase agreements (PPAs) – state of play

PPAs play an essential part in the energy transition, particularly for the renewables-based decarbonisation of energy-intensive industries

- A Power Purchase Agreement is a **long-term bilateral electricity supply contract**, concluded between renewable energy generator and customers. It provides a guarantee to customers that the acquired electricity is generated from renewable sources
- Since 2021, according to GEO 143/2021 for amending and supplementing Law 123/2012, the participants in the wholesale electricity market are allowed to conclude **PPAs bilateral contracts negotiated directly** for the purchase of electricity for new investments in new capacities
- The **NRRP reform aims to encourage the conclusion of bilateral PPA's by all generators**, outside the centralized market, freely and directly negotiated with final suppliers or consumers and with the possibility to be signed before the start of construction

Physical PPA

- Delivery of electricity directly to the customer.
- Considers the variability of the renewable plants power production and how matches power consumption of customer
- The surplus of power is sold to the grid
- Any additional power needed by the customer can be bought from the grid/utility
- The customer receives guarantees of origin

Virtual PPA

- Difference settlement between the spot price and PPA strike price
- Is in scope of IFRS 9
- Apply hedge accounting
- The customer receives guarantees of origin

Power purchase agreements (PPAs) – regulatory barriers & recommendations

Long-term contracts provide predictability to energy consumers, asset developers, and investors while mitigating the impact of short-term price volatility

- The **uncertainty of electricity price development** and **nationally-driven regulatory changes** are major barriers to enter into long-term contracts. The current emergency measures and other **revenue cap mechanisms**, aiming at protecting consumers in period of crisis against sustained high market prices, **pose a threat of lowering appetite for new investments** in case they don't guarantee correct accounting for PPAs.
- Solid revenue security on the long-term might stir up an interest for PPAs. For instance, **exposing PPAs to the risk of windfall tax, hold back such agreements.**
- Government needs to take into consideration that PPAs are perceived as purely commercial contracts and, there is a risk of creating a type of **"hidden" subsidy** for such agreements. Those subsidies may lead to **society bearing a cost**, and it could also negatively affect competition with other, more cost-efficient products.

Regulatory barrier

- PPAs require long contract durations for new assets and high collaterals
- Non-standardized contract template for PPA
- Lack of permitted renewable energy projects
- Uncertainty regarding evolution of future electricity prices
- Lack of transmission and distribution capacities and interconnectors for cross-border trade

Impact

- The PPA market is currently accessible to large players
- Bureaucratic burden
- Decrease renewables uptake
- PPAs can mitigate short term price volatility, but also lock-in a price for the long-term
- The lack of transport capacity can lead to limited volumes

Recommendations

- Enhancing customer contracting framework by widening options for market participants to do short and long-term hedging and contracting
- Providing a market-based investment framework, allowing investors to create tailored contracts based on public, private or direct market agreements
- Designing enhanced framework to coordinate identification of future system needs

Benefits

- Bring benefits of low-carbon & RES generation more directly to consumers, while encouraging active demand participation
- Enable deployment of RES capacities, ensure system flexibility and ensure revenue stabilization for generators
- Allow timely development of flexible & reliable power generation capacities & network infrastructure

Source: EU 2023 Staff working document regarding EU market design, Eurelectric 2022 Electricity market design Report, Deloitte analysis

State aid available for RES investors

Various grants & incentives are available for RES investors, focus of state aid support directed towards PV & wind generation

Modernization Fund

- According to EU Directive 2018/410, 2% of the total quantity of allowances from EU-TS scheme for 2021-2030 period should be actioned to establish the Modernization Fund
- Priority projects (incl. RES developments):
  - At least 70% of available funds
  - Funding up to 100% of eligible expenses
- Priority investments in Romania:
  - Modernization & construction of new power network sections
  - Renewables & energy Storage
  - Green hydrogen
  - Nuclear energy
  - Replacement of coal-based capacities
  - High-Efficiency cogeneration
  - Energy efficiency in industrial installations included in the EU-ETS
  - Biofuel production and adoption

Just Transition Fund

- Just Transition Fund was established through Regulation EU 2021/1056
- JTF will focus on:
  - Economic diversification of territories most affected by climate transition (including through RES)
  - Reskilling and active inclusion of workers and job seekers within these territories
- As a measure to support recovery following the coronavirus pandemic, budget was increased from 7.5 to EUR 40 bn. (2018 prices)

National Recovery and Resilience Plan

- Over EUR 30 bn. were allocated to Romania to mitigate the economic and social impact of the coronavirus pandemic
- The National Recovery and Resilience Plan shall encompass an Energy and green transition axis supporting:
  - Investments in RES production
  - Investments in intelligent transmission and distribution networks for transitional fuel and RES
  - Investments in production capacities for transitioning from solid fuels to transition fuels (natural gas)

REPowerEU

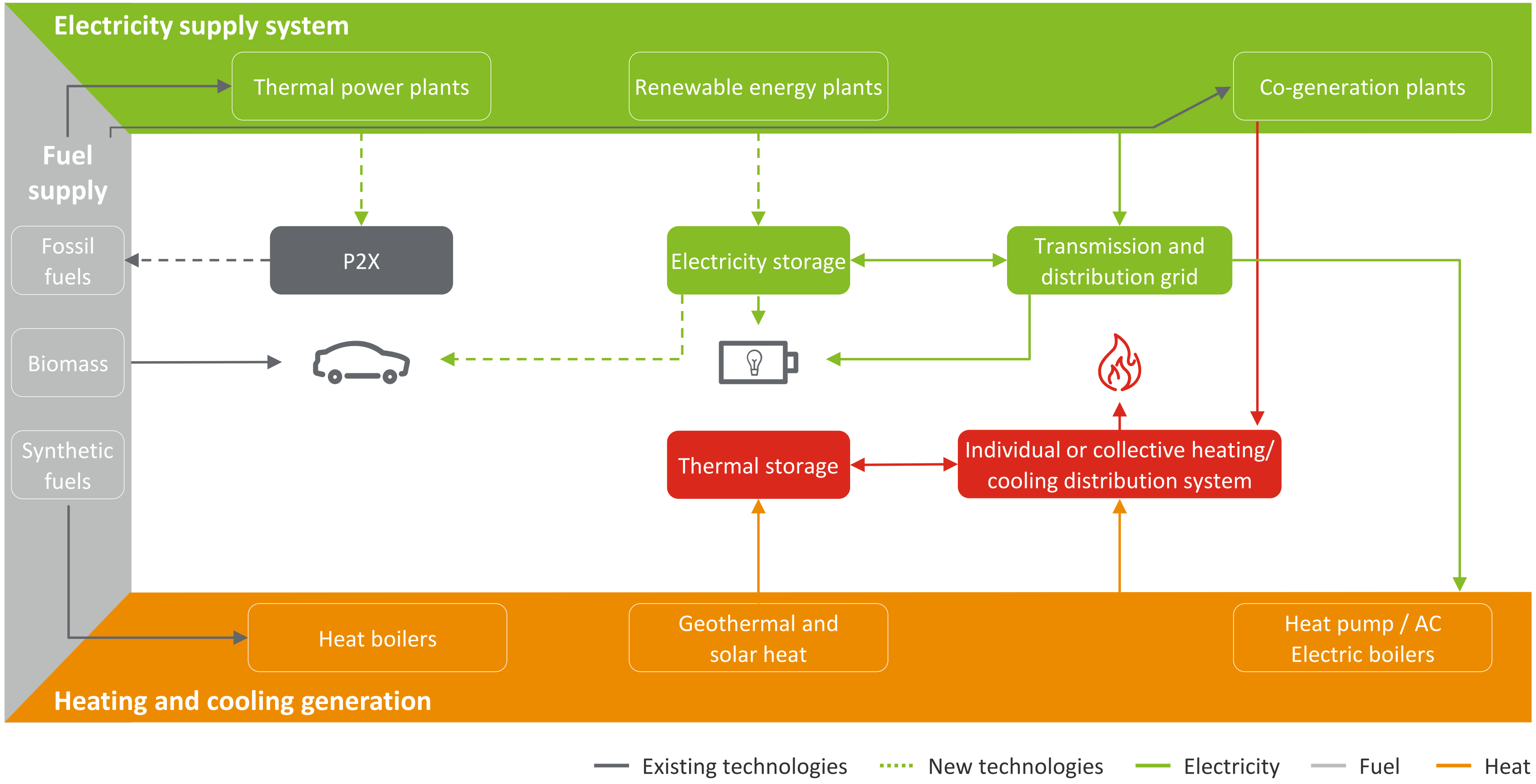
- Over EUR 1.4 bn. were allocated to Romania through REPowerEU to enchant national energy independence
- REPowerEU chapter foresees investments in:
  - Elaboration of the legal framework for the use of non-fertile land for RES development
  - Professional training in the fields of production, storage, transport and distribution of green energy
  - Increasing energy efficiency and green energy production
  - Agriculture sector decarbonisation
  - Rooftop PV and energy storage for residential buildings
  - Energy Autonomous Villages
  - New RES production capacities
  - Digitization, efficiency and modernization of the NES and natural gas transmission network

Unlocking the Potential

Sector Coupling

Overall structure and steps for coupling different sectors

The combination of end-use sector coupling, renewable H_2 and P2X solutions may reduce the overall energy system decarbonisation costs



- Sector coupling strategy consists of either **linking an energy source to a type of service** such as heat or transport, or the development of **new links between energy carriers** to allow for indirect electrification of processes, such as in industrial operations
- P2X solutions between electricity, gas and heat can serve as an additional source of energy system flexibility and security of energy supply
- The use of renewable H_2 and P2X solutions can facilitate renewables integration and enhance energy security
- In order to strengthen national energy resilience, Romania needs to promote the use of renewable H_2 and P2X solutions

Source: IRENA Sector Coupling 2022 Report

Sector coupling – key dimensions

Sector coupling can serve as a substantial enabler of the energy system decarbonisation

- While different end-use sectors require various technologies to transform to direct and indirect electrification, all potential technologies should be considered in a coordinated way to maximize the optimal use of resources and strengthen the synergies between them
- Sector coupling can contribute to the cost-efficient decarbonisation of the energy system, by valuing synergy potentials and interlinkages between different parts of the energy system
- Moreover, sector coupling can improve the efficiency and flexibility of the energy system as well as its reliability and adequacy
- To foster the full potential of sector coupling in several end-use and supply applications, existing technological, financial, as well as institutional and regulatory barriers must be removed

Technology

- Technology considerations for sector coupling are primarily linked to technology advances and developments, as well as the maturity of sector coupling solutions across multiple scales – from individual components and units to the integration of the entire system. Thus, P2X technologies should be improved so they can be deployed on a large scale.
- Moreover, an increasing amount of new renewable generation assets – both mature and emerging renewables technologies – is needed to achieve full decarbonisation. These increased amounts will have a direct impact on accompanying infrastructure, both new and retrofitted, including transmission, distribution, and storage assets.

Financial

- Measures for advancing sector coupling currently lack financial incentives, as flexibility is not always adequately rewarded. In this regard, many of these technologies as well as ancillary services need tailored and relevant market designs answering to the different needs and financial capacities of developing, emerging and industrialized markets.
- These designs include the development of viable business models tailored to specific regions. If implemented properly, such market structures can deliver a cost-efficient system enabling an optimized use of resources and storage opportunities along with cost-efficient utilization and investments in infrastructure.

Institutional and regulatory

- Sector coupling requires the implementation of clear definitions of specific P2X technologies, integrated system planning, and legal or institutional arrangements. Institutional and regulatory frameworks also encompass activities that address and foster co-ordination and collaboration among different stakeholders at multiple levels. These frameworks also need to stipulate go-to institutions responsible for system planning to identify opportunities for sector coupling. This can be accomplished by co-operation among prosumers, DSOs and TSOs at local and regional levels as well as international arrangements and trade agreements with supportive incentives and pricing mechanisms

Source: IRENA Sector Coupling 2022 Report

Sector coupling – key drivers

Enabling policy frameworks should be set up to incentivize and accelerate successful sector coupling projects

Decarbonisation of energy supply and energy efficiency measures

- Direct electrification is a key enabling measure because of the maturity of renewable energy technology. Energy efficiency measures will lower the required energy supply as well as the primary energy demand. However, some applications will still require thermal energy (e.g. hydrogen).
- Indirect electrification, in which electricity is used to produce gas, liquids or heat sources of energy, can result in larger efficiency losses than with direct electrification. Therefore, as a rule, indirect electrification should be applied only in hard-to-decarbonize sectors (e.g. shipping and aviation).

Infrastructure optimization

- Electrification of non-power end-use sectors would allow more players to participate in demand response programs. Smart system integration can contribute to the optimization and the utilization of the existing infrastructure and reduce the need for isolated infrastructure investments.
- Optimizing the energy infrastructure can additionally improve system security and resilience. In turn, energy infrastructure optimization creates an opportunity to save resources, lower operational costs and reduce the environmental impact

Improve energy access and reliability

- Delivering energy access to remote areas is an ongoing challenge which can be overcome by scaling up decentralized renewable energy approaches, focusing on micro- and mini-grid approaches.
- By integrating decentralized energy access measures, offered by renewable energy sources, with broader sector coupling opportunities, many countries would avoid being locked into volatile fossil fuel markets and could consume energy more efficiently and reduce overall energy demand.

Flexibility potential and energy system optimization

- Energy sector coupling and smart integration will require further digitalization. In addition, the electricity system needs smart energy management. Progressive digitalization allows for better observation, forecasting, monitoring and control of the increasing number of renewables-based, distributed generation resources.
- Digitalization contributes to reducing connection and activation costs and enables small prosumers to participate in the energy transformation democratically, making the energy system more just and inclusive. More digitalized energy infrastructure that encompasses the deployment of smart grids not only improves operating efficiency, but also integrates new demand-side flexibility resources.
- A full exploitation of different flexibility options, such as demand response or electricity storage options (not limited to batteries), requires a proper regulatory framework that can ensure the development of flexibility services alongside market participation, remuneration and related business cases.

Promoting the additional benefits of sector coupling

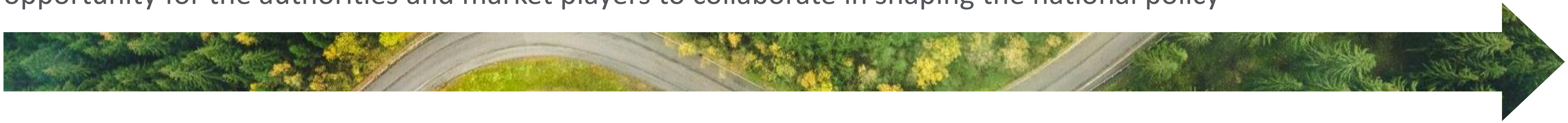
- While sector coupling has generally been identified as an integral part of the energy transformation, applications are still few and for the most part concentrated in developed countries.
- Therefore, increasing the understanding of the concept among policy makers and businesses is crucial to increase real world applications
- Awareness of sector coupling strategies could be strengthened by including approaches within energy access projects

Source: IRENA Sector Coupling 2022 Report

National Policy Roadmap

New National Energy Policy Roadmap

2023 and 2024 are critical years for Romania's energy sector, in which specific strategic objectives are drawn – an opportunity for the authorities and market players to collaborate in shaping the national policy



National Long-Term Strategy

Quarter 2, 2023

- The preliminary version of Romania's LTS for GHG reduction was released for public consultation in Q2 2023
- The document proposes 3 scenarios (with 2050 outlook); however, the recommended optimal energy mix scenario is the only one approaching climate neutrality. However, the Strategy lacks a sectoral approach to policies and concrete measures to ensure GHG reduction
- The present Study offers a reference point for the industry in comparing the optimal energy mix scenarios

National Hydrogen Strategy

Quarter 2, 2023

- Complementary to the LTS, the first version of the National Hydrogen Strategy is due to be released for public consultation in Q2 2023 by the Ministry of Energy
- The Strategy shall include concrete objectives and measures for kickstarting hydrogen production and utilization, including financing instruments; furthermore, it will include a primary and secondary legislative package to make (renewable) hydrogen projects possible and develop the associated value chain

Draft NECP

June 2023

- By June 30th 2023, Romania must submit to the European Commission a proposal for updating its NECP with the scope of defining more ambitious national targets in accordance with reaching overall FitFor55 and REPowerEU objectives
- The proposal must account for the analytical base and optimum scenario defined in the Long Term Strategy, as well as for the adverse environmental impact stemming from reaching NECP objectives

Final NECP

June 2024

- Twelve months after submitting the NECP update proposal, Romania must present the Commission the final format of the updated NECP, including the associated environmental impact assessment
- Prior to reaching the final format, the updated NECP must implement the recommendations of the European Commission and it must undergo extensive public consultation – an additional opportunity for market players to leverage on the results of the current Study and shape the NECP update