Energy Community Baseline Scenario – Preliminary results

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Presented by: A. De Vita

Based on work by: V. Karakousis, A. Flessa, K. Fragkiadakis, P. Karkatsoulis, L. Paroussos, G. Asimakopoulou, S. Evangelopoulou

Supported by the PRIMES modelling team and in particular M. Kannavou, Th. Fotiou, P. Siskos and others

Contact: devita@e3modelling.com

E3Modelling Energy Economy Environment

in cooperation with:

IIASA International Institute for Applied Systems Analysis www.iiasa.ac.at

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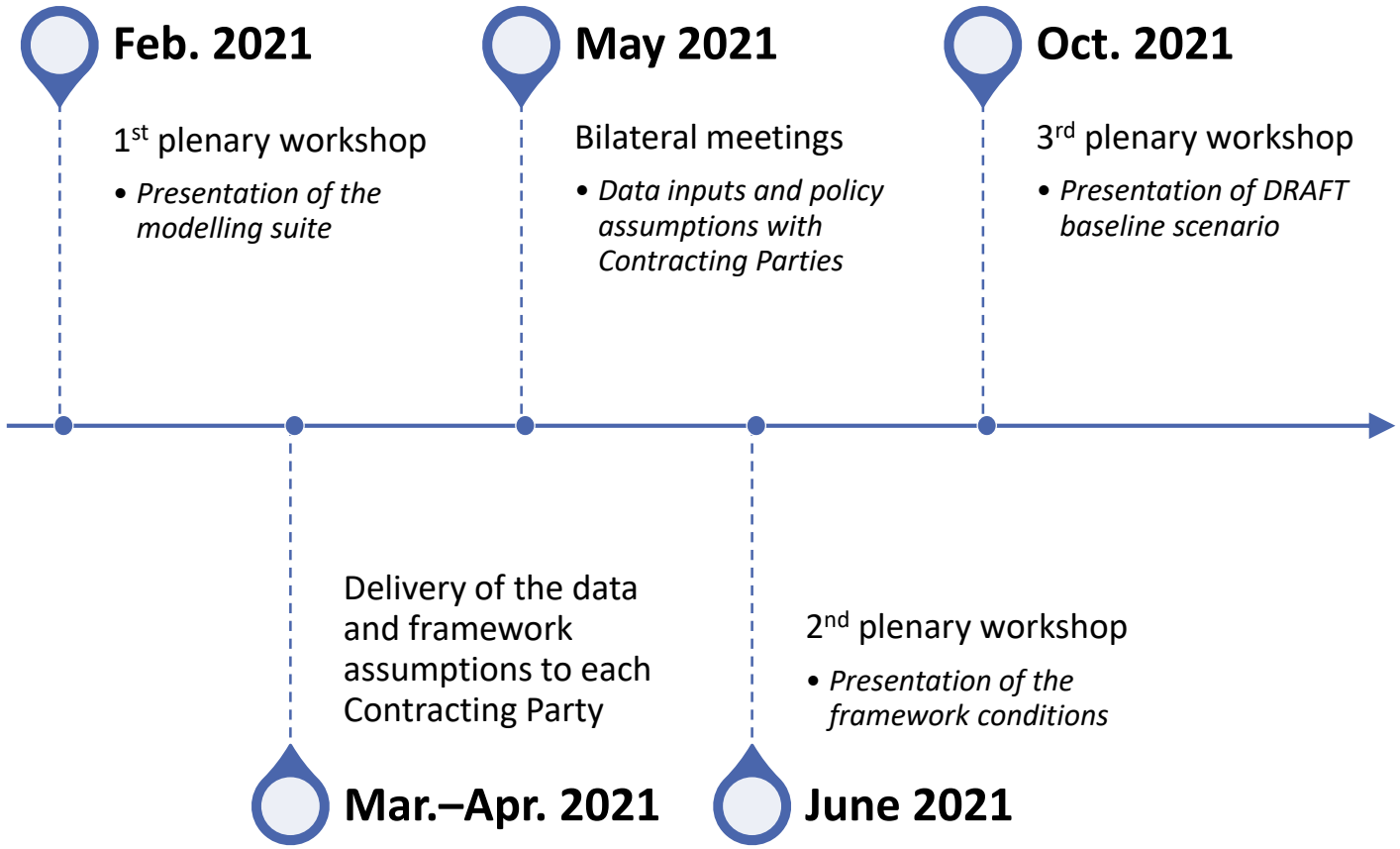
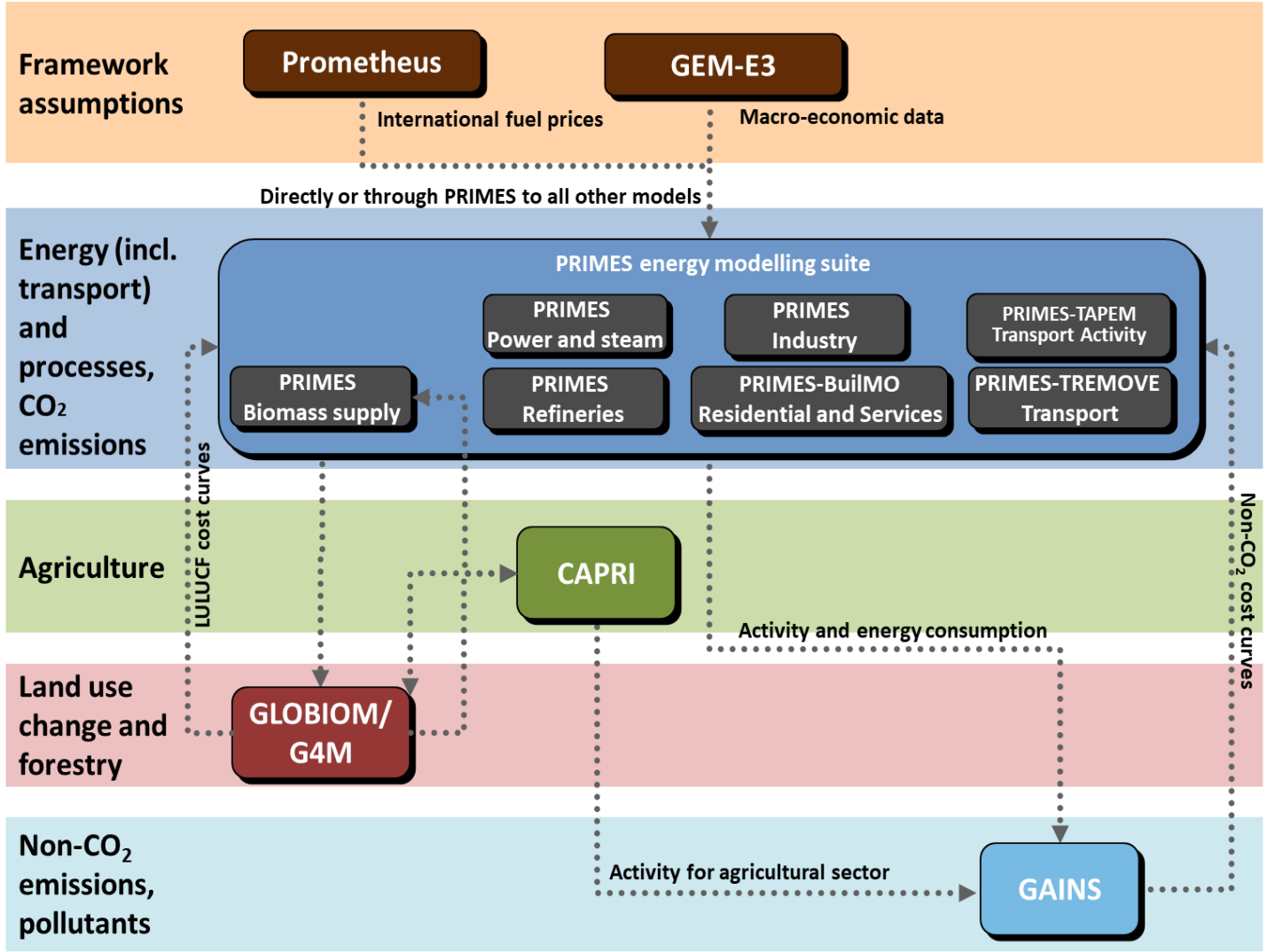
Project status



Modelling suite – Outputs

- ✓PRIMES output
  - Final energy by sector
  - Power sector developments
  - Primary energy
  - CO_2 emissions
  - Costs
- ✓CAPRI output
  - Agricultural projections
- ✓GAINS output
  - Non-CO_2 emissions by sector
- ✓GLOBIOM output
  - LULUCF sector developments & emissions



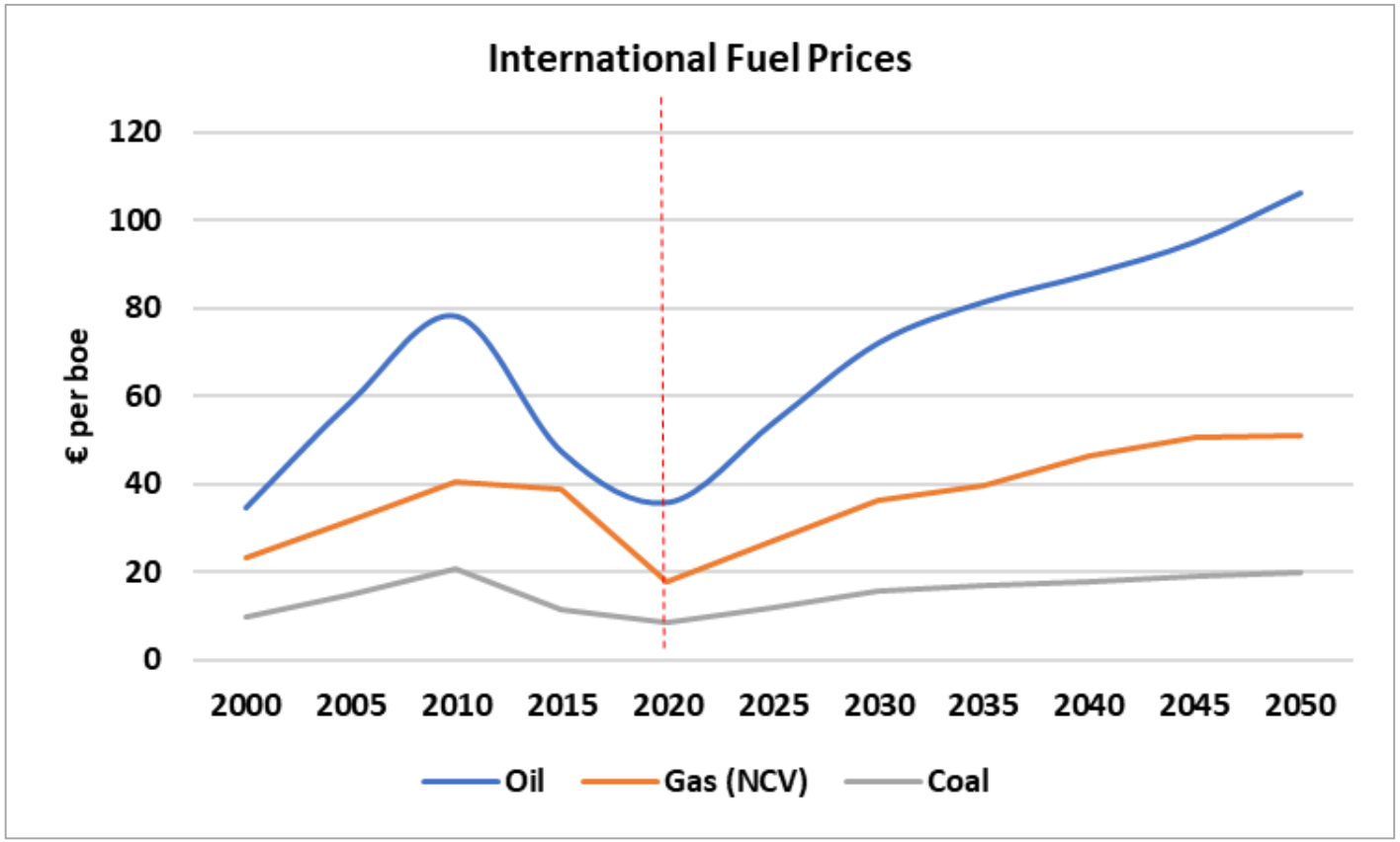
Framework Assumptions

International fuel prices

The projections of the POLES-JRC model – elaborated by the JRC and derived from the Global Energy and Climate Outlook (GECO) – are used to obtain long-term estimates of the international fuel prices.

National specificities are taken into account (social pricing, domestic resources, etc.)

Note: The assumptions have not considered recent oil, gas and coal price trends

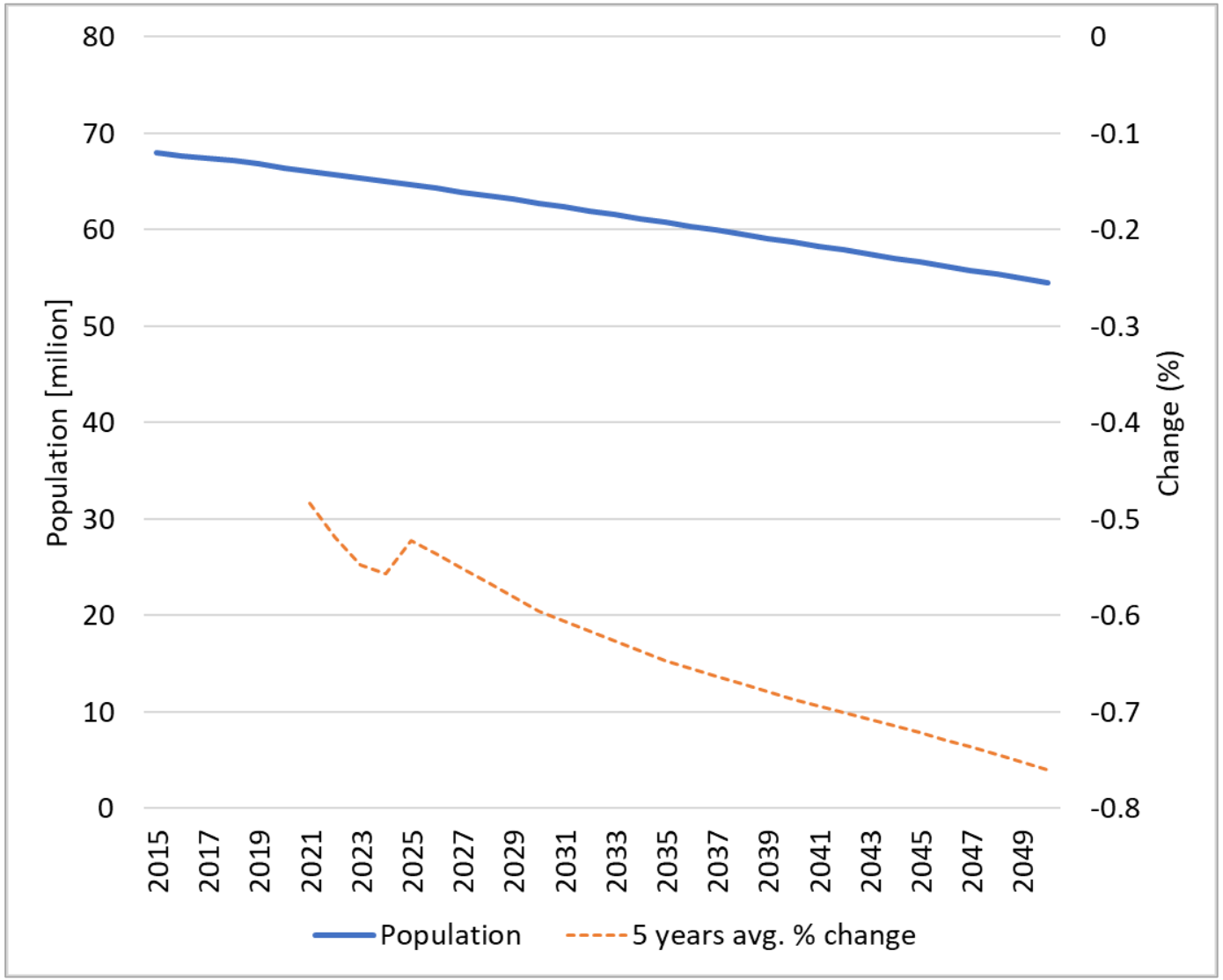


Demographic projections

UN estimates for Population and Working Age population (from: World Population Prospects 2019)

Population in the Energy Community is projected to decline

- All countries follow a similar trend, with either stabilisation or decrease of population
- Working population is expected to decline at a slightly higher pace

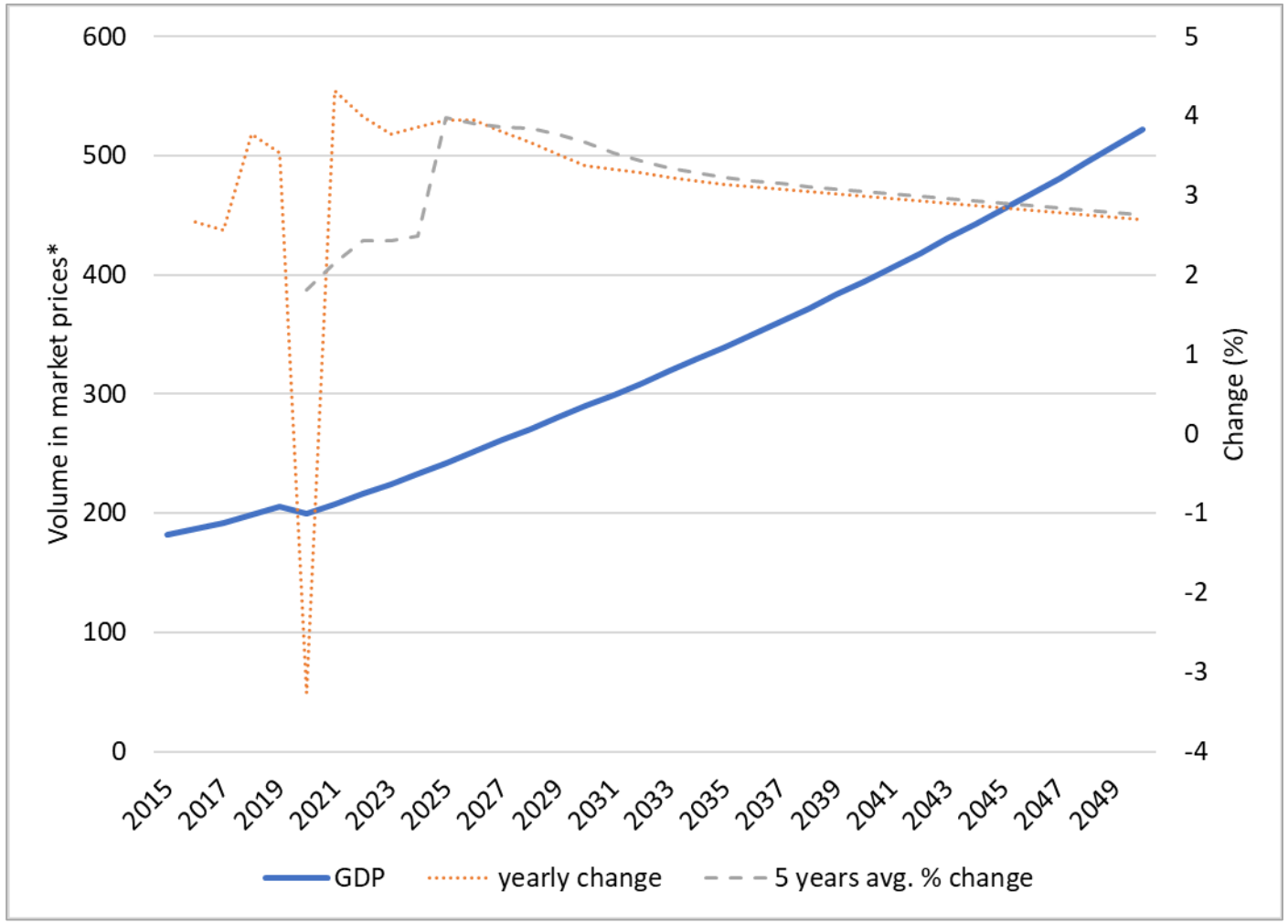


Macro-economic projections

Short-term projection of GDP growth is highly uncertain in the wake of the COVID-19 pandemic

However, the macro-economic scenario assumes a successful recovery of economic growth, shortly after 2021

Economic growth remains sustained in the long-term despite the decrease in population



Main policy assumptions

- No green-field investments on coal or nuclear
- Decreasing FiT support for the current decade
- RES enabling policies (licensing, grid development, subsidies) remain modest despite the economic attractiveness of RES technologies
- Endogenous lifetime extension decisions for coal power plants
- Assumed lifetime extension of existing nuclear power stations (Ukraine)
- Gradual penetration of natural gas supported by new gas infrastructure (Kosovo, Montenegro, Albania); gas use limited in power generation and industry.

Final energy demand

Preliminary results

Energy demand & fuel mix

Industry

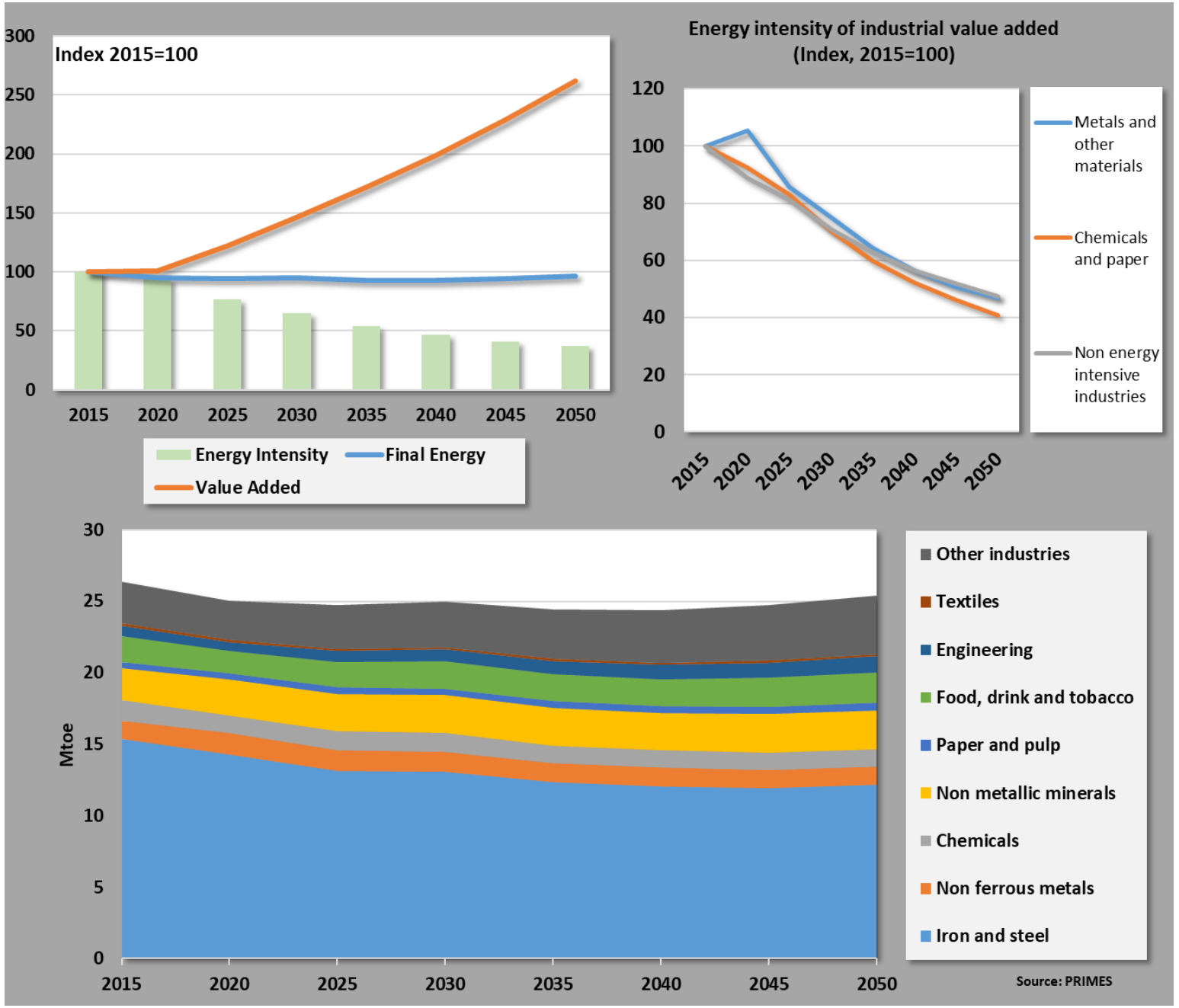
Energy demand in industry follows a slightly decreasing trend in the medium term and stabilizes in the longer term. Energy demand also decouples from the value added.

The projection shows considerable improvement of energy efficiency in industry

Energy intensity is being improved in all sectors across the whole projection period, tending to reach a plateau in the longer term (2040-2050).

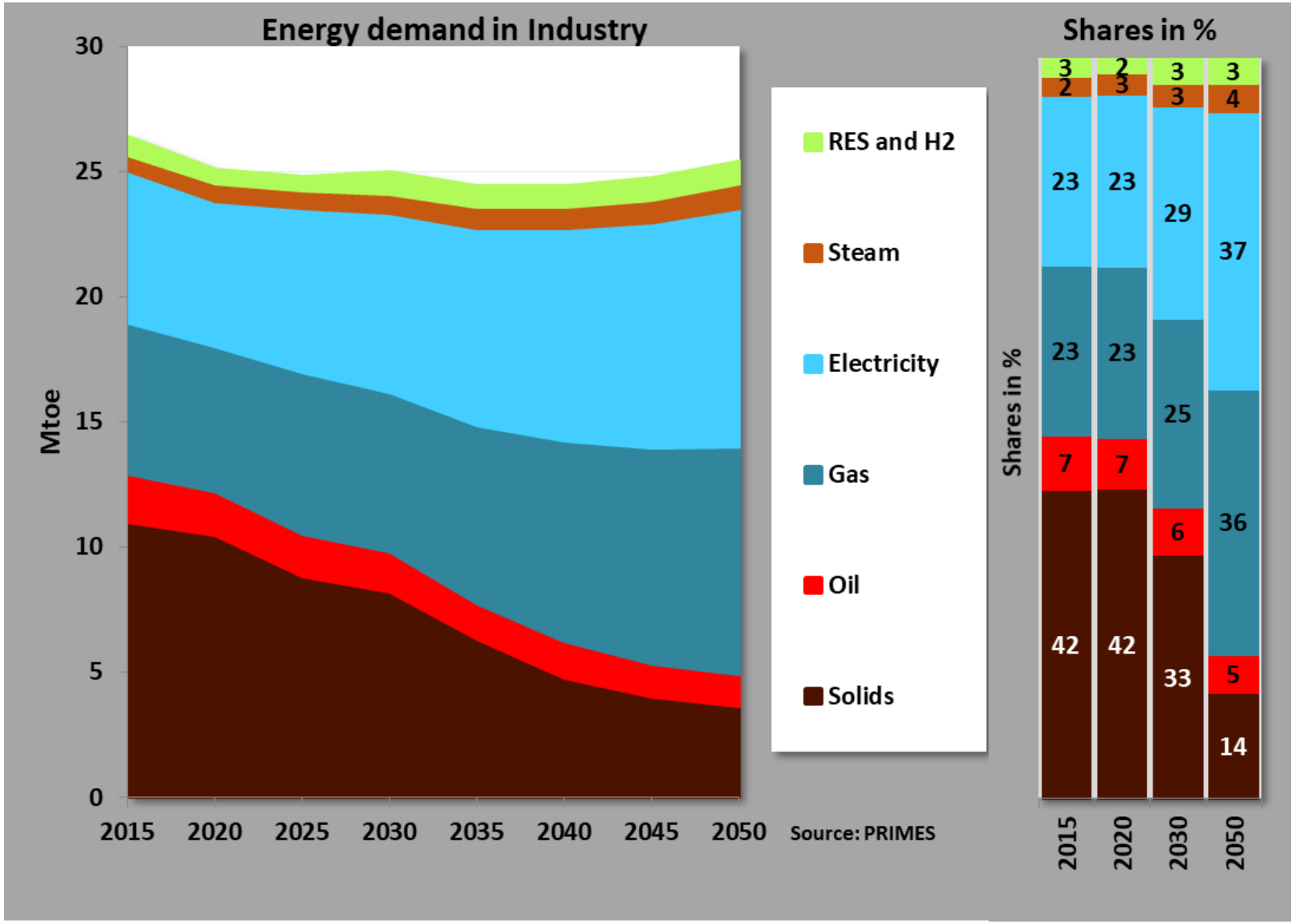
It is driven by:

- Technological progress embedded in industrial investment, as needed to modernize industry and sustain its competitiveness
- Higher shift, than historically, away from energy-intensive product varieties to high value-added production in all industrial sectors
- Policy support favoring energy efficiency, albeit of modest ambition and resources



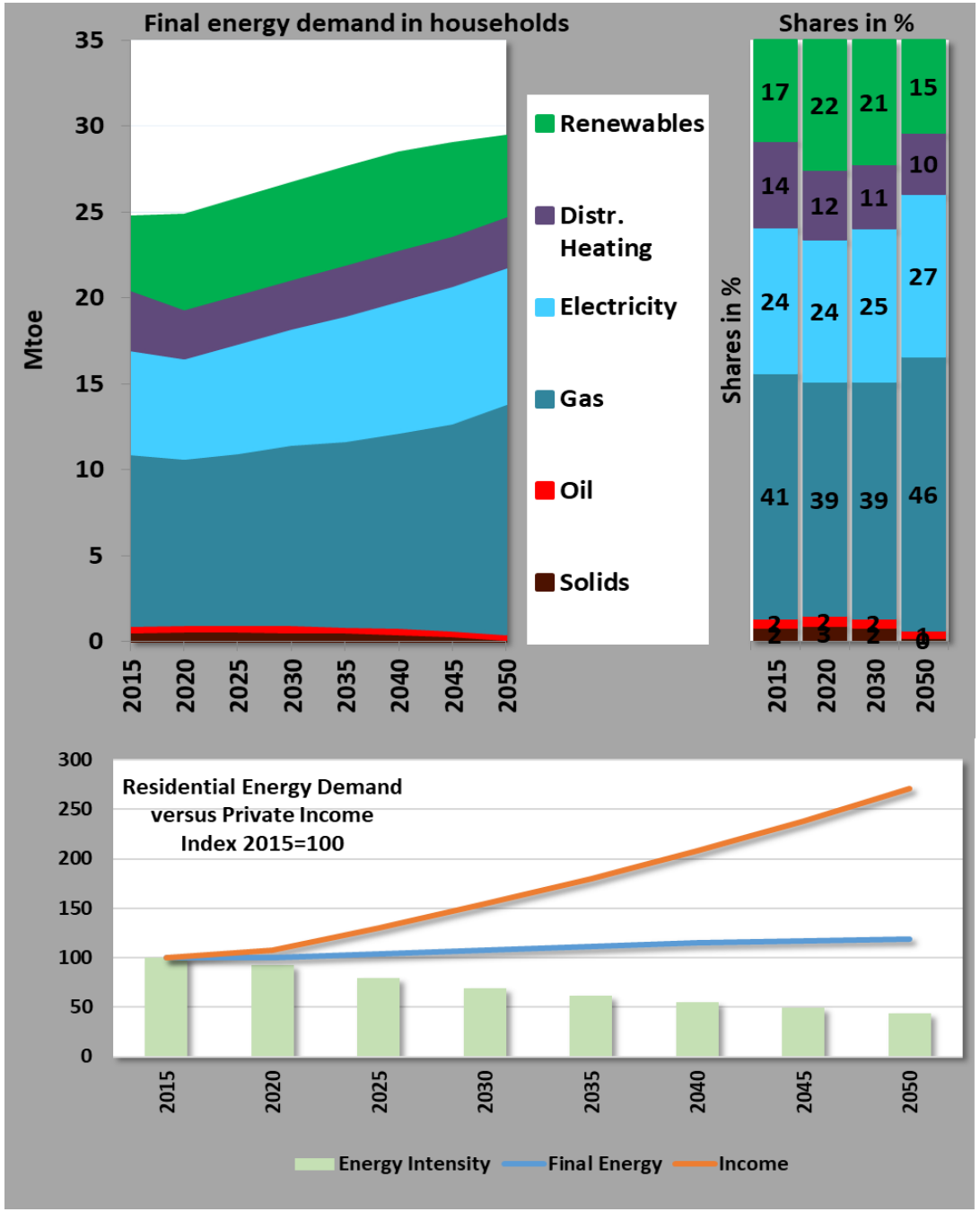
Energy demand & fuel mix
Industry

- The fuel mix in industry is gradually changing.
- Drivers:
  - Local pollution (coal, fuel oil)
  - Change of technologies, embedded in industry modernizing investment (electrification)
  - High value-added product varieties (favoring gas and electricity)
- Solids and, to a lesser extent, oil are substituted by natural gas and electricity.
- Renewables and steam (both moderately increasing) are assumed to maintain their share in the mix.
- Electrification is pronounced, particularly in the long term (2040-2050).



Energy demand & fuel mix
Households

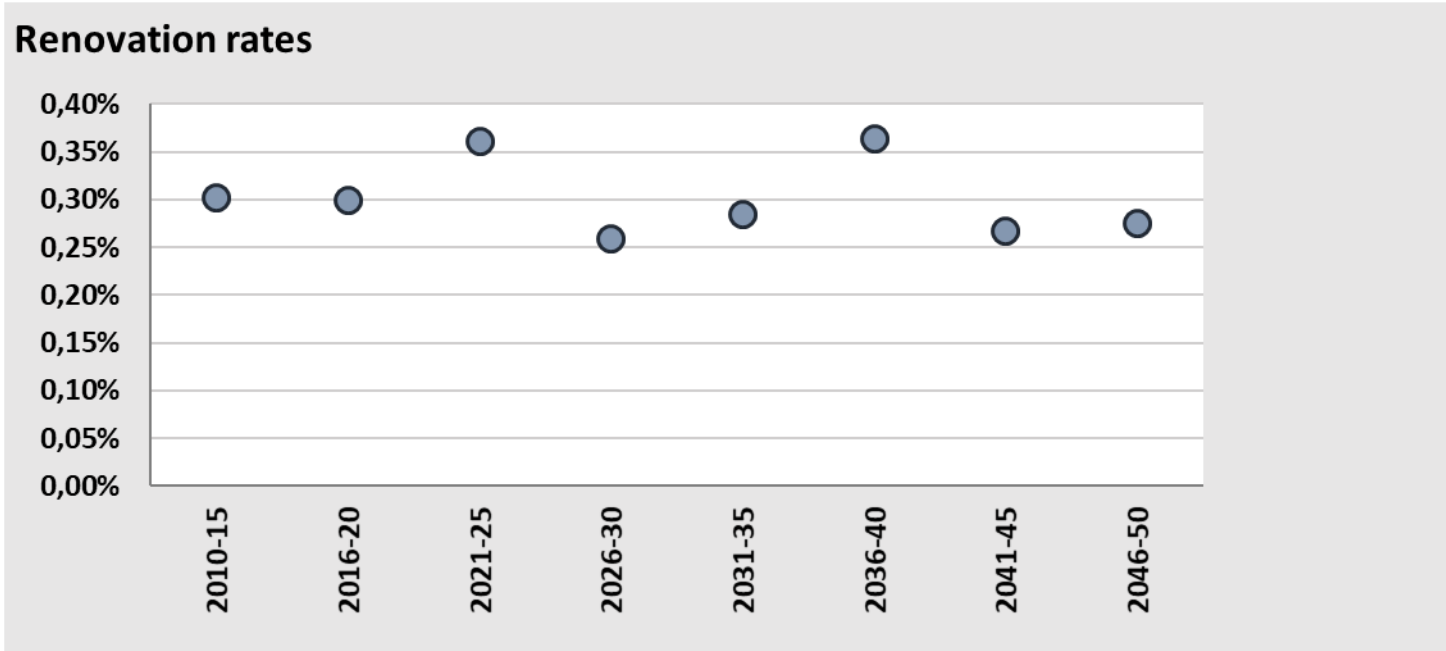
- Despite the diminishing population, energy demand is increasing after the period 2015-2020, albeit at a decelerating growth rate in the longer term. This is driven mainly by the income growth that leads to higher thermal comfort levels and higher penetration of electric appliances.
- Although the adoption of energy efficiency policies are at an early stage, energy demand decouples from income growth, due to technological advancement embedded in new appliances, lighting and heating equipment. Building renovation for energy savings remains poorly developed in the baseline policy context.
- The evolution of the fuel mix in the residential sector continuous recent consumption trends - evident in the energy balances – characterized by increase of gas use enabled by gas grid expansions and electrification, driven by appliances, air conditioning and higher use of electricity for heating.

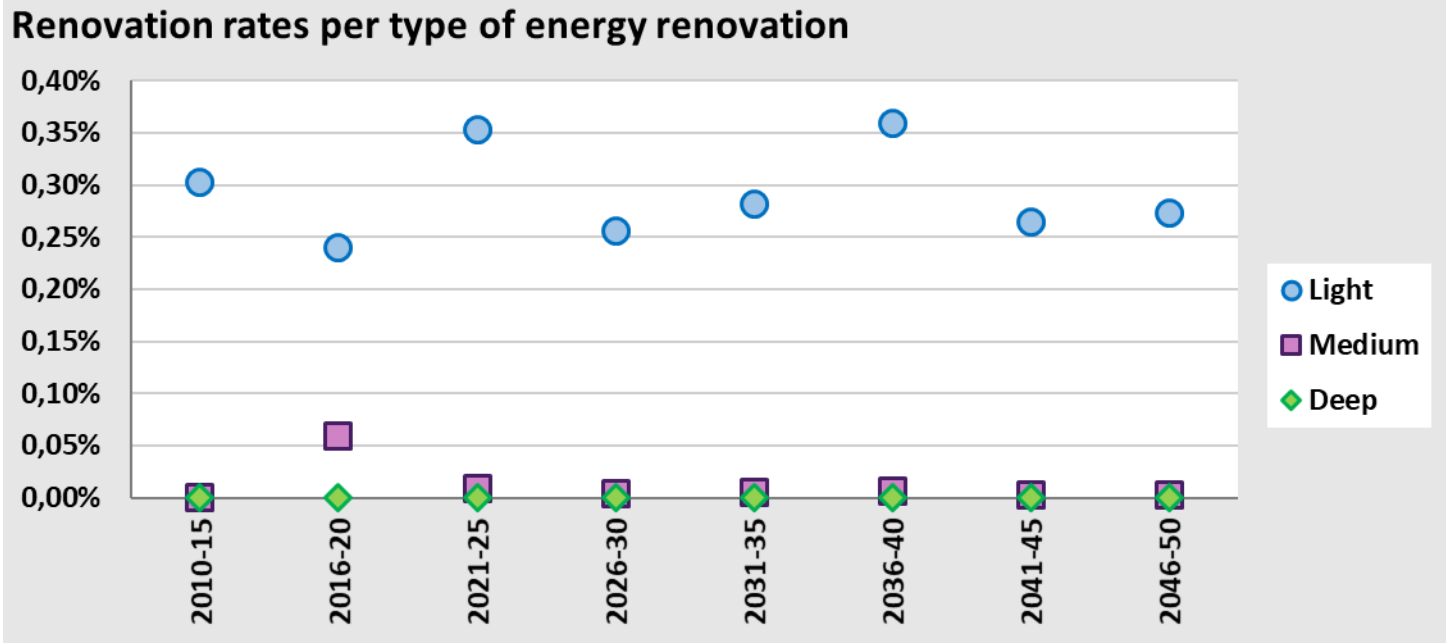


Renovation *Households*

The average renovation rates are stable throughout the whole projection period, due to poor policies towards the enhancement of renovation.

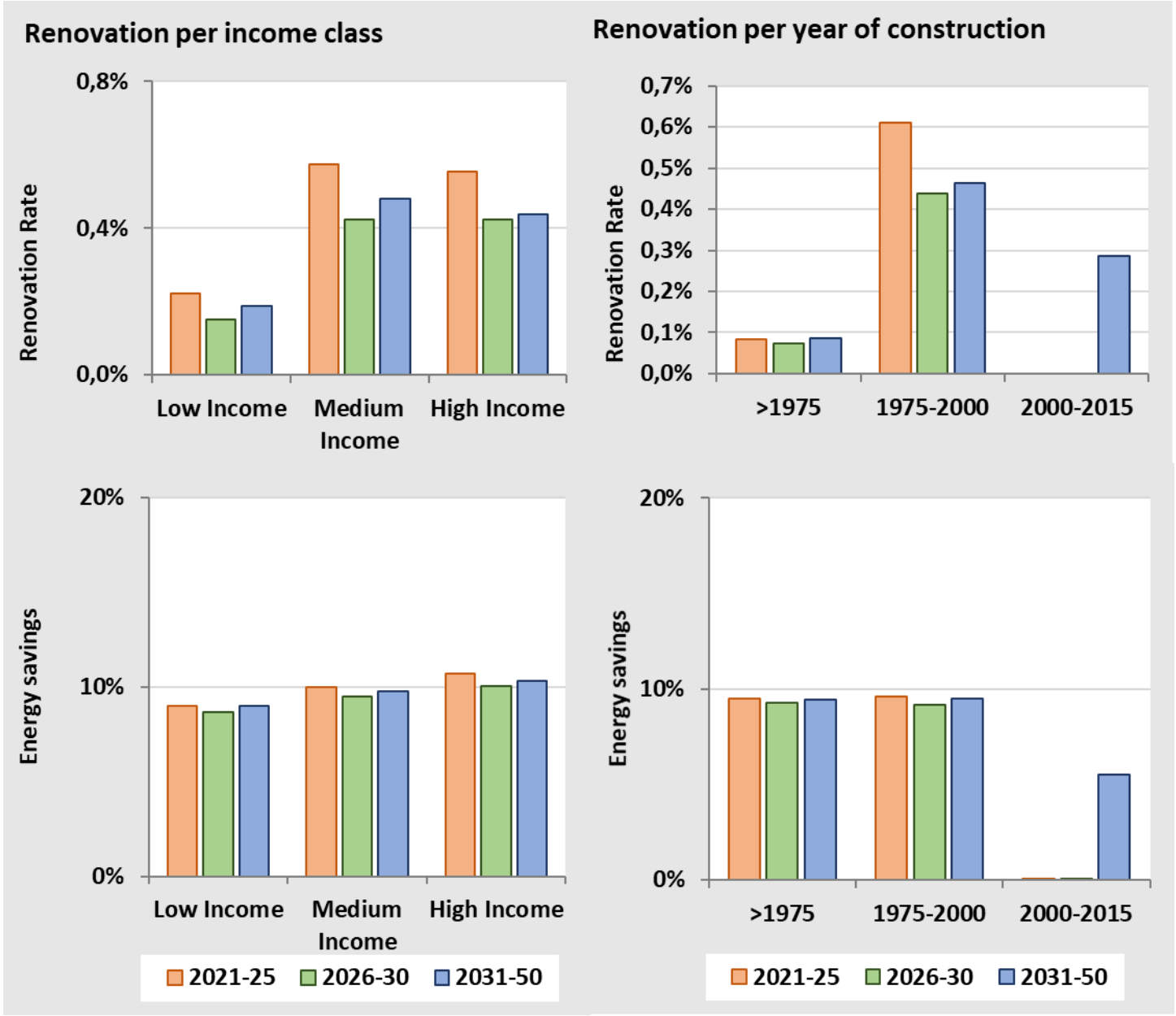
It is assumed that given the uncertain policy framework, the scenario involves only light renovation interventions.





Renovation *Households*

- Low-income households invest to a lesser extent on renovation, both regarding the frequency and deepness, compared to higher income classes.
- Thus, energy savings are greater in medium and high-income households, due to higher renovation rates and higher per capita consumption.
- Mid-aged buildings are expected to undergo higher degree of renovation, while retrofitting of older buildings is associated with higher costs. Regarding recent constructions, shifting renovation in the long-run is more cost-effective.



Energy demand & fuel mix
Tertiary sector

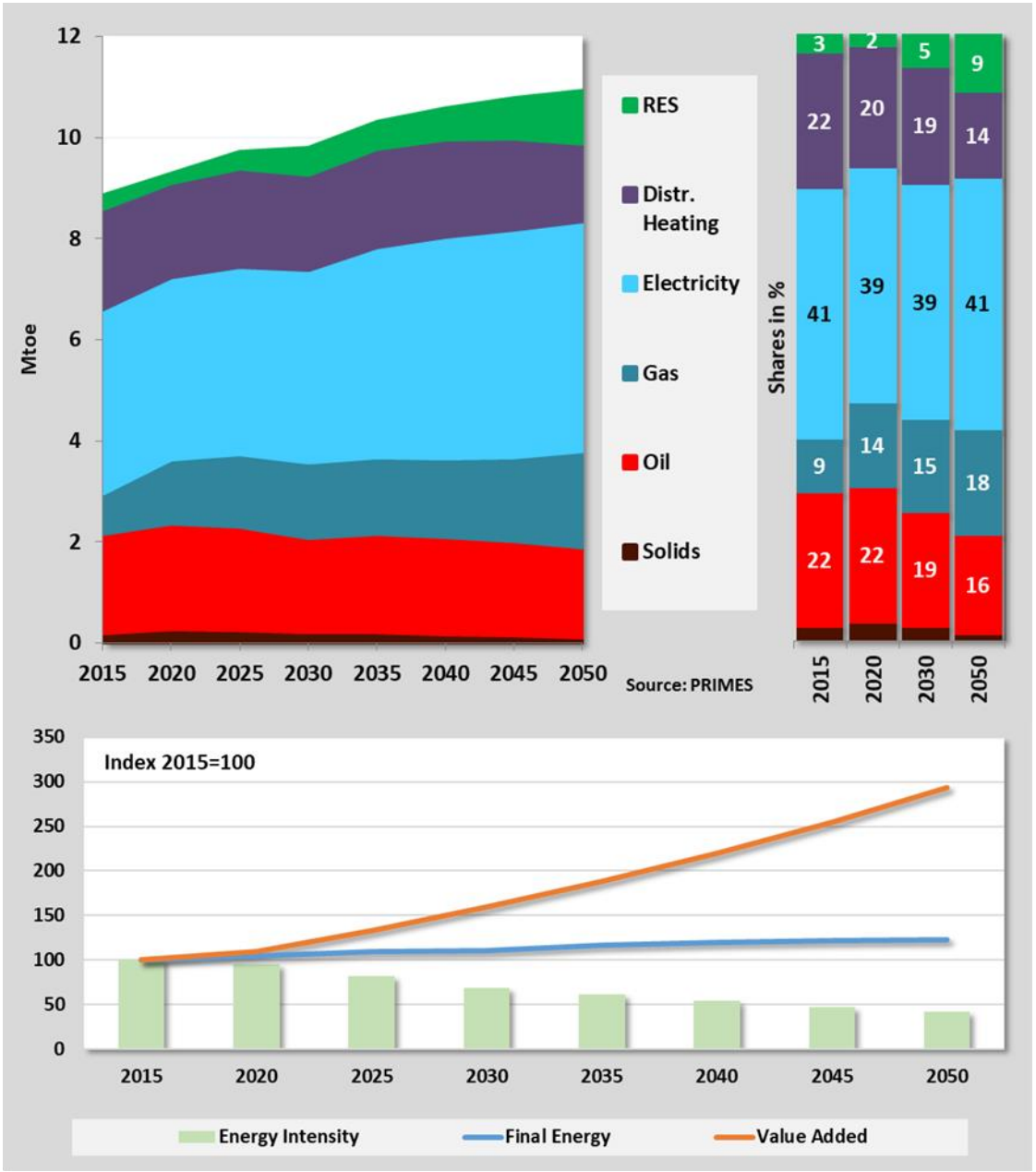
The services sector is the most important source of value added and grows significantly.

The projection of energy demand in the services sector continues the increasing trend observed in the recent past.

However, the growth rate of energy demand slows down in the long-run.

The projection shows strong decoupling between energy and activity due to energy efficiency enabled by technological improvement, embedded in appliances and lighting, as well as in the increasing use of electricity for heating and cooling.

Electrification is also due to the increasing use of electric appliances and equipment in the sector.



Energy demand & fuel mix in *Transport*

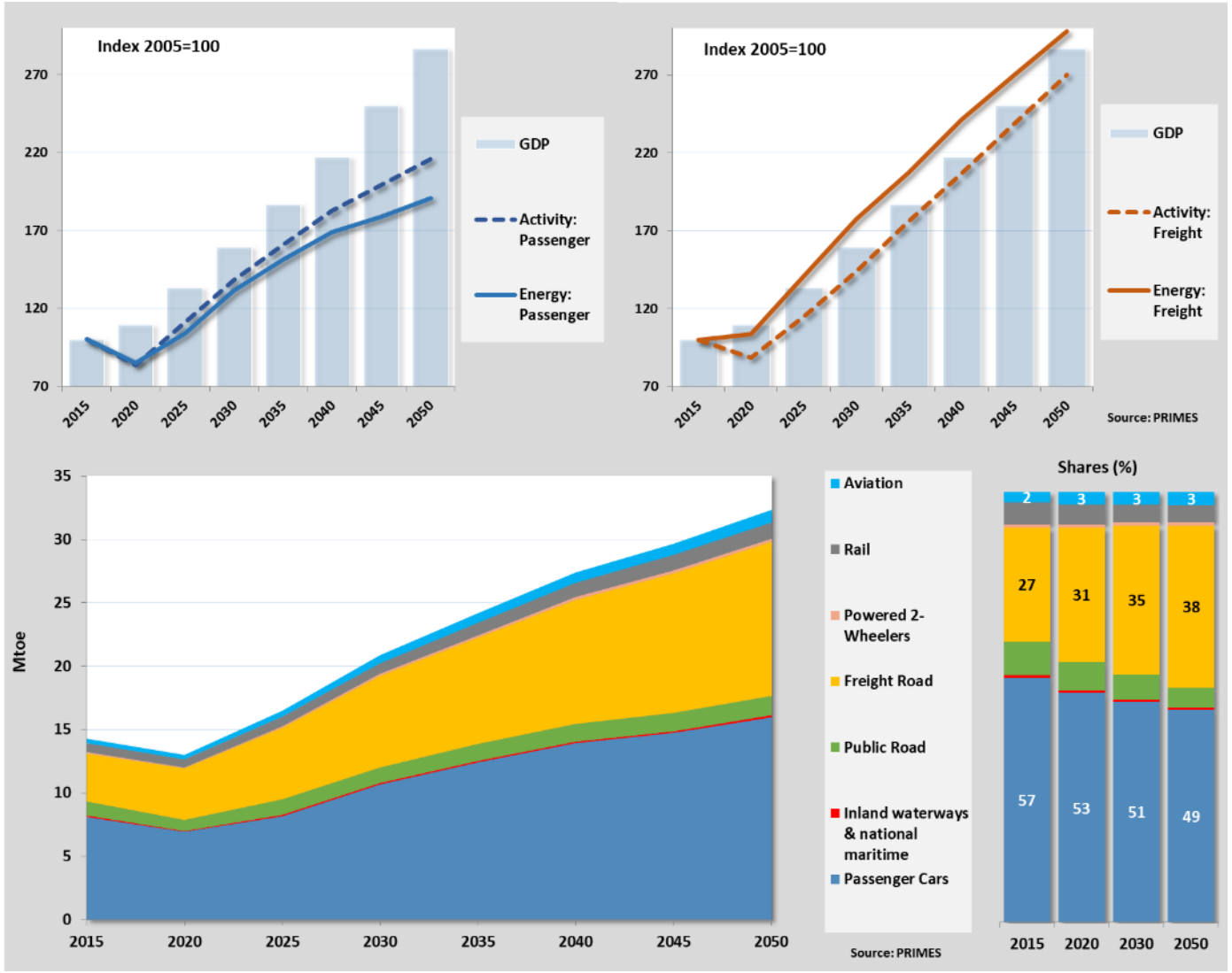
After the COVID downturn, passenger transport returns to an increasing trend. Passenger activity per capita in the Energy Community is much lower compared to EU average. Far from reaching saturation, activity increases in line with income. A slight decoupling from GDP emerges in the long run.

Freight transport activity projected to continue strong coupling with GDP growth throughout the projection period.

In lack of ambitious policies to improve the efficiency of the transport system, energy demand follows the pace of transport activity growth. Technology improvement of conventional vehicles is slow and thus the implied energy intensity improves also slowly.

Passenger cars represent the largest share in energy demand. Energy use by freight road vehicles increases faster than for passenger cars, due to higher increase in activity.

Aviation and rail maintain small shares in total energy demand by passenger transport.



Energy demand & fuel mix
Transport

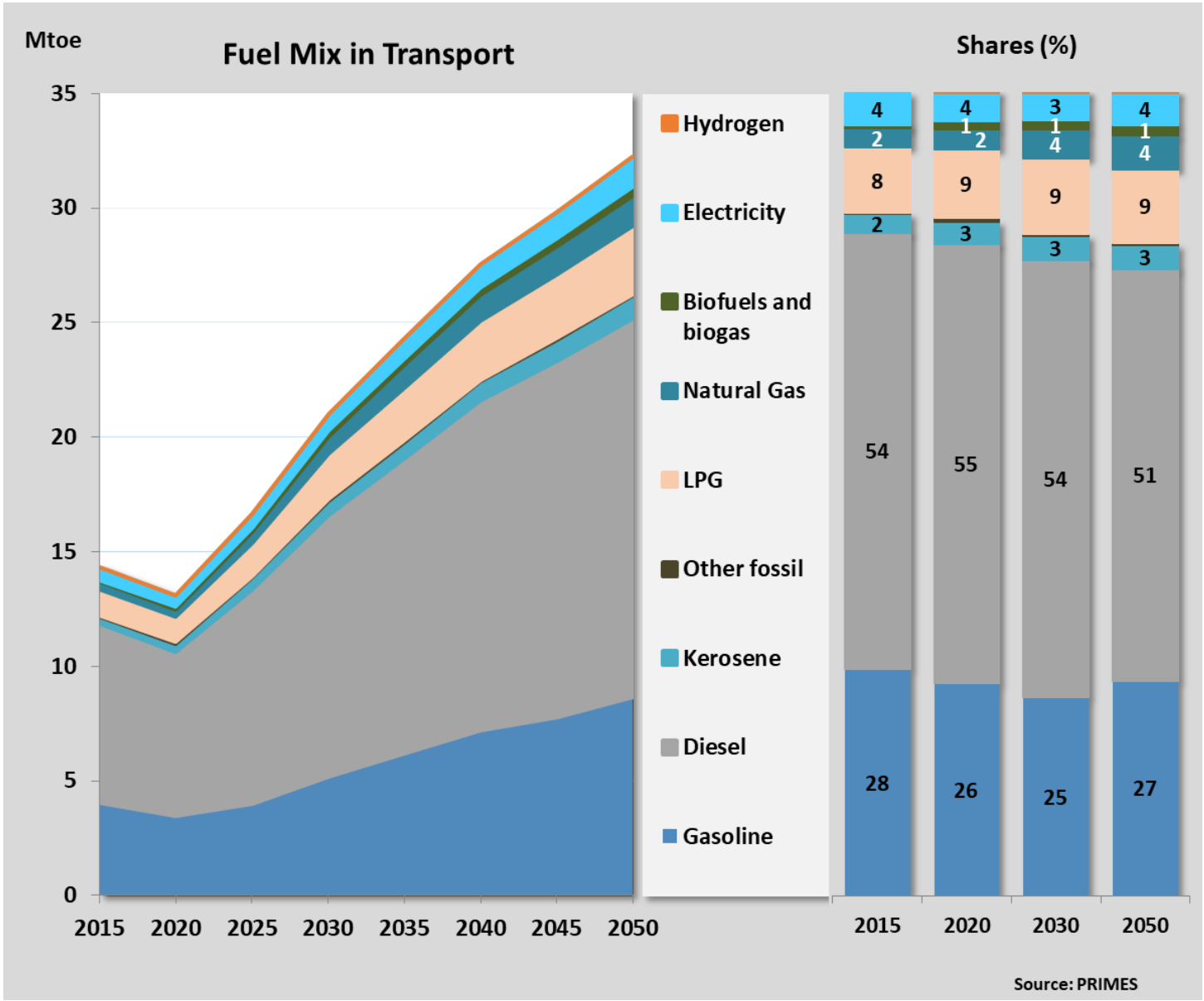
The scenario does not include policies for fuel substitution in the transport sector and thus alternative fuels uptake remains relatively limited.

The projected fuel substitutions occur for economic reasons. An example is the wider use of LPG.

Oil products heavily dominate the market accounting, covering 78% of total consumption 2050; a mere 4% drop from 2015 levels. Demand for gasoline increases slightly less than total consumption in the transport sector, whereas demand for diesel increases at a slightly higher pace driven by relative costs and its exclusive use for freight transport and rail.

Electricity accounts for 4% of total energy consumption, which remains stable covering part of rail transport.

The share of biofuel in final energy consumption hardly reaches 1%, as a result of modestly ambitious policies that impose small blending quotas.



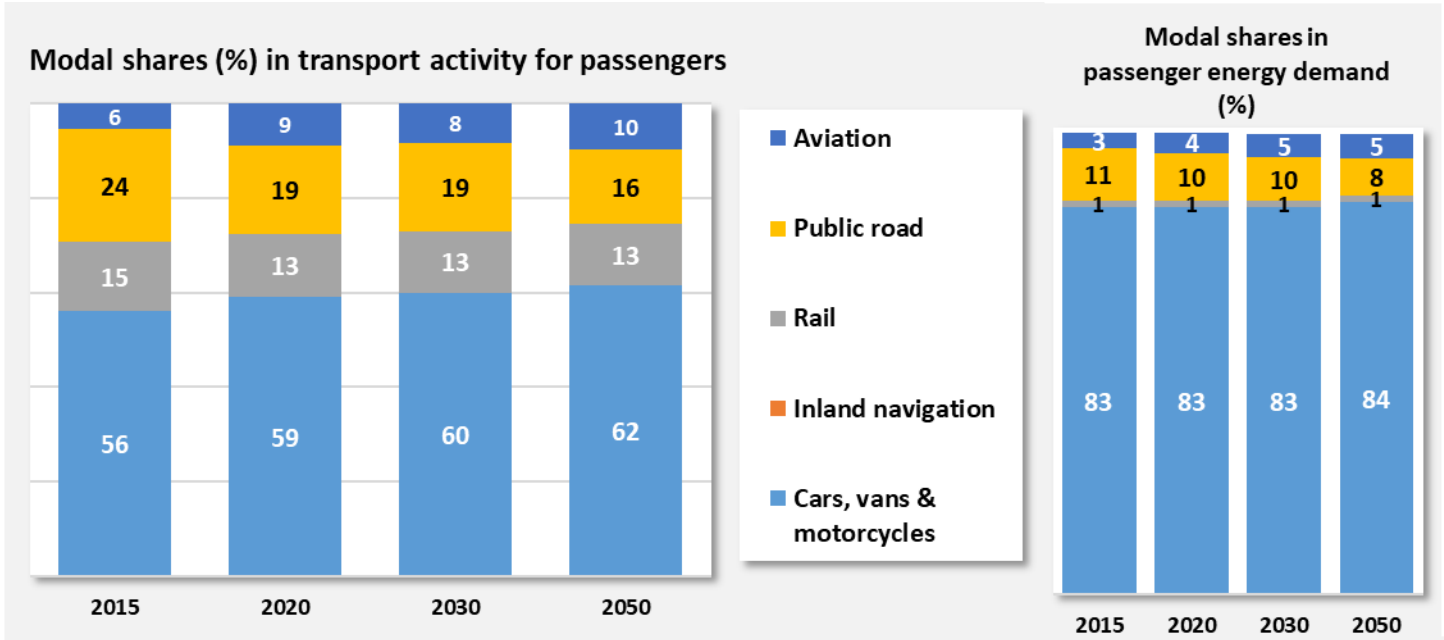
Energy demand & fuel mix

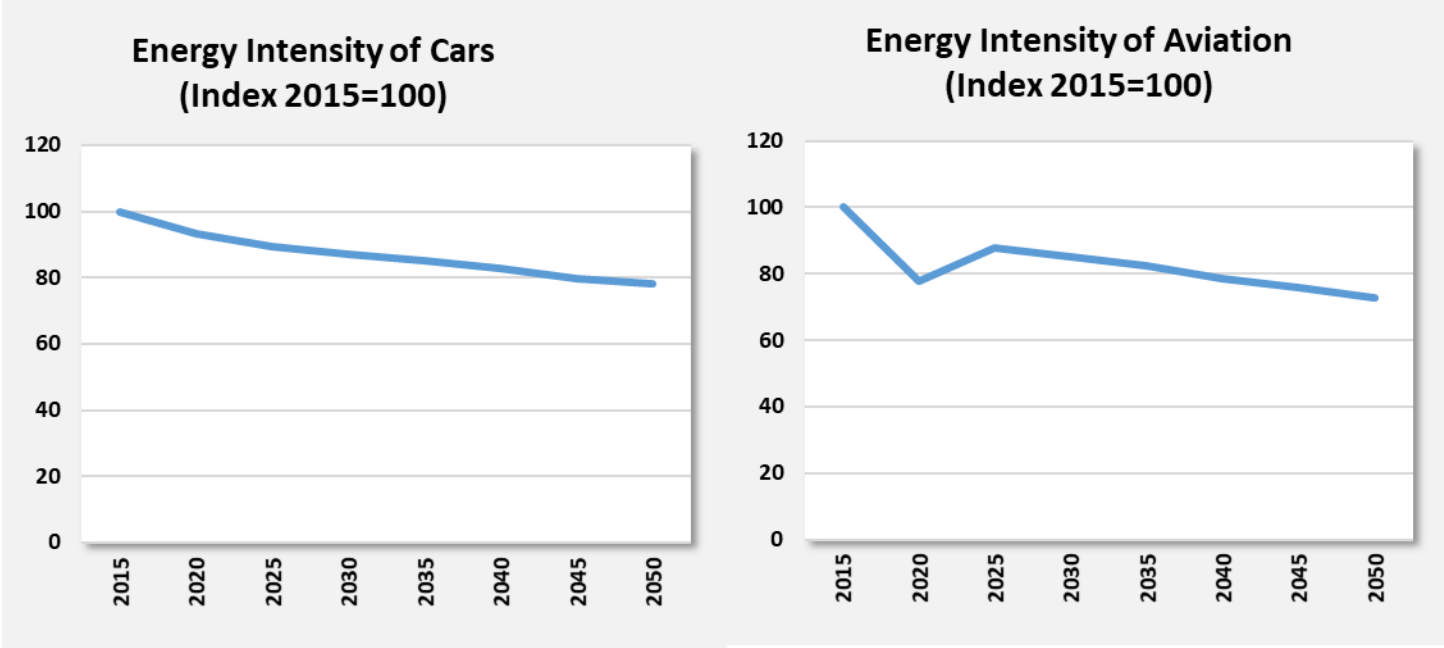
Passenger Transport

Far from reaching car ownership saturation in the Energy Community, private cars increase their share by 6 percentage points until 2050, up from 2015 levels, mainly to the detriment of public road transport.

The improvement of energy efficiency of passenger cars is slow due to the wide use of imported second-hand cars. The moderate energy efficiency improvement allows the share of cars in total energy consumption of passenger transport to remain stable, despite their modal share increase.

The share of air transport in total energy use slightly increases over time, driven by increasing activity shares.





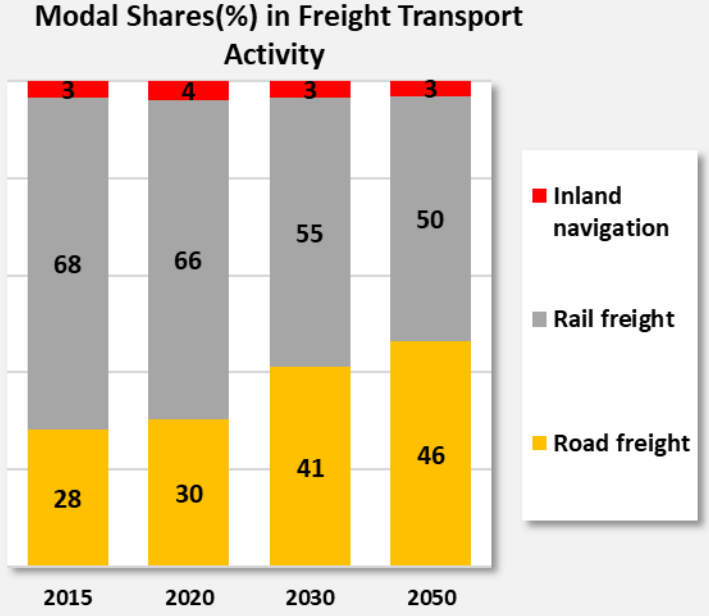
Energy demand & fuel mix

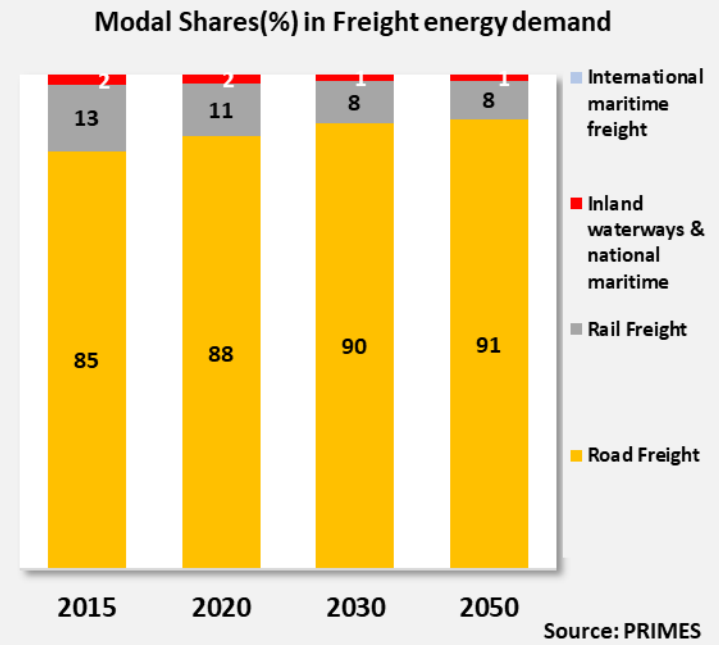
Freight Transport

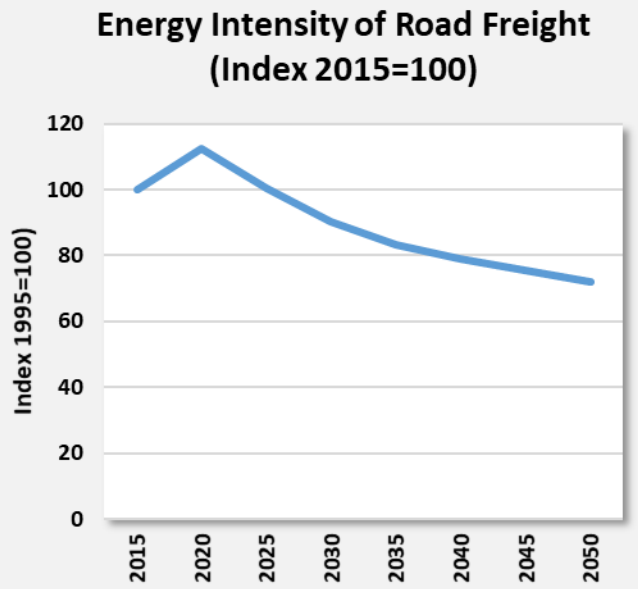
The projection of modal shares in freight transport involves a considerable shift in favor of road transport, which increase its share by 14 percentage points until 2050, up from 2015 levels. The share of freight rail transport equally decreases.

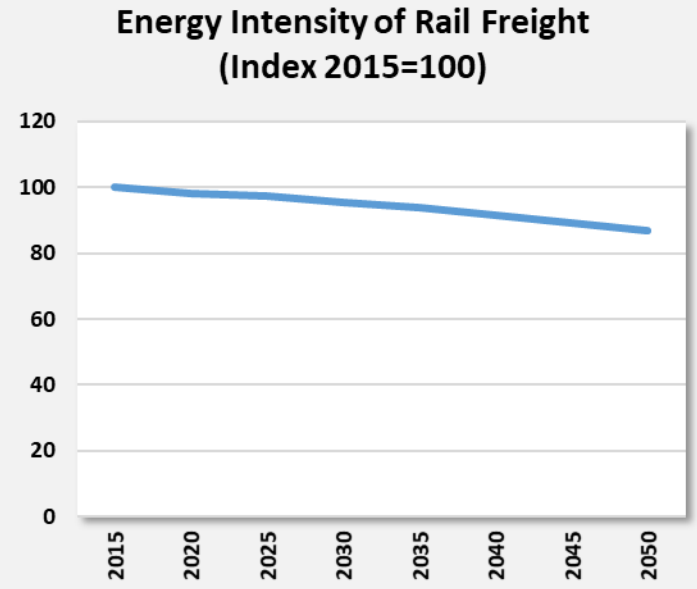
No specific policies are assumed to incentivize freight rail in the baseline scenario. Limited investment in rail infrastructure also deteriorates the technical and economic competitiveness of freight rail. Despite the rapid increase in road freight, rail's share does not go below 50% until 2050.

As trucks are highly energy intensive, energy consumption of freight increases, and consumption of trucks exceeds 90% of total energy demand in freight transport.



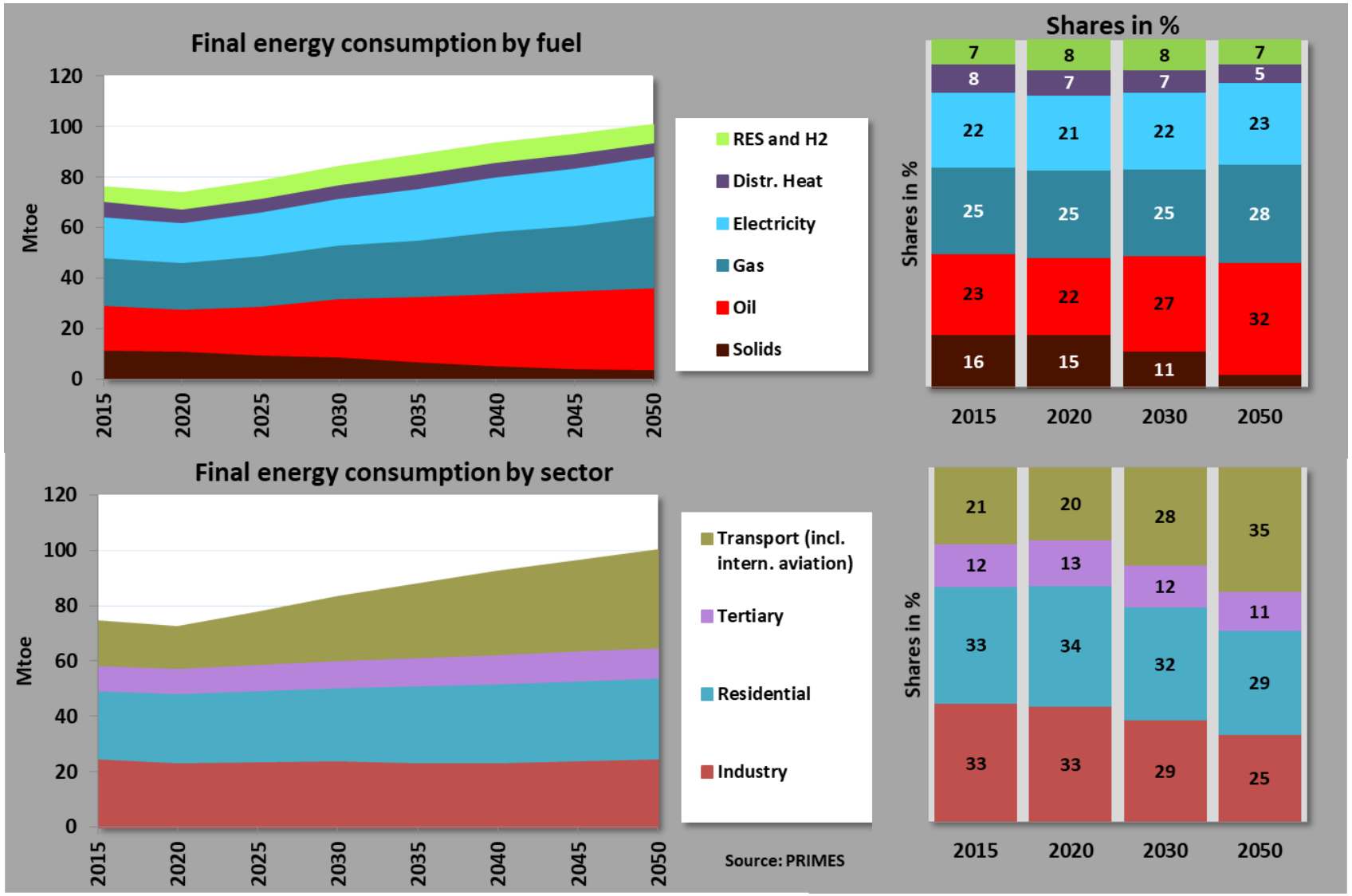






Total final energy demand by *Fuel & Sector*

- Final energy use of solids declines, substituted mainly by natural gas and electricity.
- The increased use of oil continuous historical trends and is due to the increase in energy demand for transportation.
- The share of RES, directly used in final energy consumption (biomass and to a lesser extent solar thermal) is stable, mainly consisting of traditional uses of biomass in specific segments of the market.
- Electrification develops moderately, but only in stationary energy uses, in the absence of policies for electromobility.
- The absence of focused policies do not allow alternative fuels to develop.
- Transport continuous historical trends representing the largest share of the incremental changes of final energy demand.
- Beyond 2030, while stationary energy demand benefits from technological progress and improves energy efficiency, energy in transport continuous to grow and conquers the largest sectoral share in total final energy demand.



Power & Steam generation

Preliminary results

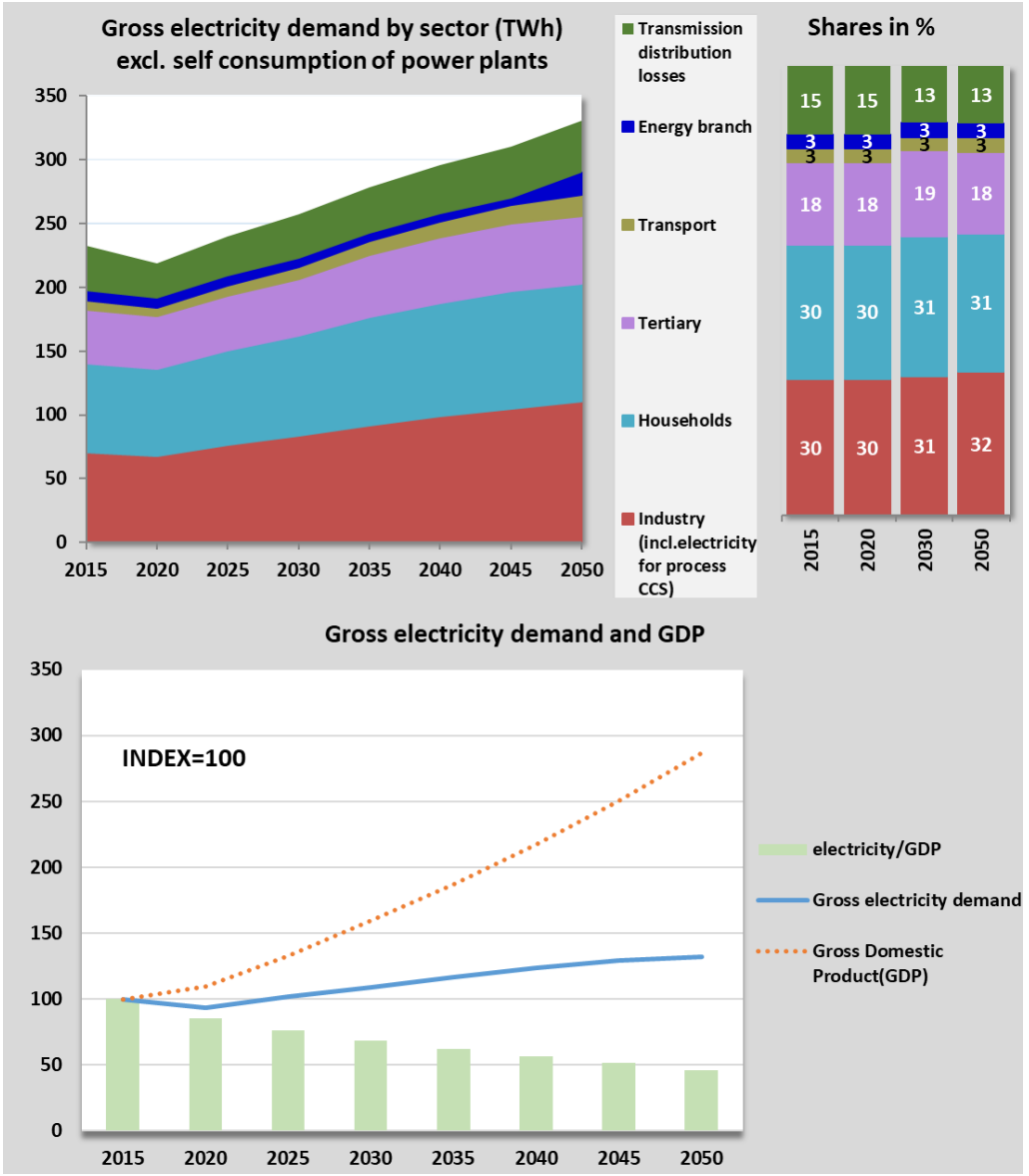
Electricity demand

Demand for electricity steadily increases in the medium and long term, following the COVID downturn in 2020.

The pace of increase in the demand of electricity is significantly faster than for the overall energy demand. The demand of electricity shows strong decoupling with GDP, driven by technological progress, energy efficiency and the shift to less energy intensive products in the industry.

The increase of electricity use takes place in all final demand sectors. However, the absence of specific policy measures, limits electrification in all final demand sectors.

Electromobility does not emerge in the baseline scenario and electricity uses remain small, originated mainly from the rail sector.



Power generation by source

Natural gas and RES cover the incremental changes of demand for electricity in the projection.

New coal do not develop, assuming that investors are reluctant to invest in greenfield coal power stations. However, assumed policy supports succeed to retard the decline of solid-based generation by retrofitting and extending the lifetime of aged coal and lignite plants. Coal-based generation decreases significantly only in the long-term.

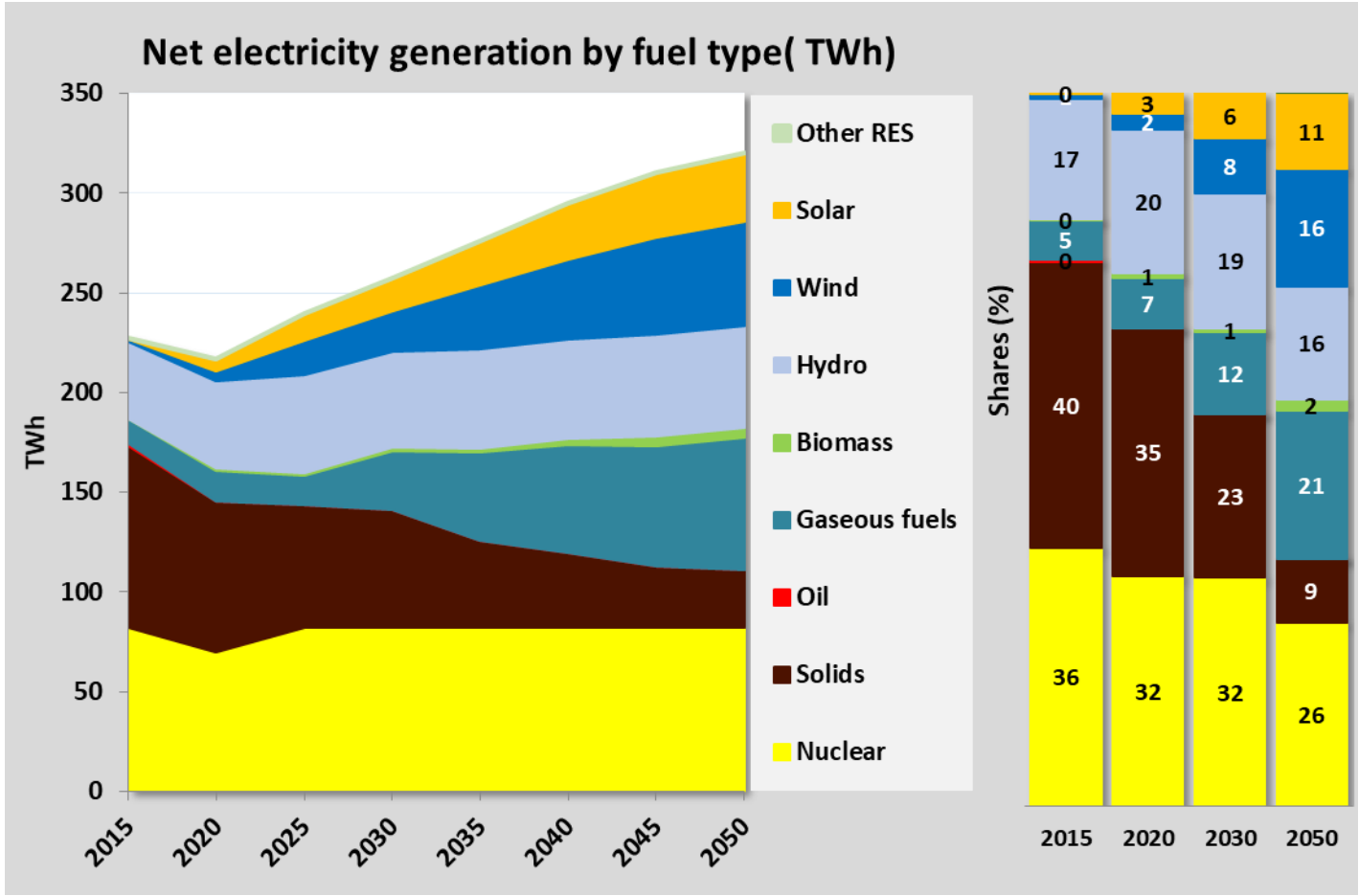
The projected long run trend shows development of gas plants, wind and solar PV. Gas supply infrastructure also develops in a timely manner. However, such a gas development is uncertain given that in the long-term demand for gas in the EU will decline in the context of green transition.

Variable RES reach shares of 14% and 25% in total net electricity generation in 2030 and 2050, respectively.

Generation from nuclear plants, belonging to Ukraine, remains stable in the projection thanks to lifetime extension of existing units, assume to be technically possible.

Hydropower capacities also remain stable (slightly increasing).

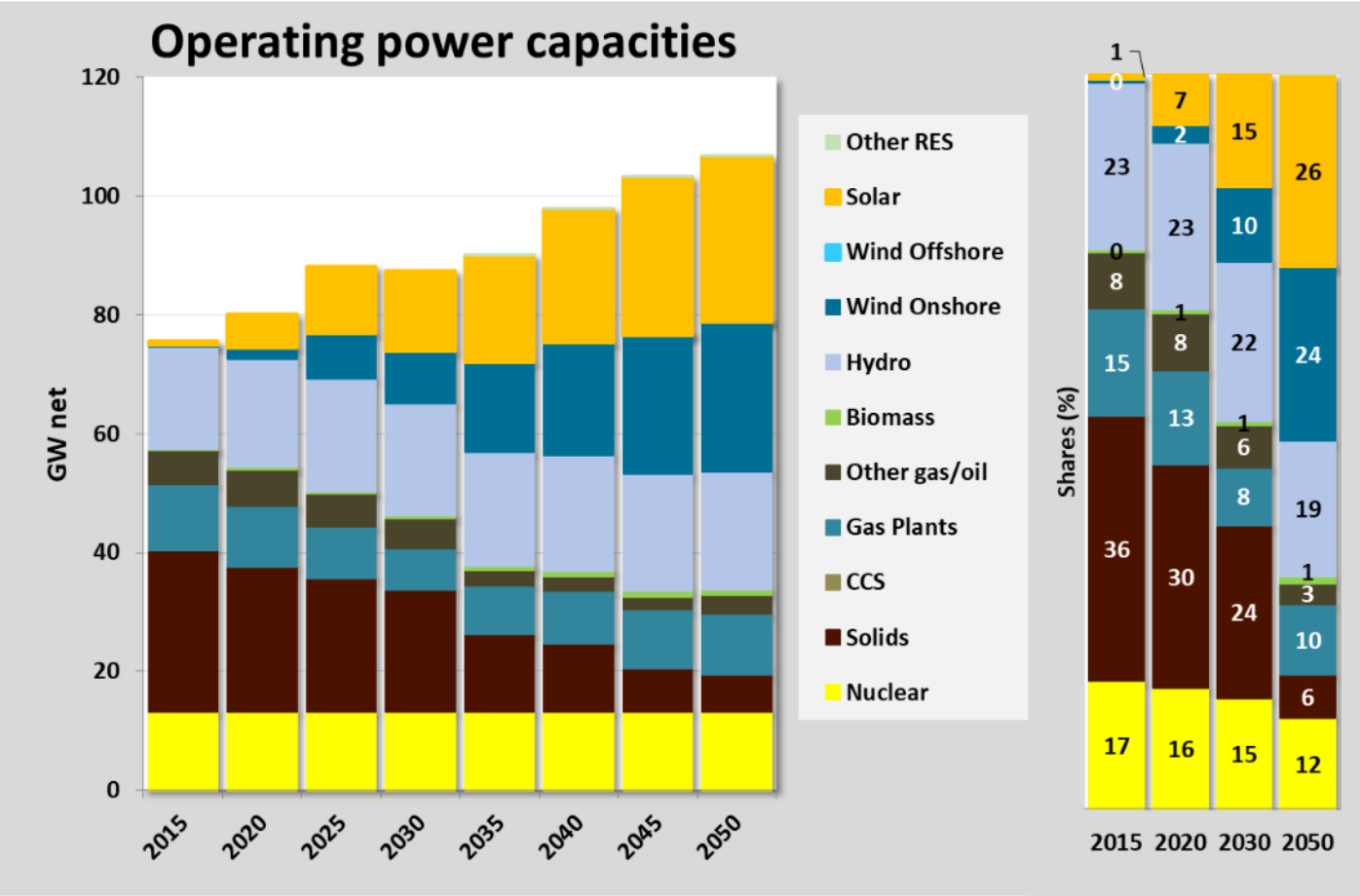
Therefore, both nuclear and hydro decrease in share terms.



Power generation capacity

The total capacity of the gas power fleet increases in the long-term and partly replaces decommissioning coal plants. New investment in CCGT technology replace old power stations, increase efficiency and modernize cogeneration used for district heating.

Coal/lignite capacities decrease only by 25% in 2030, compared to current levels, thanks to the lifetime extension of ageing plants.



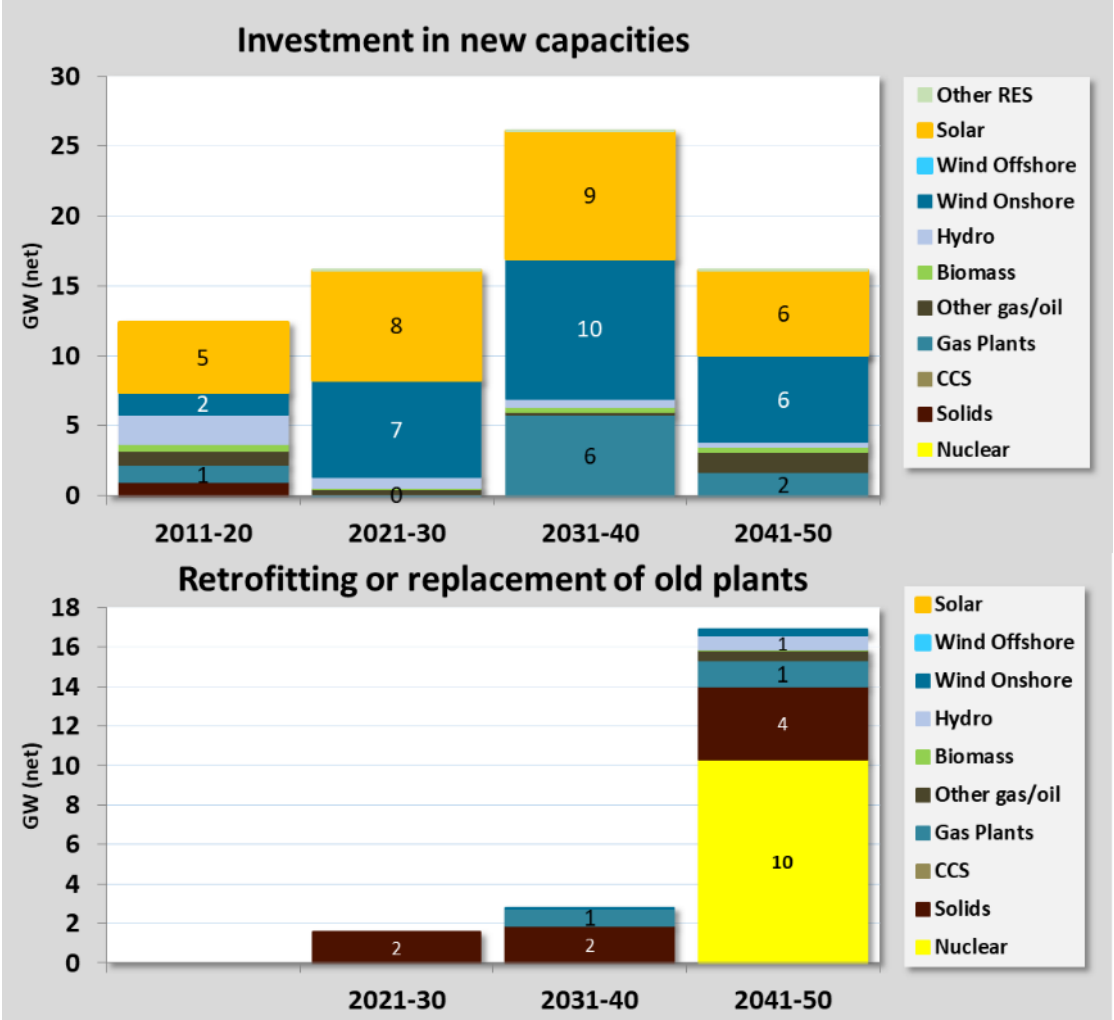
Capacity Investment

Investment in new power plants mainly concerns RES, notably solar PV and wind.

Gas power investment mainly takes place after 2030, obstructed by the delayed decommissioning of coal plants.

Between 2021 and 2050, a total of 8 GW of coal plants are retrofitted cumulatively

10 GW of retrofitted nuclear plants allow maintaining the Ukraine nuclear fleet in operation



Electricity prices

Electricity prices are currently significantly lower than the EU average, but comparable to prices in the East EU Member States.

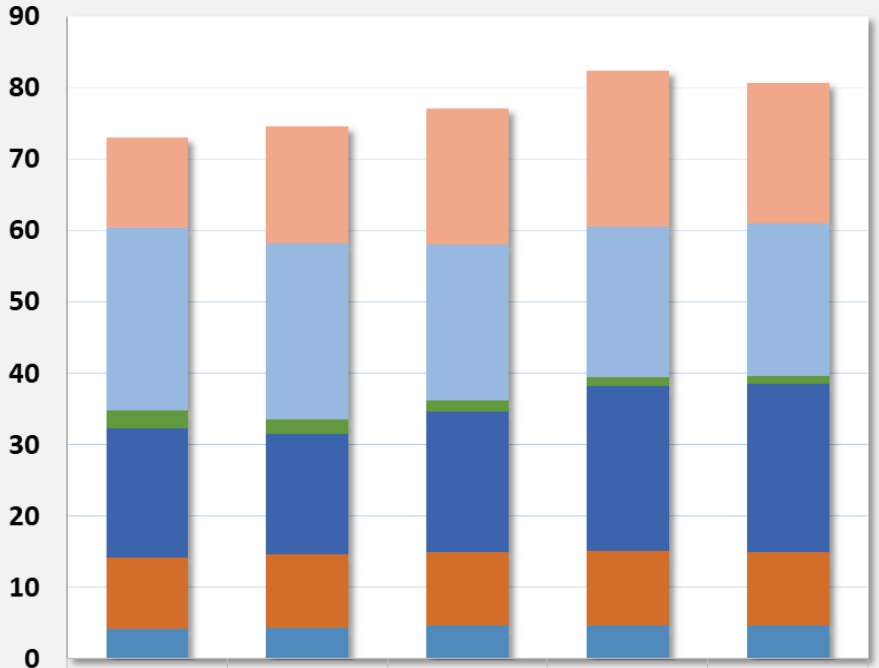
It is doubtful if current prices do recoup total generation costs, including capital costs. Underpricing has been a policy practice to address affordability issues. It is uncertain, and for how long, whether such a policy will continue.

Taxation and the non application of ETS partly explains the low electricity tariffs. Also grid costs are low, probably due to low modernization investment and probably a non-full recovery of capital costs.

The projection shows a moderate increase in electricity prices as needed to recover capital costs of new investment and the increased fuel cost in the long-term due to the partial substitution of coal by gas. The low levelized cost of RES mitigates the upward pressure on electricity price.

Decomposition of average electricity price

€'15/MWh

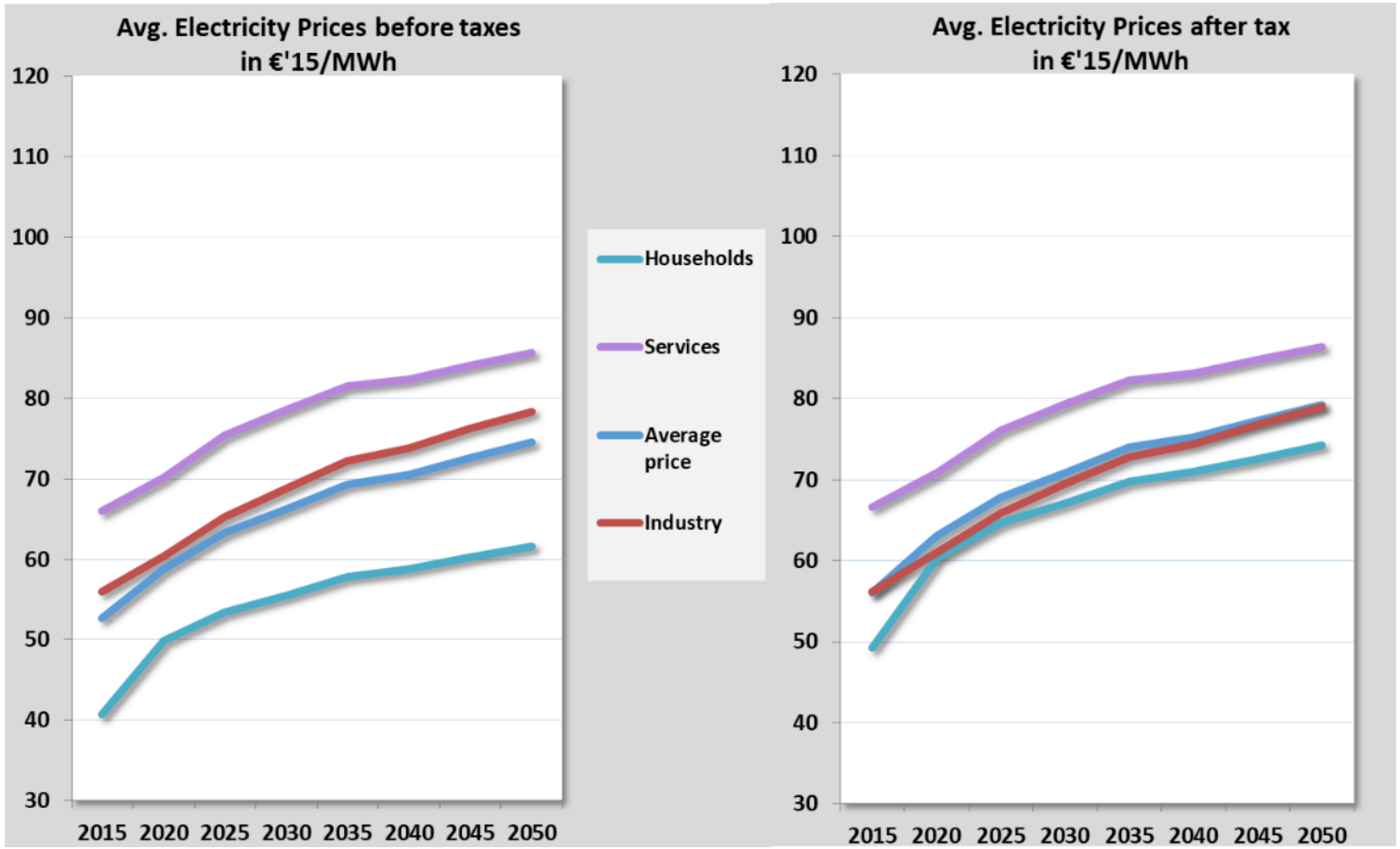


	2015	2020	2030	2040	2050
Annual capital cost	13	16	19	22	20
Fixed costs	26	25	22	21	21
Variable costs	3	2	2	1	1
Fuel costs	18	17	20	23	24
Tax on fuels and ETS payments	0	0	0	0	0
Grid costs	10	10	10	10	10
Excise tax and VAT on electricity	4	4	5	5	5
Average price of electricity (after tax)	62	67	73	77	80

Electricity prices by sector

The households enjoy lower electricity tariffs than industry due to policies that allow cross-subsidization, contrary to the optimum cost allocation structure that would suggest industrial prices to be much lower than households' tariffs.

This is an odd situation, assumed to continue in the future.

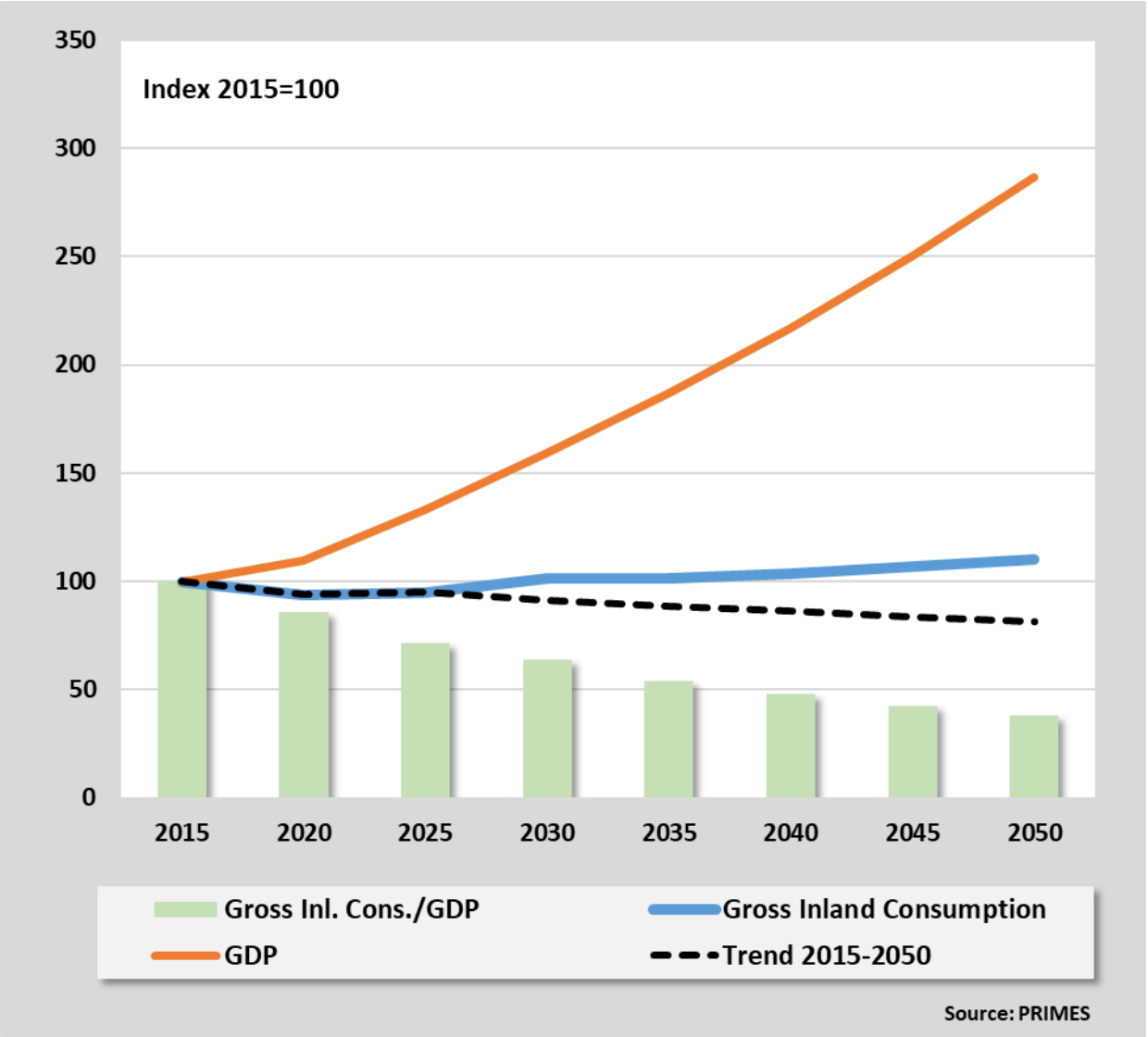


Primary energy demand & supply

Preliminary results

Primary energy demand and economic growth

- The decoupling of primary energy requirements from economic growth is continuous and further increases in the long term
- The decoupling of energy from economic growth is due to technological progress, the electrification, albeit modest, and the penetration of RES, and to a lesser extend CCGT technologies, in the power sector.



Gross Inland Consumption (GIC)

Gross Inland Consumption grows significantly until 2030 but decelerates close to 2050.

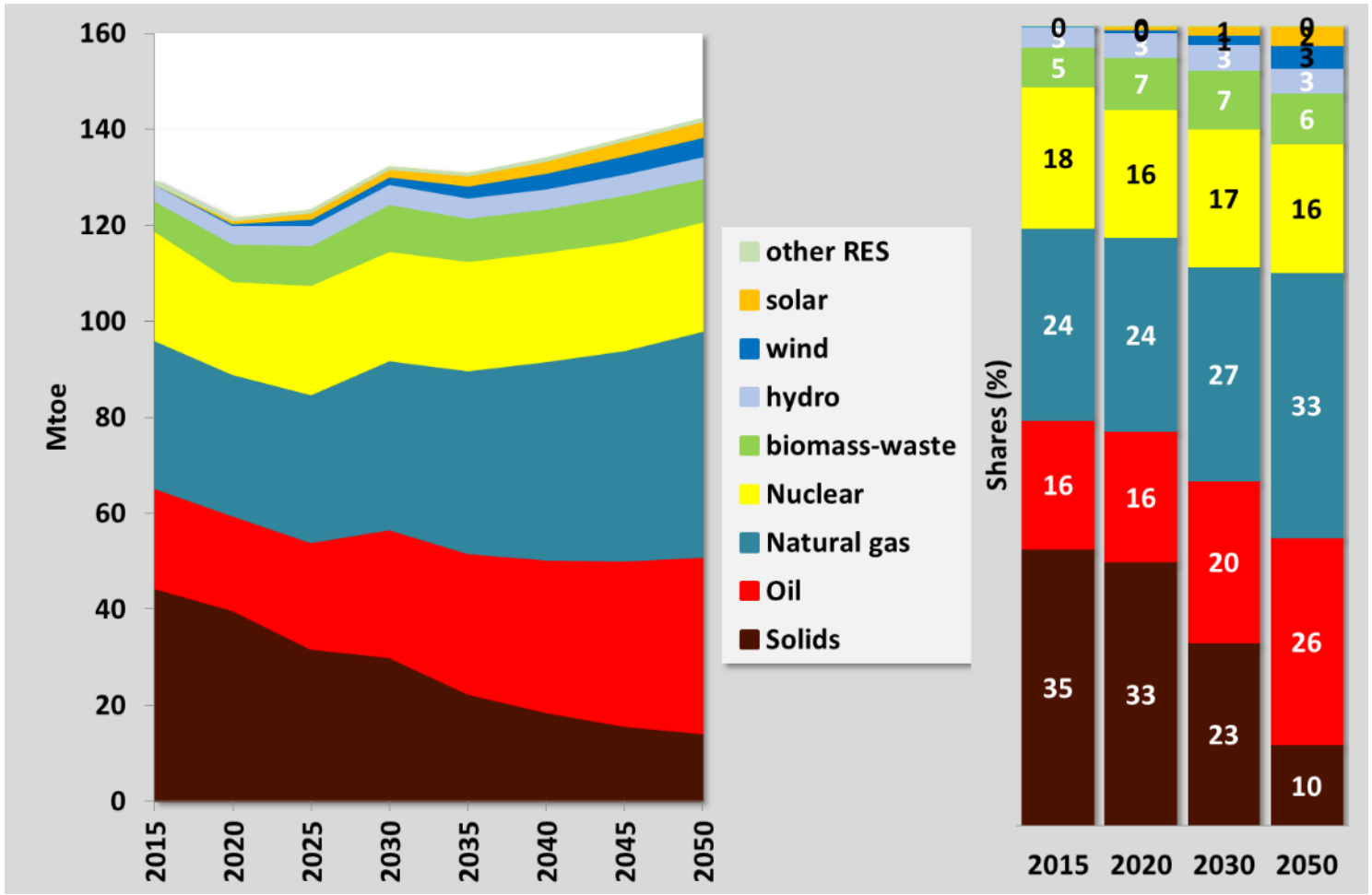
Solid fuels decline, both in the power and final demand sectors

Renewables increase slowly, mainly in power sector driven by their low costs. Among the RES, solar energy is projected to grow fastest.

Oil maintains a large share in primary energy requirements, due to limited substitution by alternative fuels in the transport sector, which presents the highest growth among all sectors in terms of activity and demand for energy.

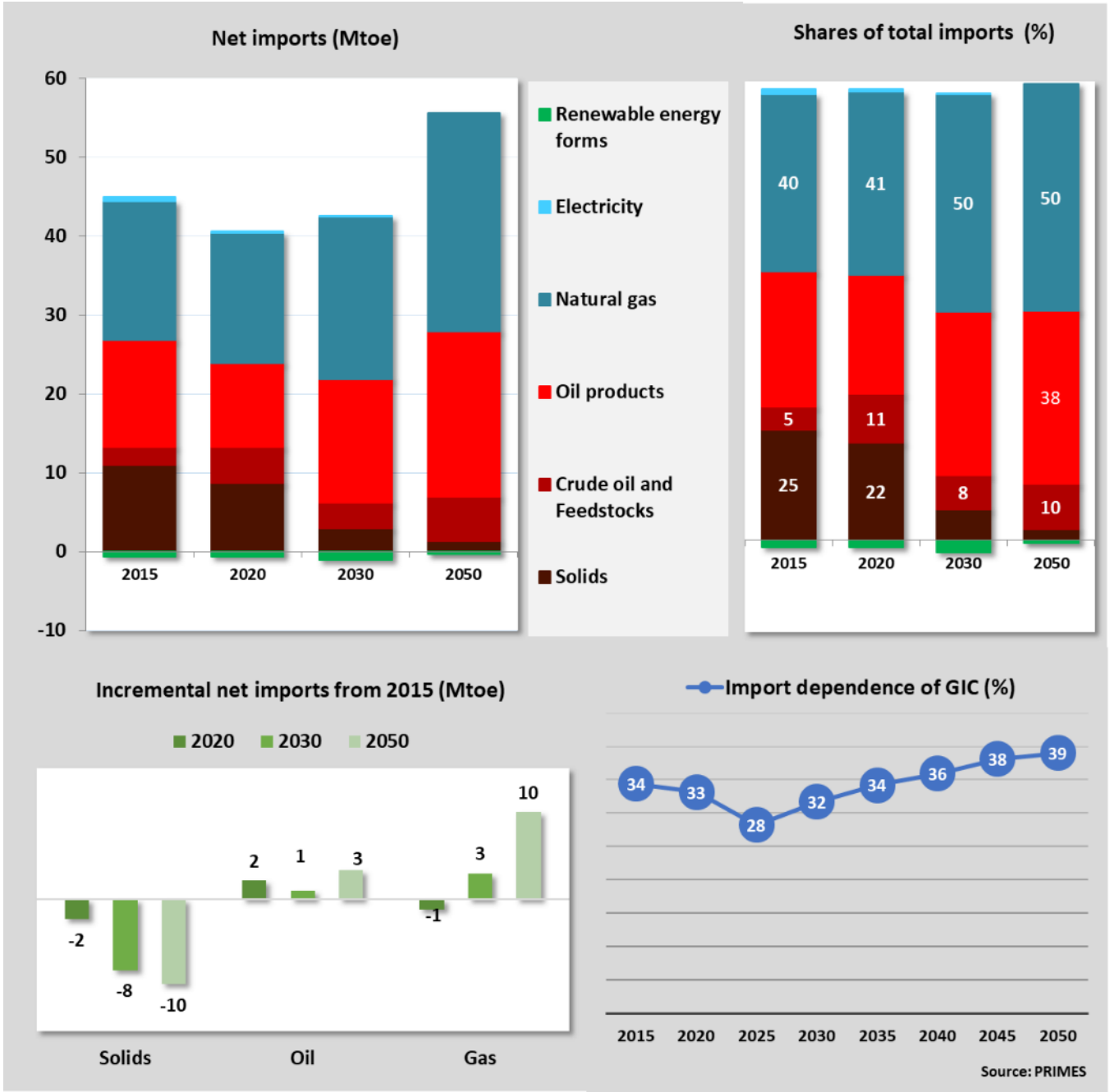
The share of natural gas increases, in all stationary energy uses, as well as in power generation.

Nuclear capacity is stable due to retrofitting investment but exhibits a slowly declining share in total primary energy, due to the absence of new investment.



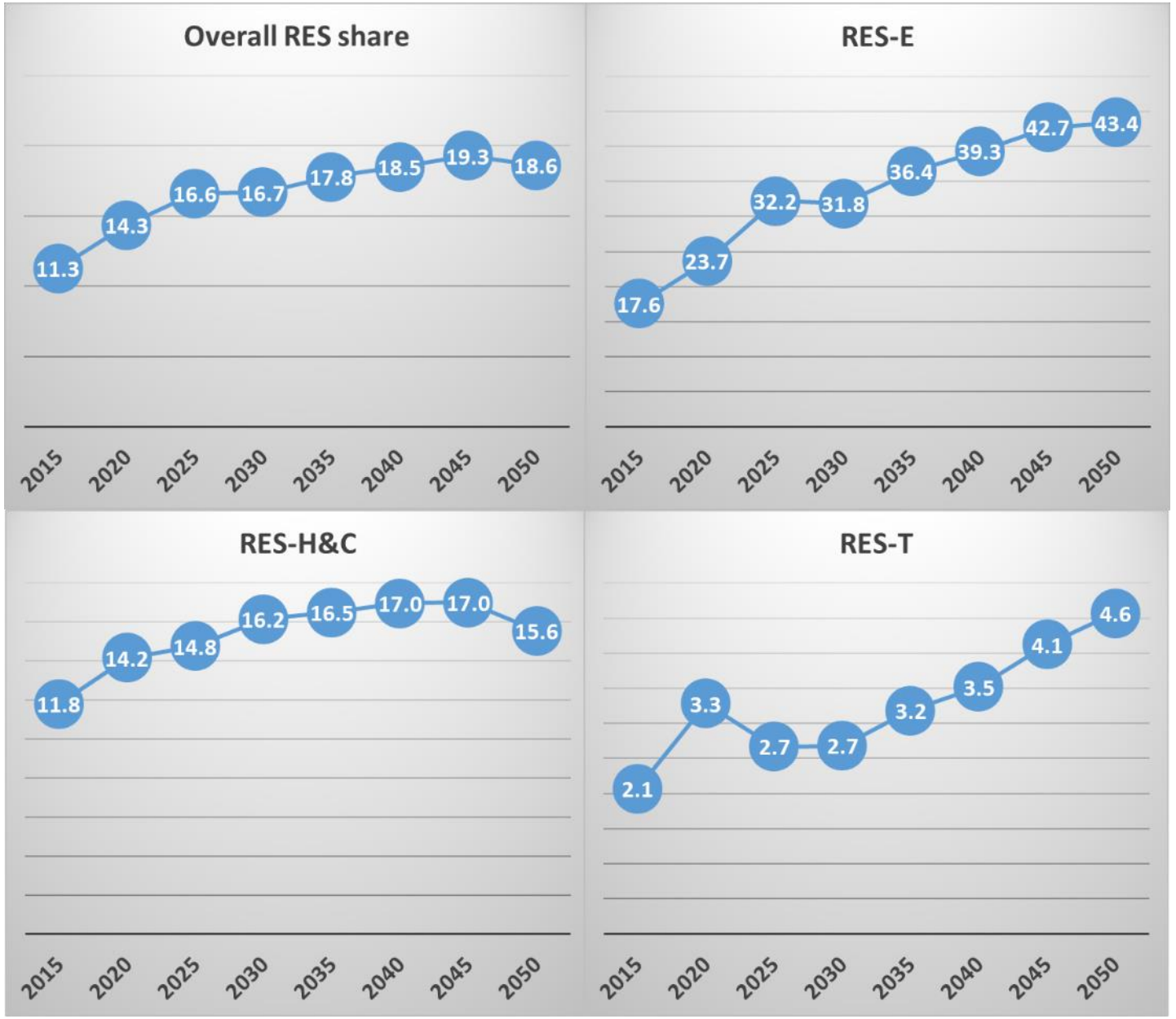
Energy Imports

- Energy import dependency of Energy Community as a whole is rather stable over time.
- Oil and natural gas are the main imported energy commodities, with volumes increasing in the future.
- Dependence of gas is significant in the long term.
- Imports of coal are limited and decline in the long-term.
- The RES deployment, which is faint, and the stable nuclear production cannot offset the rising net imports.
- The substitution of the domestically produced fossil fuels (solids) by imported oil and gas increase the import dependence in the Energy Community Contracting Parties.



RES shares

- The overall RES share increases modestly throughout the projection 2050, due to absence of ambitious policies and despite penetration of RES in the power sector.
- RES -E steadily increases until 2025 at the same pace, but the growth pace slows down after 2025.
- The RES H&C increases in the period 2025-2030 and then remains stable
- Transport uses biofuels to a small extent, since although the legislation for biofuel mandates is in place in most CPs, implementation is slow.



Energy Costs and Investment
Preliminary results

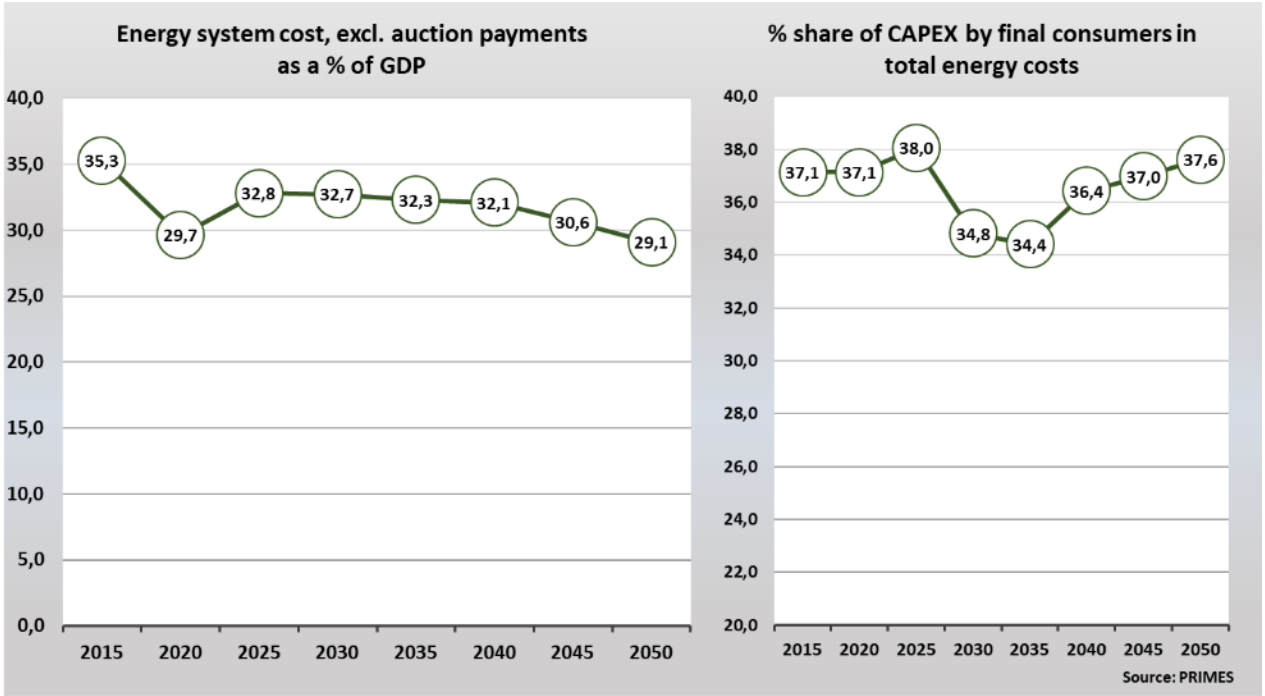
Energy System Costs

Explanation:

- Energy system costs are meant from energy end-user perspective, i.e., households, agriculture, services, industry and transport; The energy system cost thus signify the amount that the economy has to pay to acquire all sorts of energy services.
- The energy system costs are annual and include annualized capital costs, variable, tax and fuel costs. A 10% discount rate is employed to annualize capital costs of investment by energy end-users. The capital and other costs of energy producers is recovered through the consumer prices that end-users pay to acquire energy products. Therefore, the CAPEX and OPEX split of costs, shown in the graphs, concern only the expenditures at the level of the energy end-users.

Projections:

- Energy system costs represent a significant share of GDP, accounting for 35% in 2015. This is not a surprise for low GDP per capita economies, such as the economies within the Energy Community.
- Despite the increase in final energy consumption, total energy system costs slightly decrease in the future. Technology improvement enabling efficiency, the reduced costs of RES in the power sector and similar trends over-compensate the projected increase in energy prices.
- The share of CAPEX (end-user level) increases in the long-term, as equipment acquisition increases to modernize and replace old stocks.



Investment Expenditures

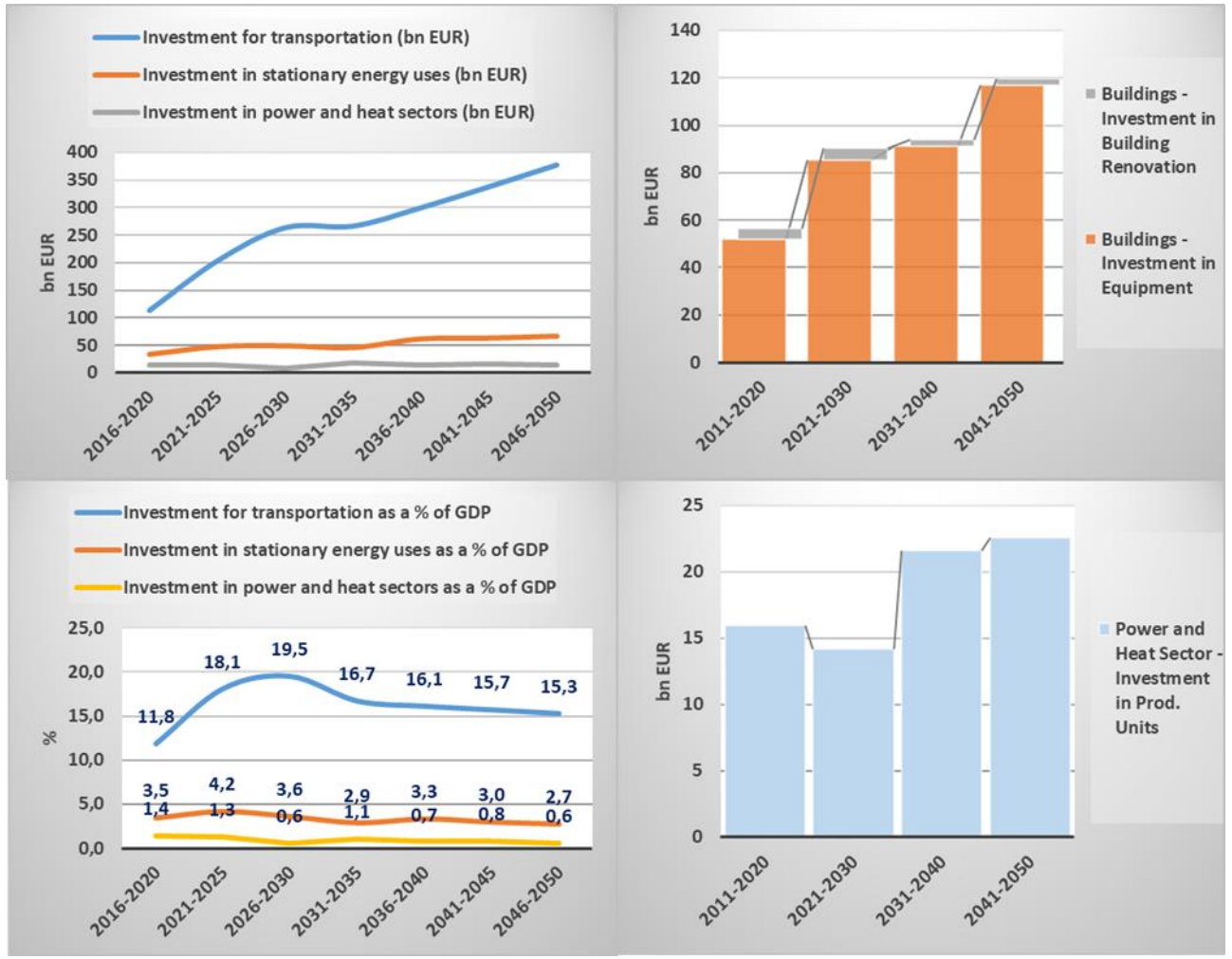
Investment expenditures are shown for all sectors, demand and supply of energy, as well as for networks

Investment amounts tend to increase in all sectors. In transport, investment includes the entire amounts for vehicles, trains, aircrafts and ships, so it is not fully comparable to other sectors.

As a share of GDP, investment expenditures increase in the decade 2021 - 2030 and slow down after 2030. This is driven by the transport activity which shows gradual decoupling from GDP after 2030.

Investment expenditure in power production (heat included) is high in the last decade of the projection period, due to the end of life-time of power plants.

The increasing trend of investments in residential sector are due to the increase in the acquisition of new equipment as income grows. Building renovation is limited due to the assumption about no efficiency-supporting policies.



CO_2 emissions *Preliminary results*

CO_2 emissions

As the scenario does not involve any GHG target, the evolution of emission is driven by technology progress, consumer choices and least-cost optimization in energy supply.

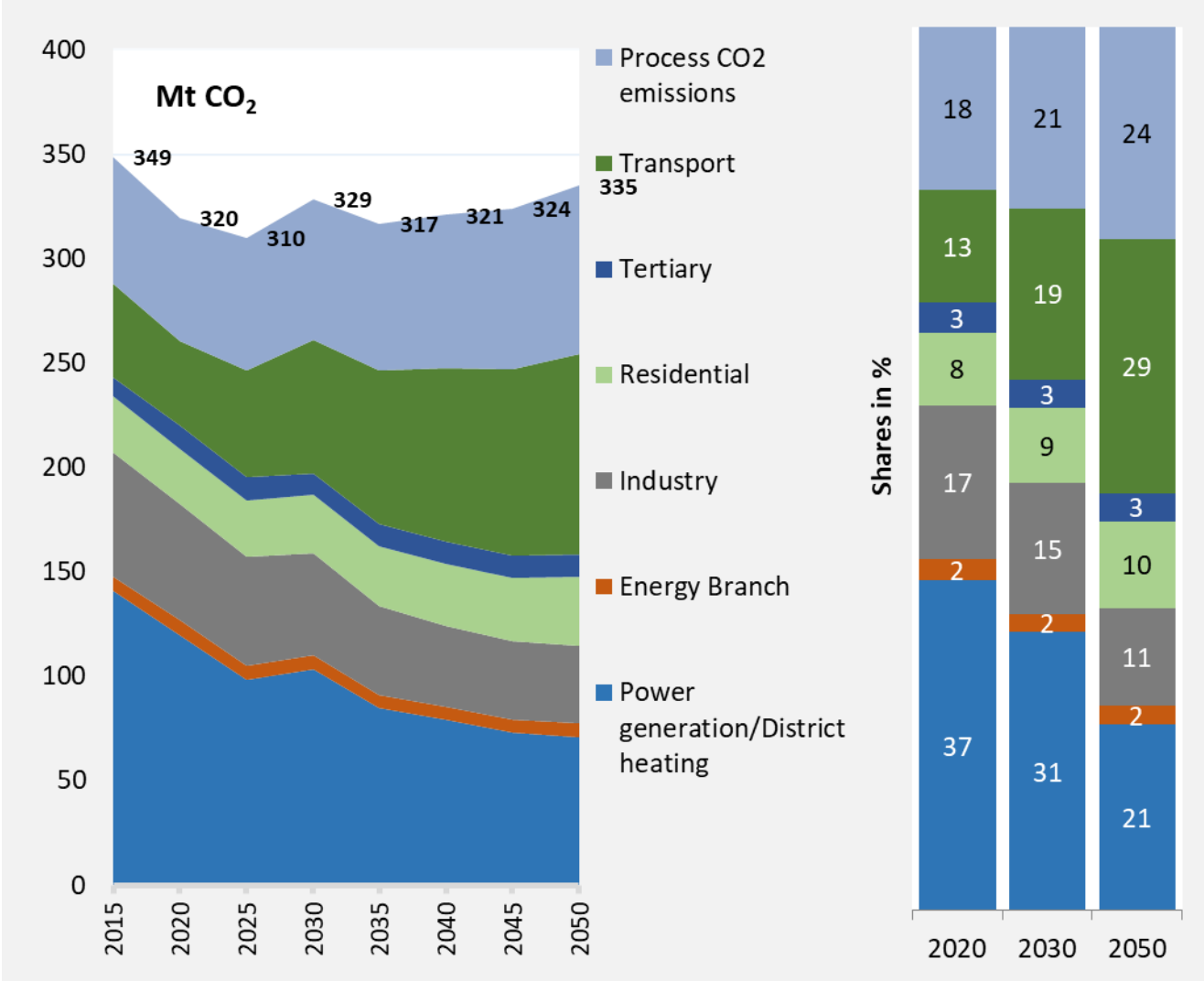
The projection shows stable GHG emissions in the long run and an increase in emissions until 2030, relative to 2020.

The emissions in the power sector steadily decrease in the long-term, due to decline of coal and the increase in RES and gas. The emissions increase until 2030 (still the problem of 2025 compared to 2020)

The industrial emissions decrease mainly as a result of significant progress of energy efficiency and the electrification.

The emissions in buildings slightly increase over time, driven by the growth of demand for energy. Electrification and RES do not increase as much as needed to offset emission growth due to demand.

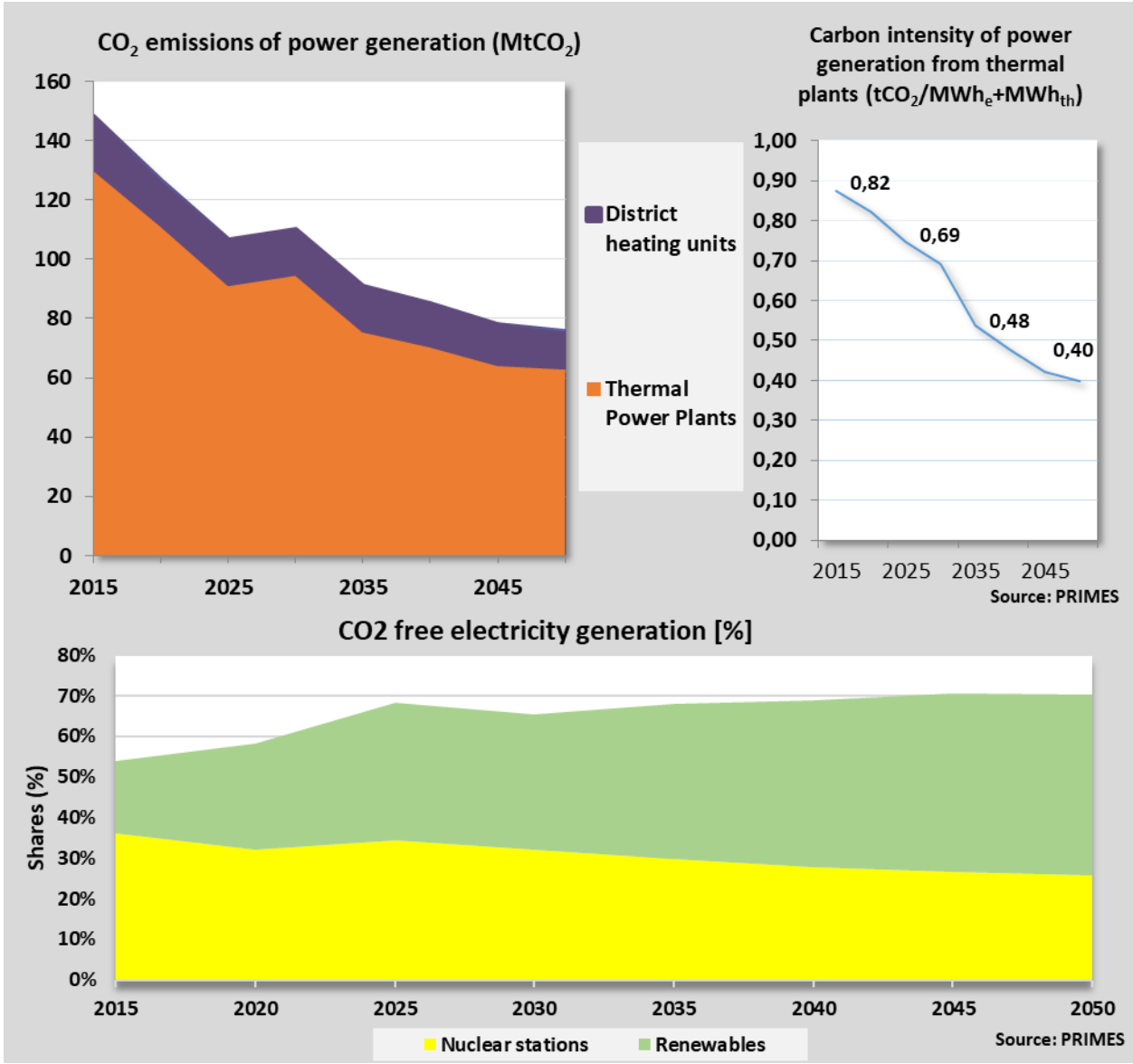
The increase in transport sector emissions is very significant and offsets the emission reduction projected in the power sector. This is linked to the lack of ambitious policies to improve the efficiency of the transport system and to drive the large-scale uptake of low - and zero-emission vehicles and sustainable alternative fuels.



CO_2 intensity of power supply

The carbon intensity of power generation decreases considerably, driven both by RES investment and substitution of coal by natural gas.

Approximately 70% of power generation becomes CO2 free by 2050.



Annex

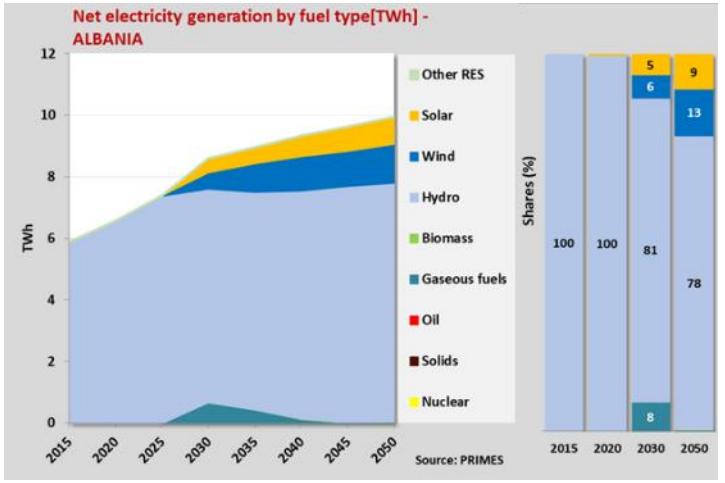
Power generation by CP

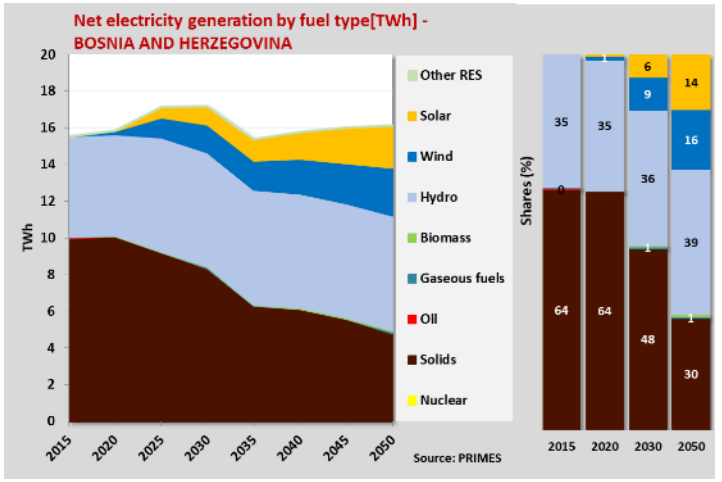
Albania: Currently electricity generation is totally produced by hydropower. Wind, solar and to a lesser extent hydro cover the incremental changes in electricity demand.

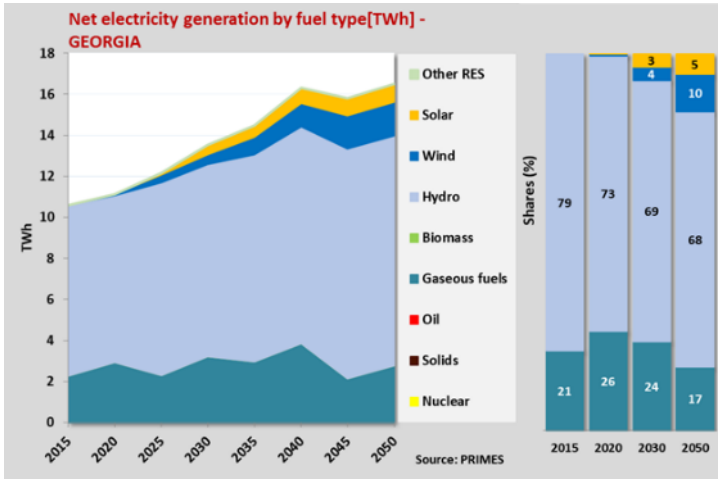
Bosnia and Herzegovina: the newer units of the Tuzla lignite station are retrofitted, retaining the share of lignite at 30% in 2050. The older lignite units are substituted by solar PV, wind and Run of River plants.

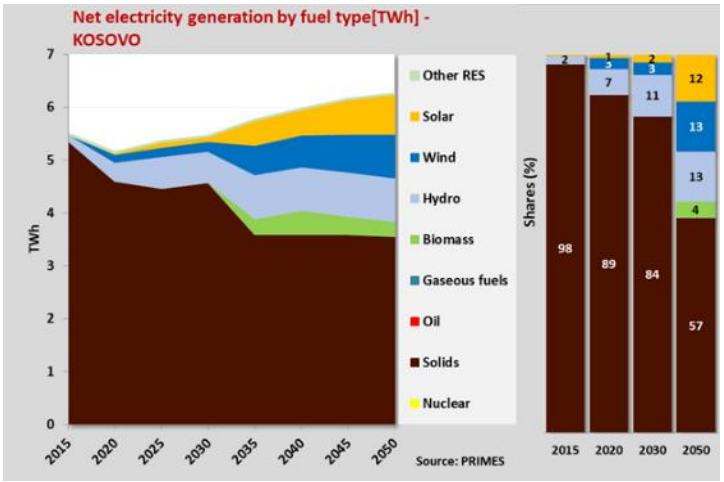
Georgia: Over 70% of electricity is currently generated by hydro power stations, whereas natural gas complements the power mix, especially during the winter period. The growth of electricity demand is primarily covered by run of river plants, utilizing partially the significant hydropower potential; they are accompanied by wind, solar and natural gas investments.

Kosovo: the power mix of Kosovo continues to rely on lignite, as a result of retrofitting investments (Kosovo B power station). Renewables increase their share in the long run, reaching 42% of the electricity generated in 2050.









Power generation by CP

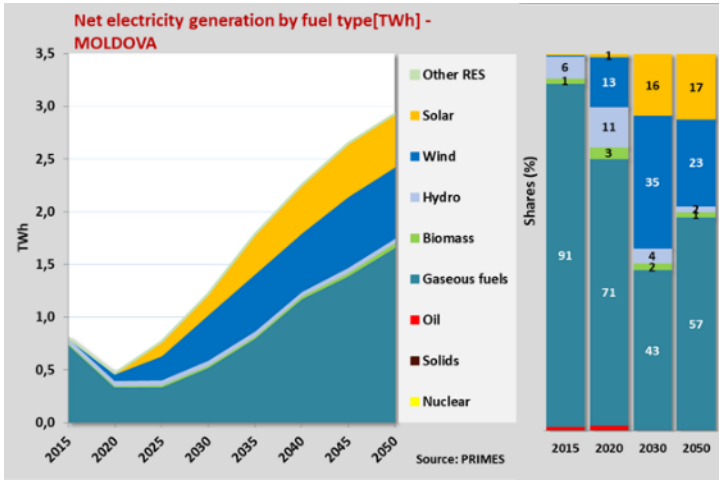
Moldova: In the baseline projections, Moldova remains a net importer of electricity. Nevertheless, imports increase at lower rate than the demand of electricity. Thus, domestic generation increases 3.6 times compared to 2015. Power mix relies on natural gas (57% in 2050) and to a lesser extent wind and solar PV.

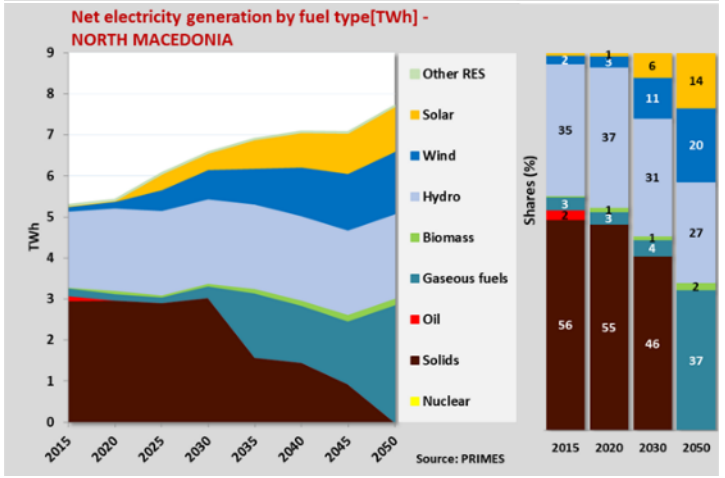
Montenegro: PLJEVLJA power station continues its operation until 2035, due to lifetime extension investment. Upon its decommissioning lignite is substituted by natural gas; The share of RES in electricity generation is projected to 76% by 2050.

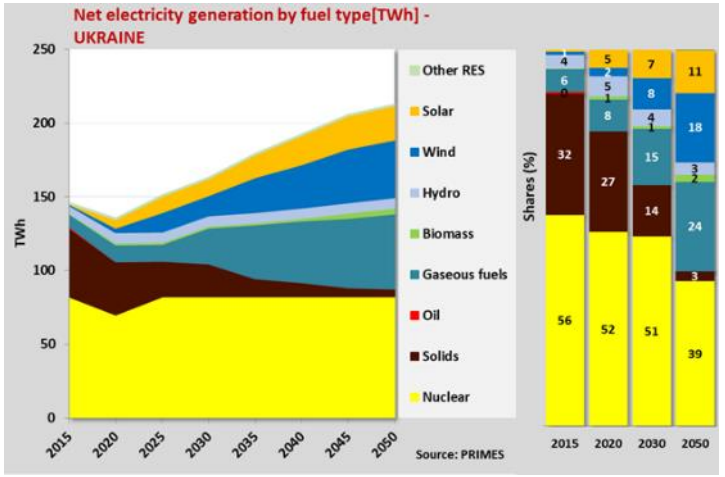
North Macedonia: the coal phase out is materialized by 2050 (end of lifetime extension of Bitola PP). The share of natural gas and renewables in power generation tends to increase after 2035.

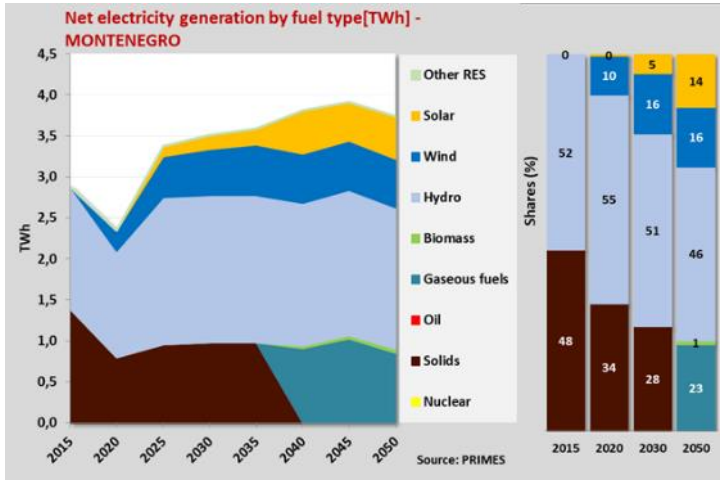
Serbia: the partial lifetime extension of lignite units retains their share in power mix at 34% in 2050. Natural gas increases its share after 2035, whereas solar PV and wind plants are deployed. The share of RES in electricity generation stabilizes around 50% of in the long run.

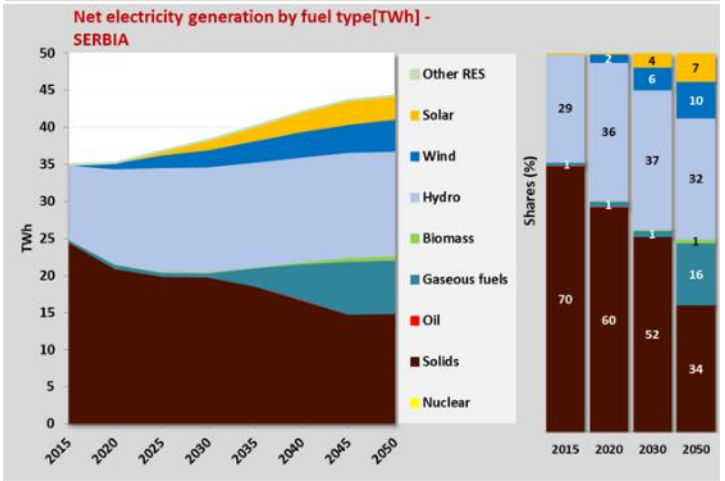
Ukraine: Ukraine electricity mix relies heavily on nuclear power stations. It is assumed that generation from nuclear is retained, through the lifetime extension of ageing power stations. As coal plants are gradually decommissioned, the incremental demand is covered by natural gas and renewables; Renewables reach 34% of electricity generation in 2050.





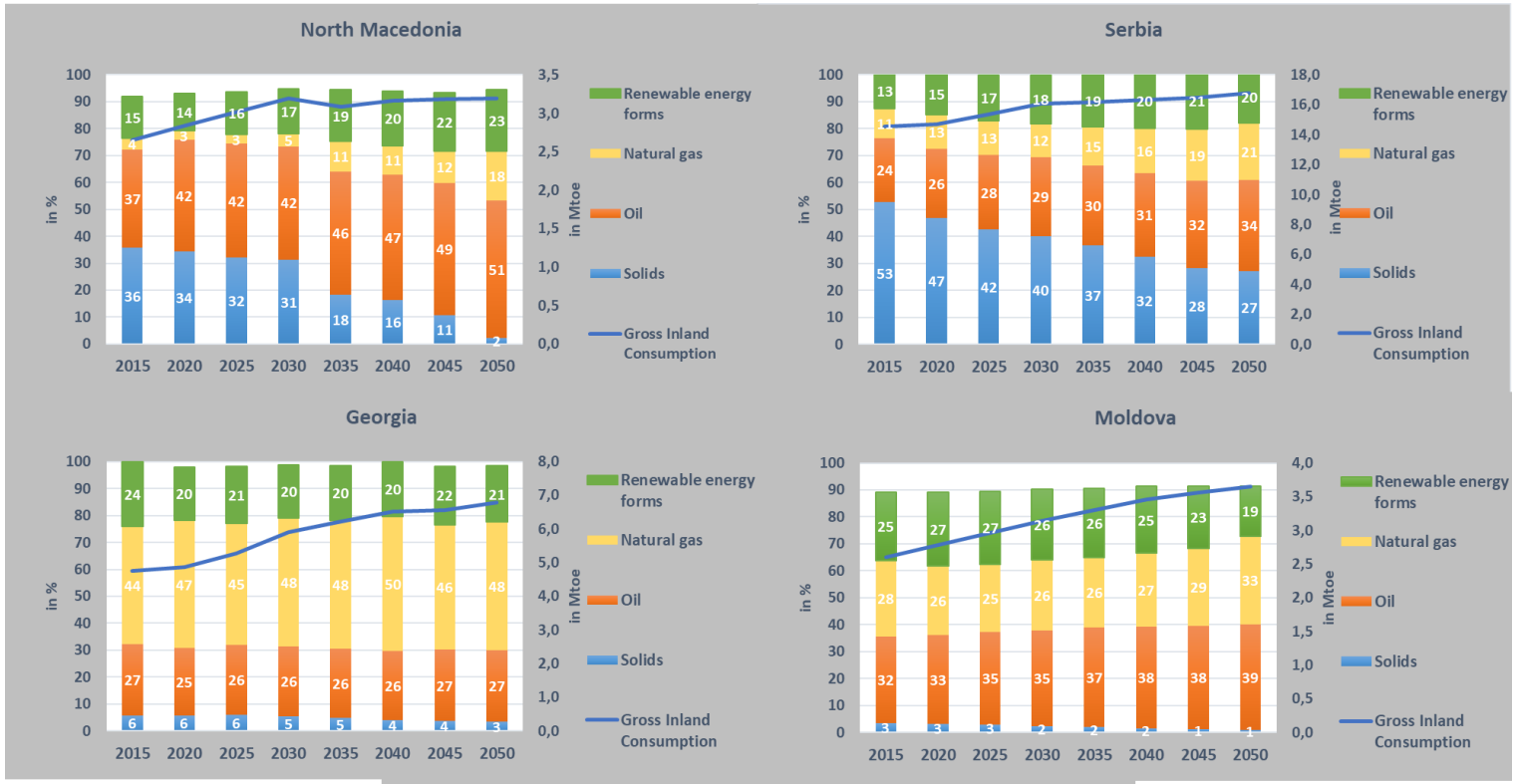






GIC
Country-specific

- The share of natural gas is growing fast, particularly in North Macedonia, Serbia and Ukraine.
- The decreasing trend of solids is notable, as a result of the introduction of natural gas in the power mix.
- Ukraine is the only contracting party that uses nuclear – assumed to remain stable.



GIC
Country-specific

- In Kosovo and Montenegro, steep decreases in solids can be observed in the periods when lignite stations are retired.
- In Bosnia and Herzegovina gross inland consumption is stabilized; this is attributed to the substitution of solid fuels by renewable energy forms.