

# BASELINE ENERGY SCENARIO FOR THE ENERGY COMMUNITY COUNTRIES – PRELIMINARY PROJECTIONS AND ASSUMPTIONS

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Project

Energy Community Study on Carbon Pricing

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## Objective and method

- Project into the future the electricity and heat production sectors under scenario-based assumptions
- PRIMES-IEM model version
  - Dynamic optimal capacity expansion, power plants, heat-only units and CHP
  - System and market operation, merit order with ancillary services and endogenous balancing and reserves
  - Interconnected system and markets – various assumptions regarding degree of integration
  - Exogenous demand projection
  - Inclusion of demand response and storage

## Coverage

- Energy Community countries and Romania, Bulgaria and Greece
- South-east European region interconnected model
- Ukraine, Georgia and Moldova as single country models
- Time horizon: 2015,2020,2025,2030,2035,2040
- Calibration to 2015 and estimation of 2020 using data until 2018
- **Warning: COVID impacts not included**

## Assumptions – Verification procedure ongoing

- Demand projection
- Fuel prices and carbon prices
- Individual power plants: decommissioning, under construction, candidate for possible investment, technical-economic data
- Renewables: policy program for support and potential
- Fuel quantity limitations, where applicable
- Technical operation constraints – opt out decisions
- Interconnections, NTCs, reserves, degree of market coupling for balancing and reserves
- Heat demand and supply assumptions

## Model outputs - projections

- Investment in power plants and heat units
- Power generation by individual plant and by type
- Imports-exports
- Electricity, heat and reserve balance
- Fuel consumption – CO2 emissions
- Market clearing prices
- CAPEX, OPEX for power and heat systems
- Unit cost of electricity and heat production, decomposed by cost item
- Electricity and heat prices at consumer level

## Lignite and coal mining costs

- Historically the costs of lignite have been low compared to other energy sources.
- In the recent past, however, dis-economies of scale have pushed lignite costs significantly upwards in some countries.
- In some cases, the prices have been kept stable artificially via direct or indirect subsidies granted by the state.
- ***This issue of continuation or not of indirect or direct subsidies to mining is an important assumption for the modelling***

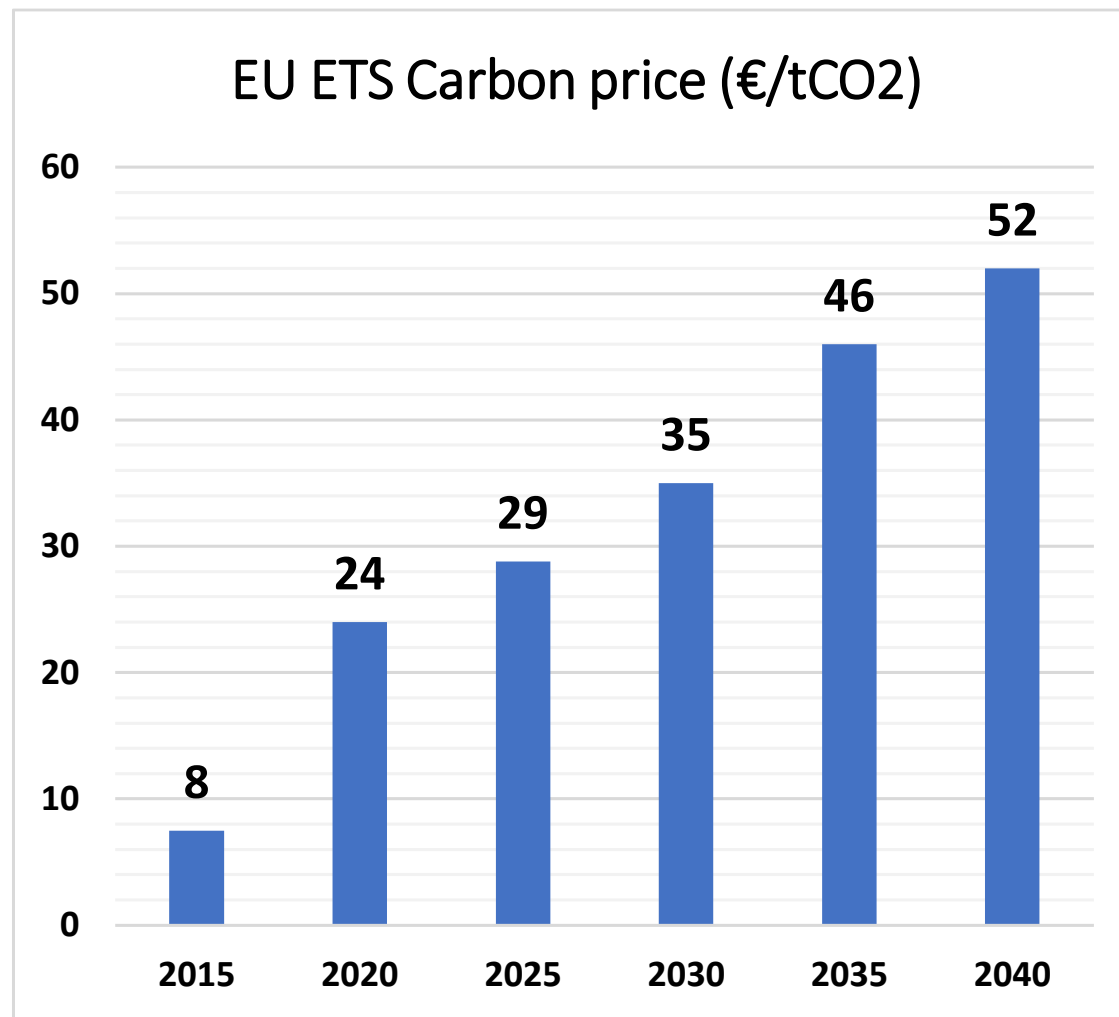
## Range of lignite or coal prices

€/MWh-fuel	Low	High
ALBANIA	NA	NA
BOSNIA_HERZEGOVINA	7.1	9.2
BULGARIA	4.8	6.3
KOSOVO	7.5	8.7
NORTH_MACEDONIA	12.1	12.6
MONTENEGRO	11.1	11.6
SERBIA	7.5	10.2
GREECE	9.8	13.6
ROMANIA	7.7	9.4
UKRAINE (Coal)	6.3	6.3
MOLDOVA (Coal)	9.2	9.2
GEORGIA	NA	NA

## Projection of EU ETS Carbon prices

- The projection of EU ETS prices into the future foresees a rather slow pace of increase in prices until 2030, following the spectacular increase happened in 2018 after the implementation of the MSR (Market Stability Reserve).
- The projection relies on recent scenarios quantified for the European Commission using the PRIMES model.
- The projections assume an effective implementation of the NECPs of the EU MS, which plan for a significant increase in vRES and include ambitious coal phase-out plans (*in the majority of countries a phase-out before 2030*).
- Therefore, carbon emissions in the EU ETS sectors are projected to decrease significantly until 2030, which to a large extent offsets the trend towards higher scarcity of allowances due to the MSR until 2030.
- Beyond 2030, the EU ETS carbon prices will tend to increase significantly, driven by the provisions of the MSR

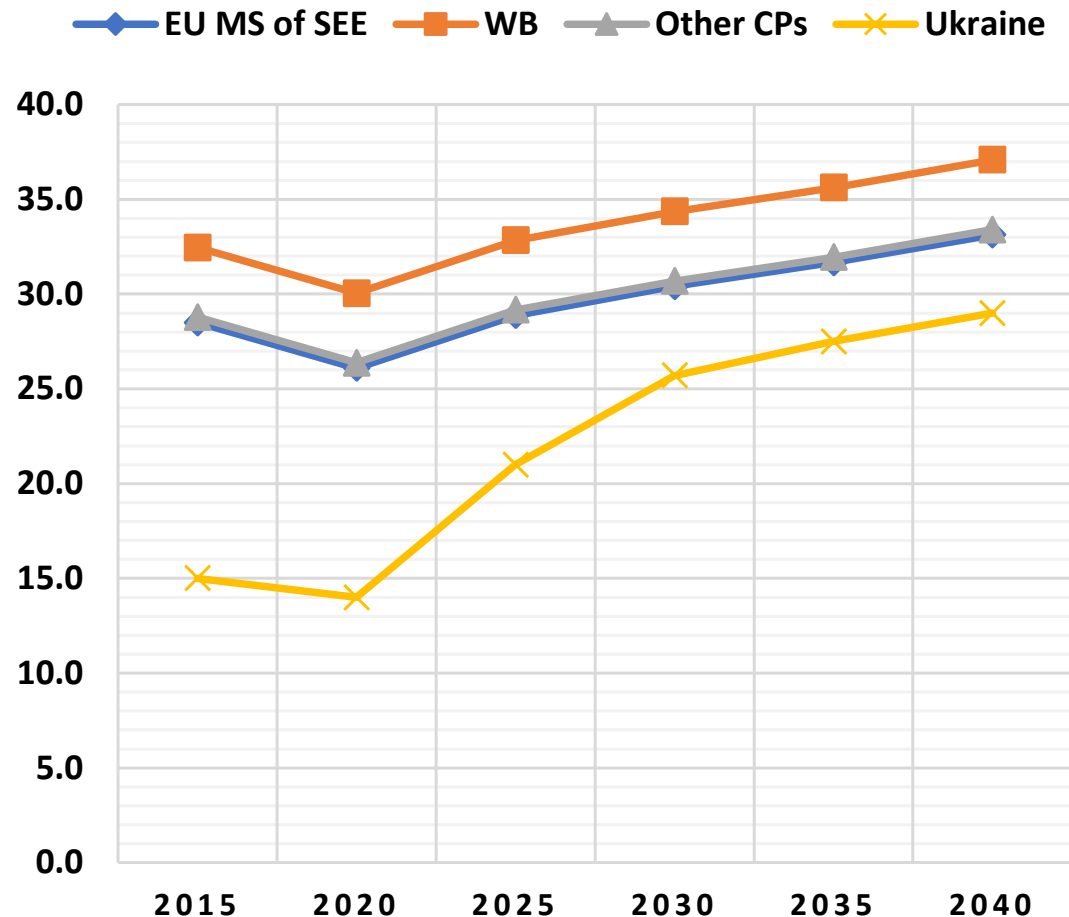
*Note: The projection does not include the Green Deal Agenda, which may further increase MSR stringency.*



## Natural gas prices

- We assume that average natural gas prices in imports increase only slightly during the decade reflecting global gas market conditions.
- Rising LNG supplies originating from US shale gas compete strongly with – until now dominant – pipeline gas. The LNG global market contests pipeline gas pricing based on oil price indexation. The gas market takes its own dynamism independent of oil.
- **Which assumption to adopt on gas development in the WB?** Looking at the WB region, the poor gas supply infrastructure, in particular the lack of interconnections and diverse entry points in the regional gas system, makes gas pricing and supply uncertain. Gasification in WB region is uncertain under such conditions.
- **Gas subsidies in Ukraine is a practice that will continue?** Also gas prices are not well known for Moldavia and Georgia.

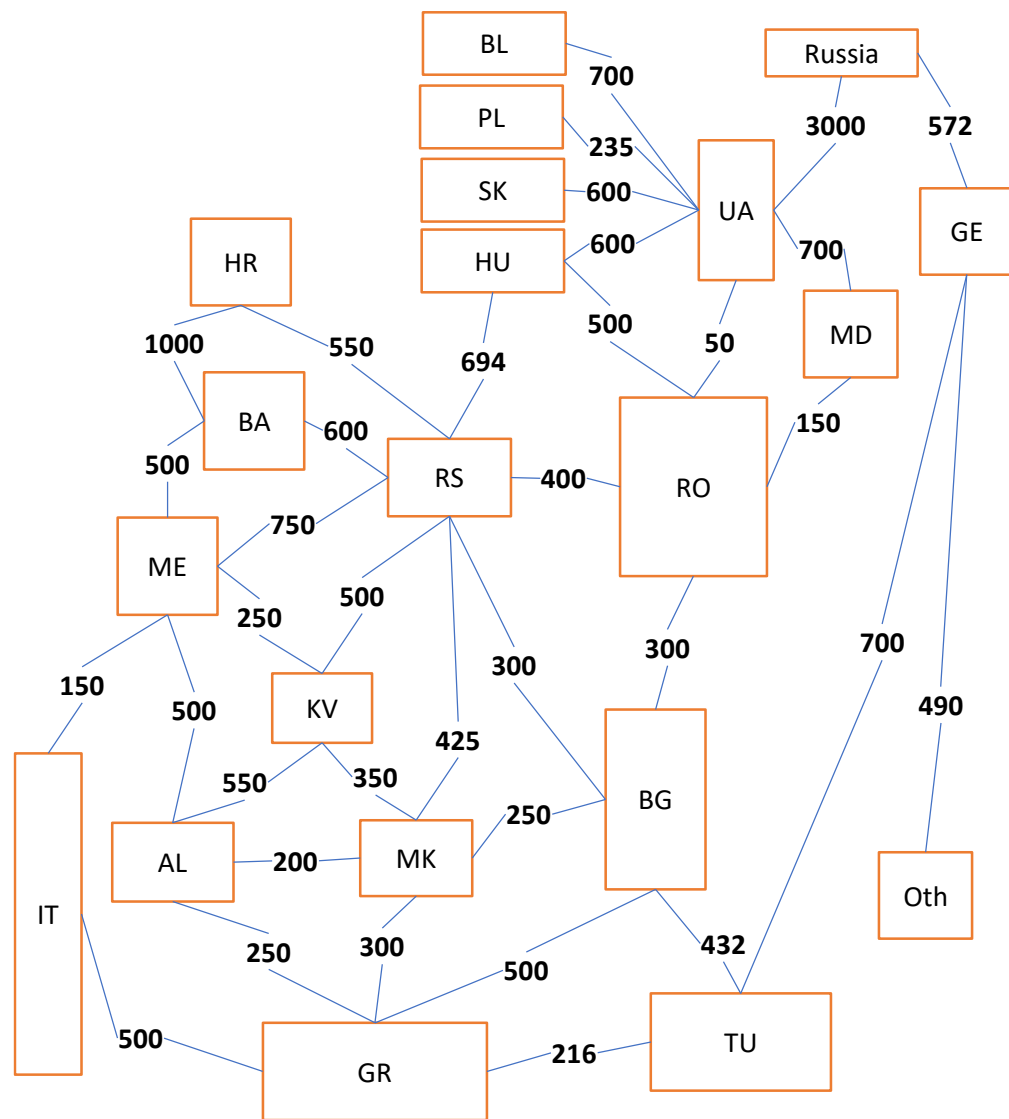
## NATURAL GAS PRICES (€/MWH-FUEL) INPUT TO POWER GENERATION



## Cross border exchanges

- New interconnections under construction add significant cross-border capacity in the region. Total interconnection capacity is likely to increase by 50% until 2025 in the region.
- However, a small fraction of the interconnection capacity is currently available to markets and traders. The NTC values are currently small in all countries. Below 30% of interconnection capacities are on average available for commercial operations.
- **By when NTCs may increase in the region**
- **By when interconnection capacity would be at 70% allocated to the markets?**
- **By When full market coupling will also apply to intra-day and reserve balancing?**

## NTCs in the Baseline



## Interconnections

Country 1	Country 2	Commissioning year	Thermal Capacity of the new interconnector (MW)
ALBANIA	NORTH_MACEDONIA	2020	1330
BOSNIA_HERZEGOVINA	SERBIA	2025	1300
BOSNIA_HERZEGOVINA	MONTENEGRO	2020	1300
BOSNIA_HERZEGOVINA	CROATIA	2025	1300
BULGARIA	ROMANIA	2020	1300
BULGARIA	GREECE	2023	1500
KOSOVO	NORTH_MACEDONIA	2025	1300
MONTENEGRO	ITALY	2020	600
SERBIA	ROMANIA	2025	2*1300
SERBIA	MONTENEGRO	2030	1300
ROMANIA	UKRAINE	2025	1300

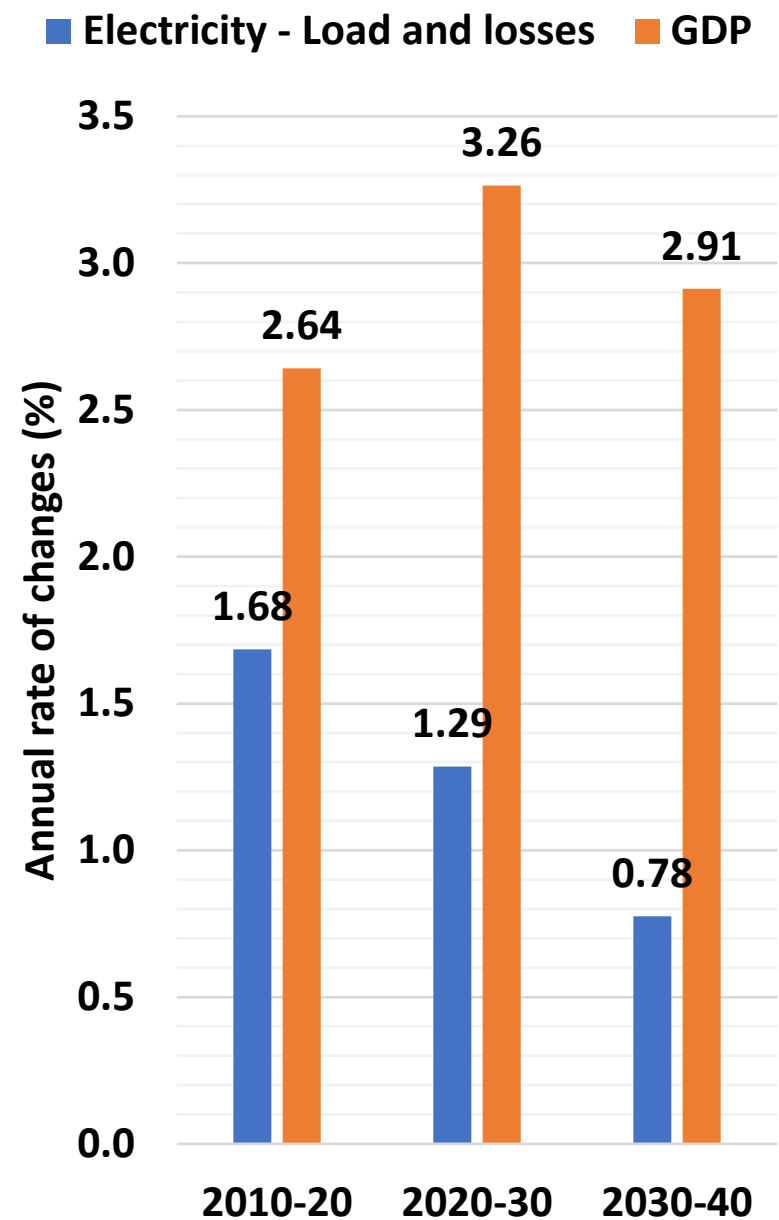
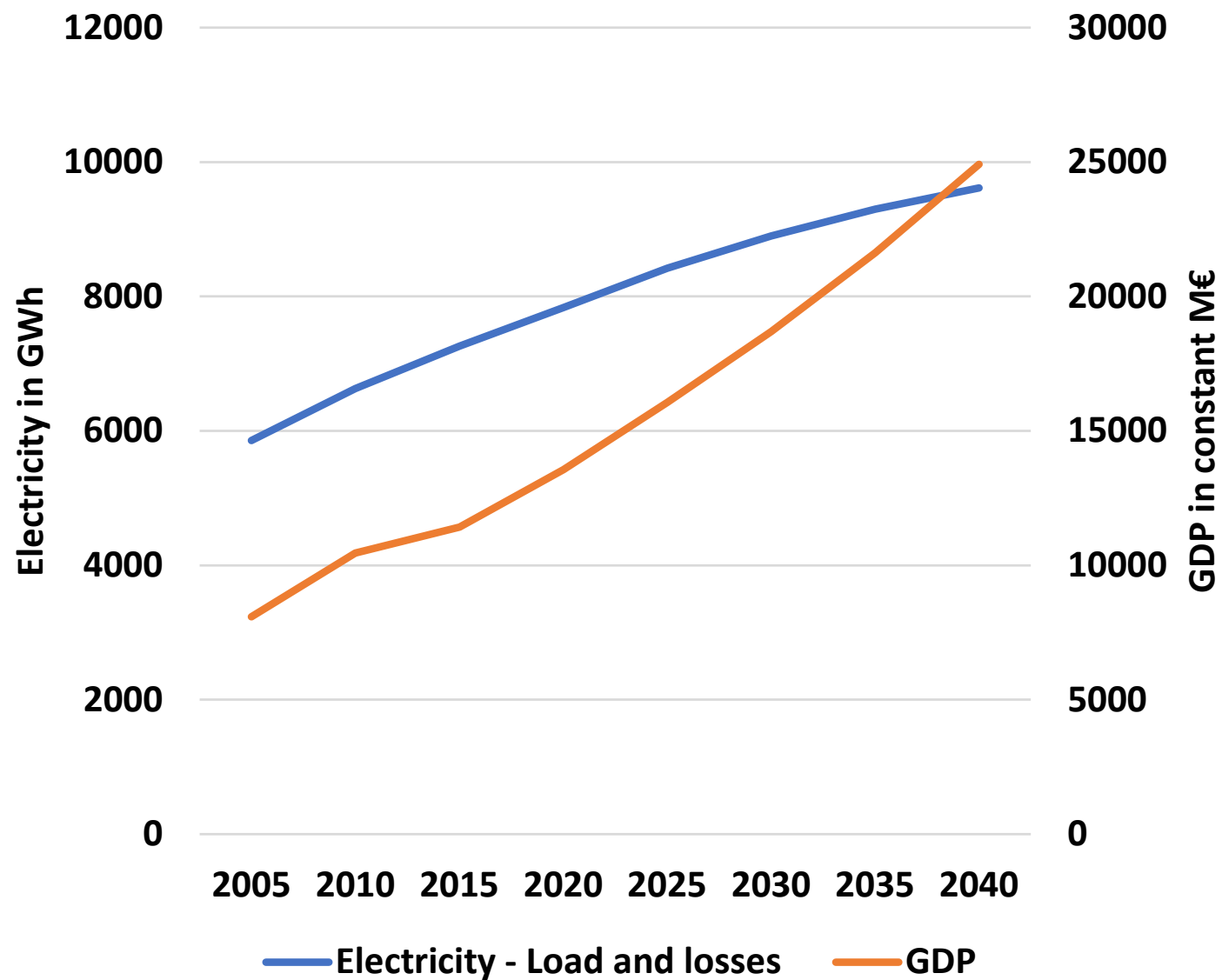
## Projection of exports and imports of electricity

	<u>2005</u>	<u>2010</u>	<u>2015</u>	<u>2020</u>	<u>2025</u>	<u>2030</u>	<u>2035</u>	<u>2040</u>
Albania	371	-949	1404	380	153	-283	-1332	-1150
North Macedonia	1599	1420	2625	2089	1055	489	1530	1042
Kosovo	265	466	8	-34	-420	-545	-398	-217
Montenegro	1790	2	523	652	193	65	179	259
Bosnia&Herzegovina	0	0	-2325	-3040	-2442	-2112	-592	-613
Serbia	-1943	-297	-63	-261	-1665	-749	-2166	-3031
Greece	3779	5705	8326	6819	6380	5141	4134	5014
Bulgaria	-7580	-8444	-10487	-6474	-533	-3463	-4625	-2739
Romania	-2902	-2274	-7504	-8388	-10978	-6801	-4987	-6823
<b>Total SEE</b>	<b>-4621</b>	<b>-4371</b>	<b>-7493</b>	<b>-8257</b>	<b>-8257</b>	<b>-8257</b>	<b>-8257</b>	<b>-8257</b>
Ukraine	-8352	-4054	-1350	-4998	-4998	-4998	-4998	-4998
Moldova	0	3032	3314	3412	3412	3412	3412	3412
Georgia	0	0	39	550	550	550	550	550

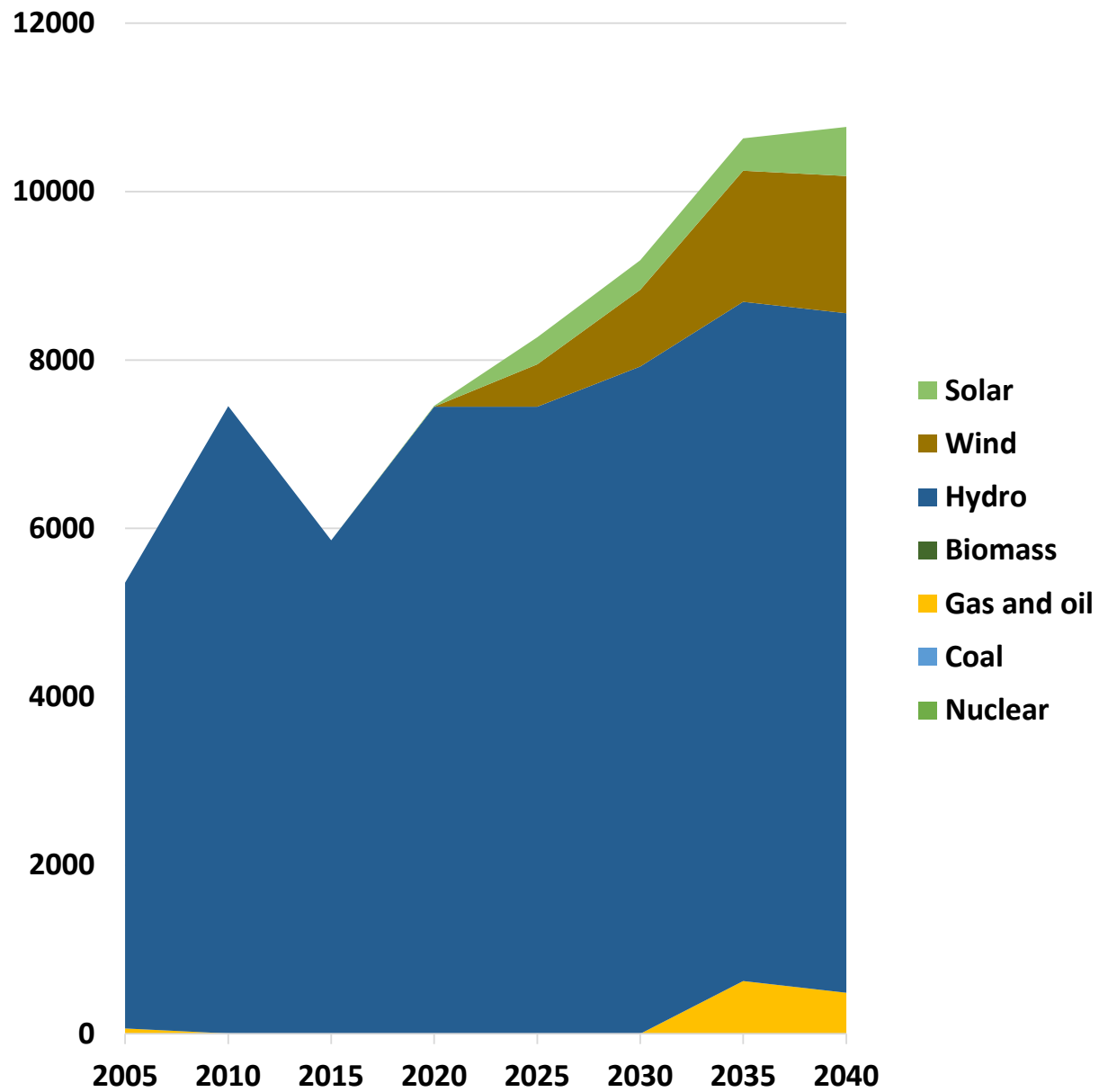
# Albania - Baseline scenario projections



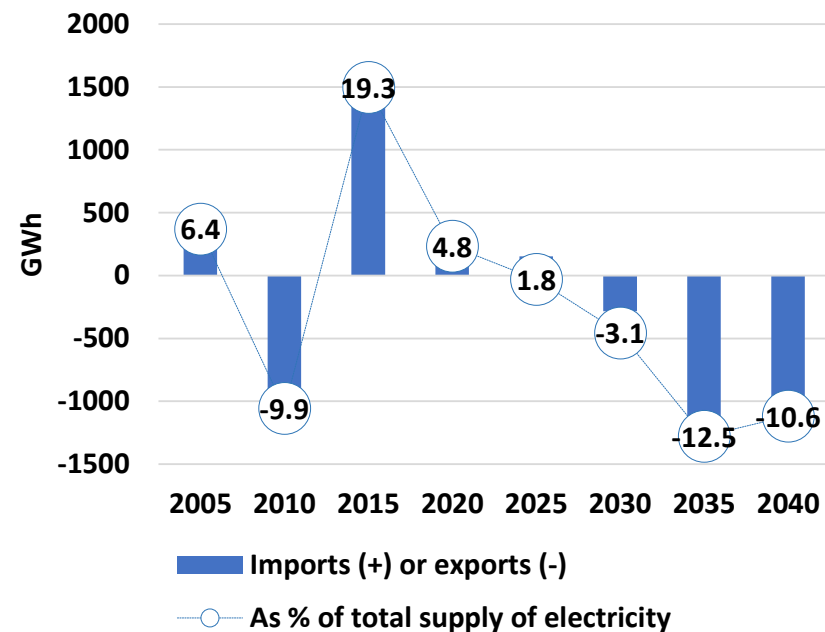
## Demand for electricity



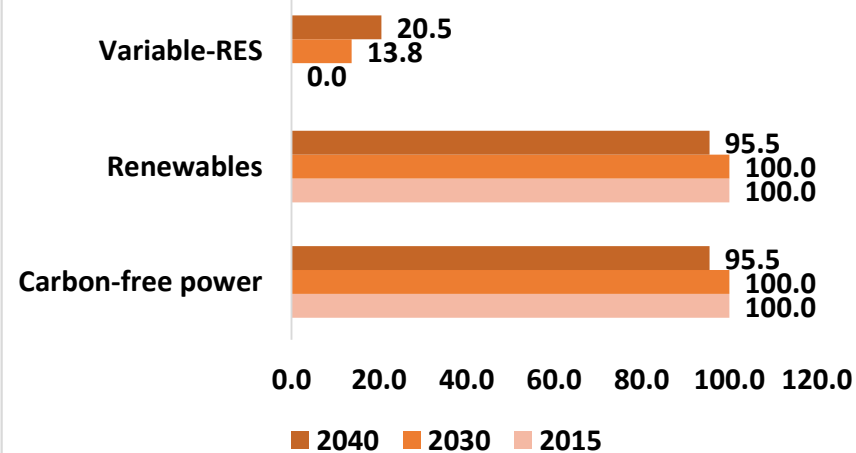
Power generation (GWh-net)



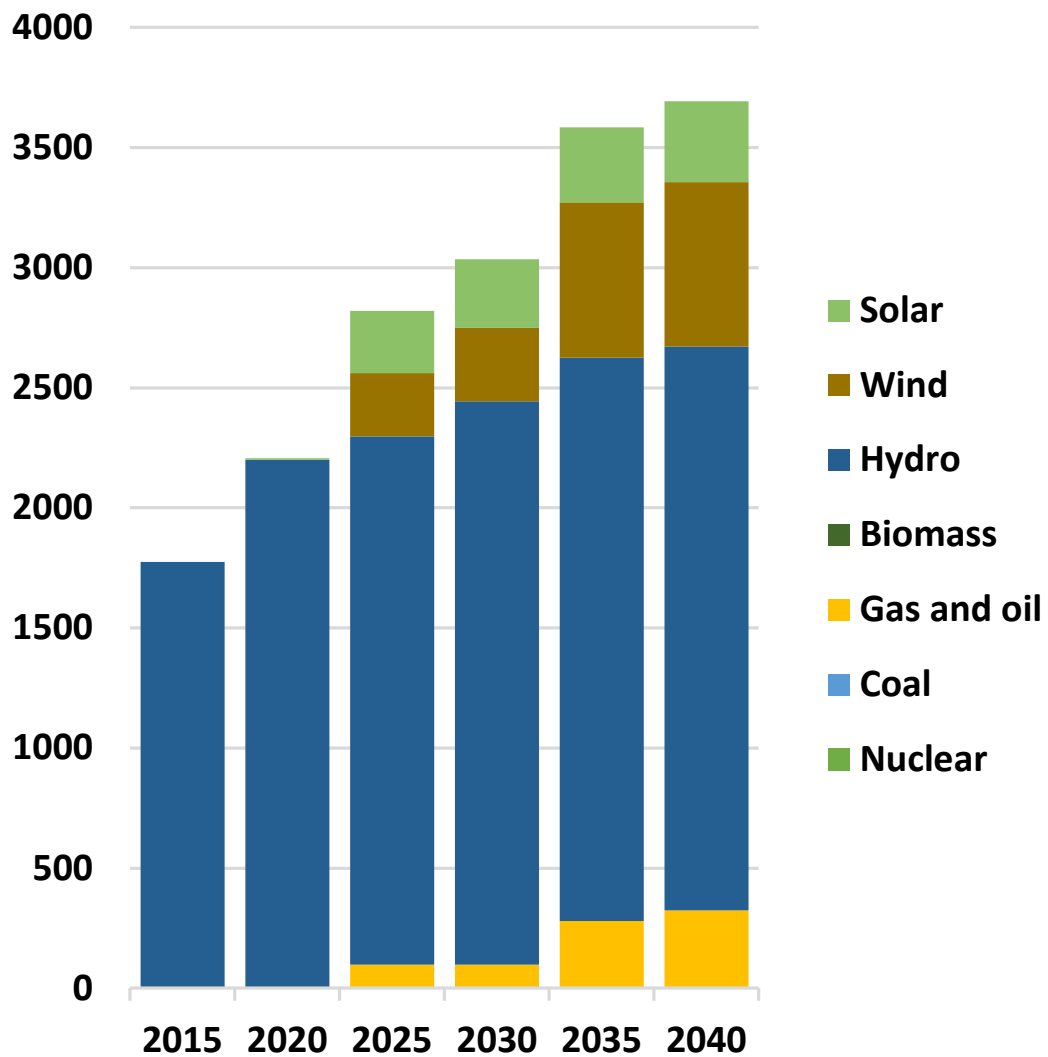
Net imports of electricity



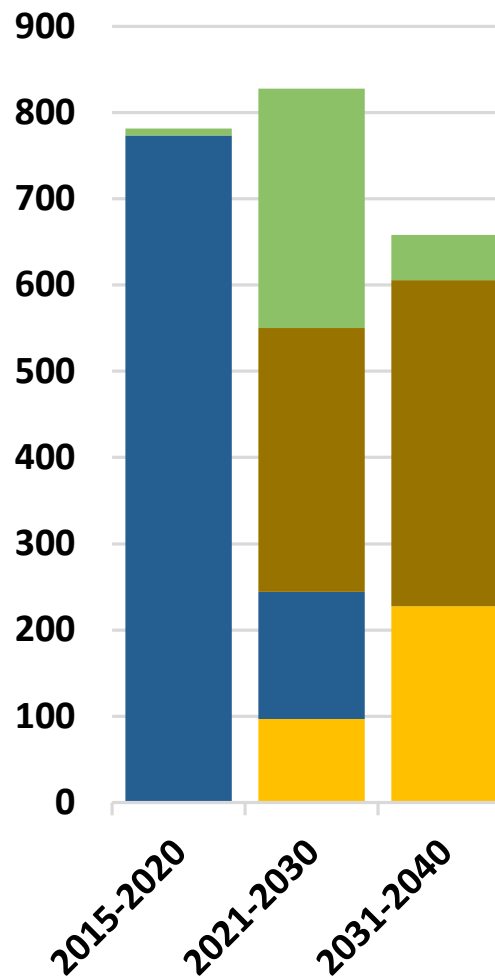
Indicators (shares - %)



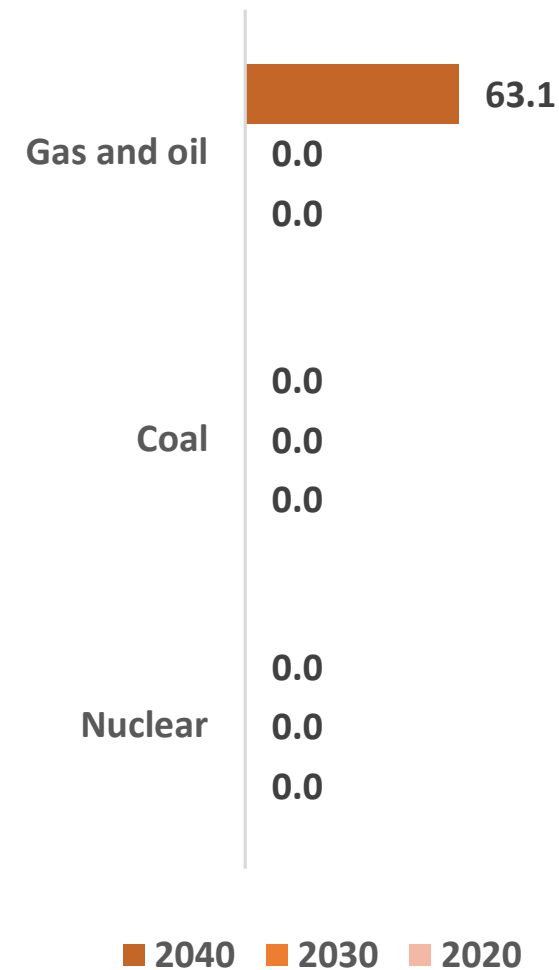
### Operating capacities (MW)



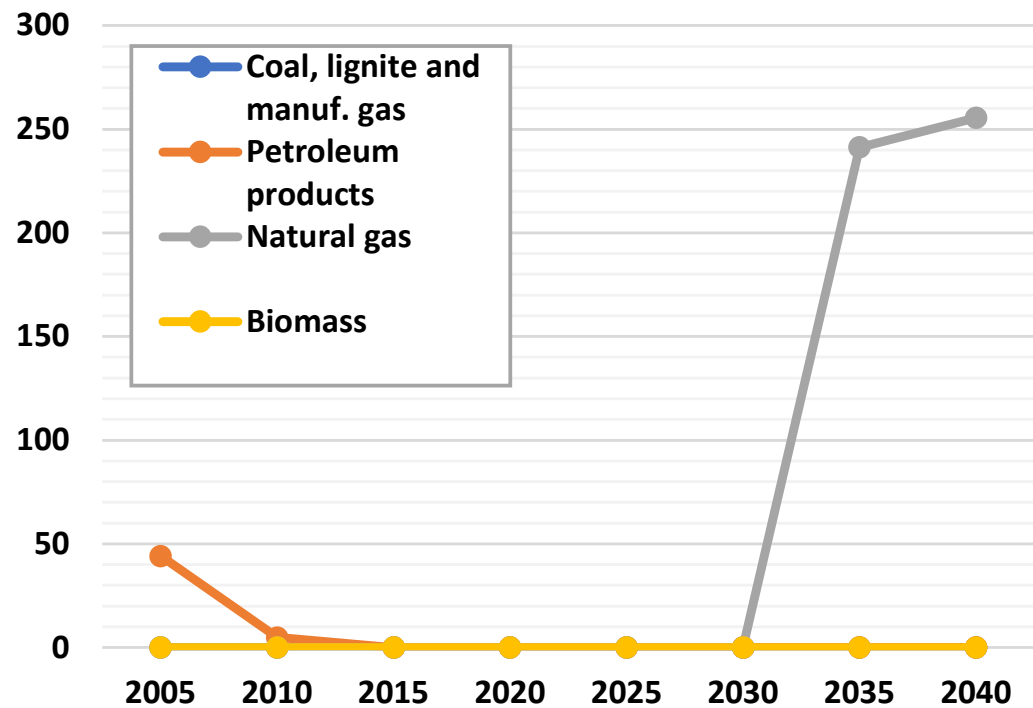
### Capacity expansion (MW)



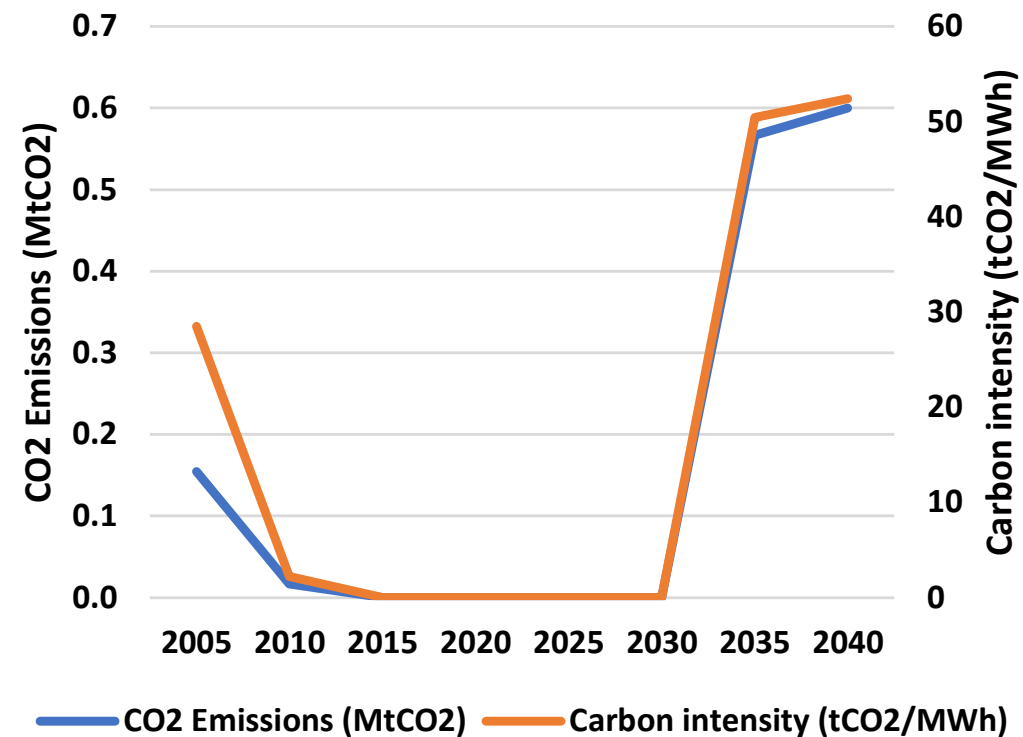
### Rate of use of capacity (%)



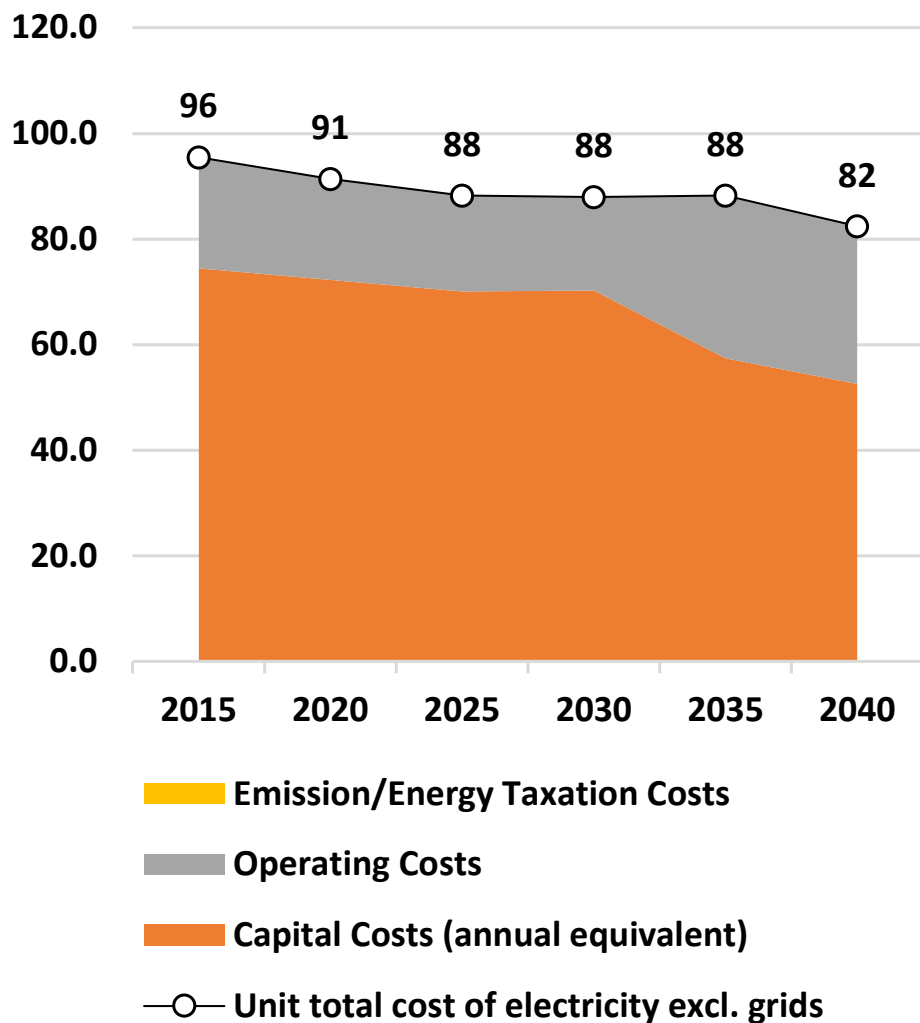
### Fuels in power sector (ktoe)



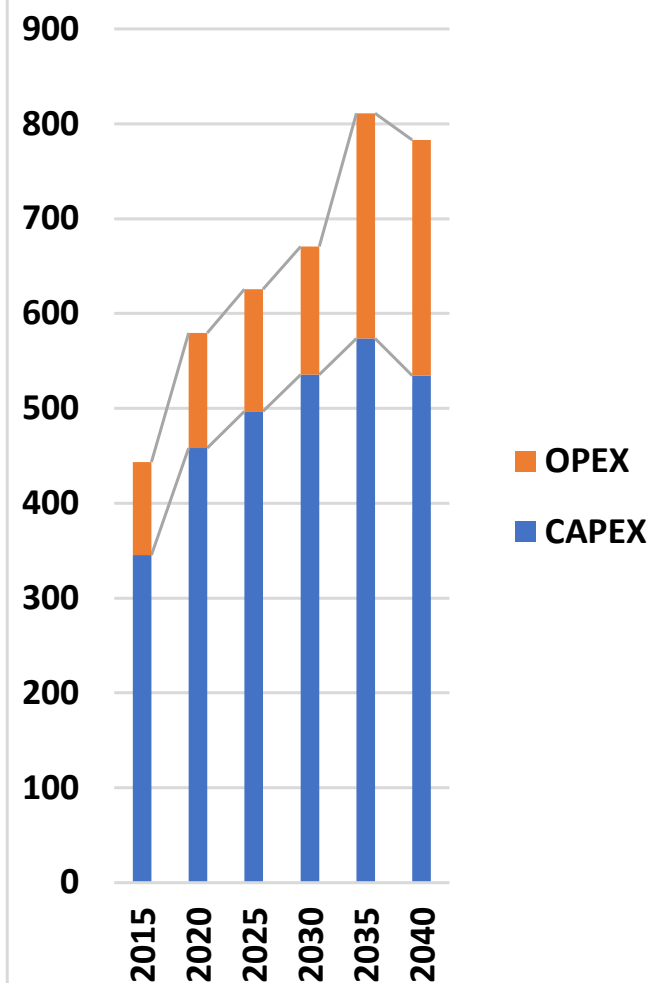
### CO2 Emissions in power generation



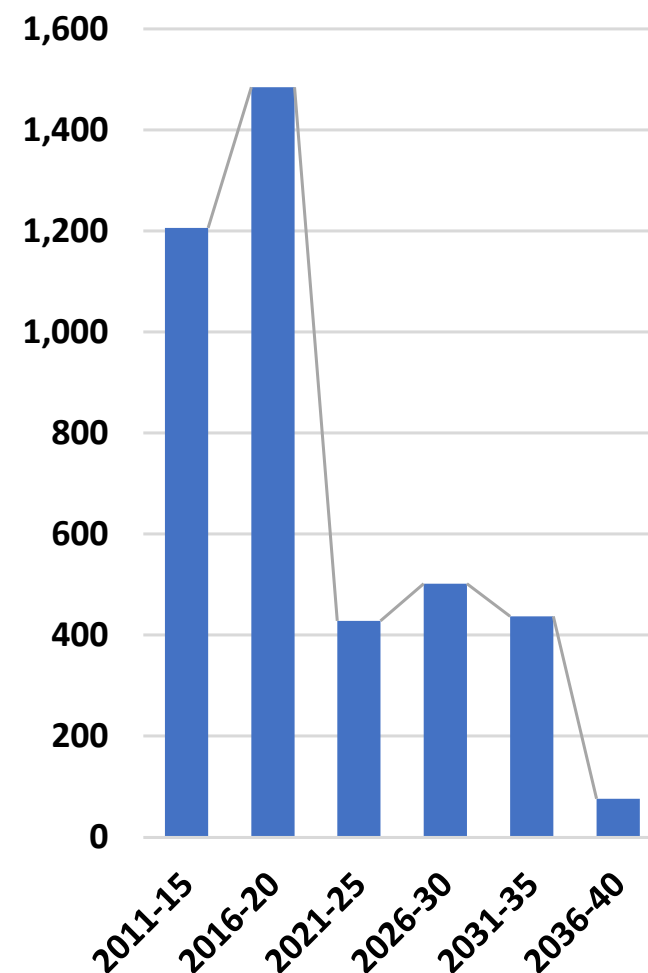
### Unit costs in €/MWh (sales)



### Total Cost of Electricity supply (in M€)



### Investment expenditures in power plants (in M€)



## Uncertainties – lack of information

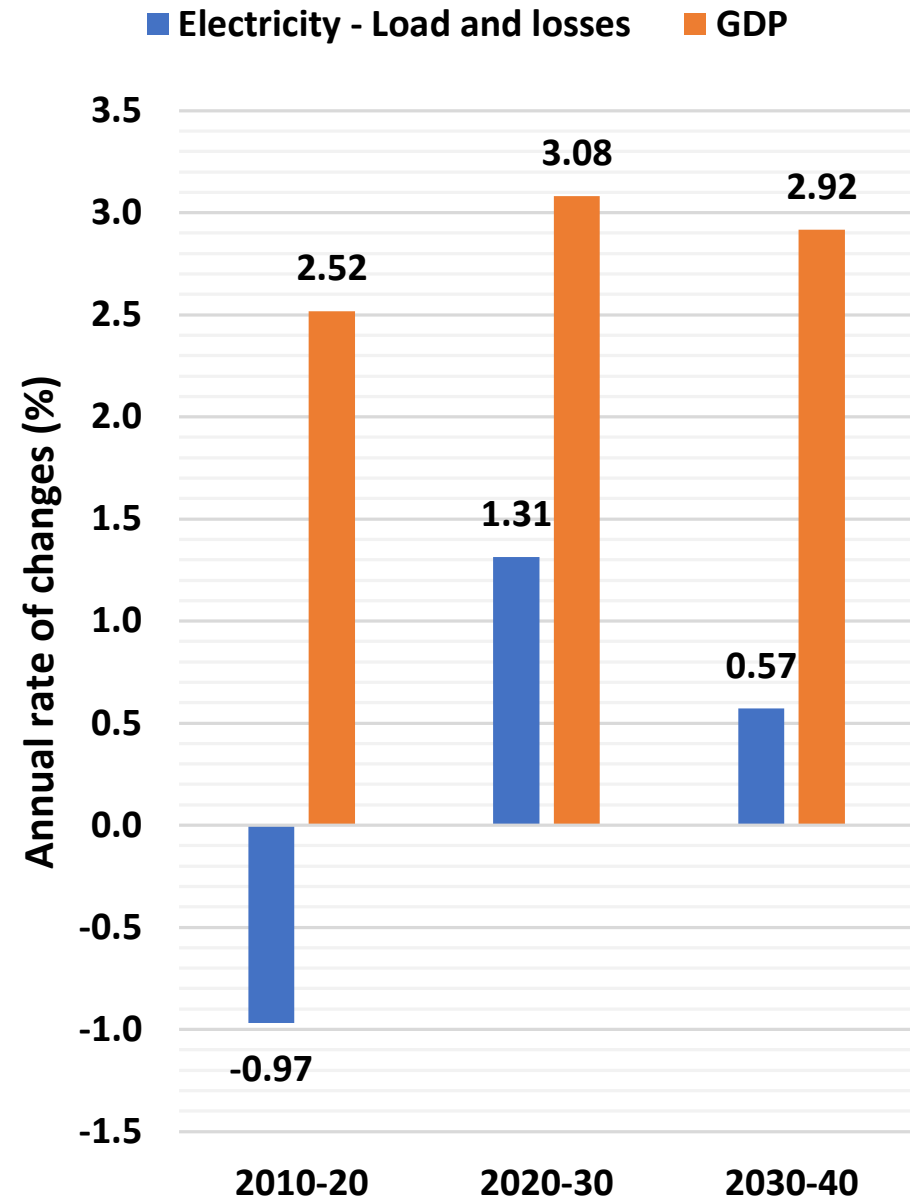
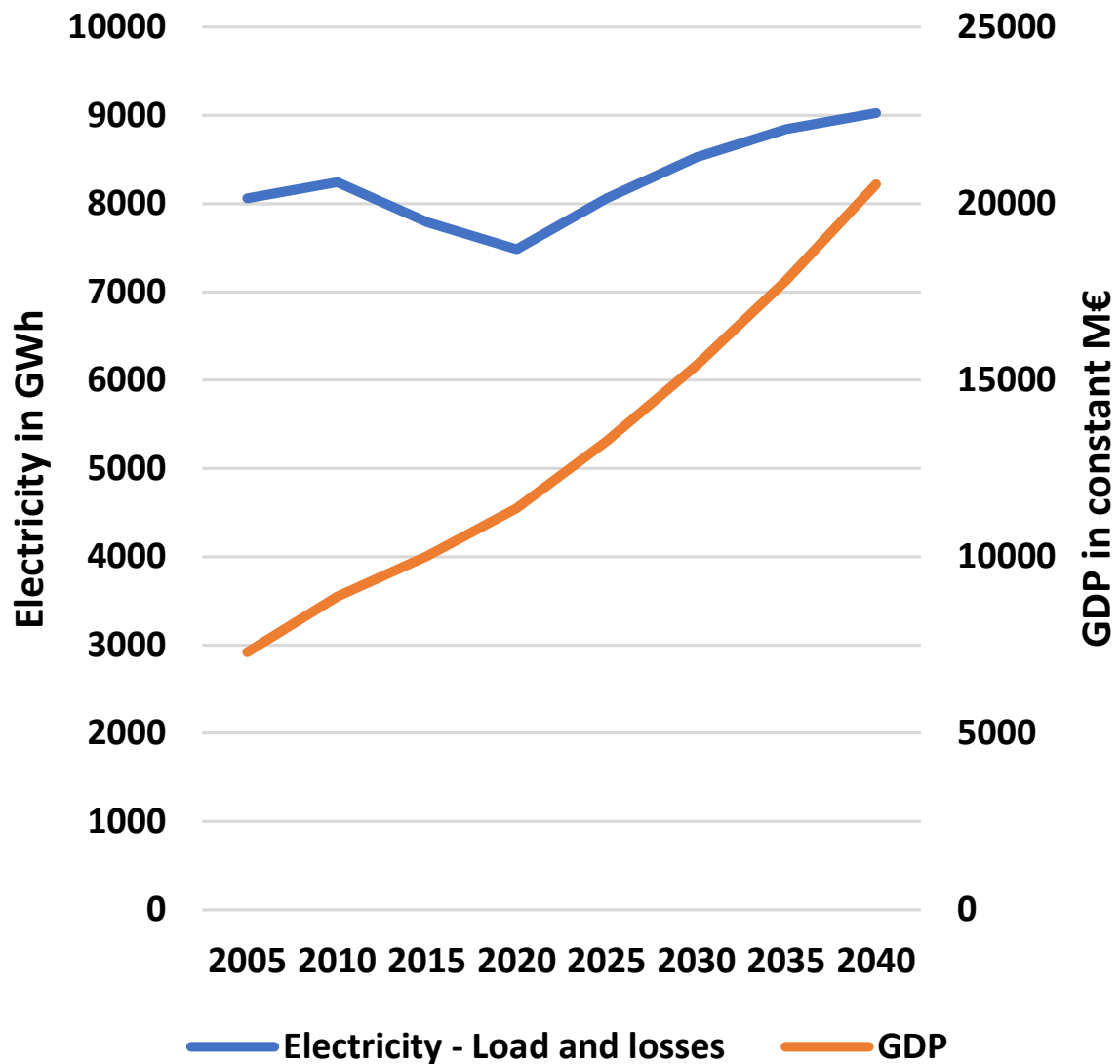
- Significant potential (over 1GW) for new hydro plants
  - How many of these are expected to be commissioned in the upcoming years?
  - The announced plan is truly under implementation?
- Cross-border trade:
  - When the new Albania-North Macedonia interconnector will be commissioned?
- Gas-fired capacity: when will Vlora PP be commissioned (e.g. 2024)?
  - What is the expected role of this plant in the system?
- Solar PV and wind support plans

## Outlook

- Thanks to renewables, the country has full resilience to carbon pricing
- Depending on further investment in RES, exports may increase
- The prices of electricity can be stable and decreasing in the future

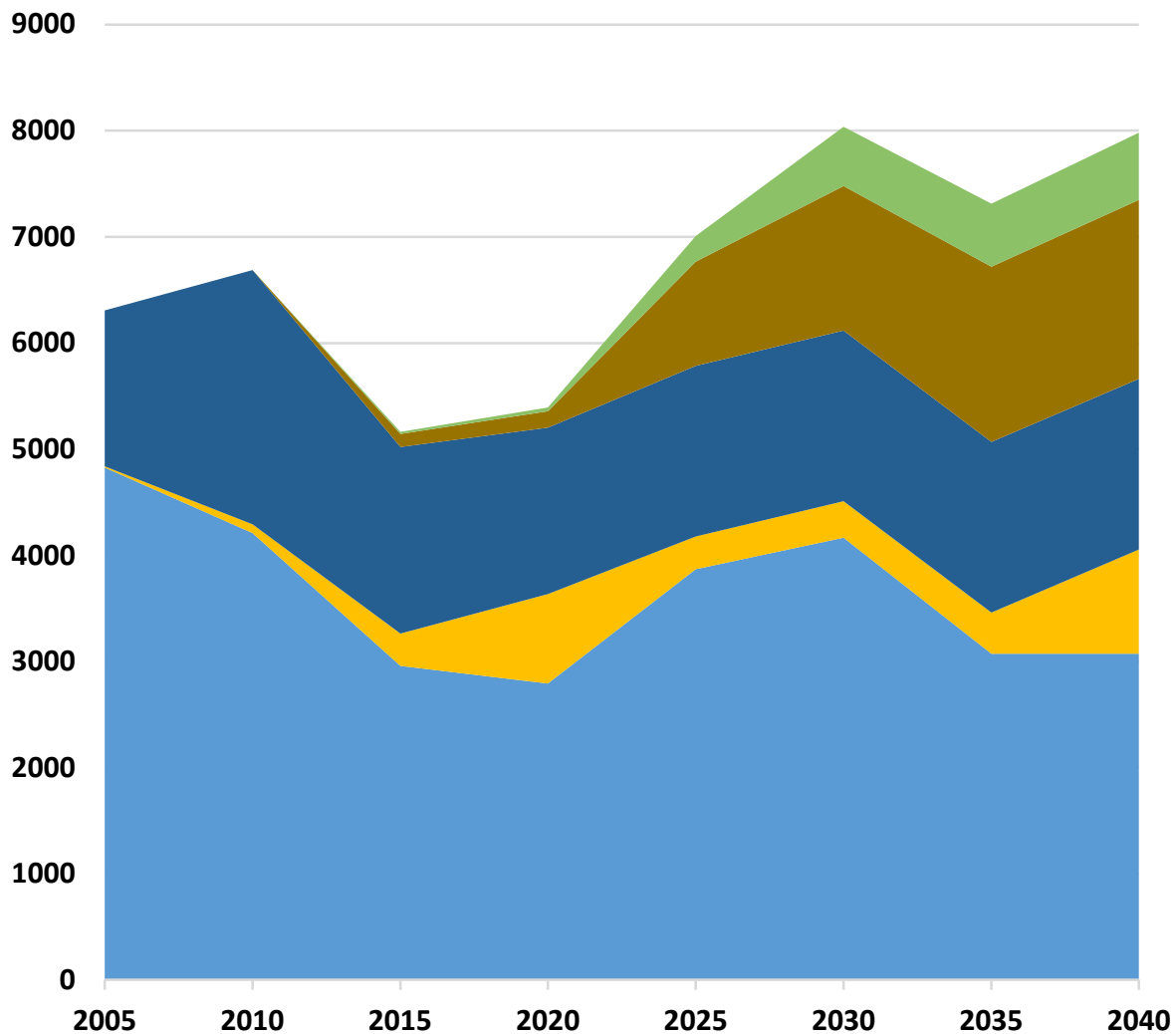
# North Macedonia - Baseline scenario projections

## Demand for electricity



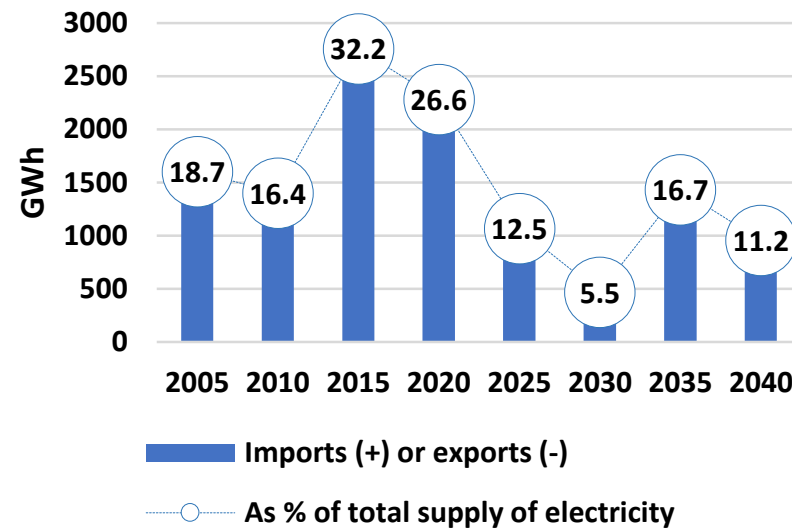


### Power generation (GWh-net)

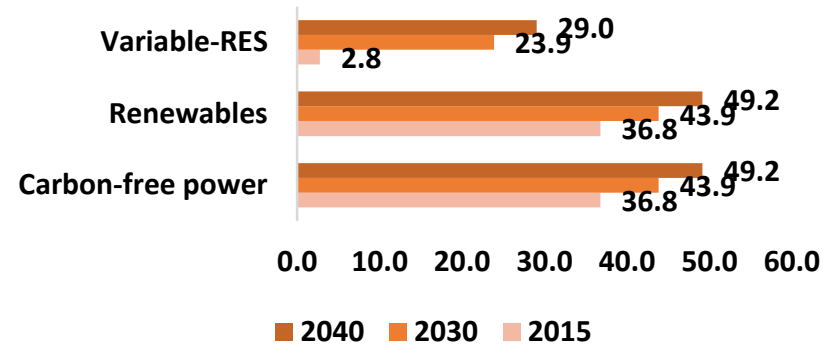


- Solar
- Wind
- Hydro
- Biomass
- Gas and oil
- Coal
- Nuclear

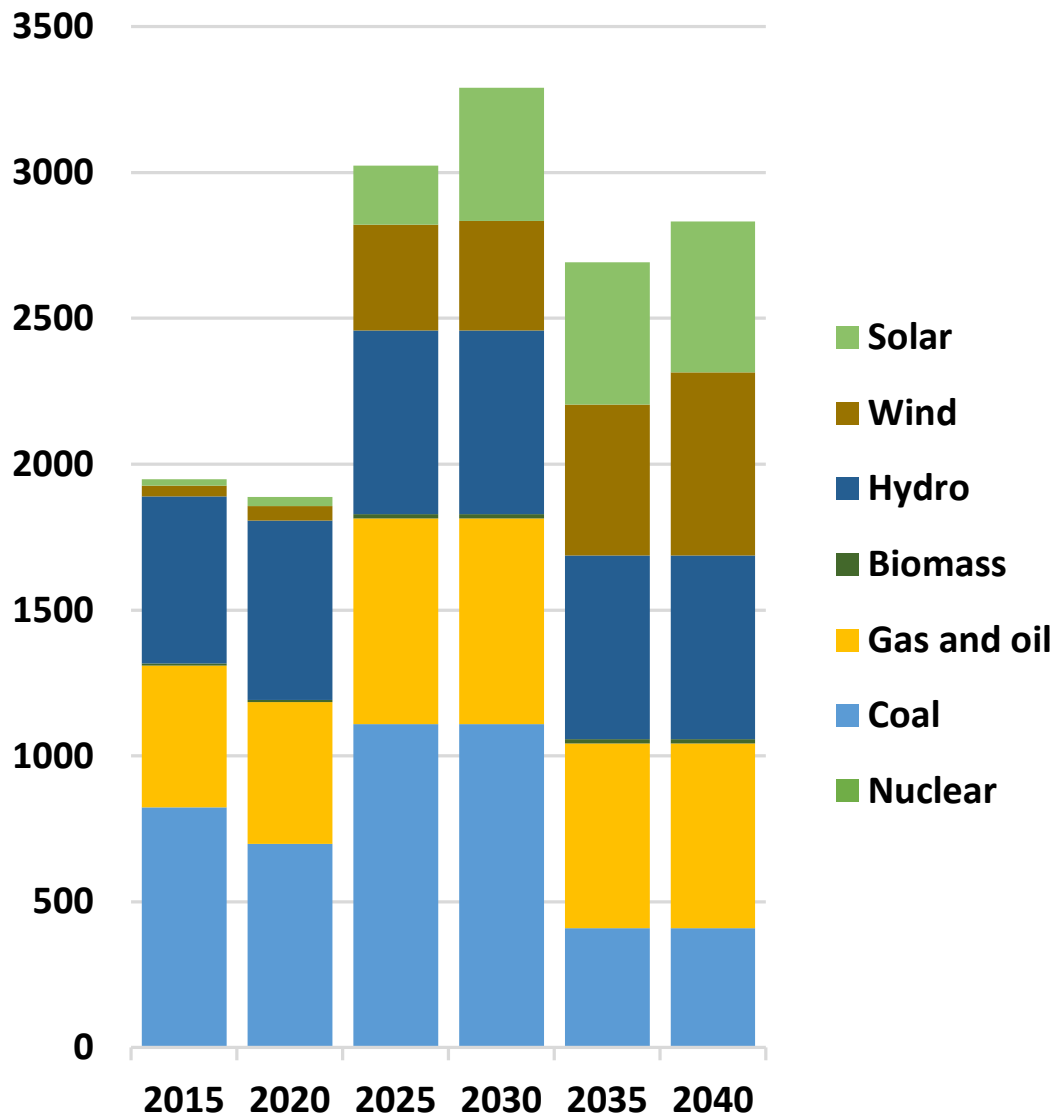
### Net imports of electricity



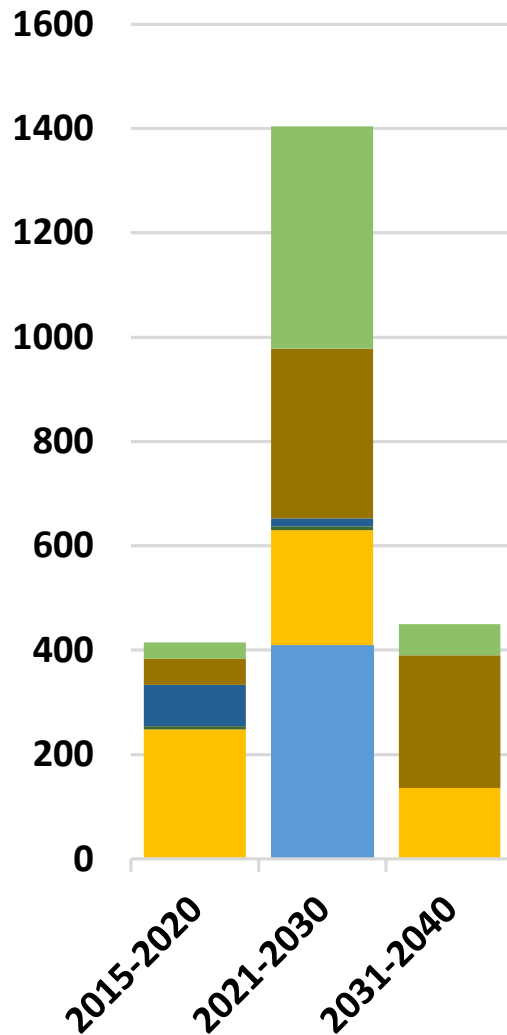
### Indicators (shares - %)



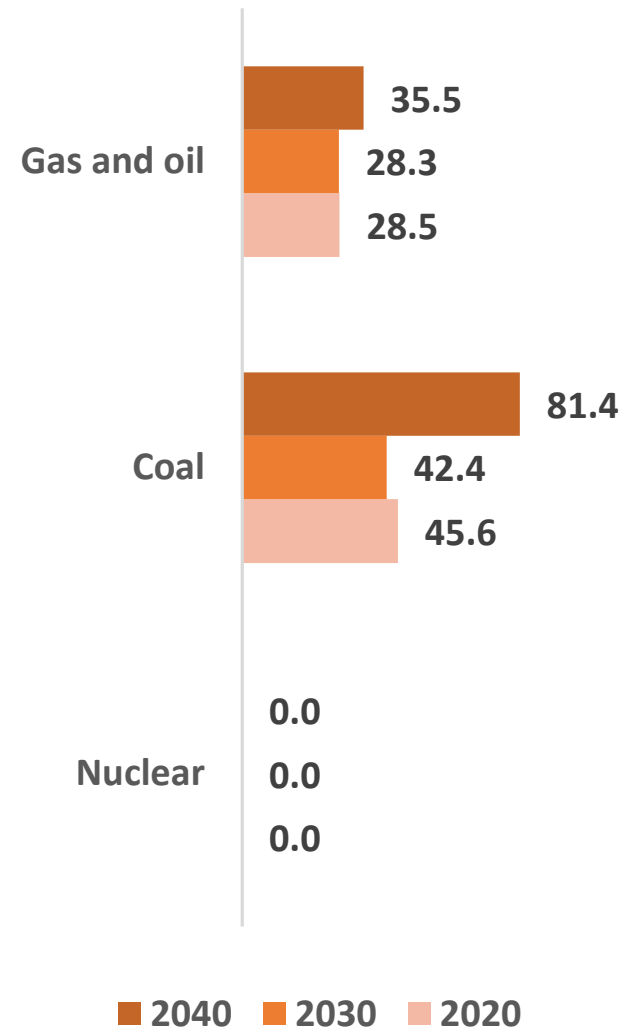
### Operating capacities (MW)



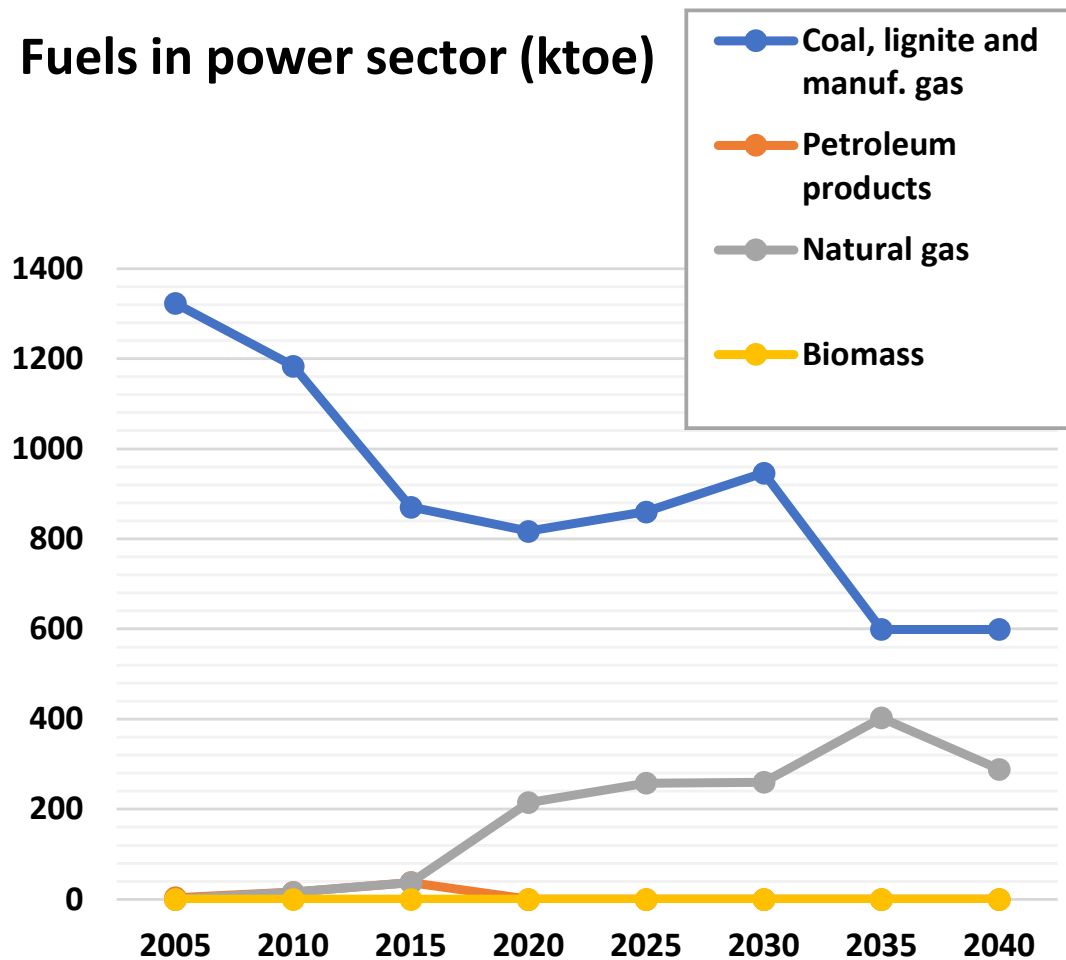
### Capacity expansion (MW)



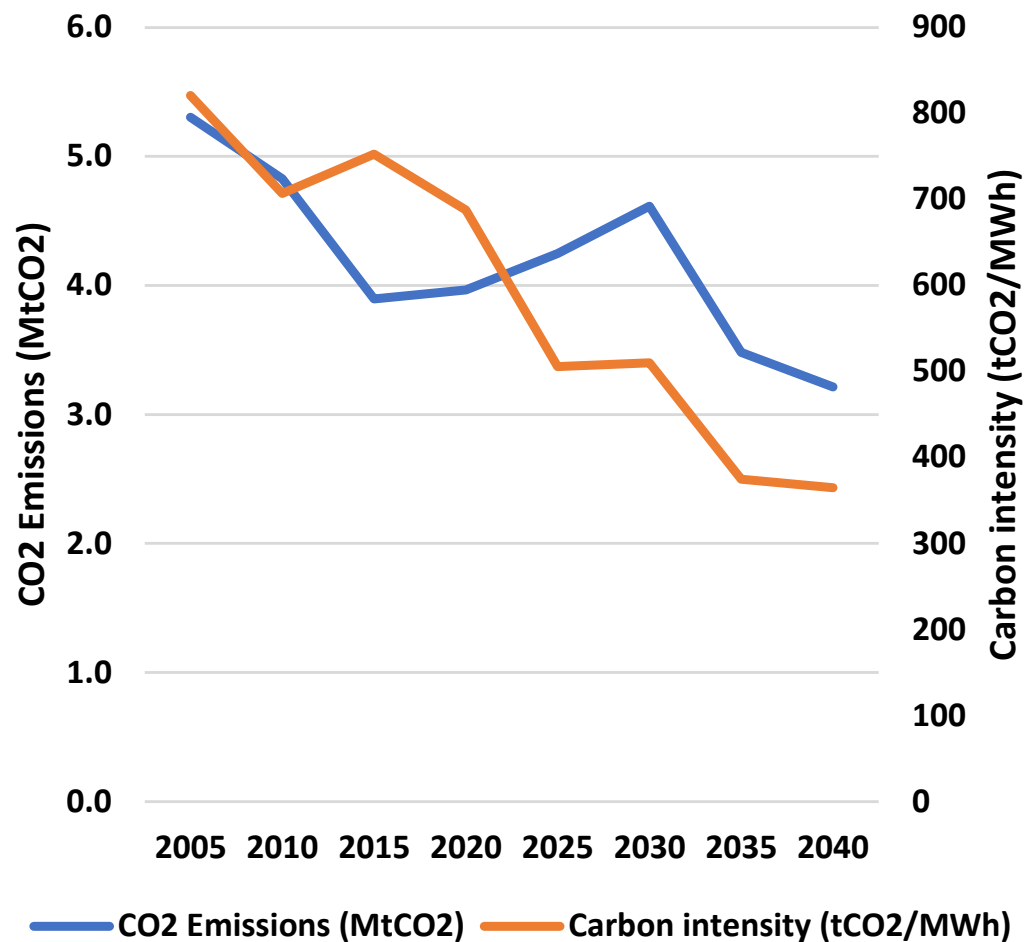
### Rate of use of capacity (%)



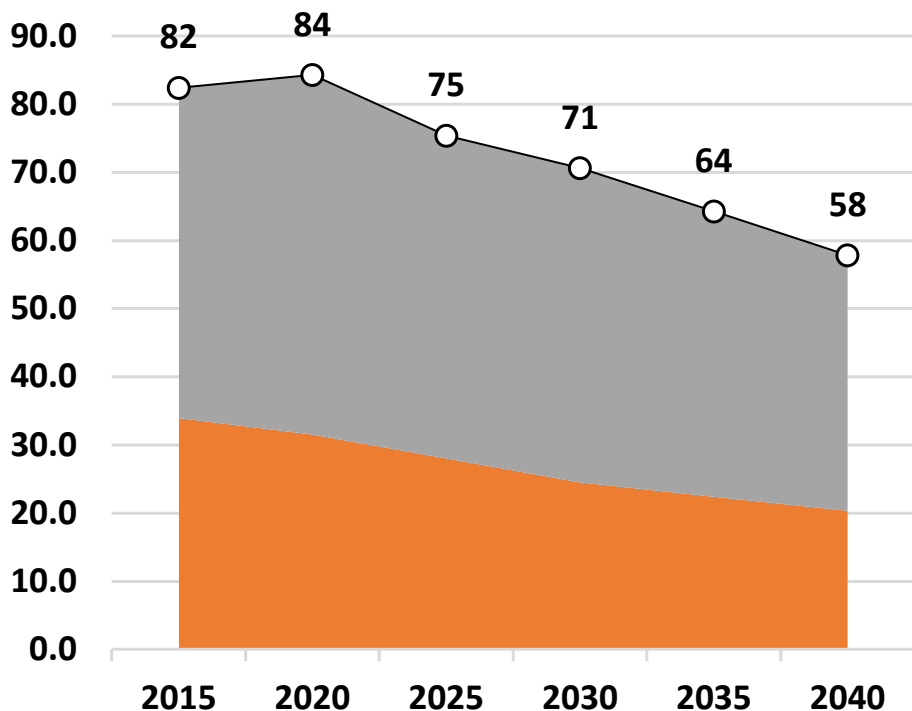
Fuels in power sector (ktoe)



CO2 Emissions in power generation

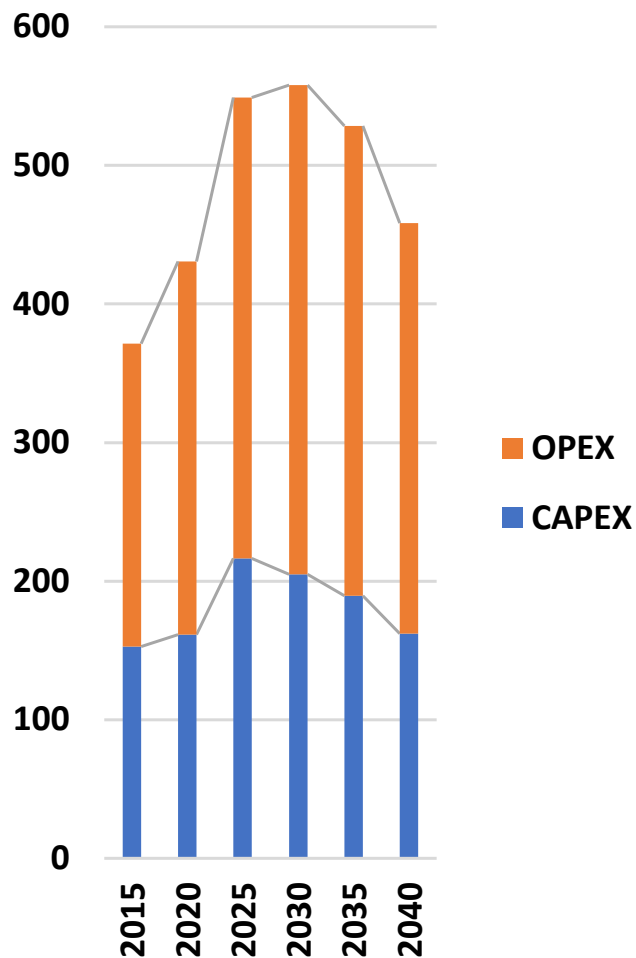


### Unit costs in €/MWh (sales)

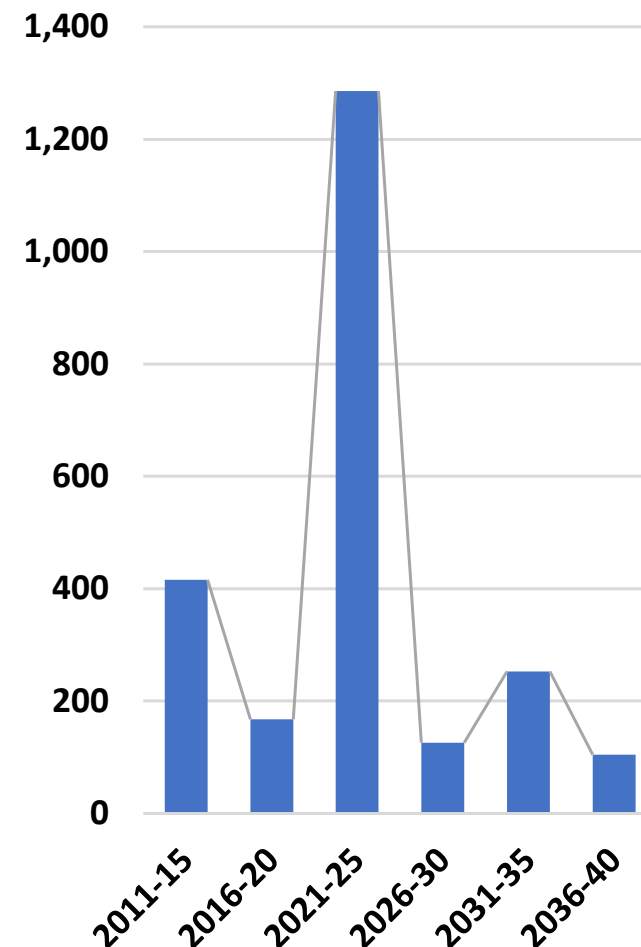


- Emission/Energy Taxation Costs
- Operating Costs
- Capital Costs (annual equivalent)
- Unit total cost of electricity excl. grids

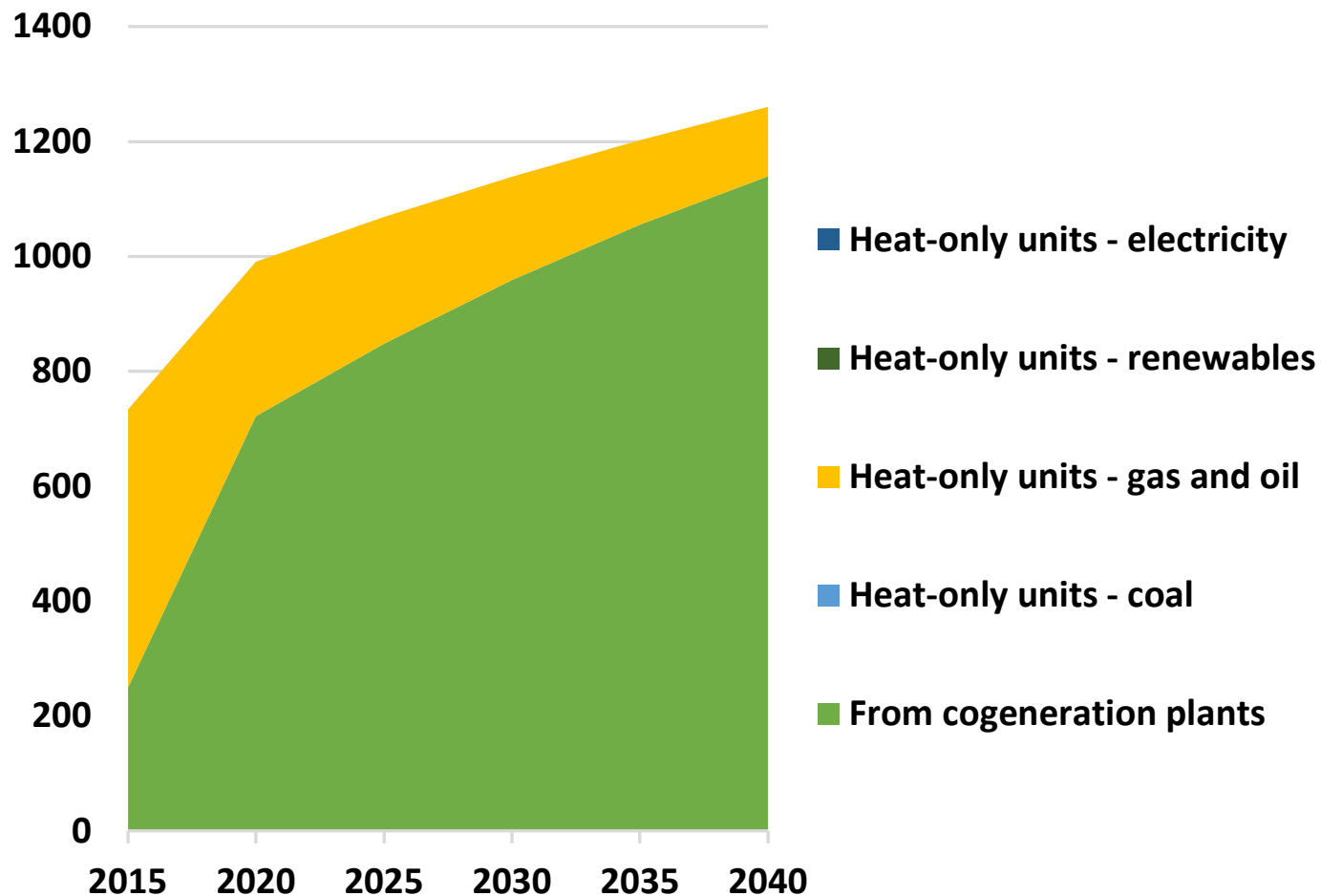
### Total Cost of Electricity supply (in M€)



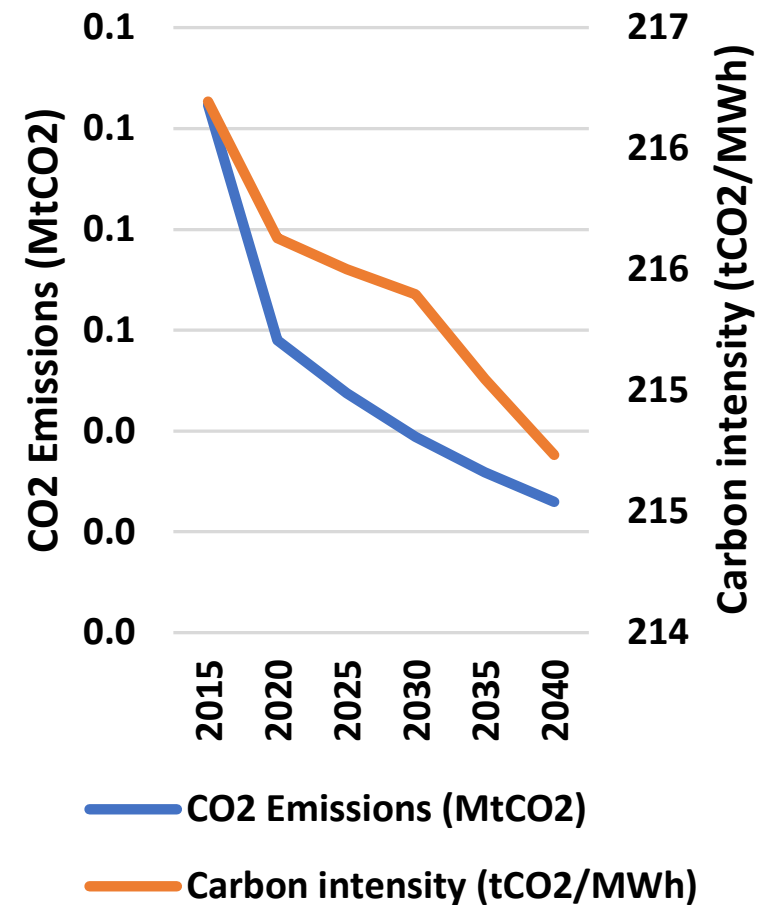
### Investment expenditures in power plants (in M€)



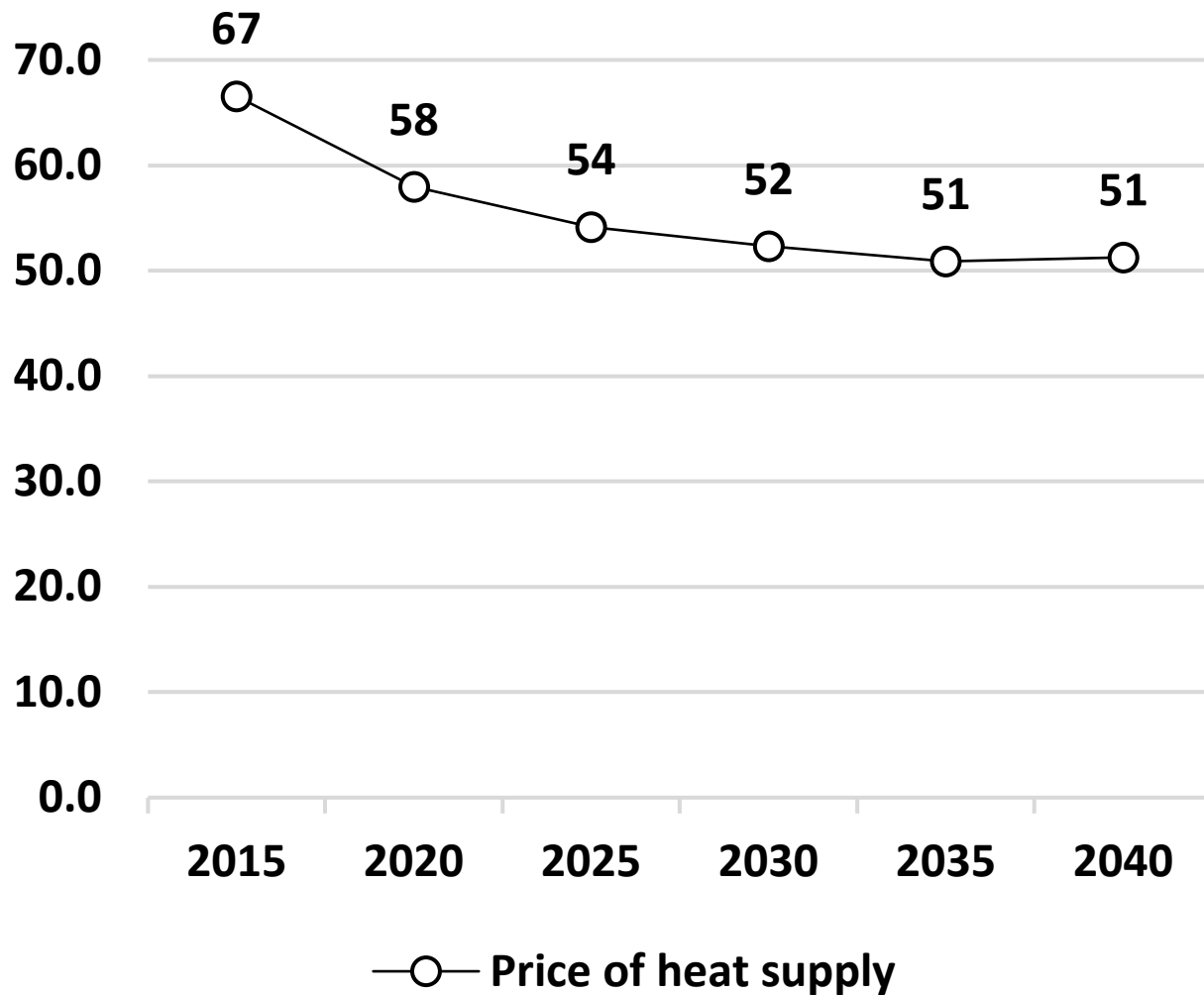
## Heat production (GWh heat)



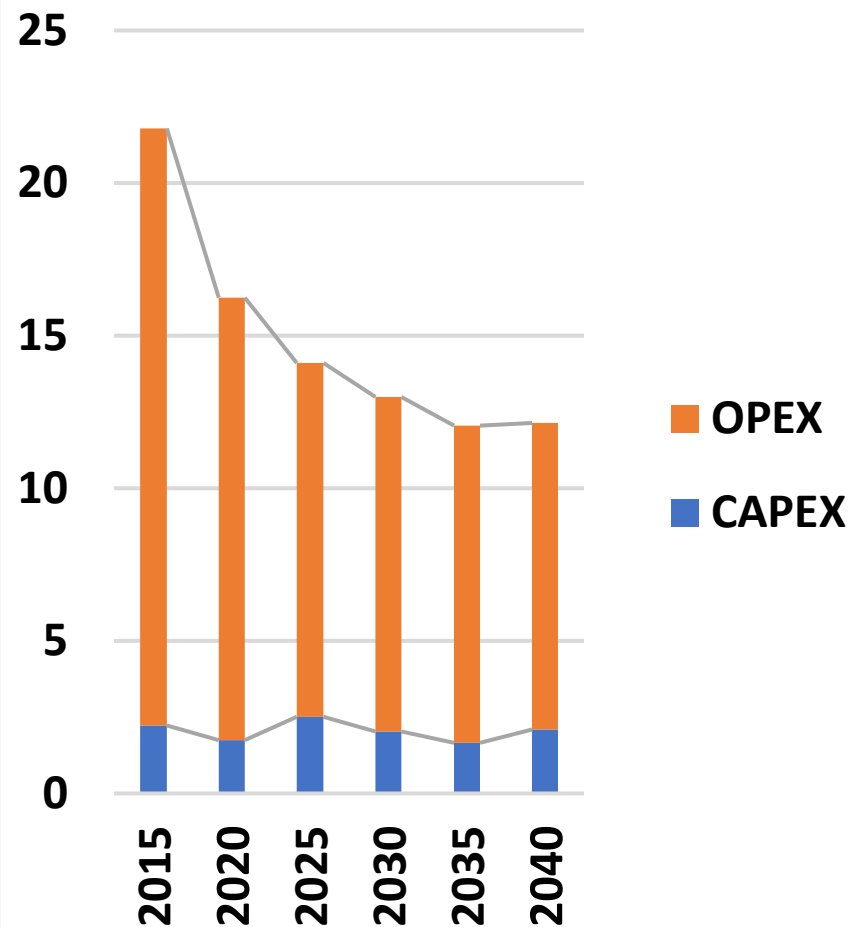
## CO2 Emissions in heat-only unit



### Unit costs in €/MWh (sales)



### Total Cost of heat production (in M€)



## Uncertainties – lack of information

- Lignite fired-plants:
  - Should we expect refurbishment of TPP Bitola (Units 1-3) or a phase out?
  - New investments are uncertain
    - Oslomej2,
    - Bitola 4,
    - Negotino 2,
    - Mariovo
  - Are there any expected developments regarding the exploitation of mines and how will this affect the cost of lignite production
- Gas plants: should we expect new investment?
  - TETO Zajcev Rid
- What about gas prices, after the TAP
- RES support plan still uncertain

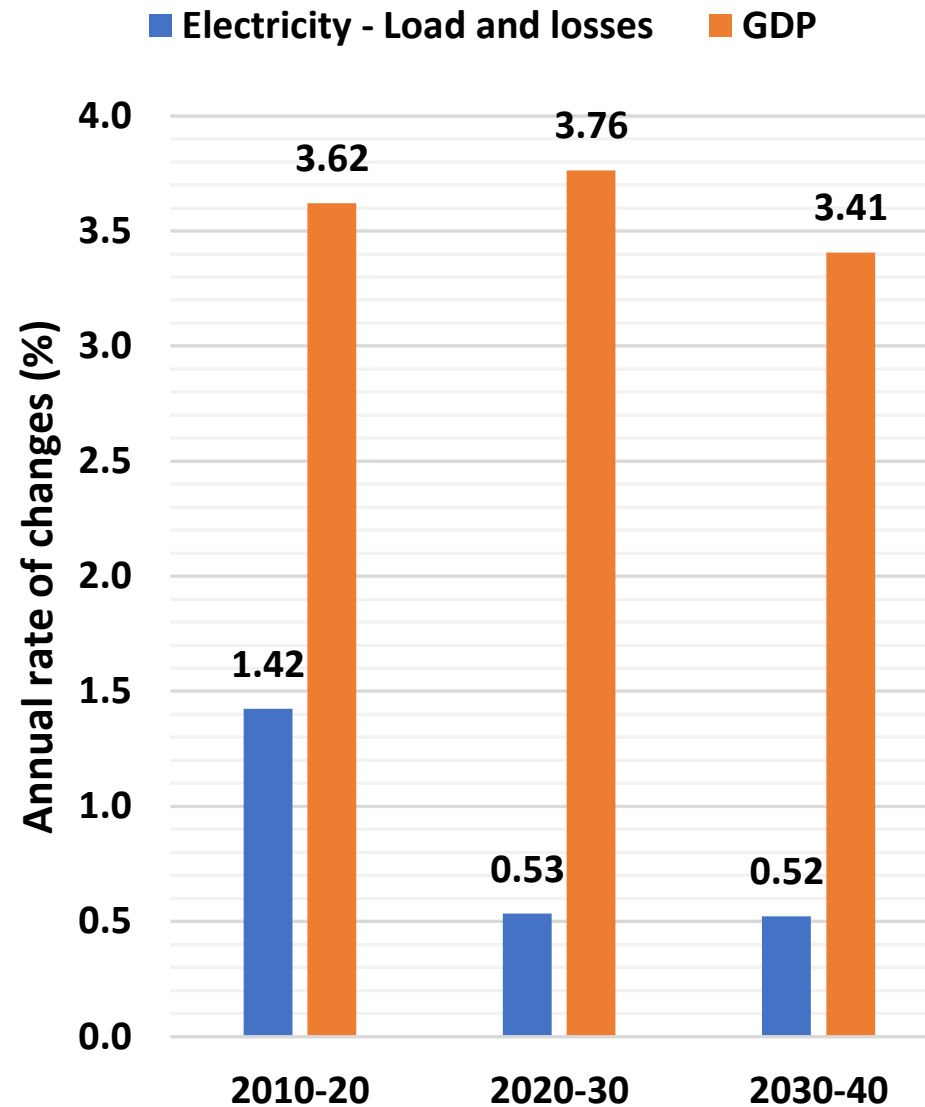
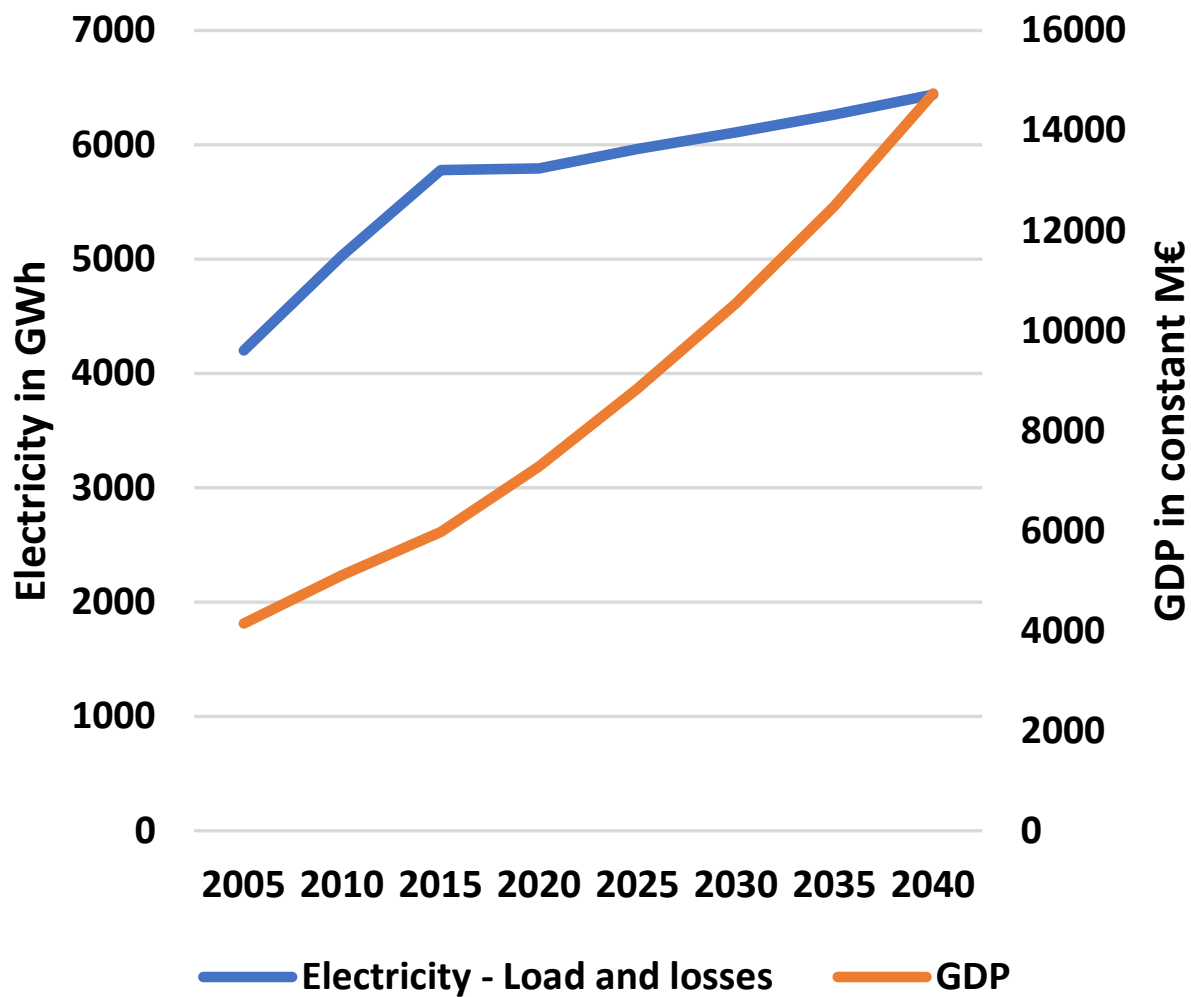
## Outlook

- The BAU outlook seems relying on lignite exclusively
- Thus, carbon pricing would imply revision of the lignite strategy
- Not clear, whether gas power development can be an alternative given the infrastructure and gas market conditions
- RES potential is considerable, and may be facilitated in a market integration context
- However, the market is isolated at present

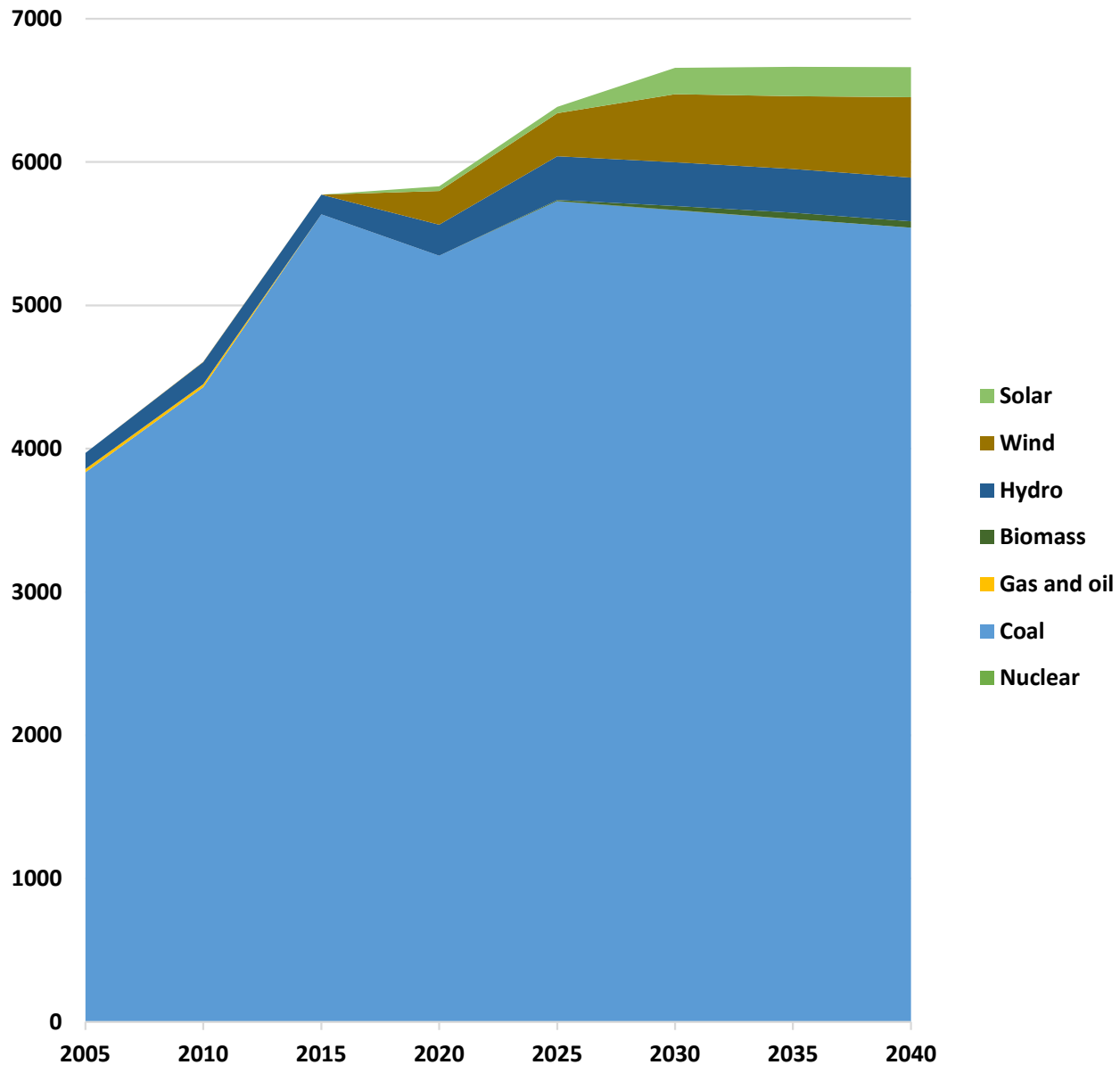
# Kosovo (\*) - Baseline scenario projections



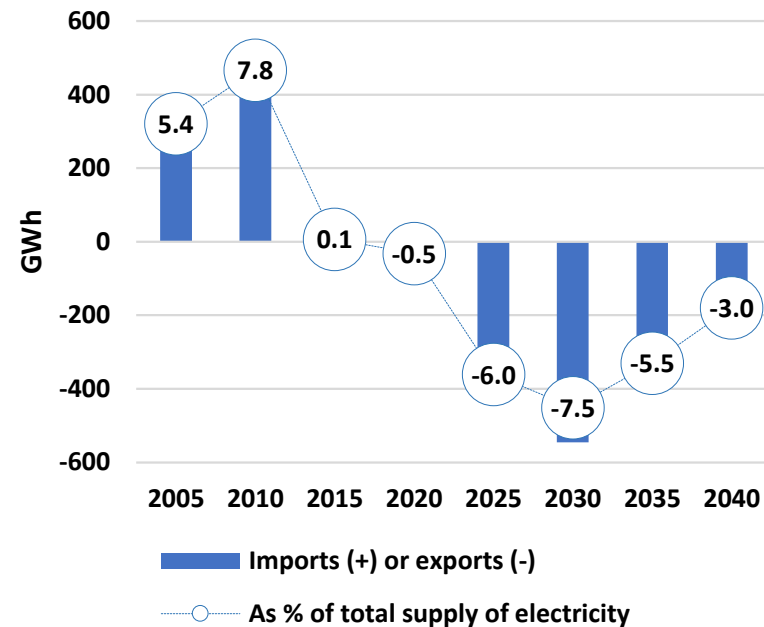
## Demand for electricity



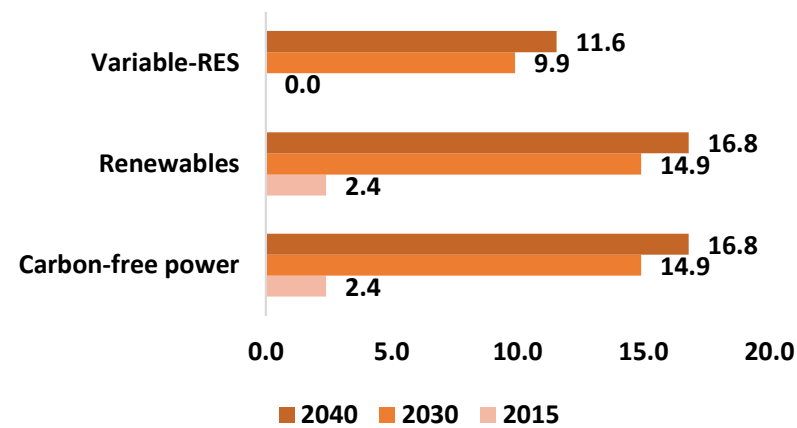
Power generation (GWh-net)



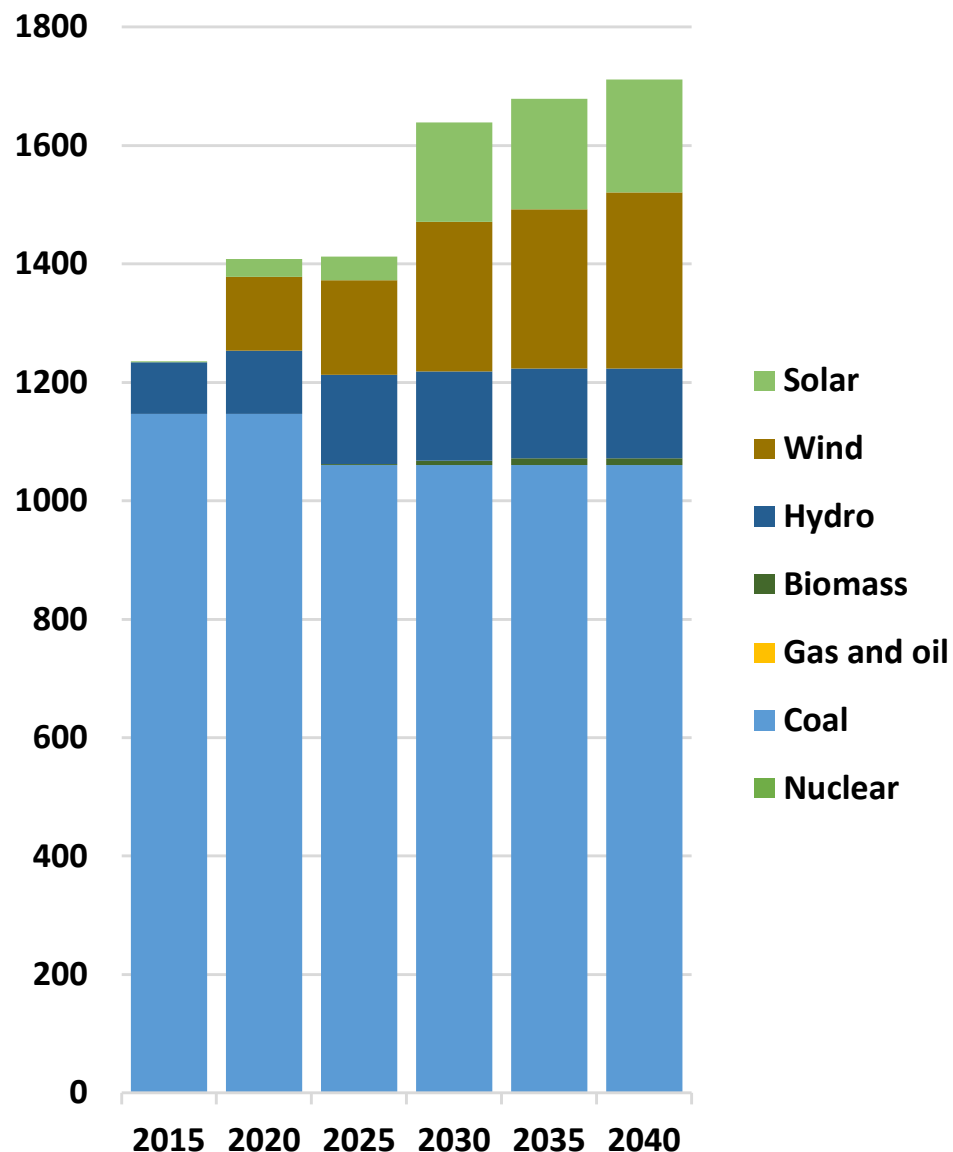
Net imports of electricity



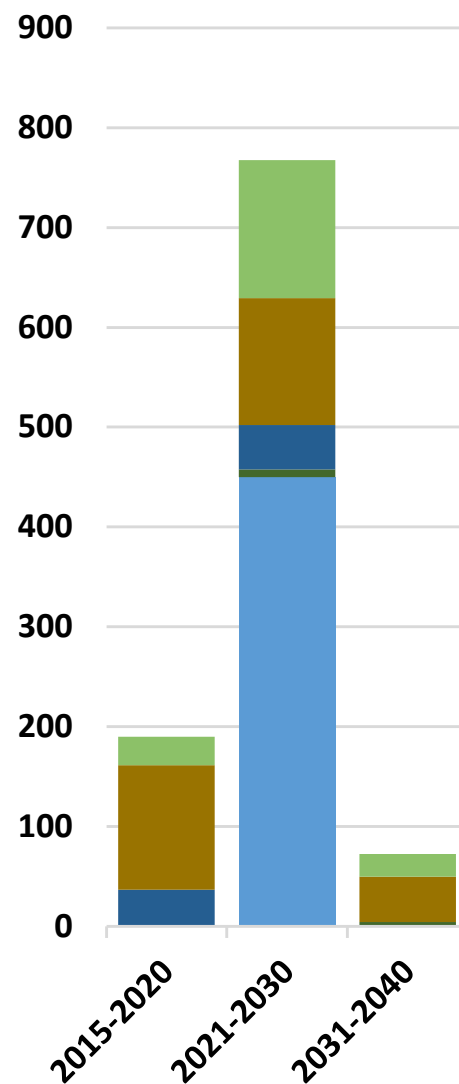
Indicators (shares - %)



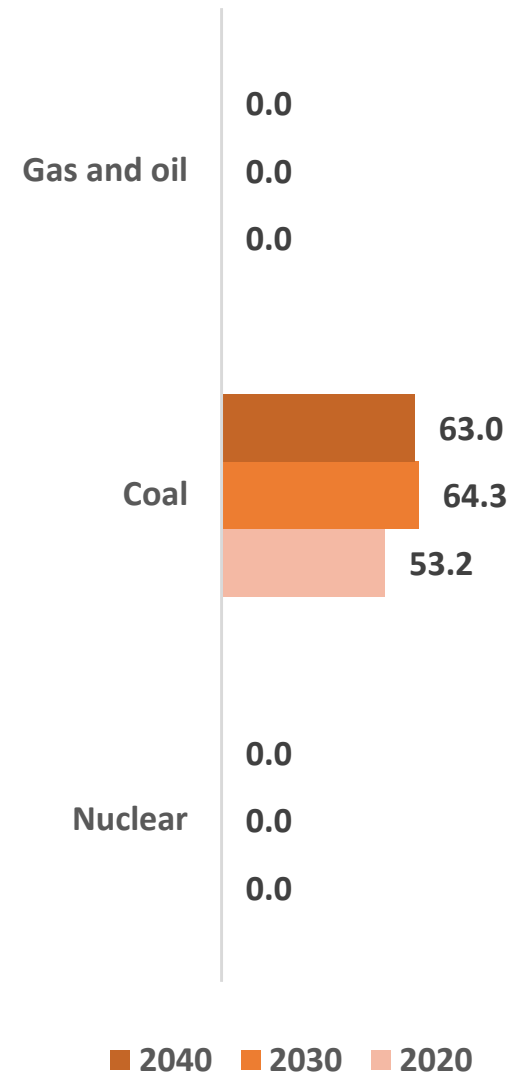
### Operating capacities (MW)



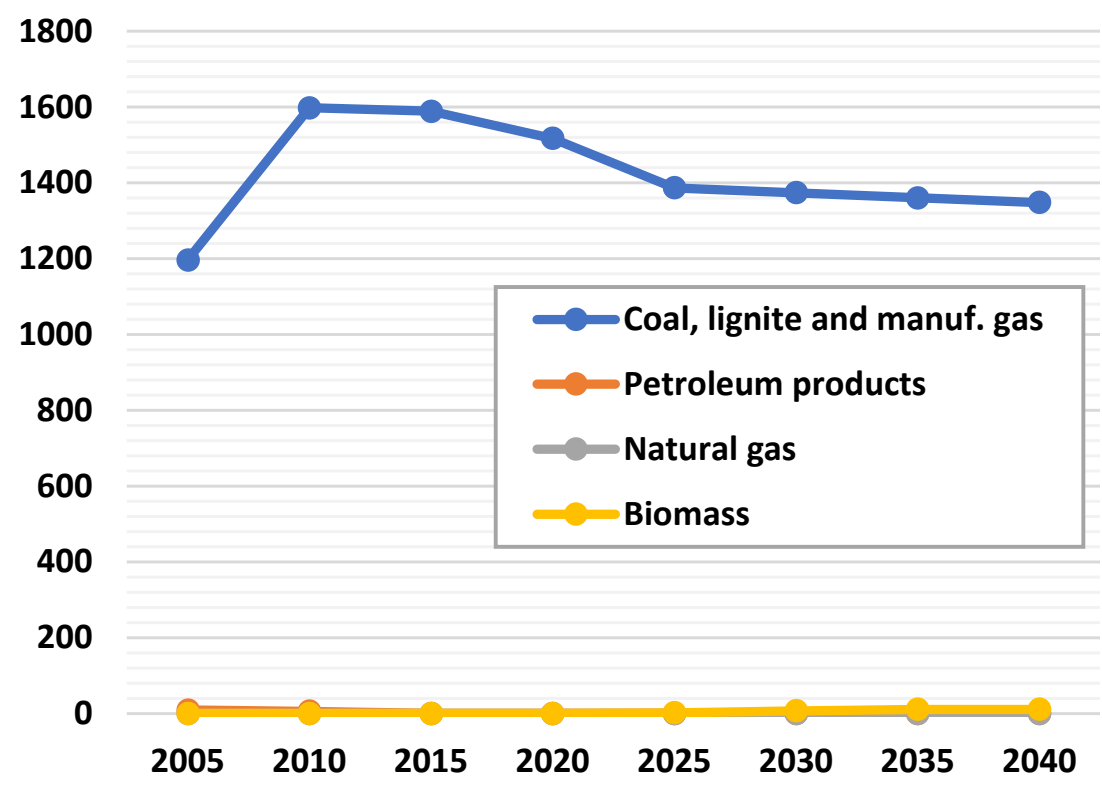
### Capacity expansion (MW)



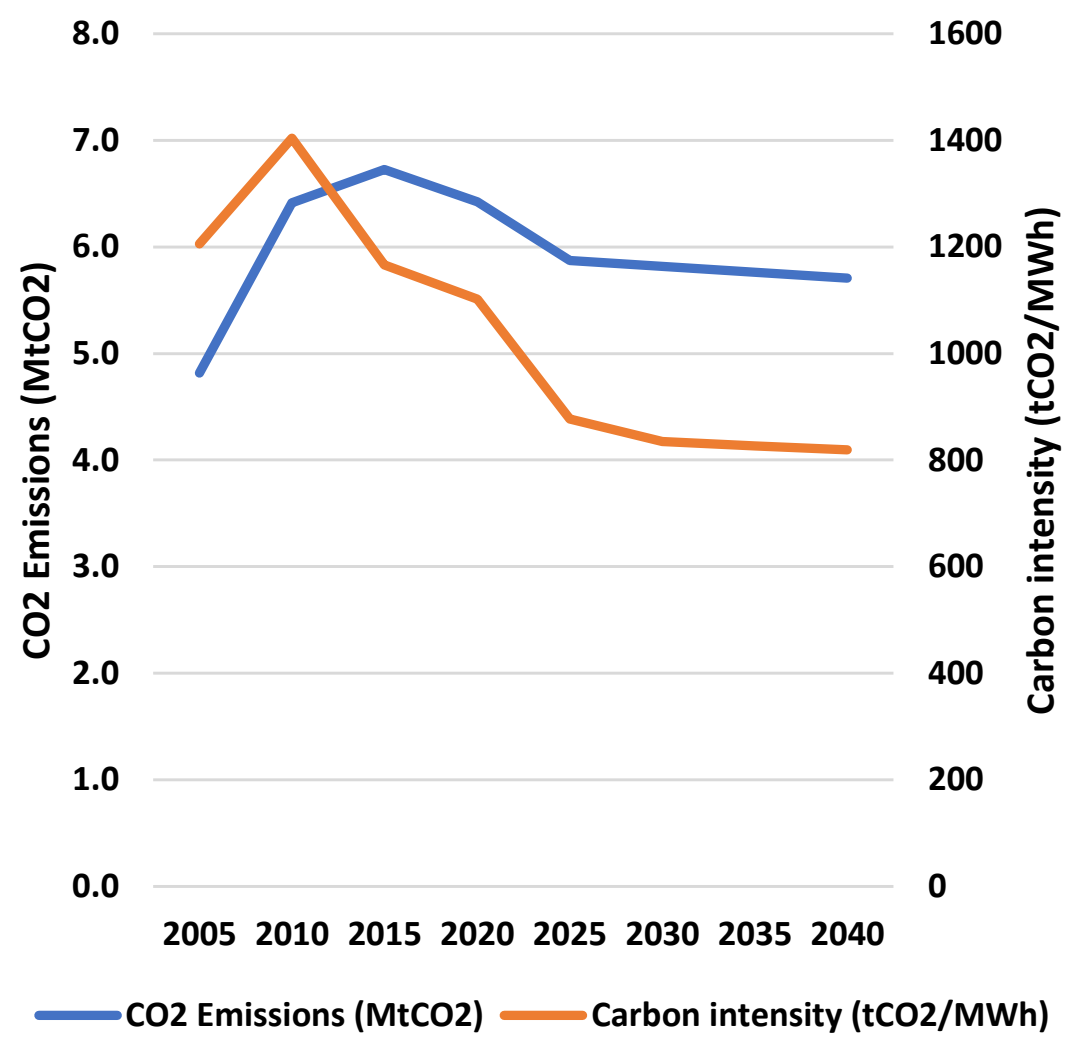
### Rate of use of capacity (%)



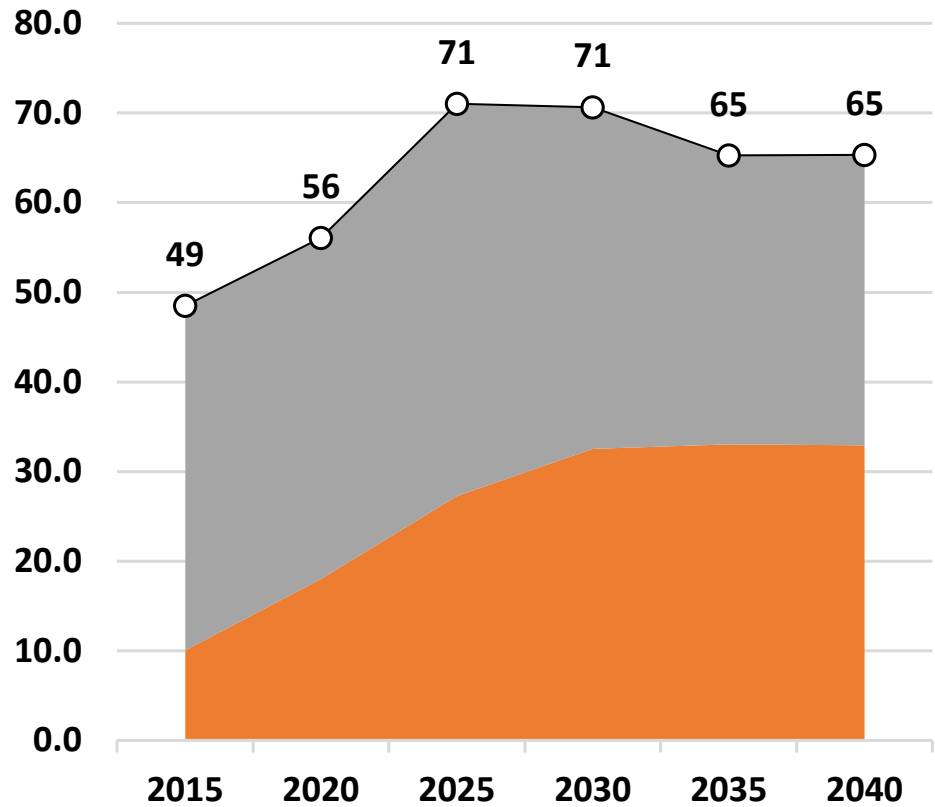
### Fuels in power sector (ktoe)



### CO2 Emissions in power generation

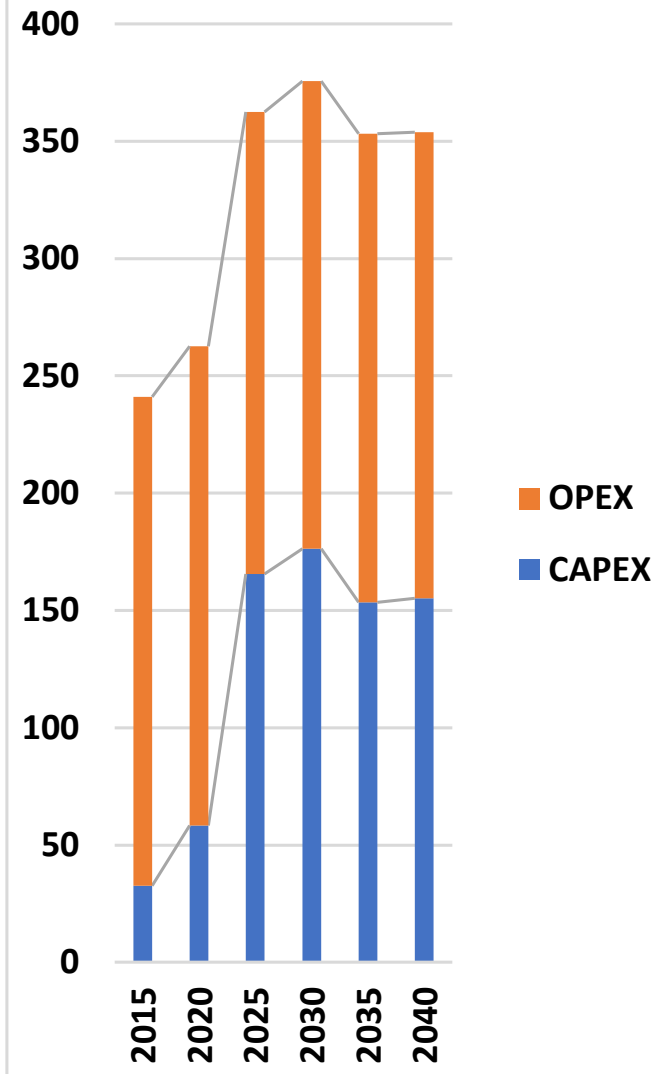


### Unit costs in €/MWh (sales)



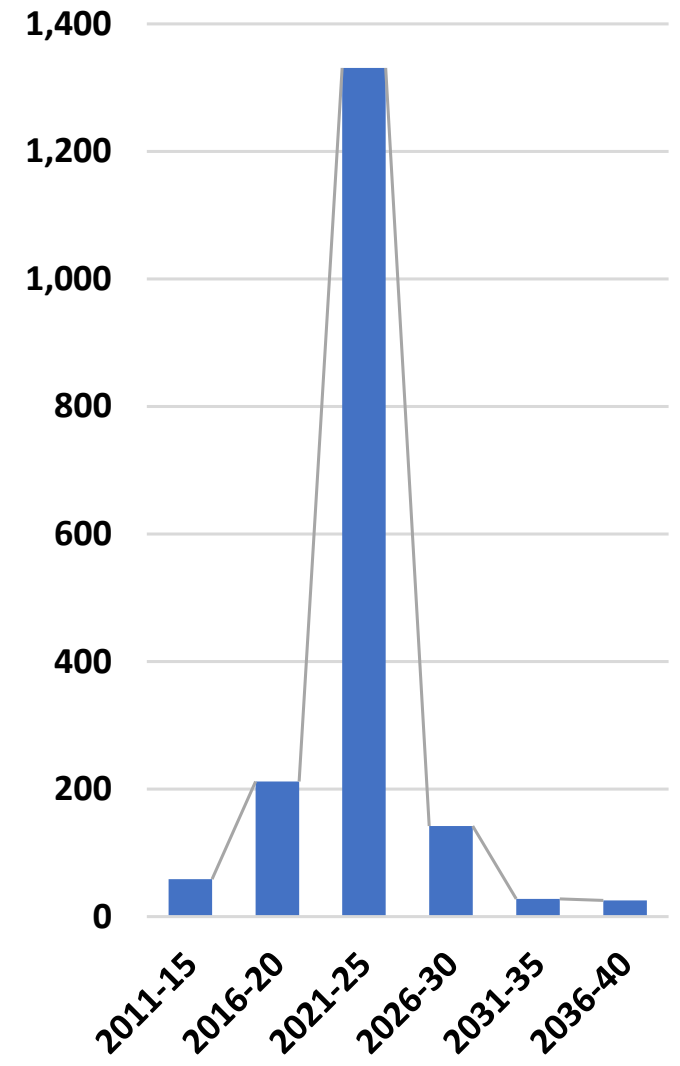
- Emission/Energy Taxation Costs
- Operating Costs
- Capital Costs (annual equivalent)
- Unit total cost of electricity excl. grids

### Total Cost of Electricity supply (in M€)

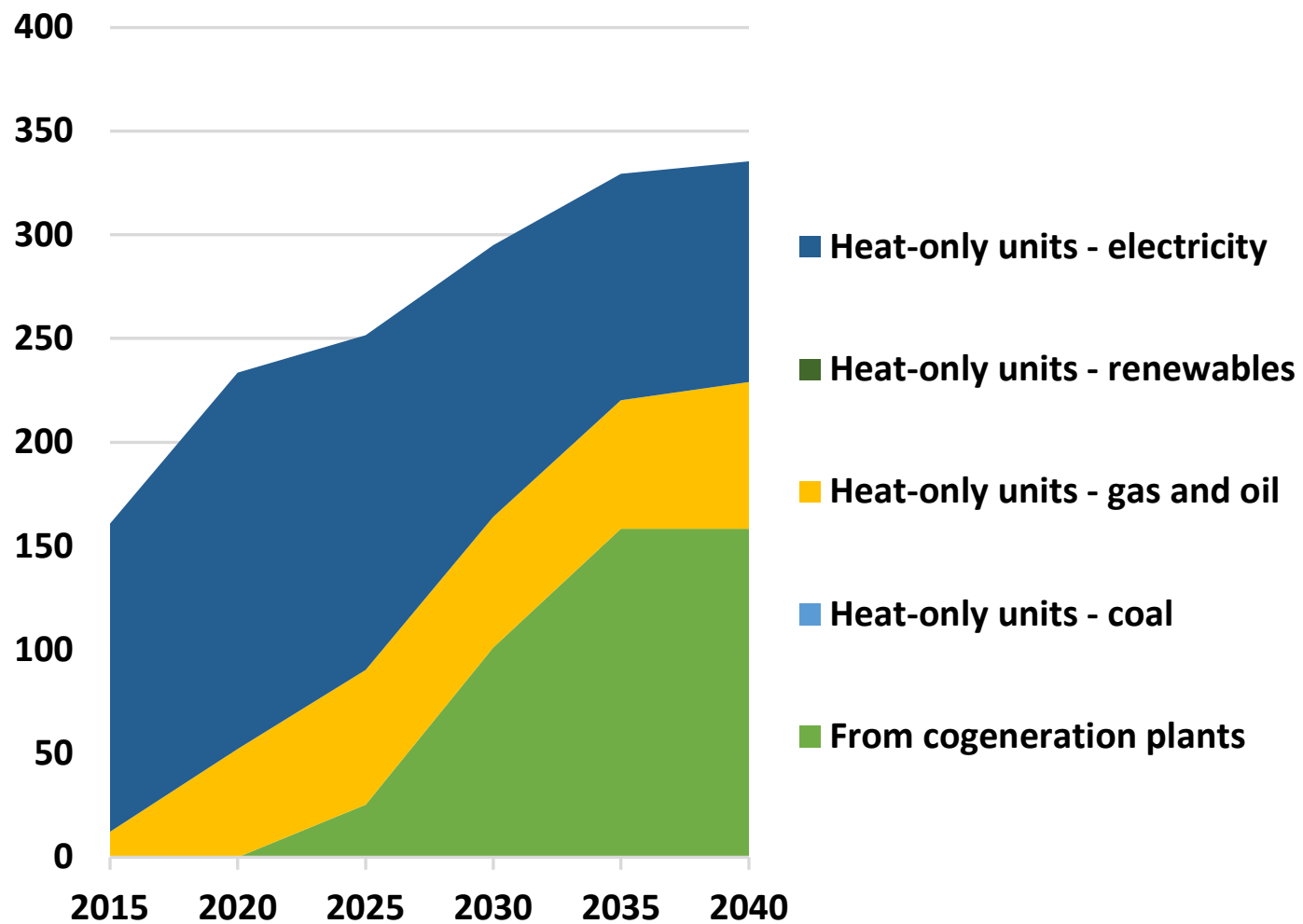


- OPEX
- CAPEX

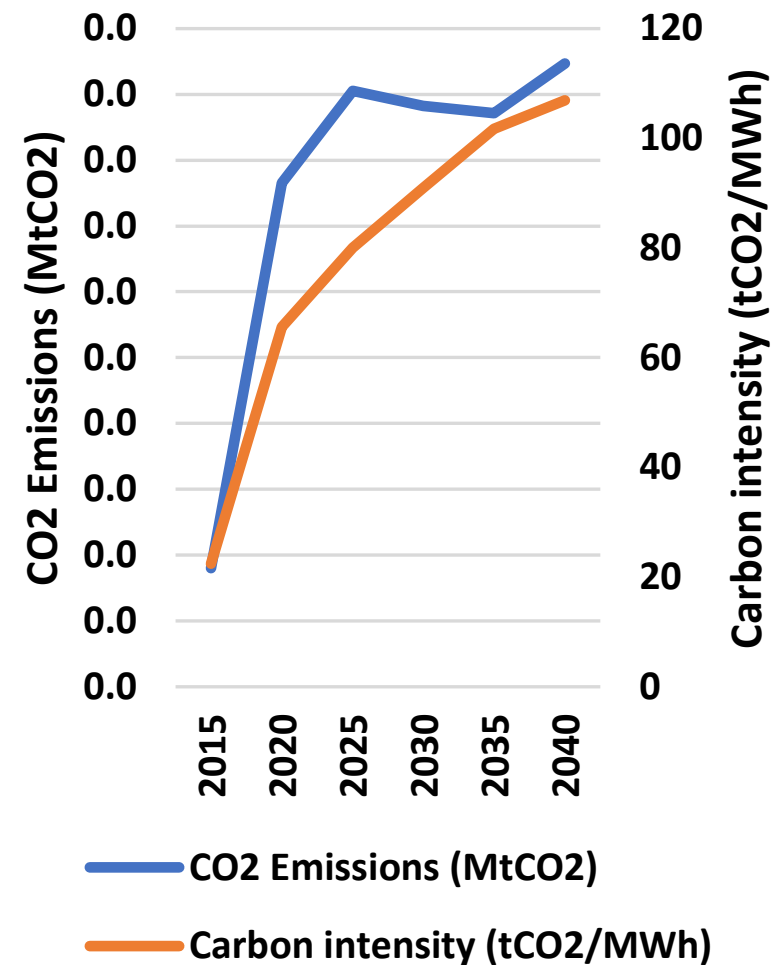
### Investment expenditures in power plants (in M€)



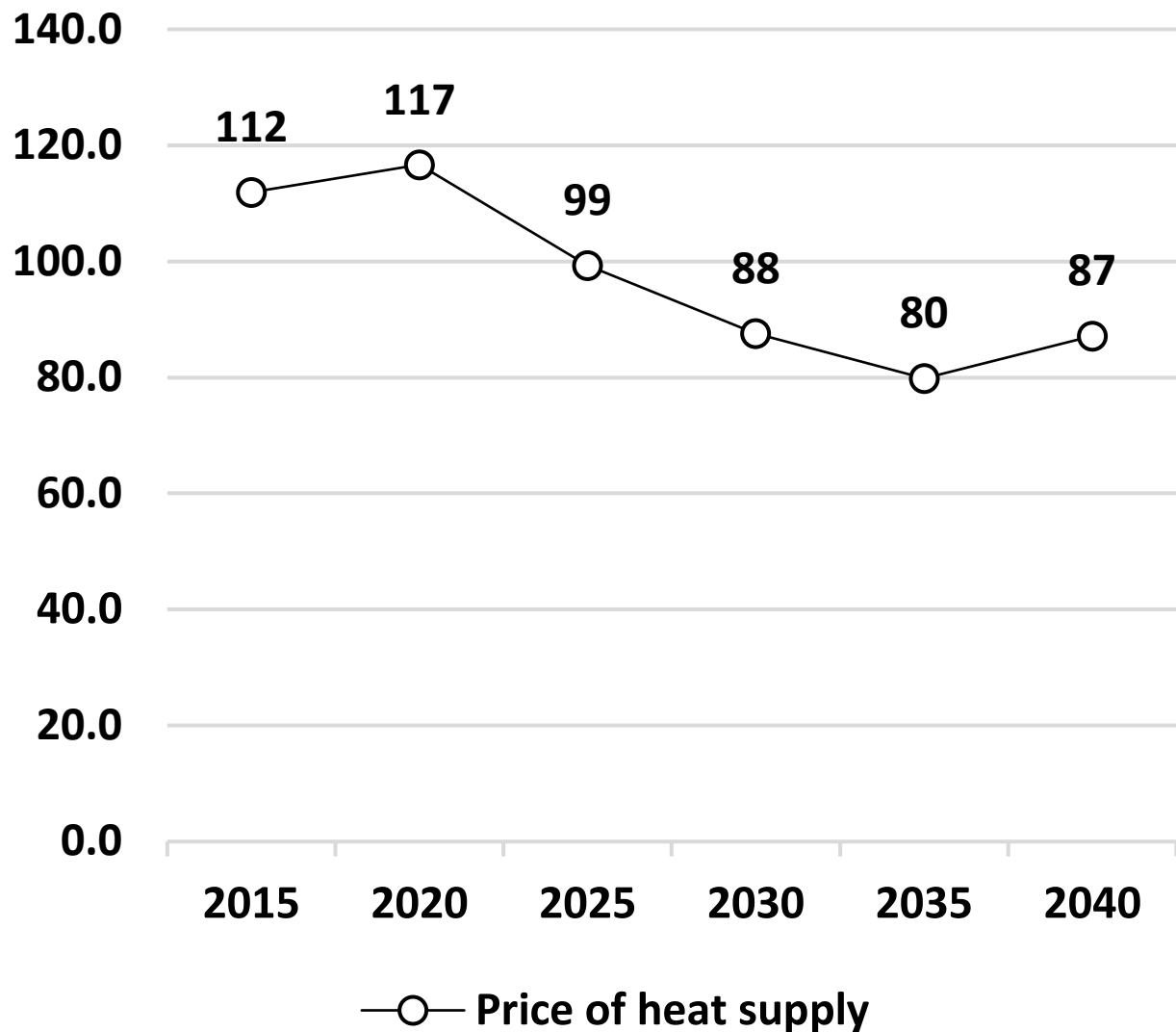
## Heat production (GWh heat)



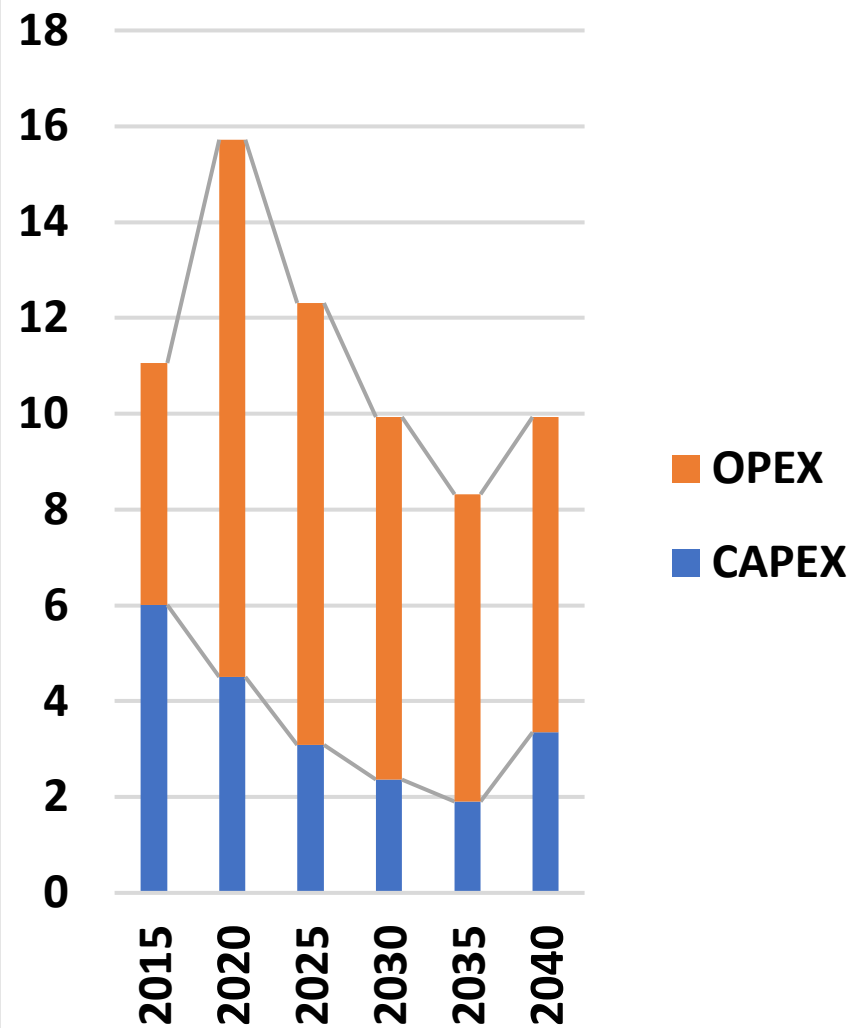
## CO2 Emissions in heat-only unit



### Unit costs in €/MWh (sales)



### Total Cost of heat production (in M€)



## Uncertainties – lack of information

- *Lignite plants:*
  - *What is the decommissioning plan for TPP Kosovo A ?*
  - *Should we include the new investment (Kosovo e Re) and for when?*
- *Reserve requirements:*
  - *As Kosovo's power system is currently unable to serve tertiary reserve, investments in flexible units (i.e. pumped storage in 2023) are planned according to TSO's schedule. Should we expect such a unit to be commissioned?*
- *Gas infrastructure:*
  - *Are there prospects of gas infrastructure? Are there any plans on improving the flexibility of the system by adding gas-fired plants?*
- *RES support plan uncertain*

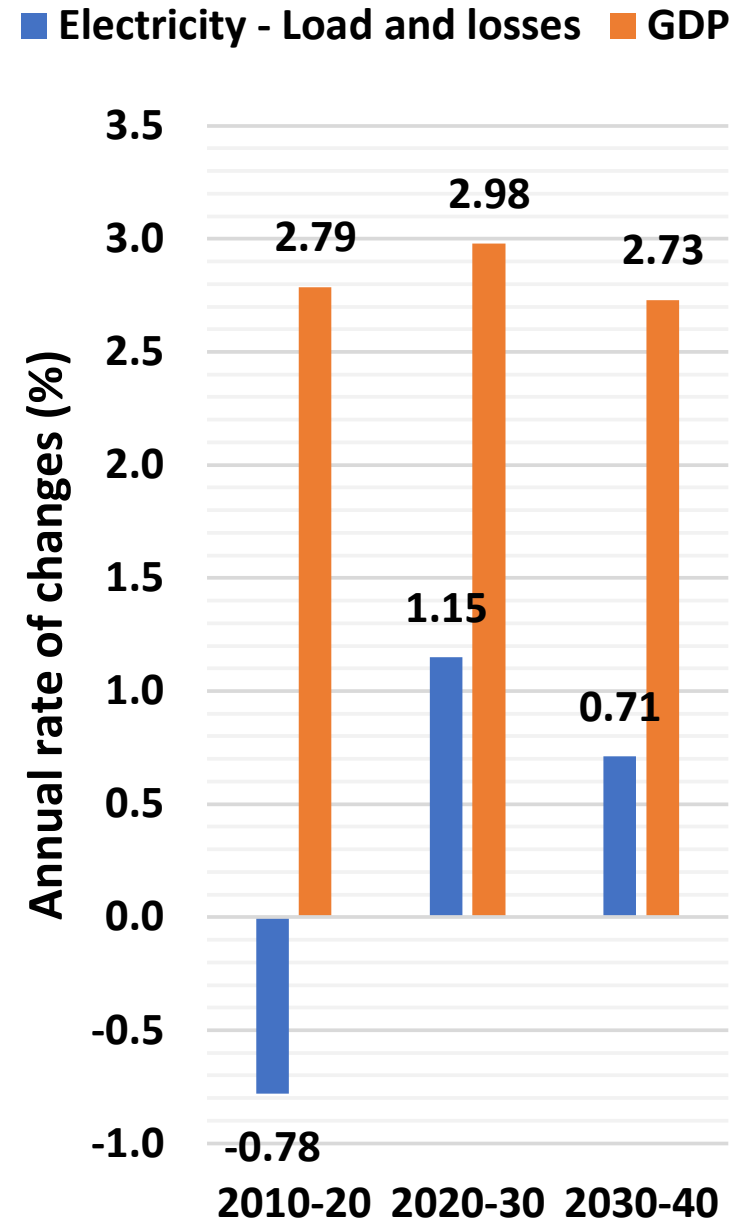
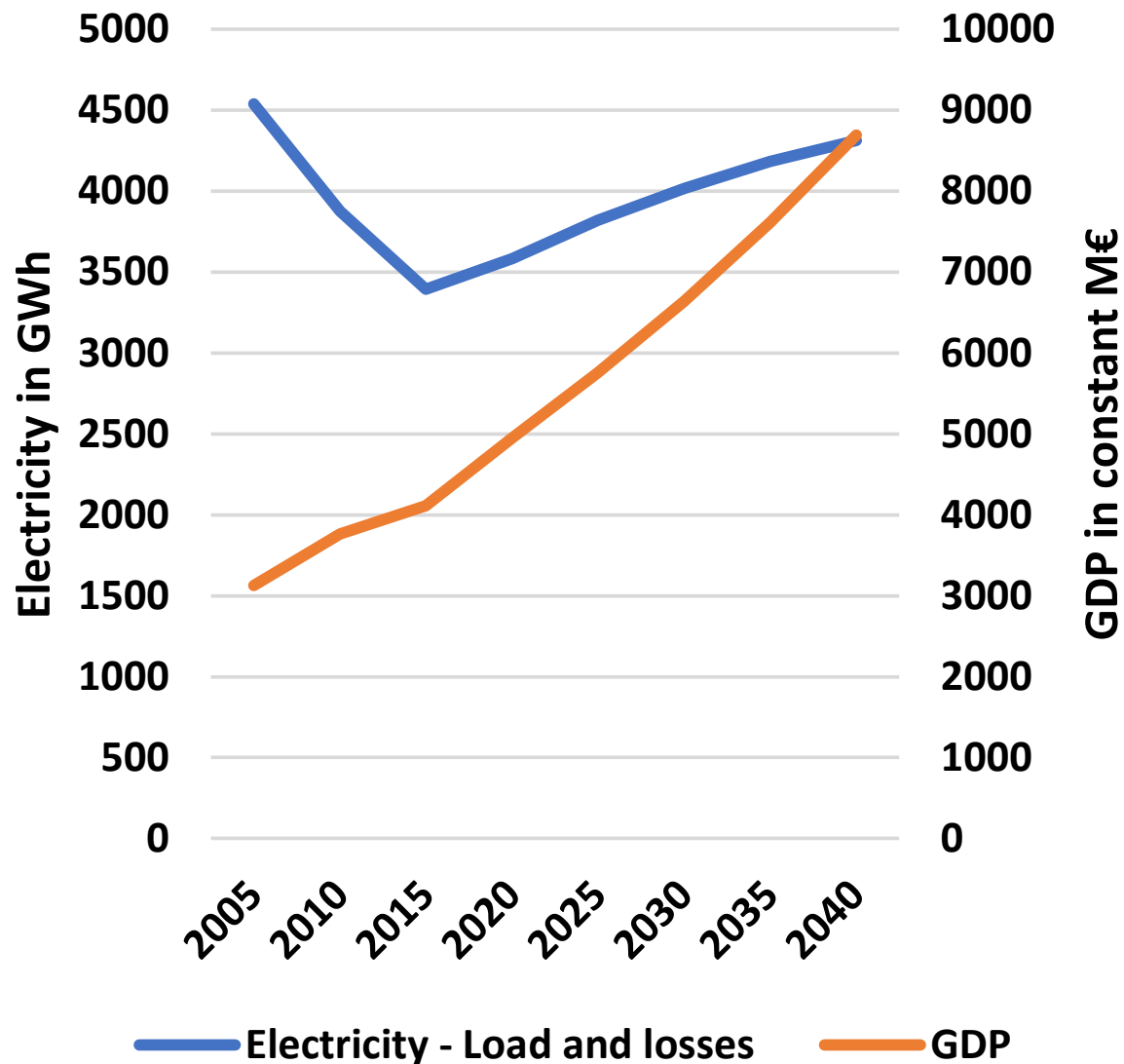
## Outlook

- Full dependence on lignite implies large impacts of carbon pricing
- Poor market integration also undermines flexibility
- Weak reserve resources also obstruct development of RES
- Lack of gas infrastructure and a liquid gas market hinders gas power investment initiatives

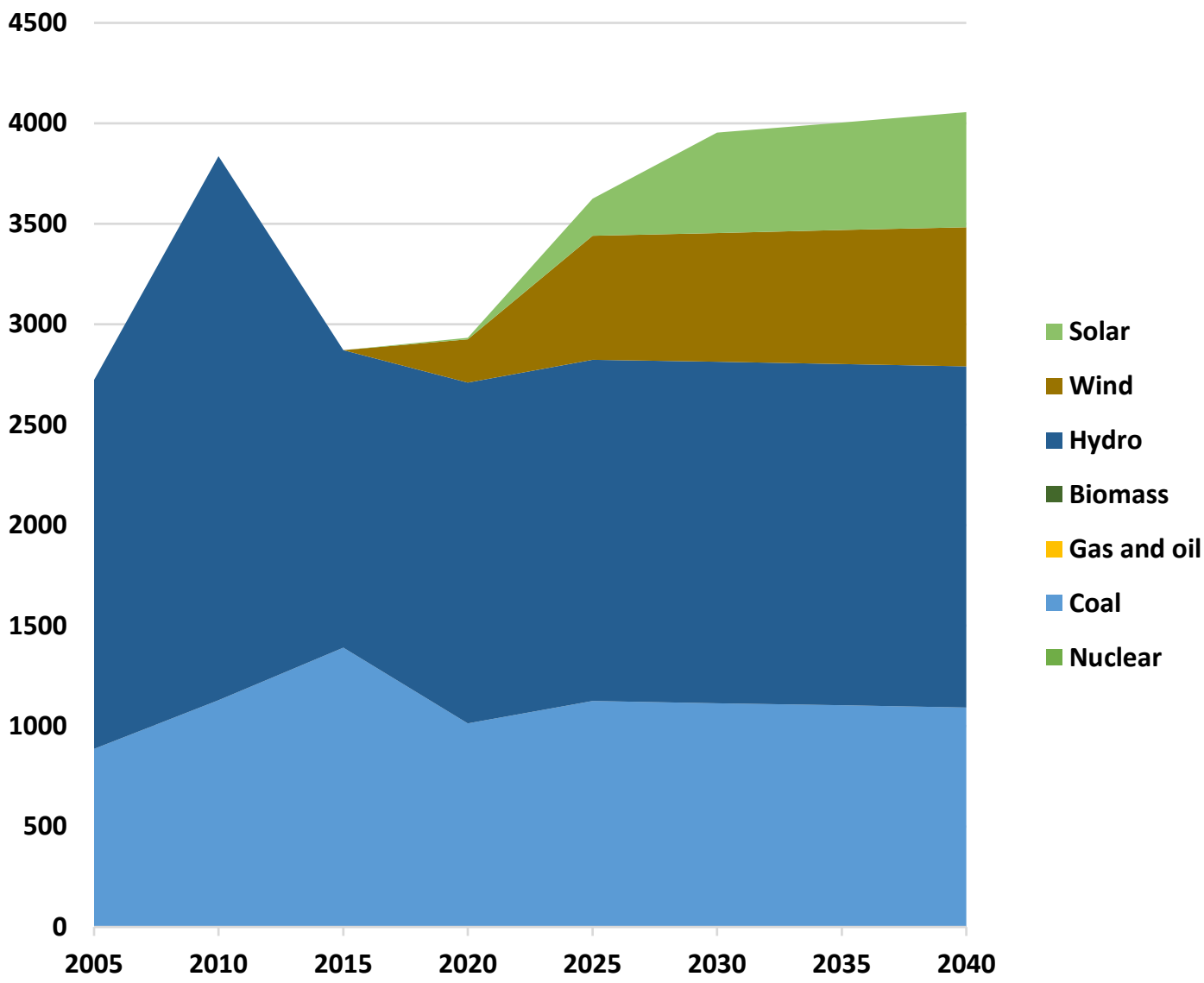


# Montenegro - Baseline scenario projections

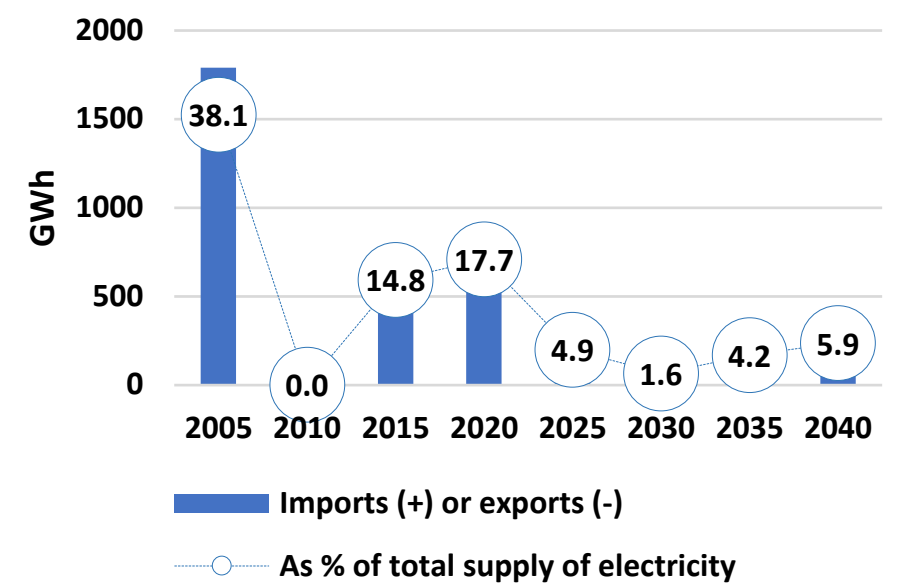
## Demand for electricity



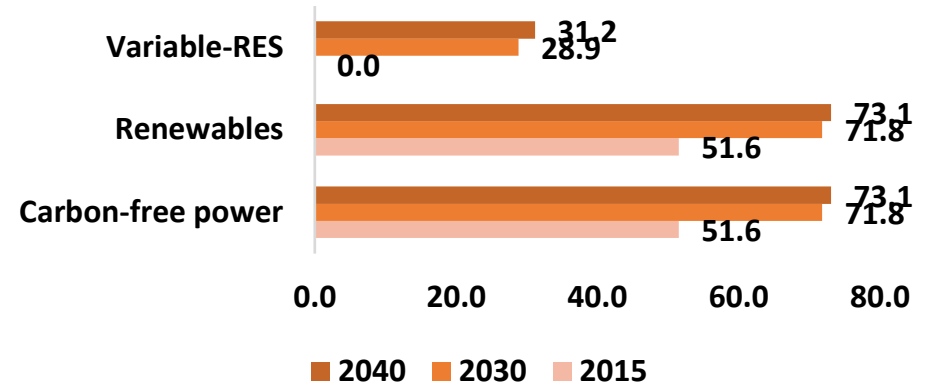
### Power generation (GWh-net)



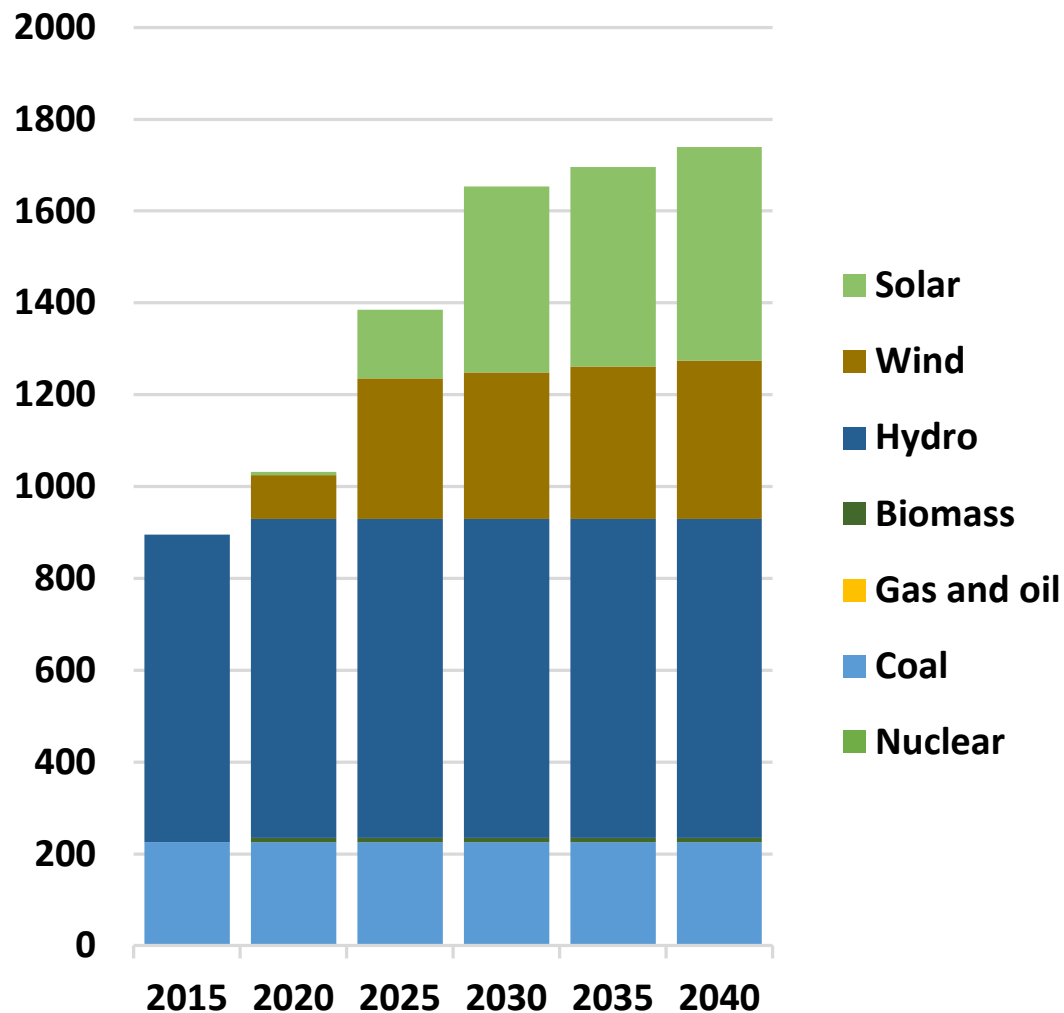
### Net imports of electricity



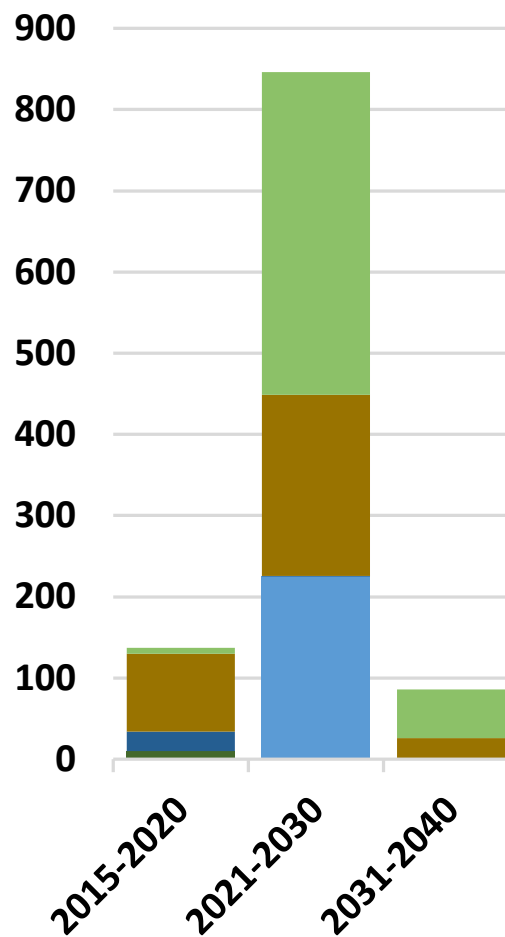
### Indicators (shares - %)



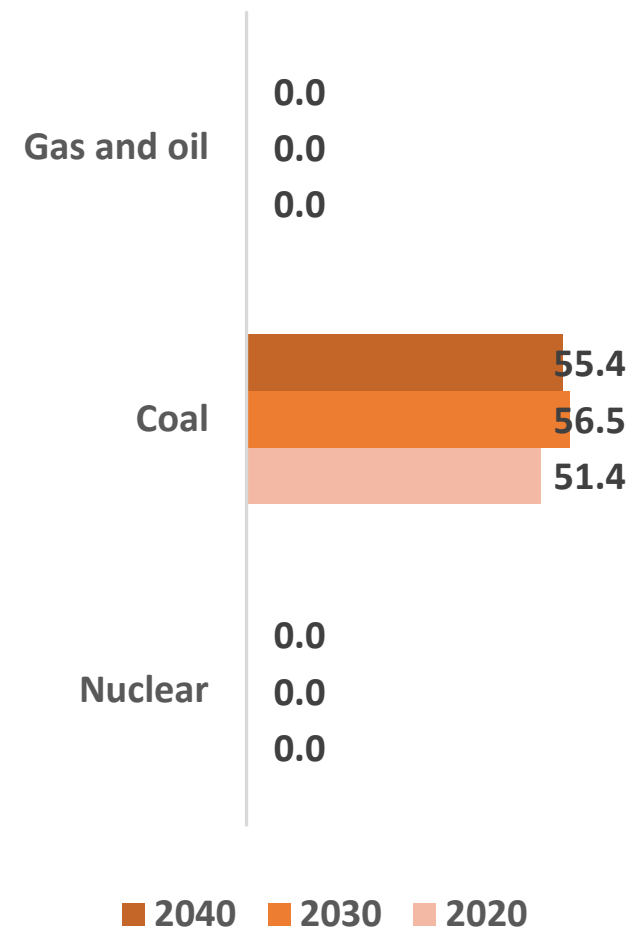
### Operating capacities (MW)



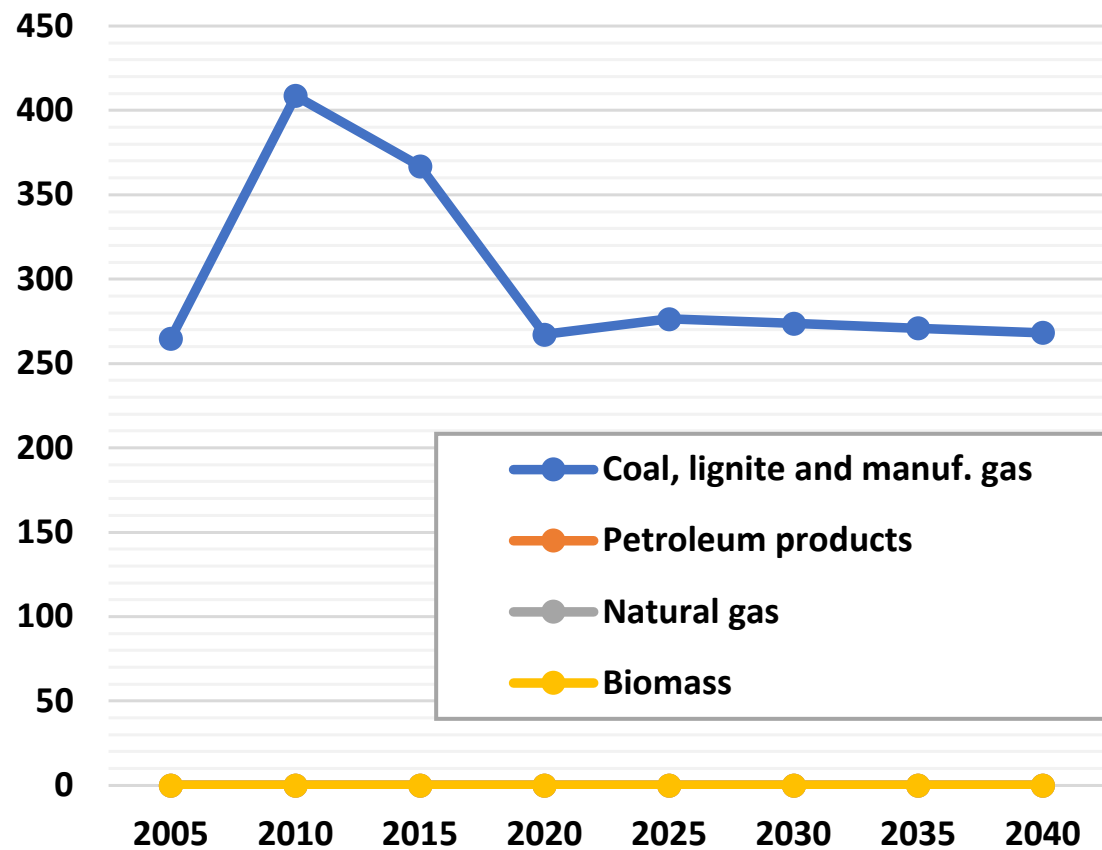
### Capacity expansion (MW)



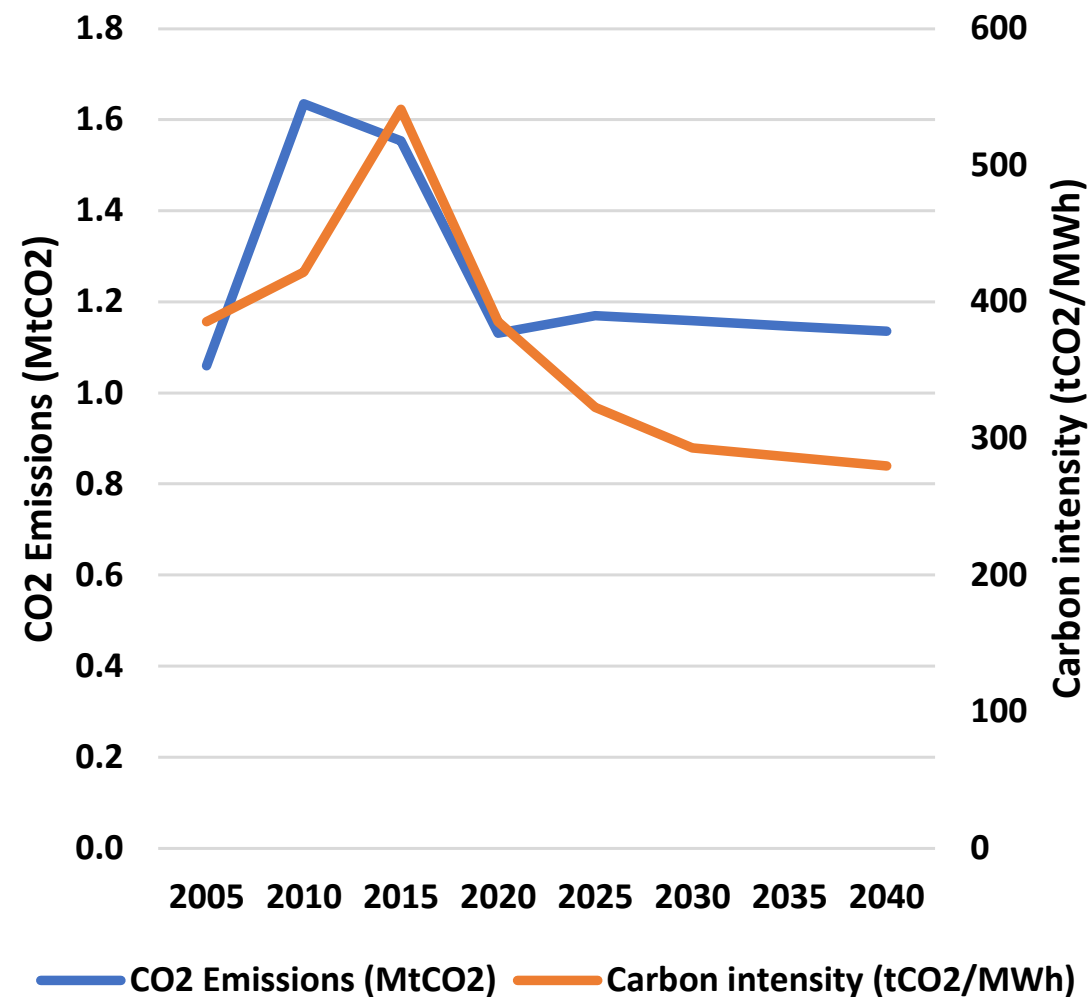
### Rate of use of capacity (%)



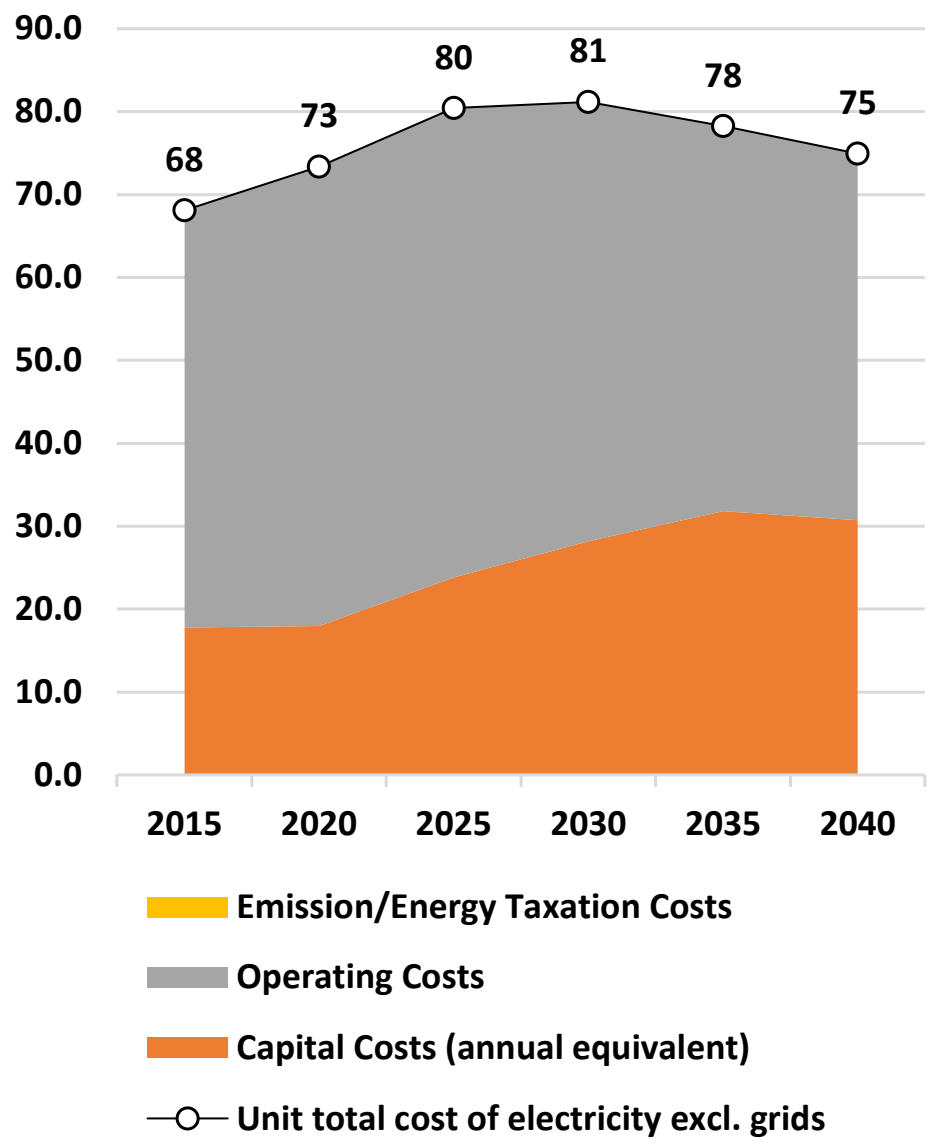
## Fuels in power sector (ktoe)



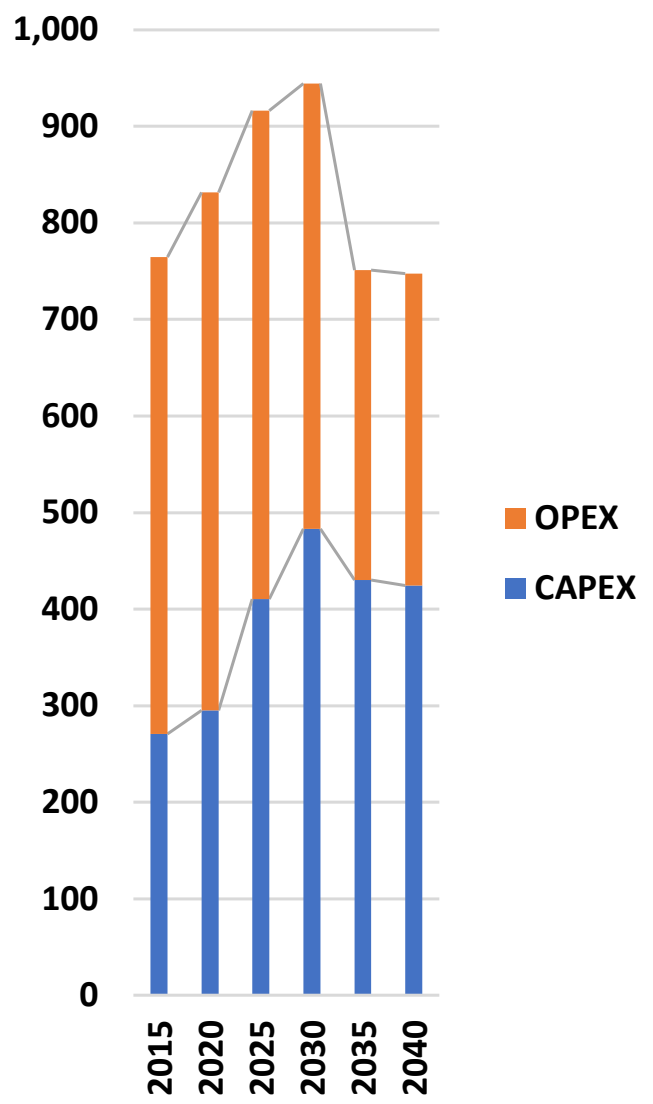
## CO2 Emissions in power generation



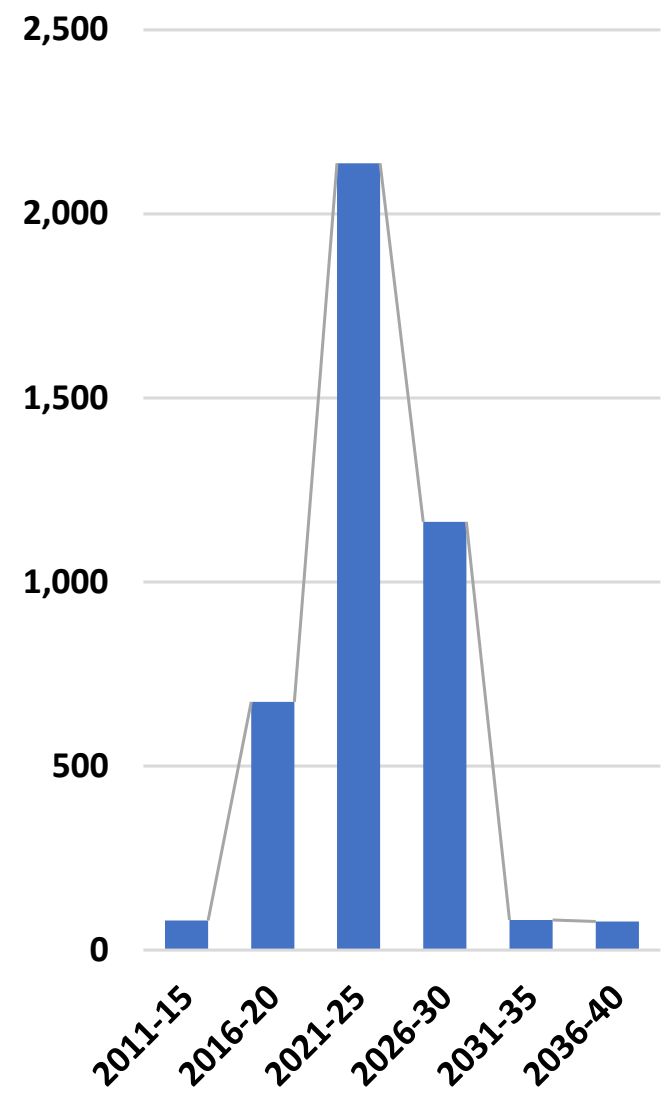
### Unit costs in €/MWh (sales)



### Total Cost of Electricity supply (in M€)



### Investment expenditures in power plants (in M€)



## Uncertainties – lack of information

- Lignite plant:
  - Will Pljevlja I be refurbished (desulphurization and de-Nox equipment) and when?
  - Is there confirmation about a new lignite plant to replace retired plants in the near future?
  - What is the expectation about the operation schedule of lignite and the provision of ancillary services and reserves?
- Hydro power plants:
  - Montenegro has a significant potential in hydropower. Apart from small hydro plants to be commissioned in the next few years, should we consider higher investment in hydro plants?
- RES support plan uncertain

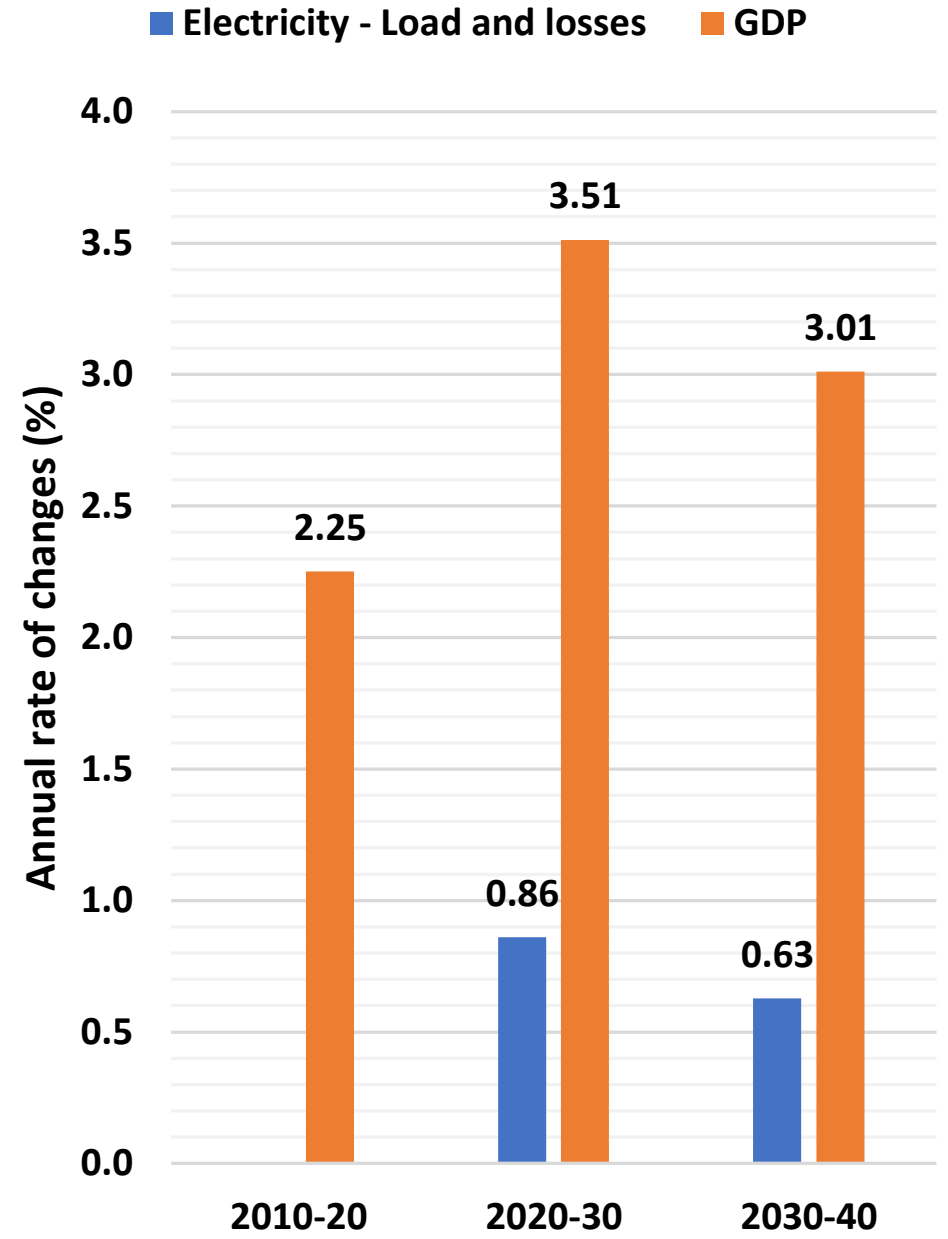
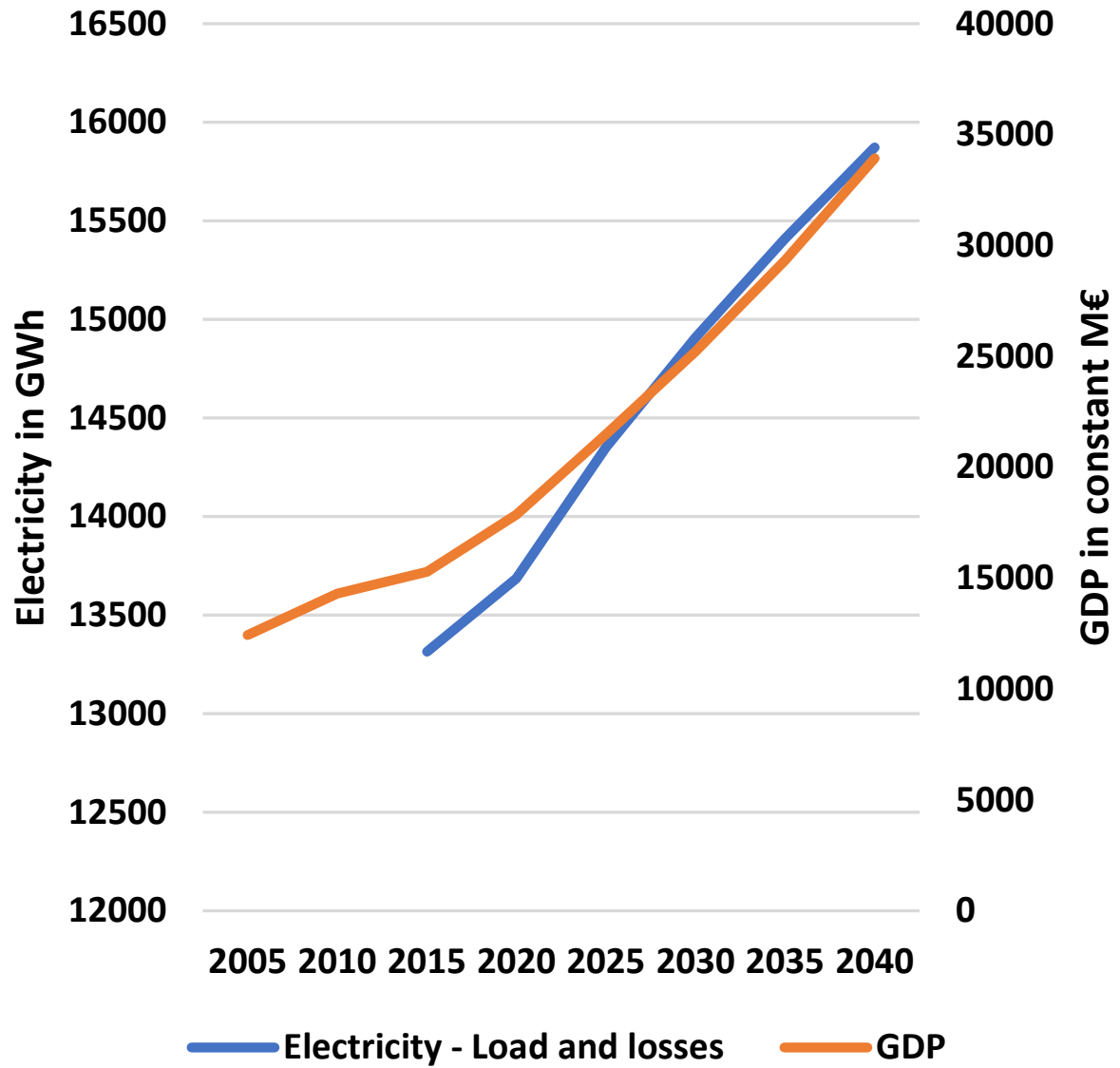
## Outlook

- Very significant RES potential can make the country fully resilient to carbon pricing
- However, RES balancing and reserves currently rely on an inflexible plant, based on lignite, and the prospect is to maintain a lignite plant for reserves. This implies unnecessary emissions
- Alternatives have to be considered for ancillary services while developing RES ambitiously
  - Storage
  - Gas
  - Cross-border balancing
  - Demand response
- The price prospects are optimistic

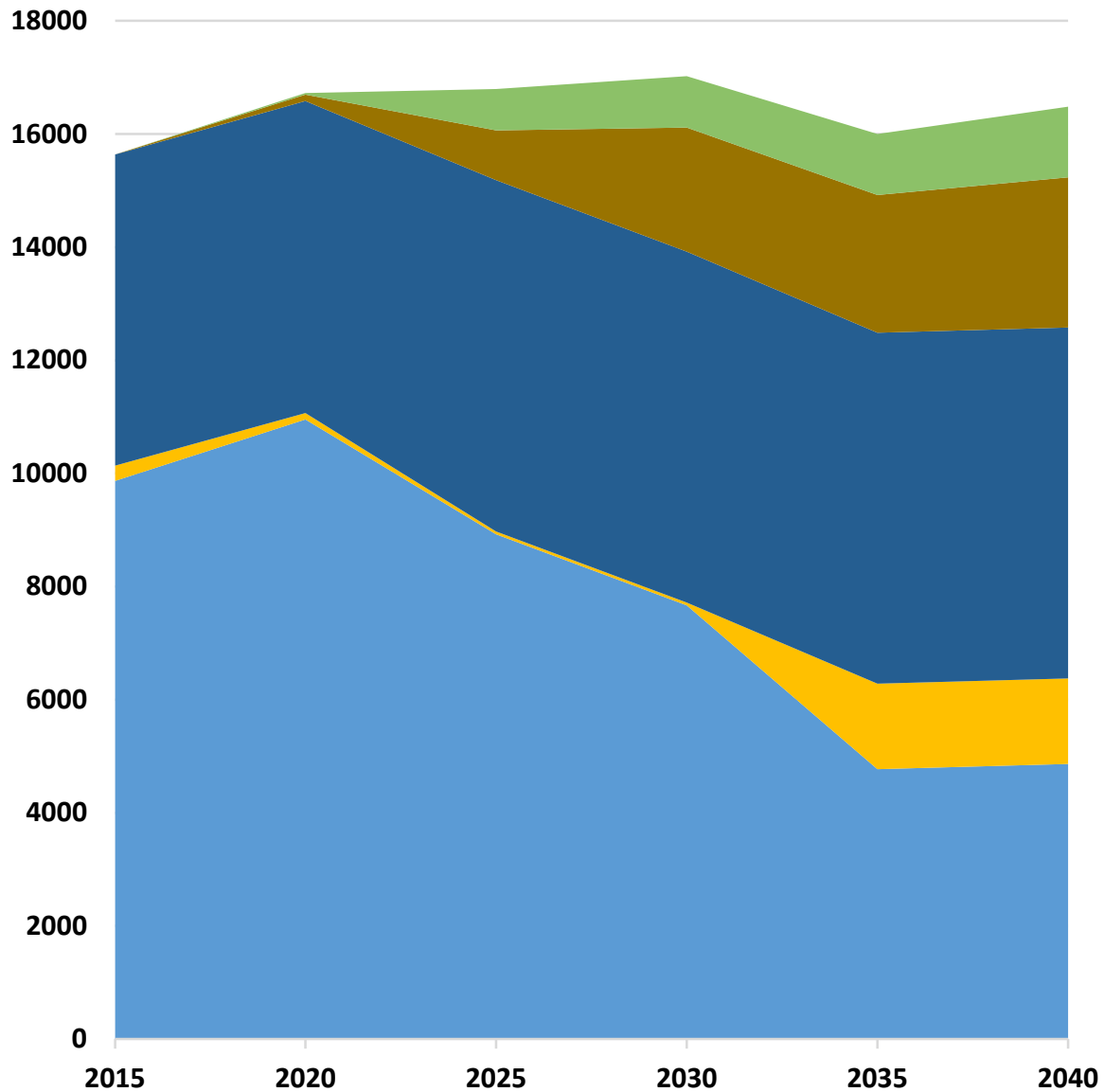
# Bosnia & Herzegovina - Baseline scenario projections



## Demand for electricity

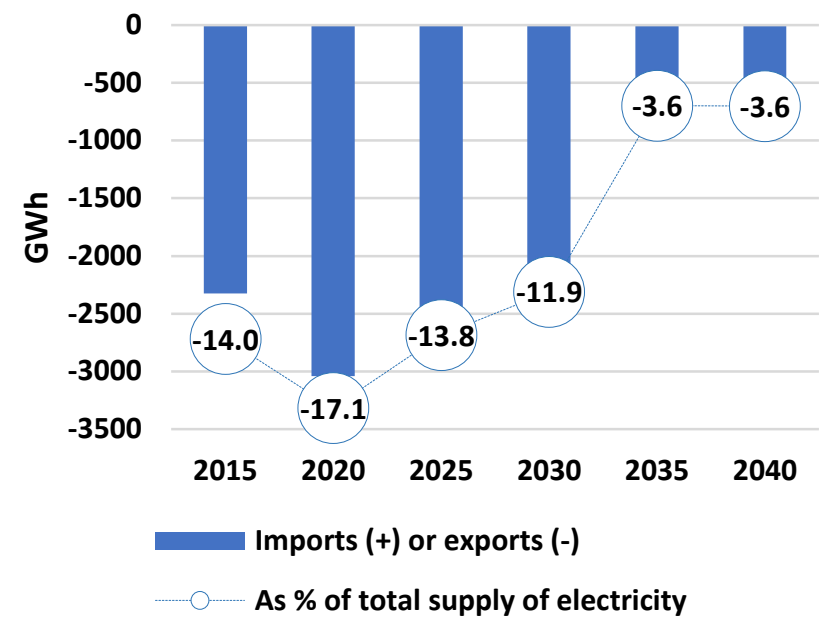


### Power generation (GWh-net)

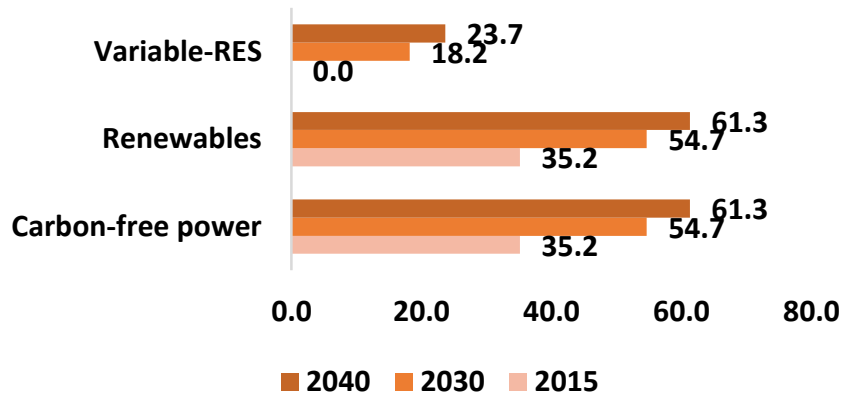


- Solar
- Wind
- Hydro
- Biomass
- Gas and oil
- Coal
- Nuclear

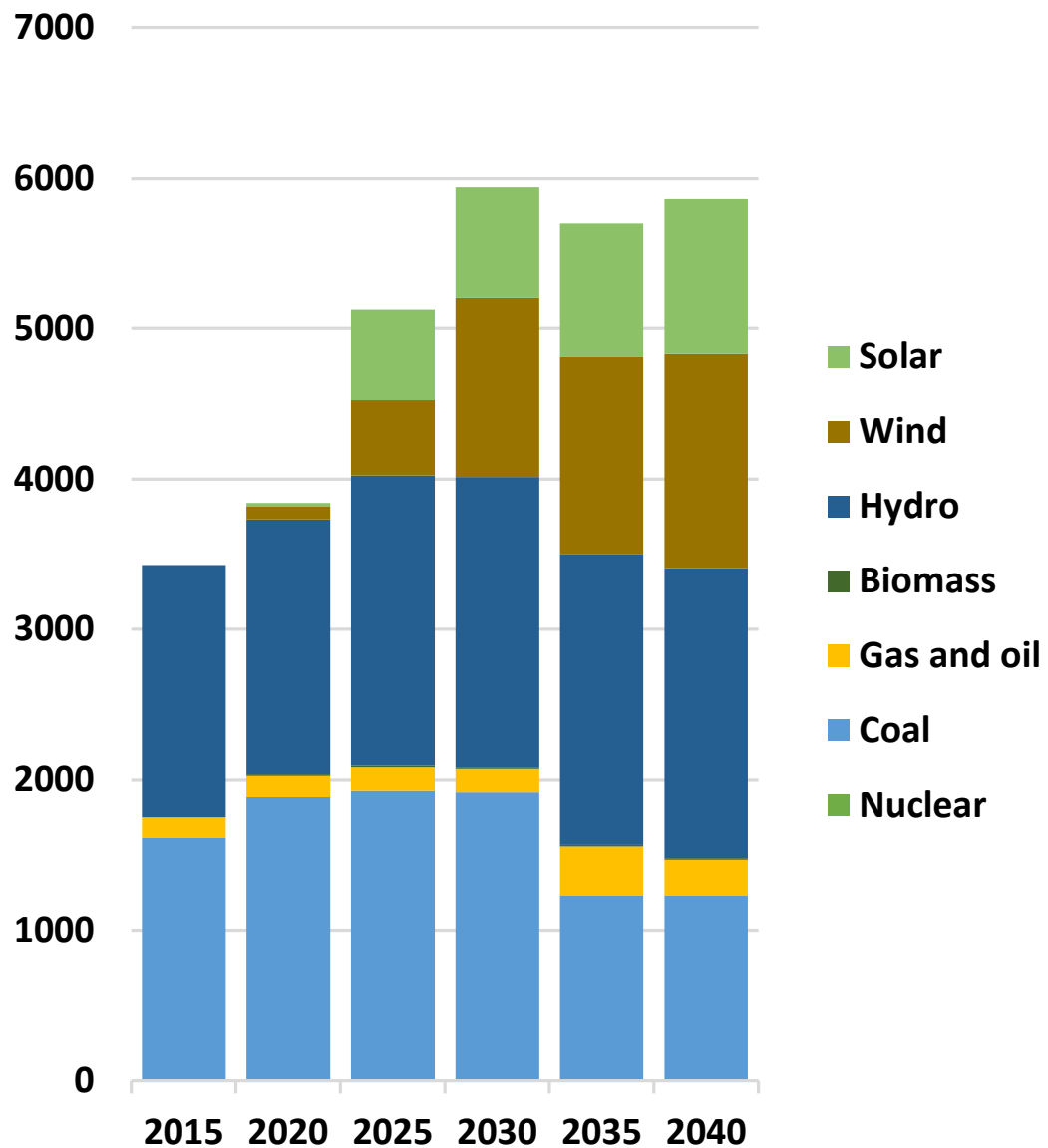
### Net imports of electricity



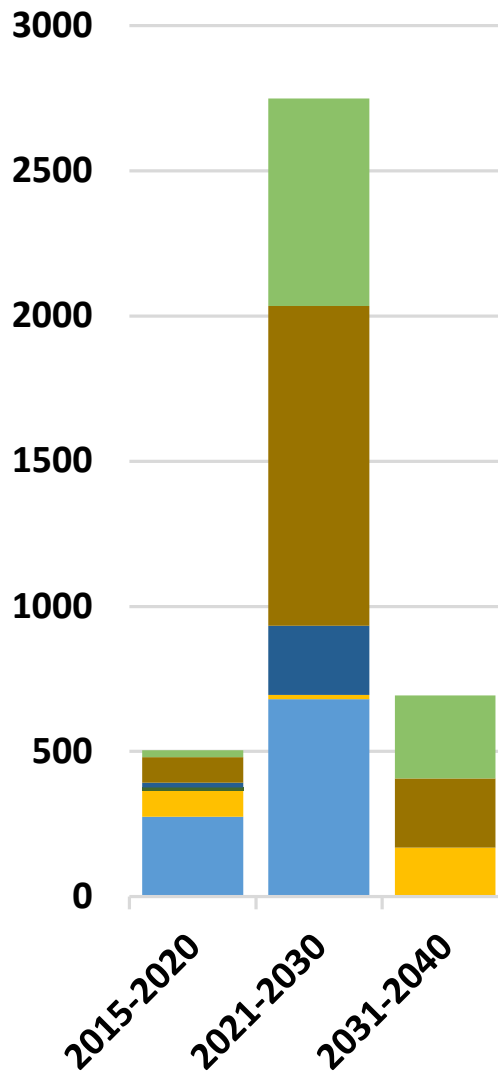
### Indicators (shares - %)



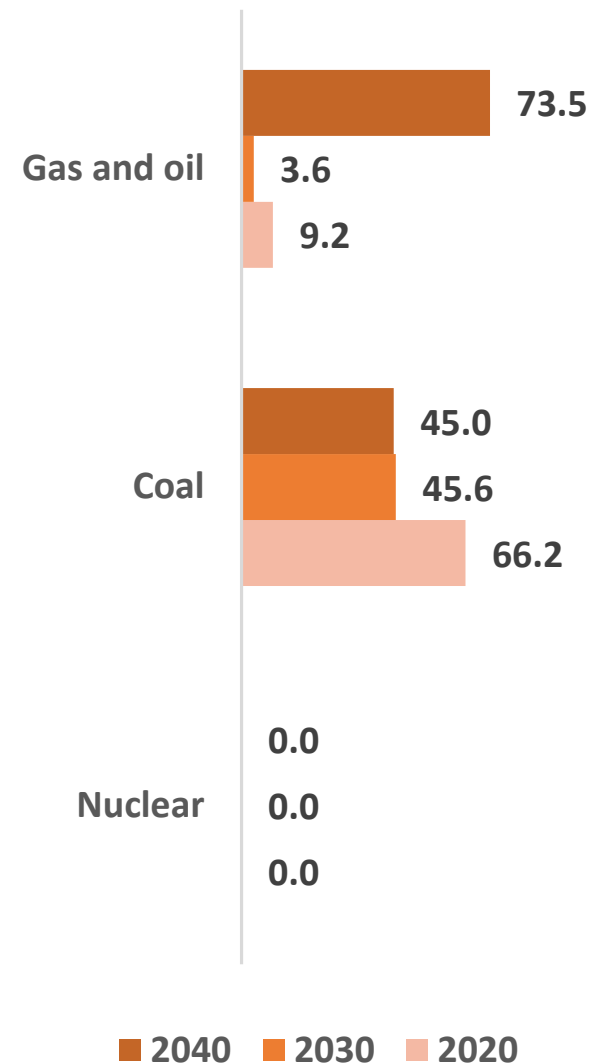
### Operating capacities (MW)



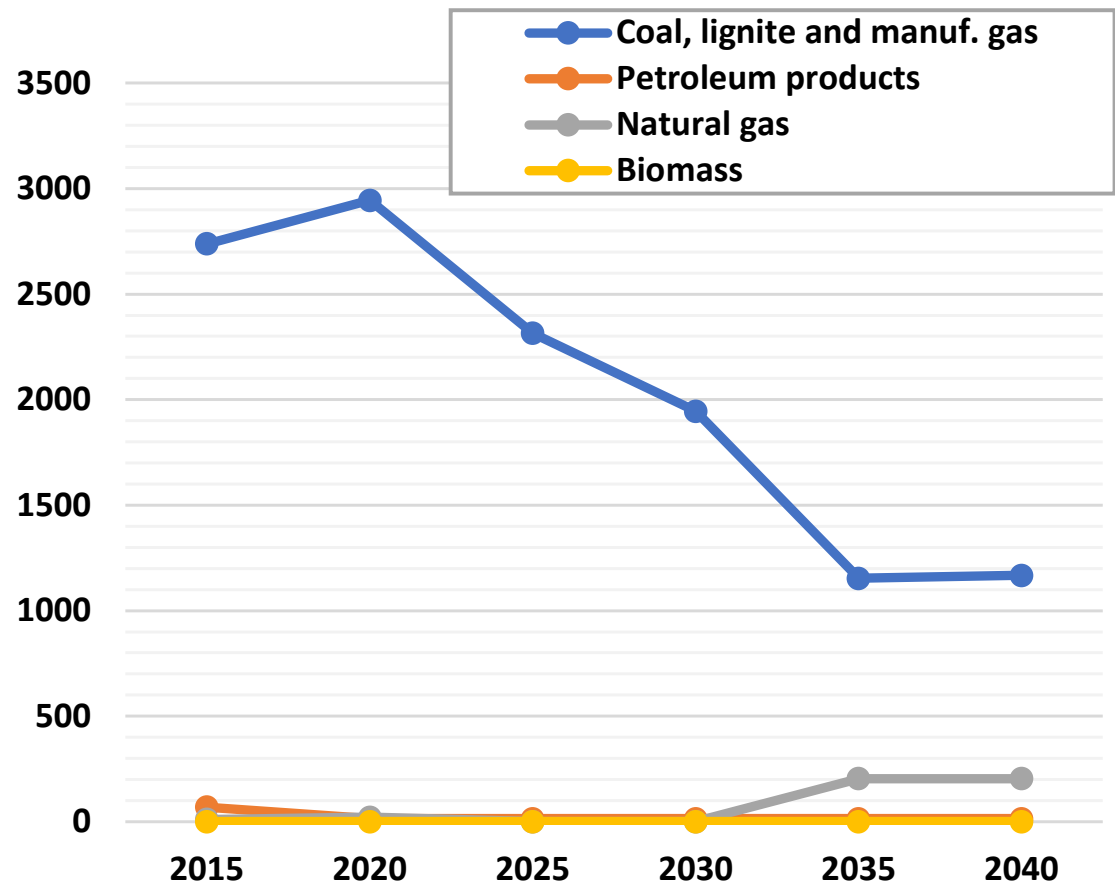
### Capacity expansion (MW)



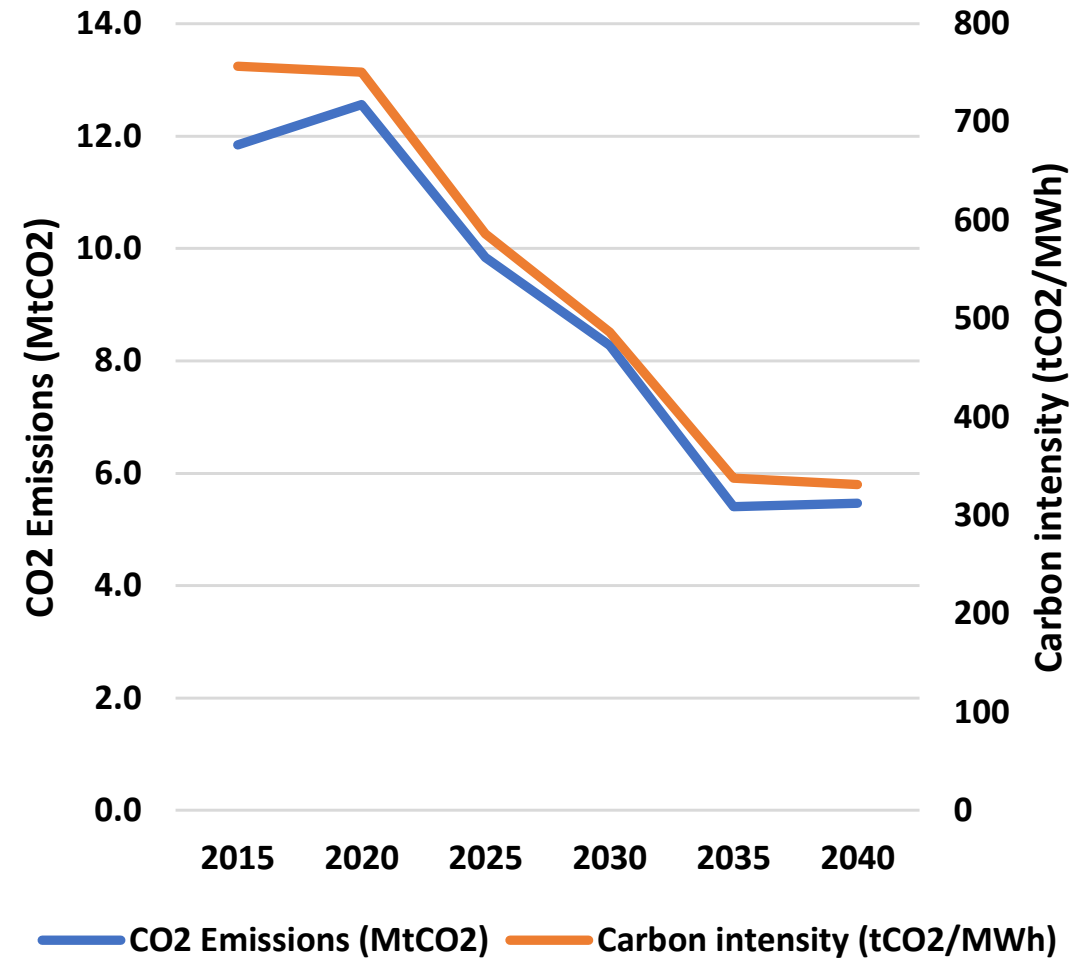
### Rate of use of capacity (%)



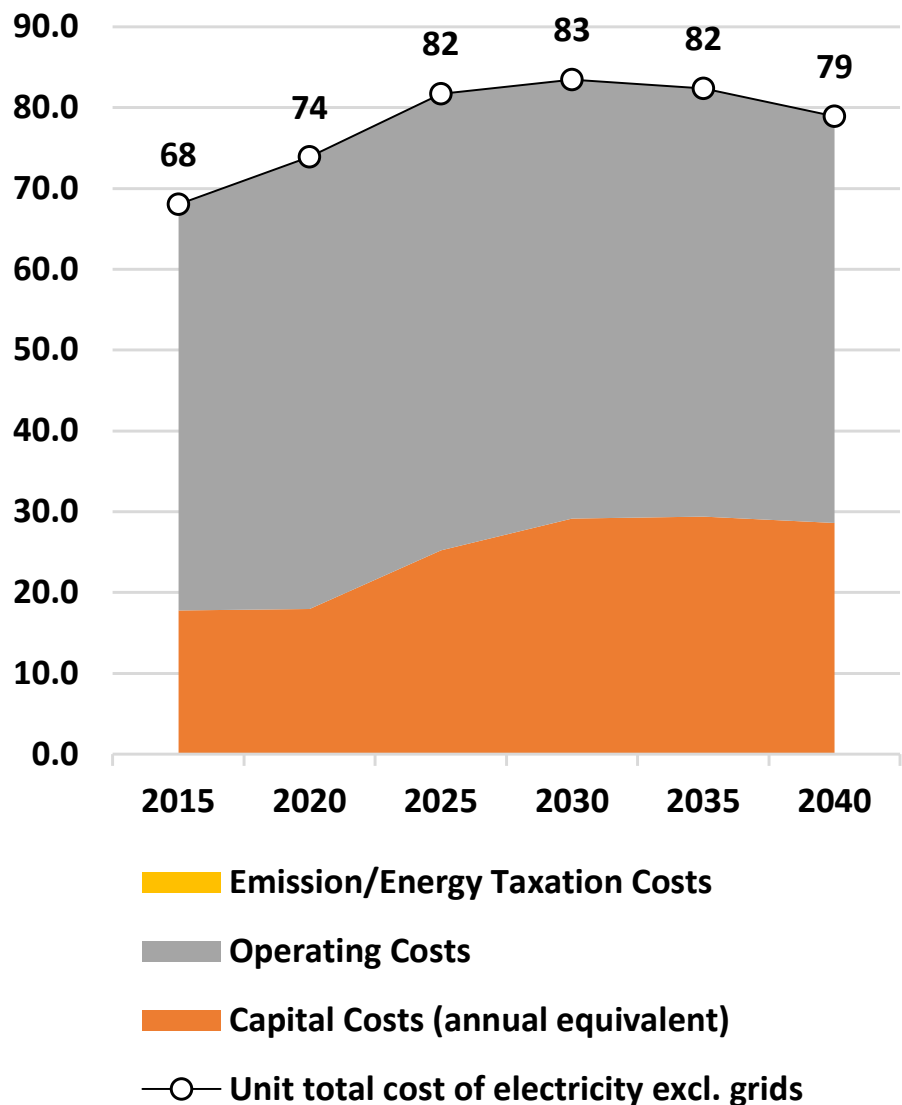
Fuels in power sector (ktoe)



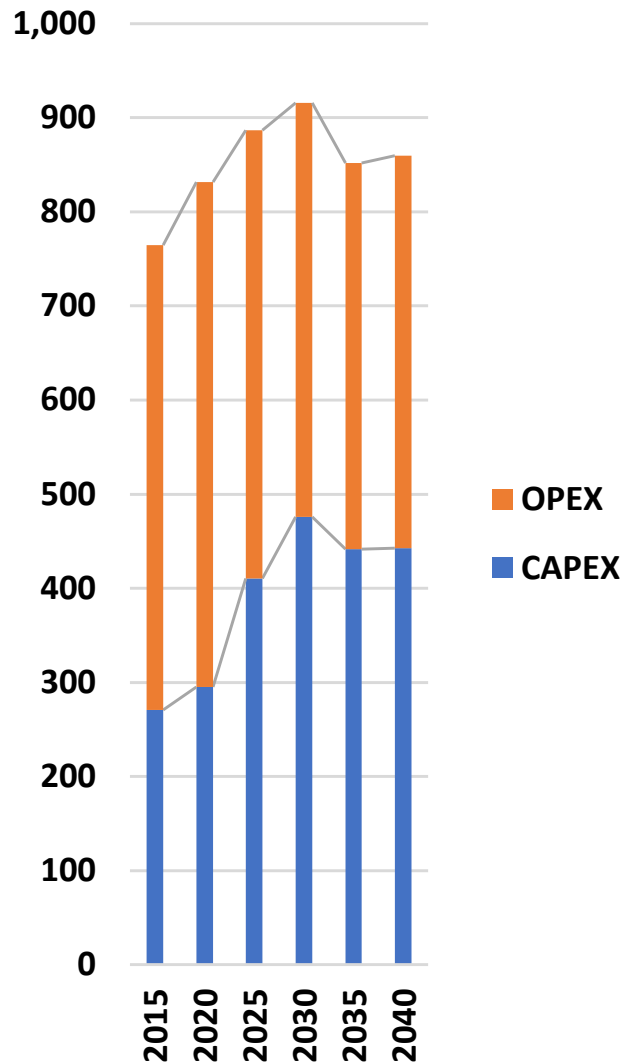
CO2 Emissions in power generation



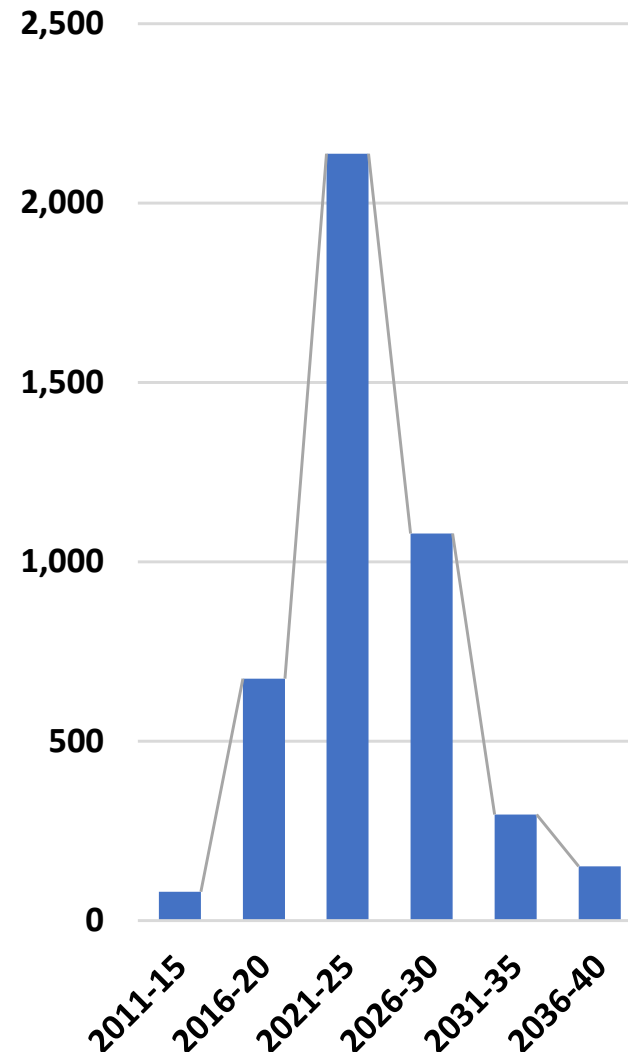
### Unit costs in €/MWh (sales)



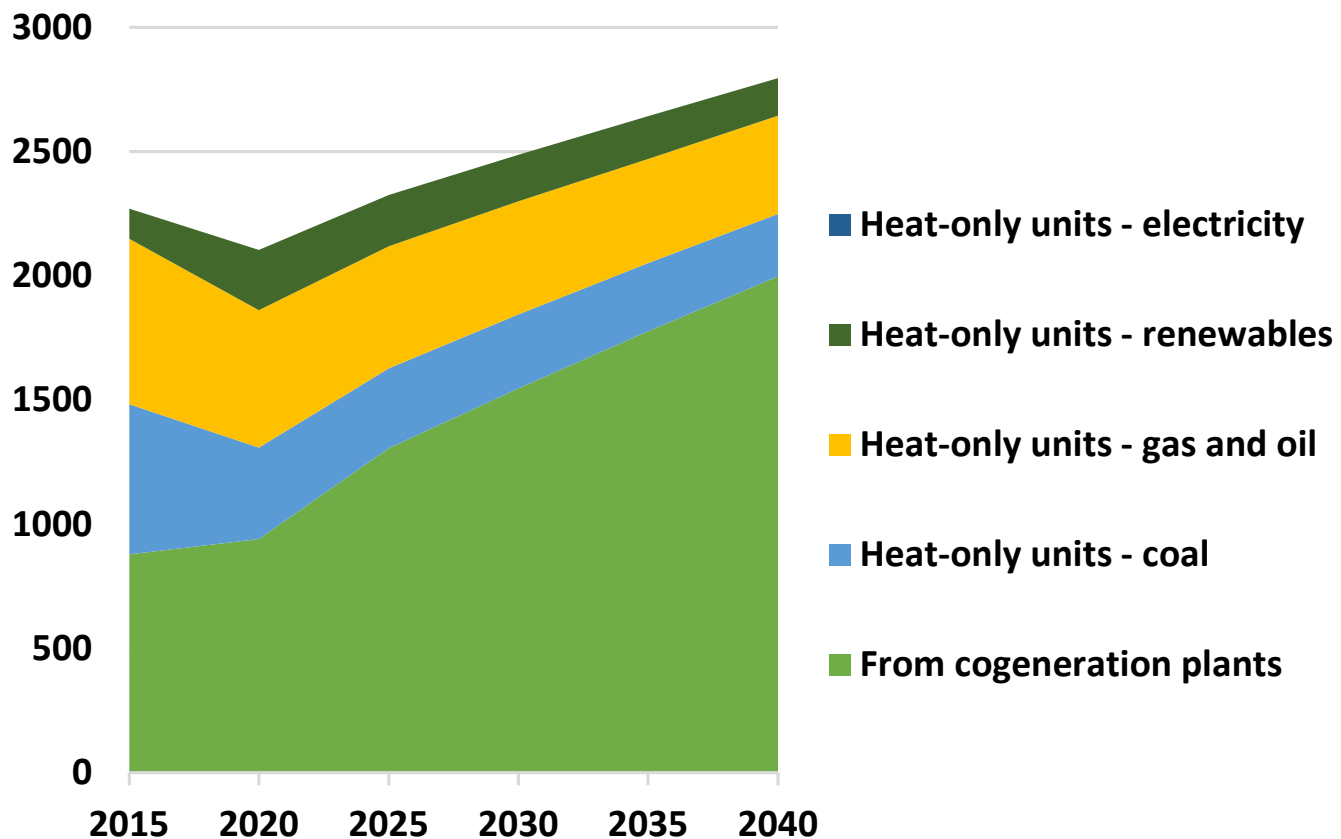
### Total Cost of Electricity supply (in M€)



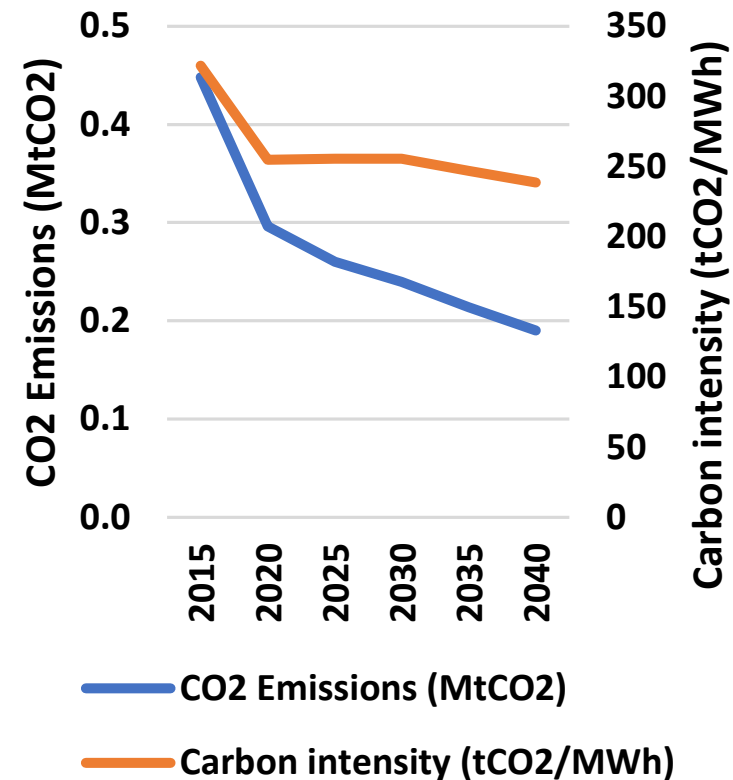
### Investment expenditures in power plants (in M€)



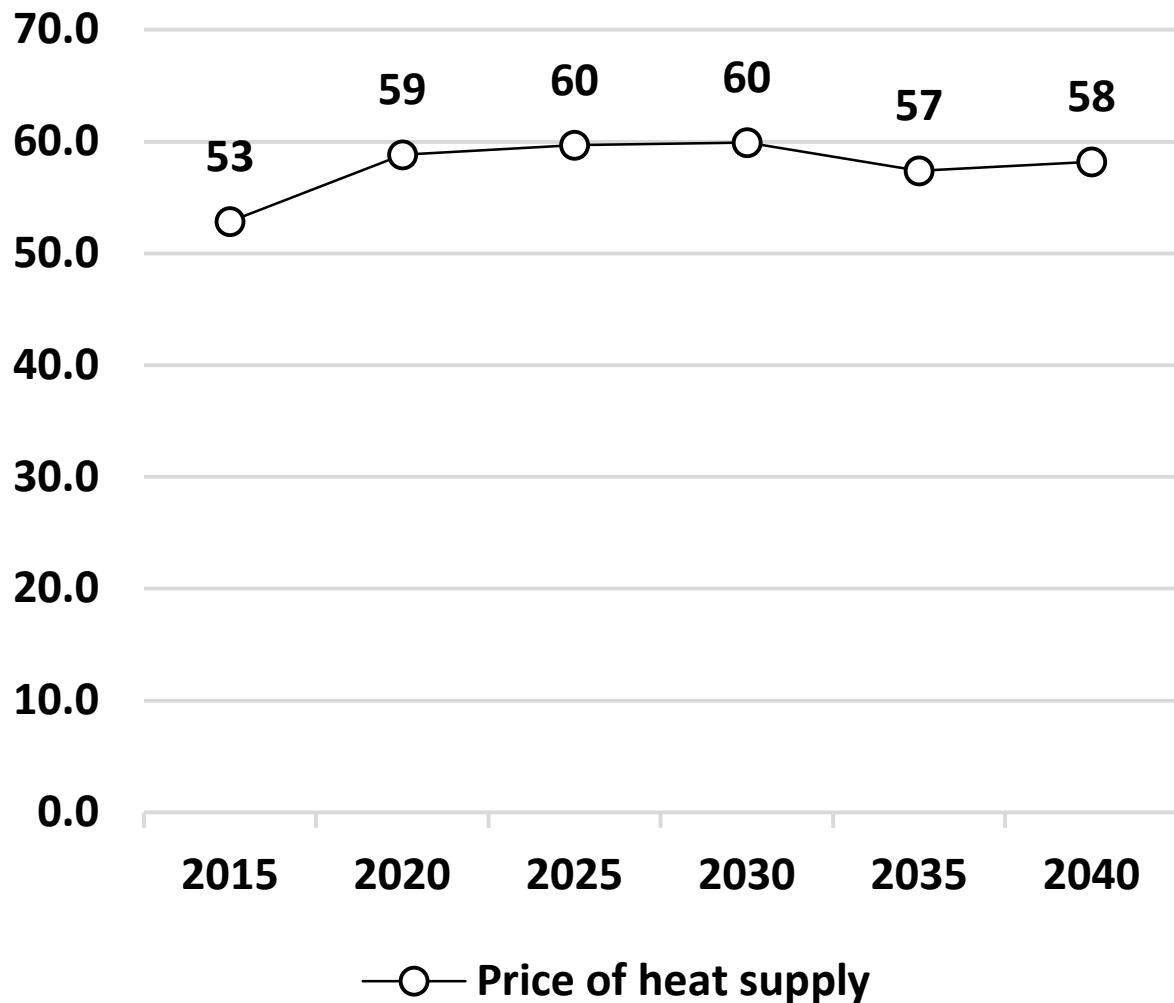
### Heat production (GWh heat)



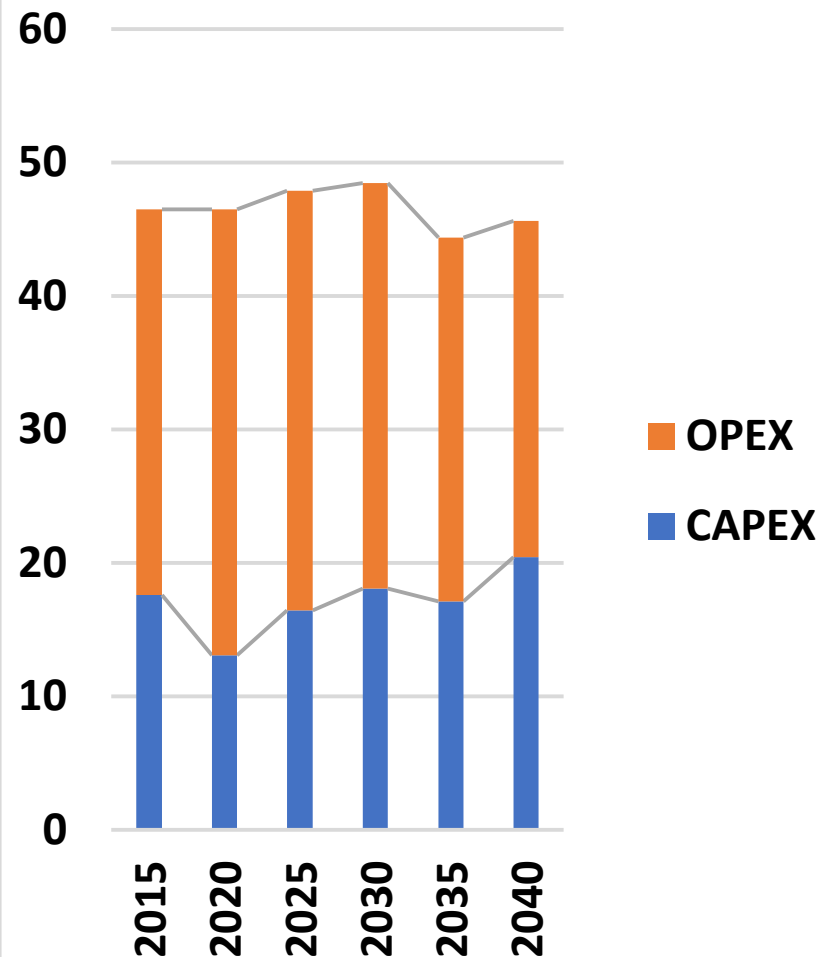
### CO2 Emissions in heat-only unit



### Unit costs in €/MWh (sales)



### Total Cost of heat production (in M€)



## Uncertainties – lack of information

- Lignite plants:
  - Opt-out of lignite plants: TPP Tuzla Units 3&4, TPP Kakanj Unit 5, last year of operation 2023
  - What is the decommissioning plan for the remaining lignite fleet?
  - Should we confirm new investments in lignite plants will realize and when? (e.g. TPP Tuzla Unit 7, TPP Kakanj Unit 8)
- Gas plants: Will a new PP (KTG Zenica - 380MW) be commissioned in 2029?
- Hydro plants: TSO's plan include 240MW of new investments up to 2030, will these investments realize?
- RES support plan is uncertain

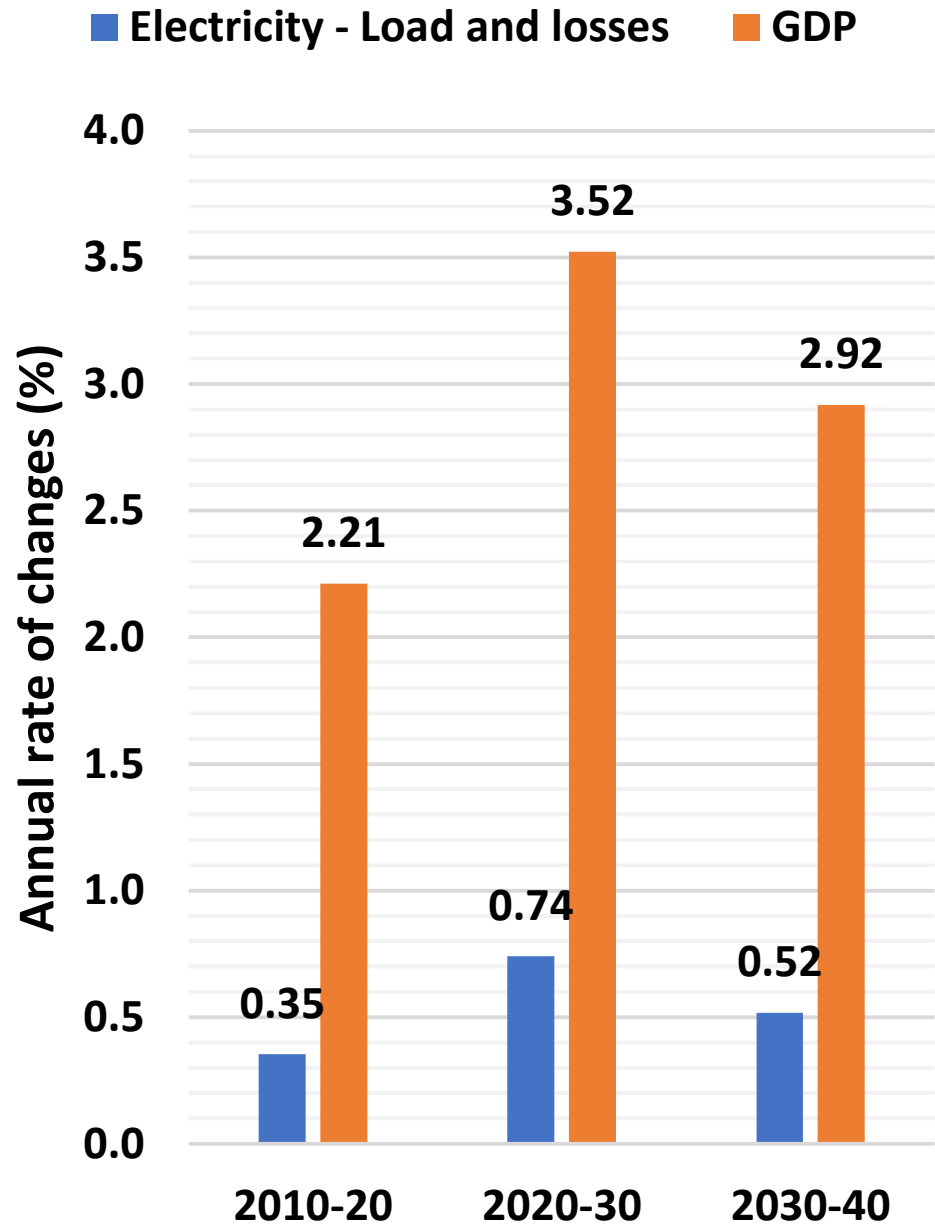
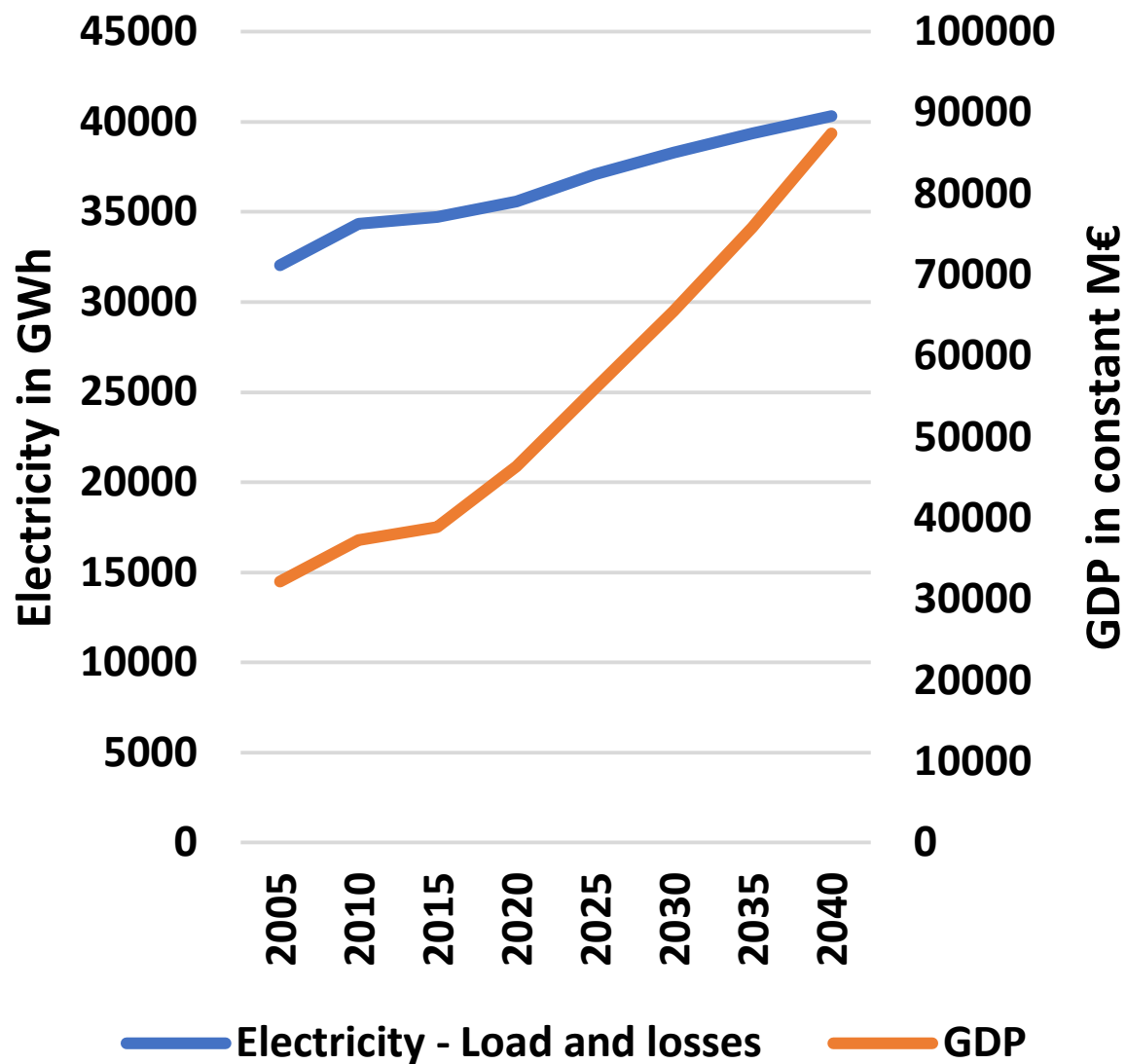
## Outlook

- Under BAU conditions, the country relies on lignite and further investment in lignite, therefore carbon pricing will imply a major disturbance
- The investment plan is ambitious, but highly uncertain
- The absence of gas development weakens flexibility and balancing hindering RES prospects
- It is unlikely to see increasing exports based on lignite exempted from carbon pricing

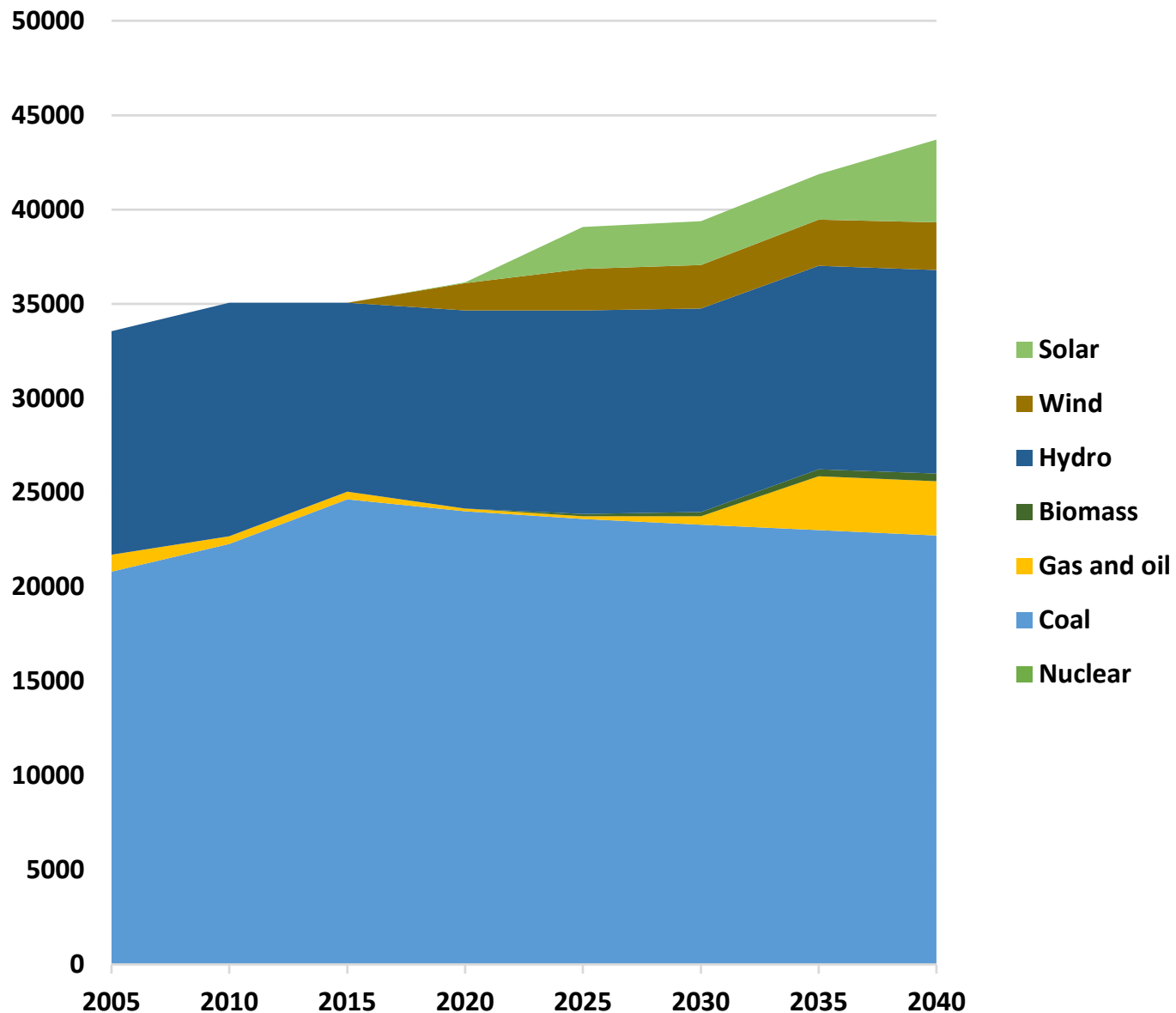


# Serbia - Baseline scenario projections

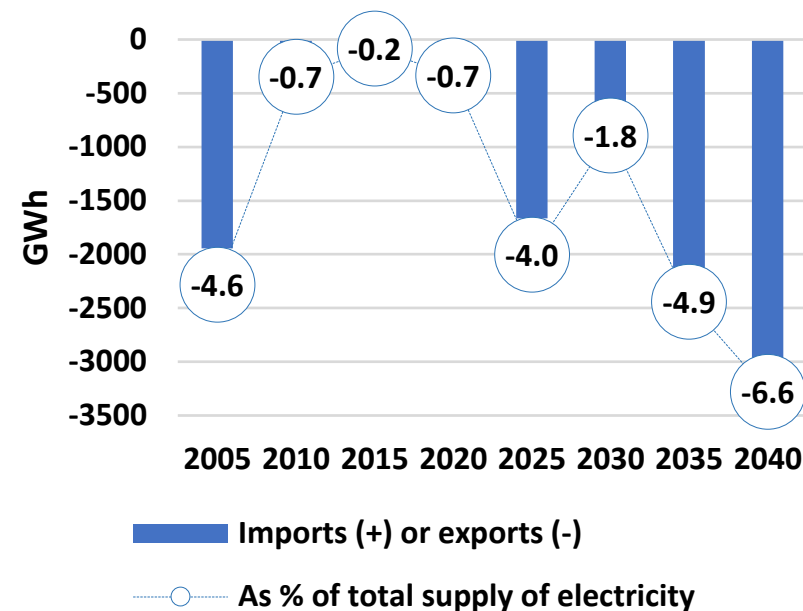
# Demand for electricity



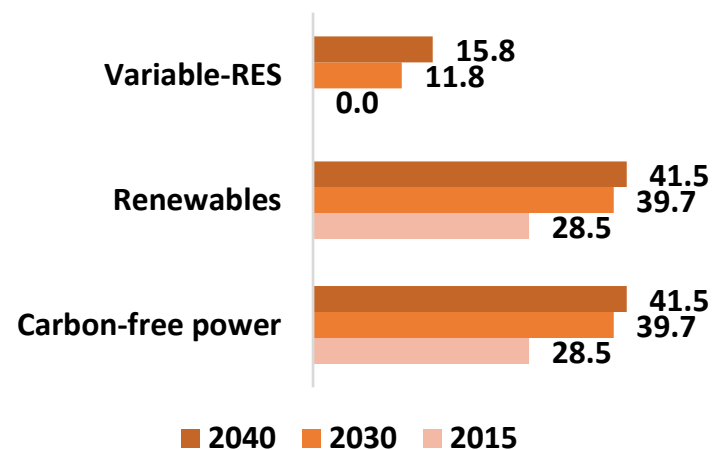
### Power generation (GWh-net)



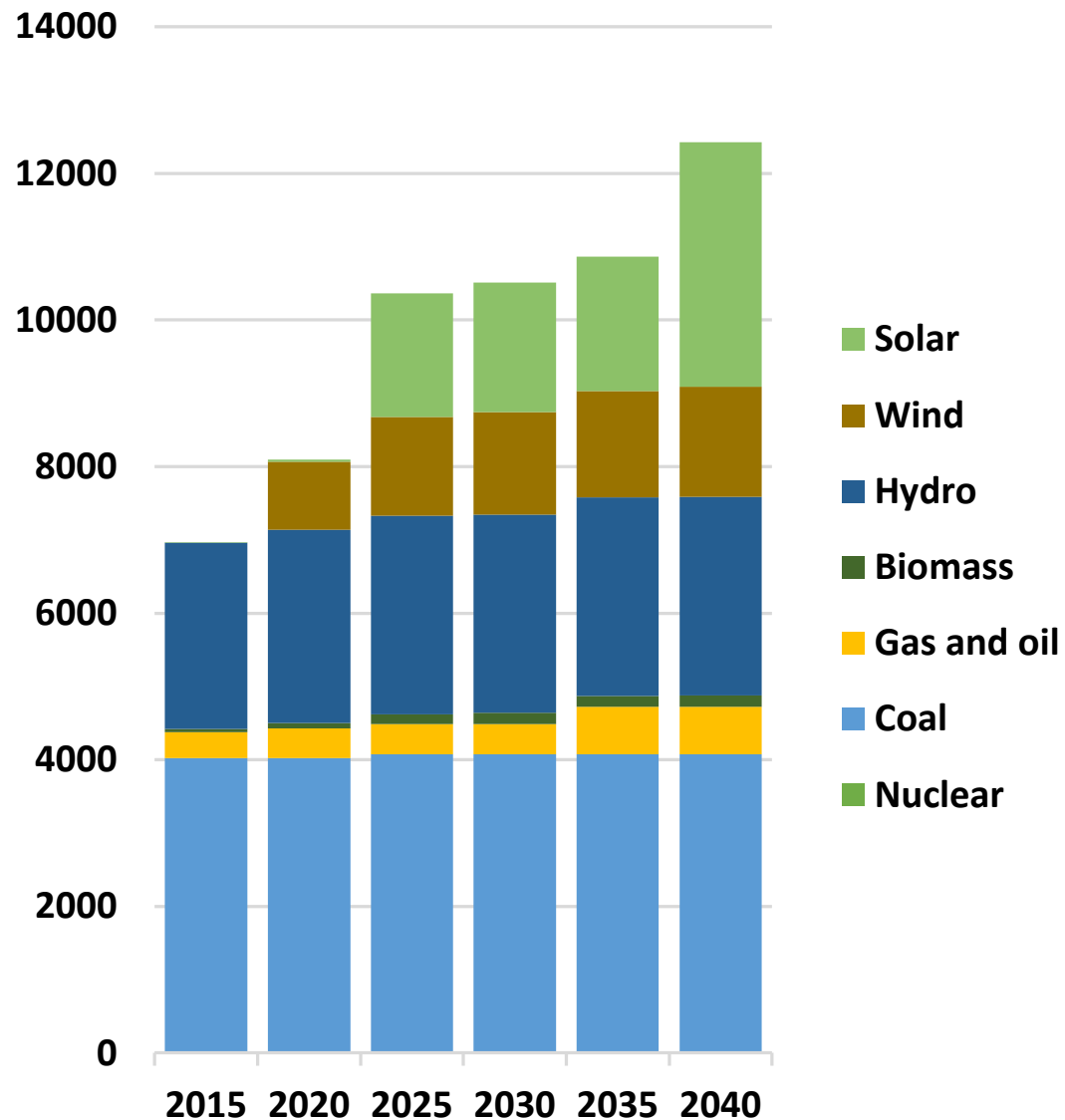
### Net imports of electricity



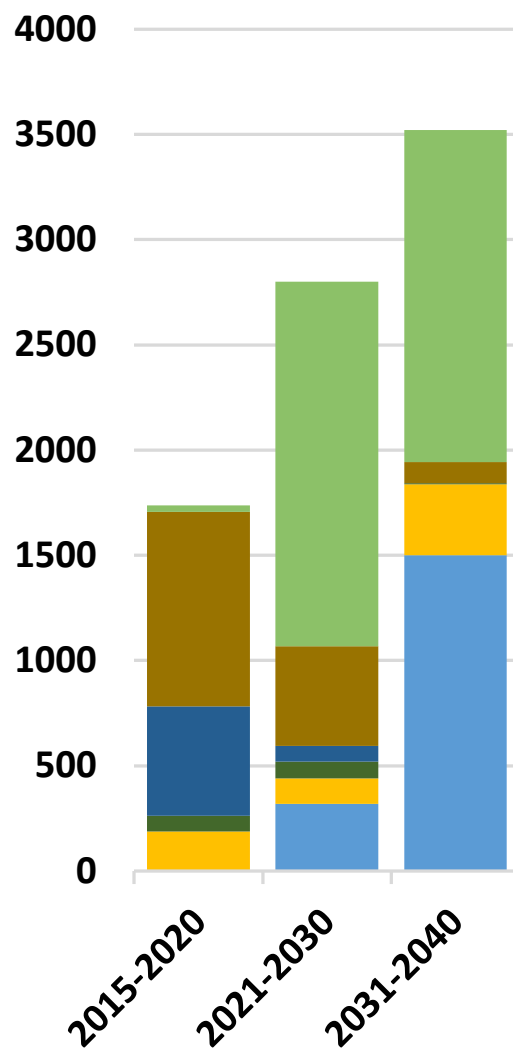
### Indicators (shares - %)



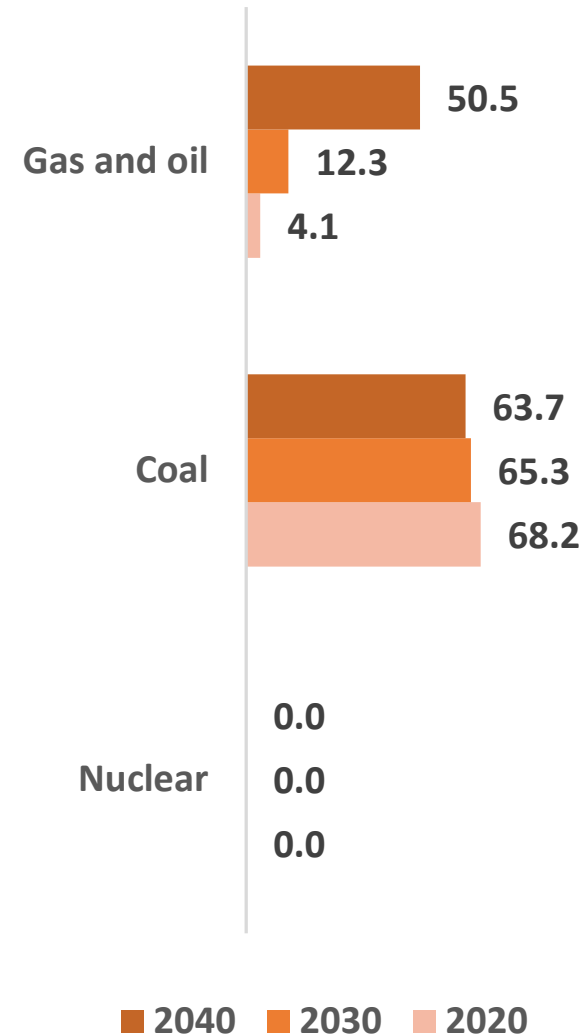
### Operating capacities (MW)



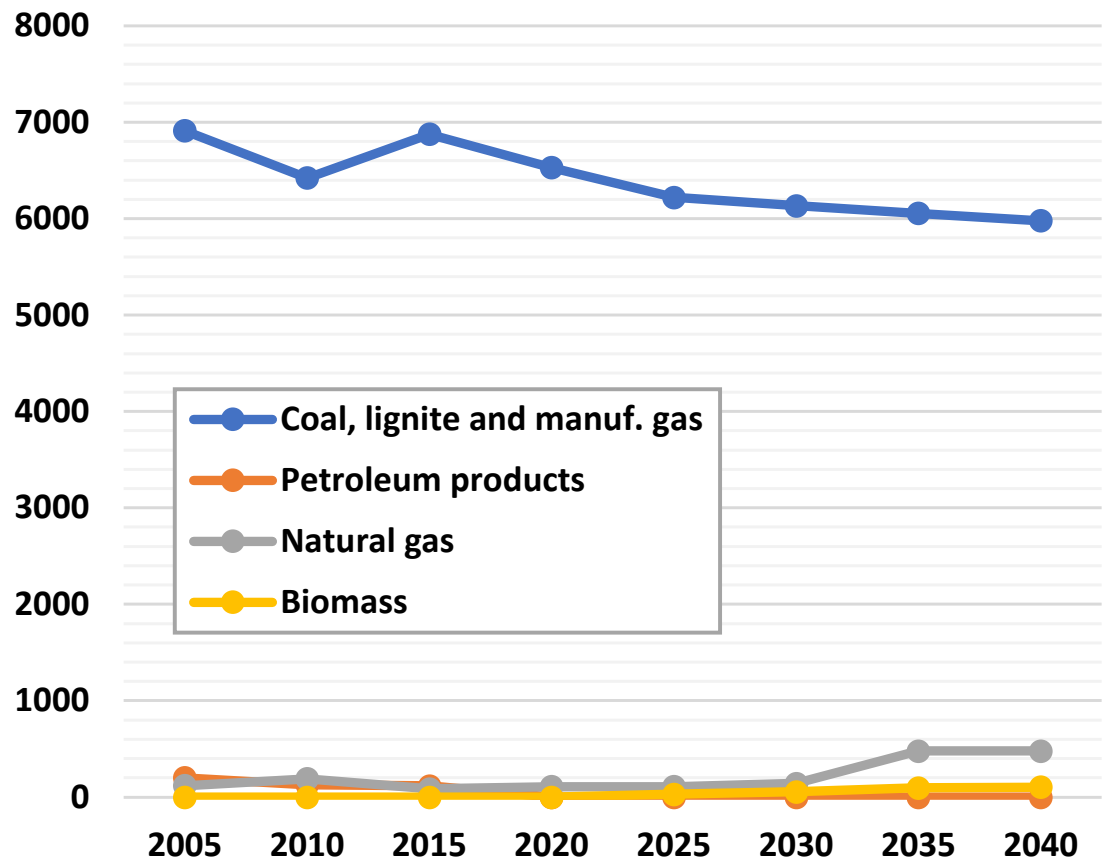
### Capacity expansion (MW)



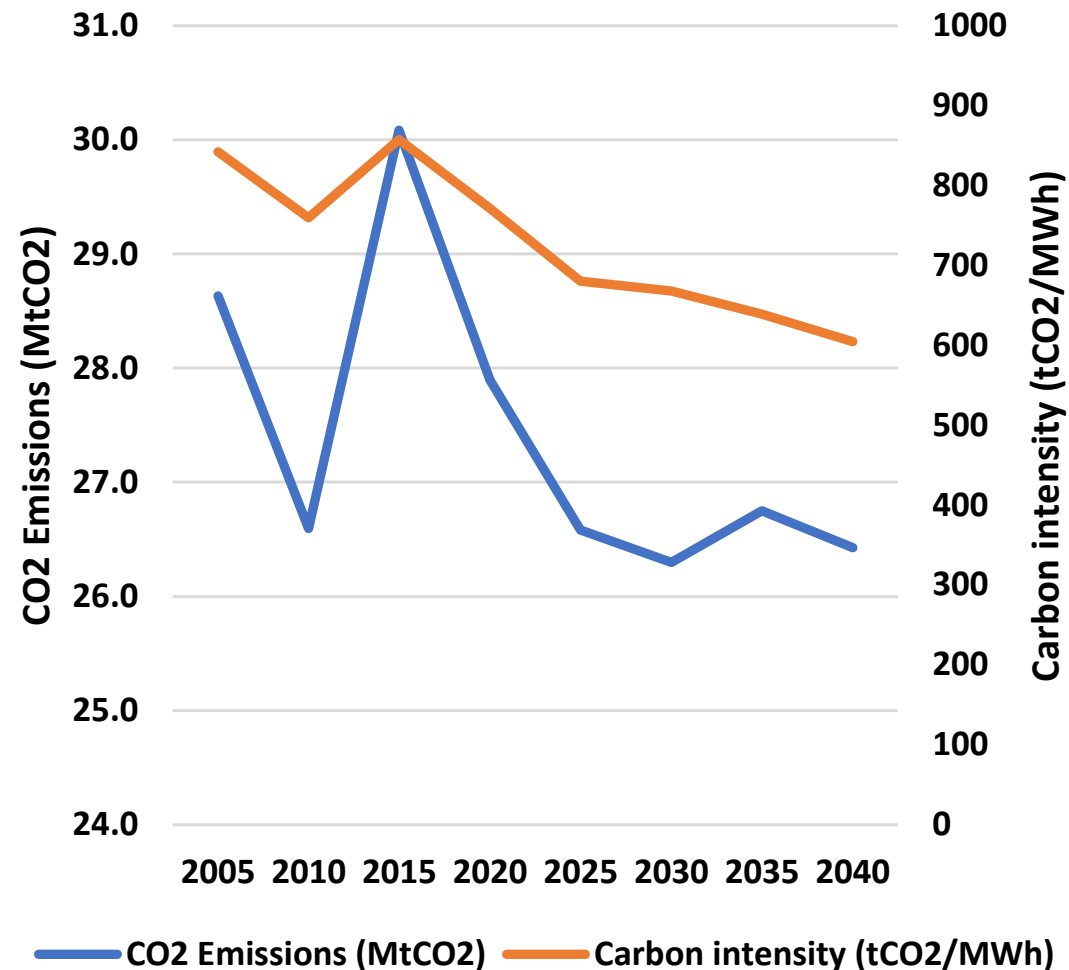
### Rate of use of capacity (%)



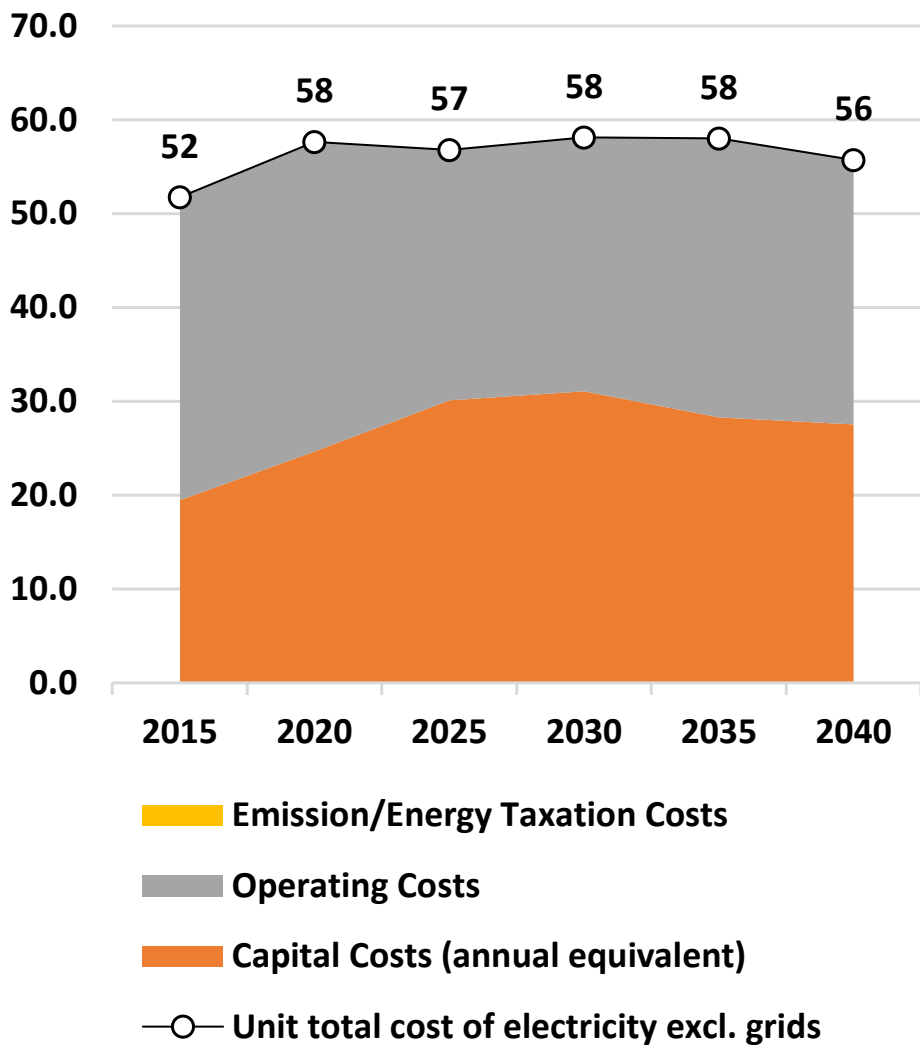
### Fuels in power sector (ktoe)



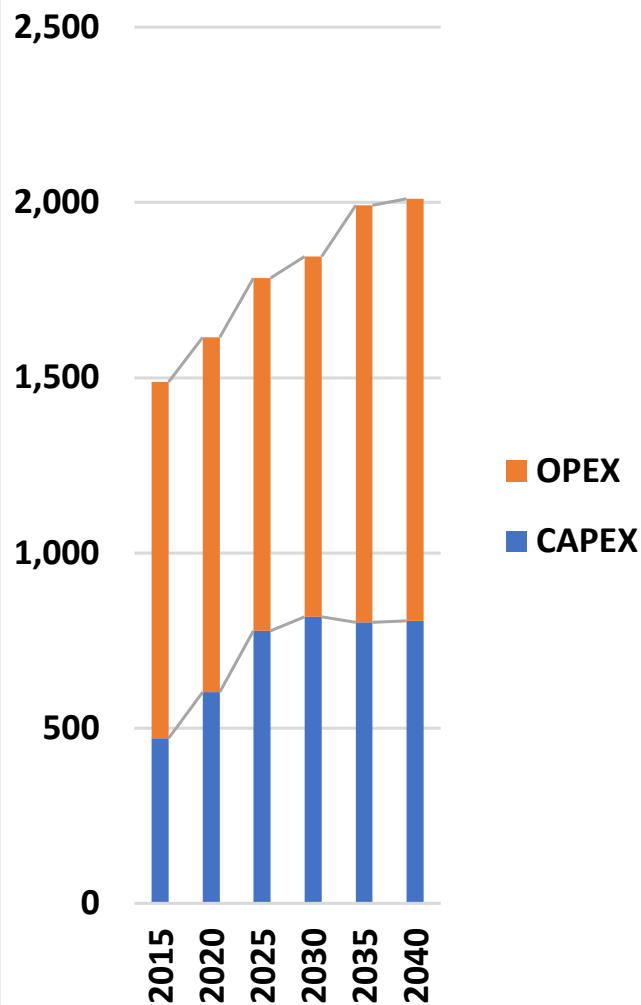
### CO2 Emissions in power generation



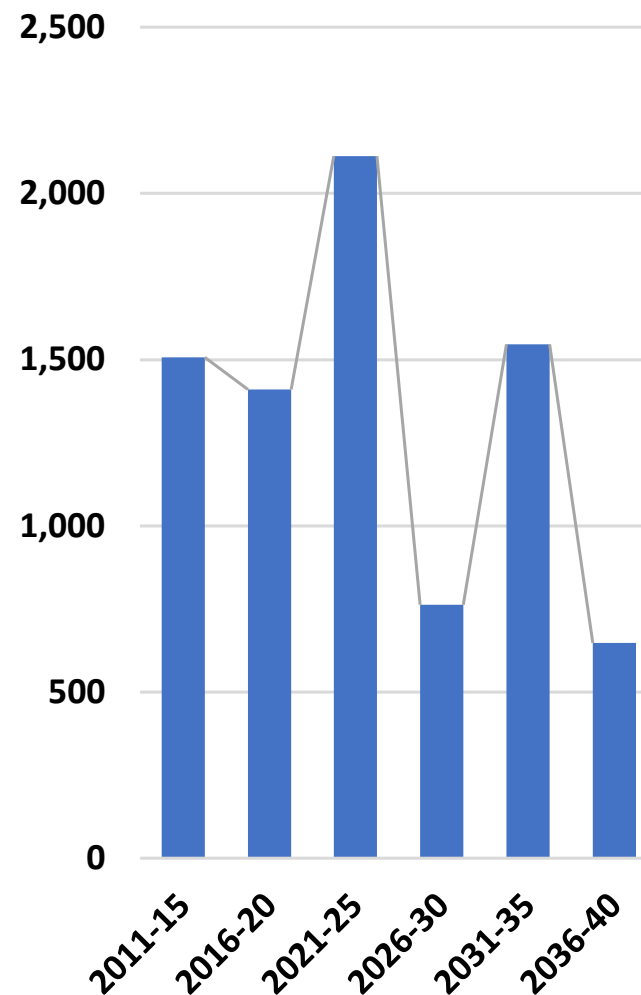
### Unit costs in €/MWh (sales)



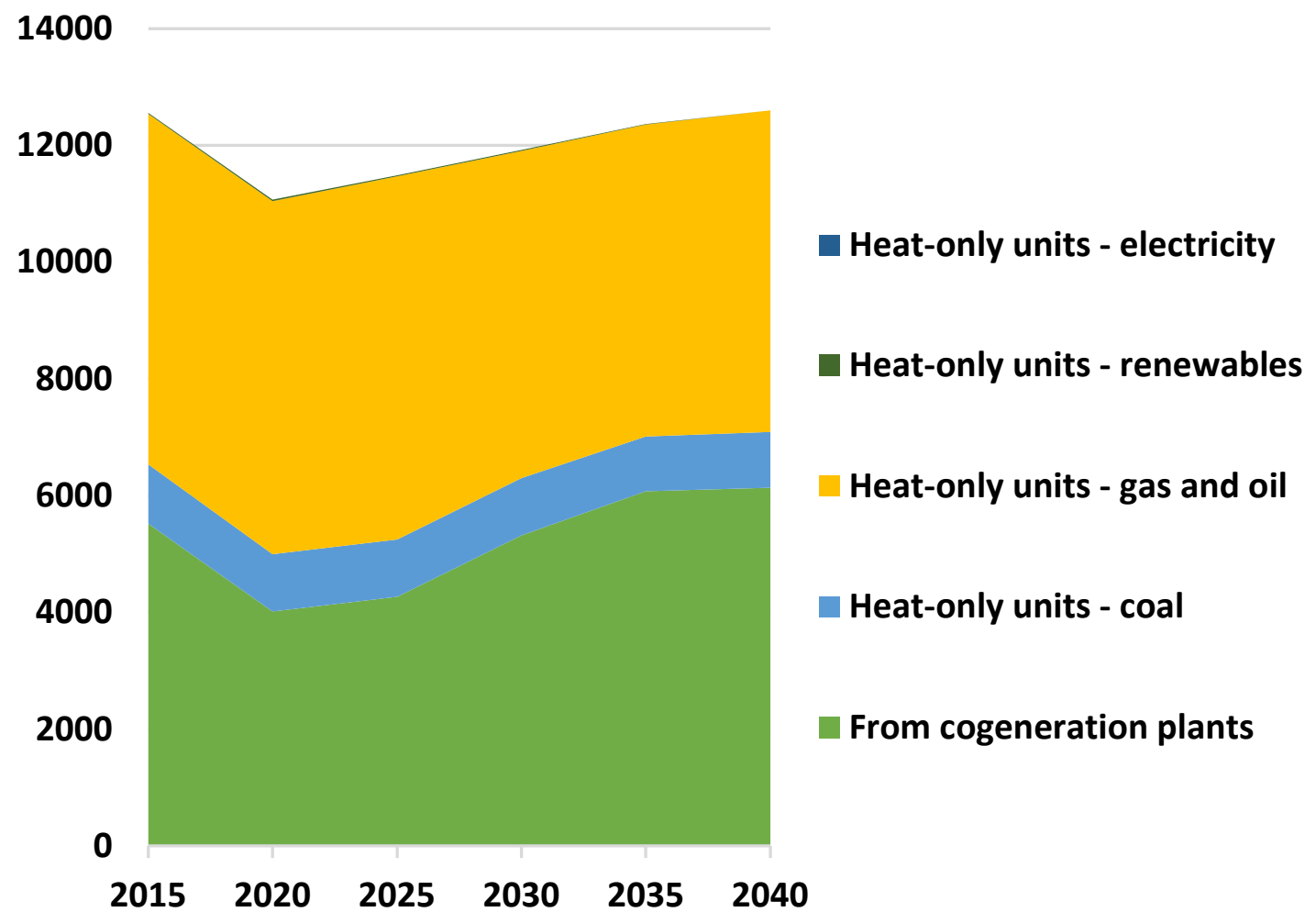
### Total Cost of Electricity supply (in M€)



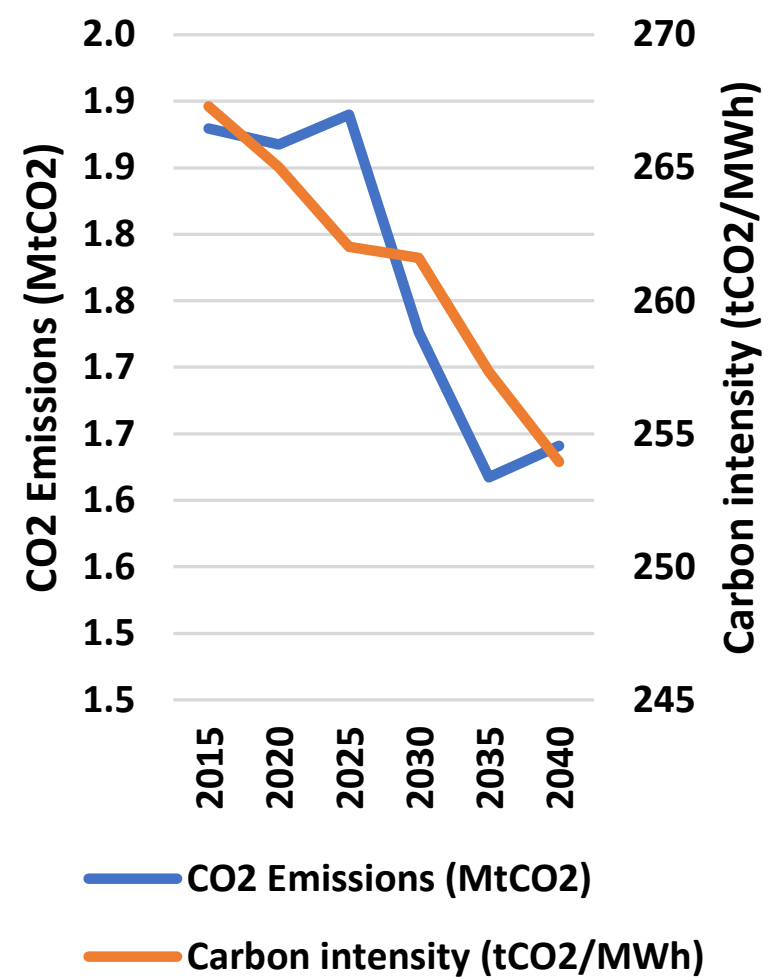
### Investment expenditures in power plants (in M€)



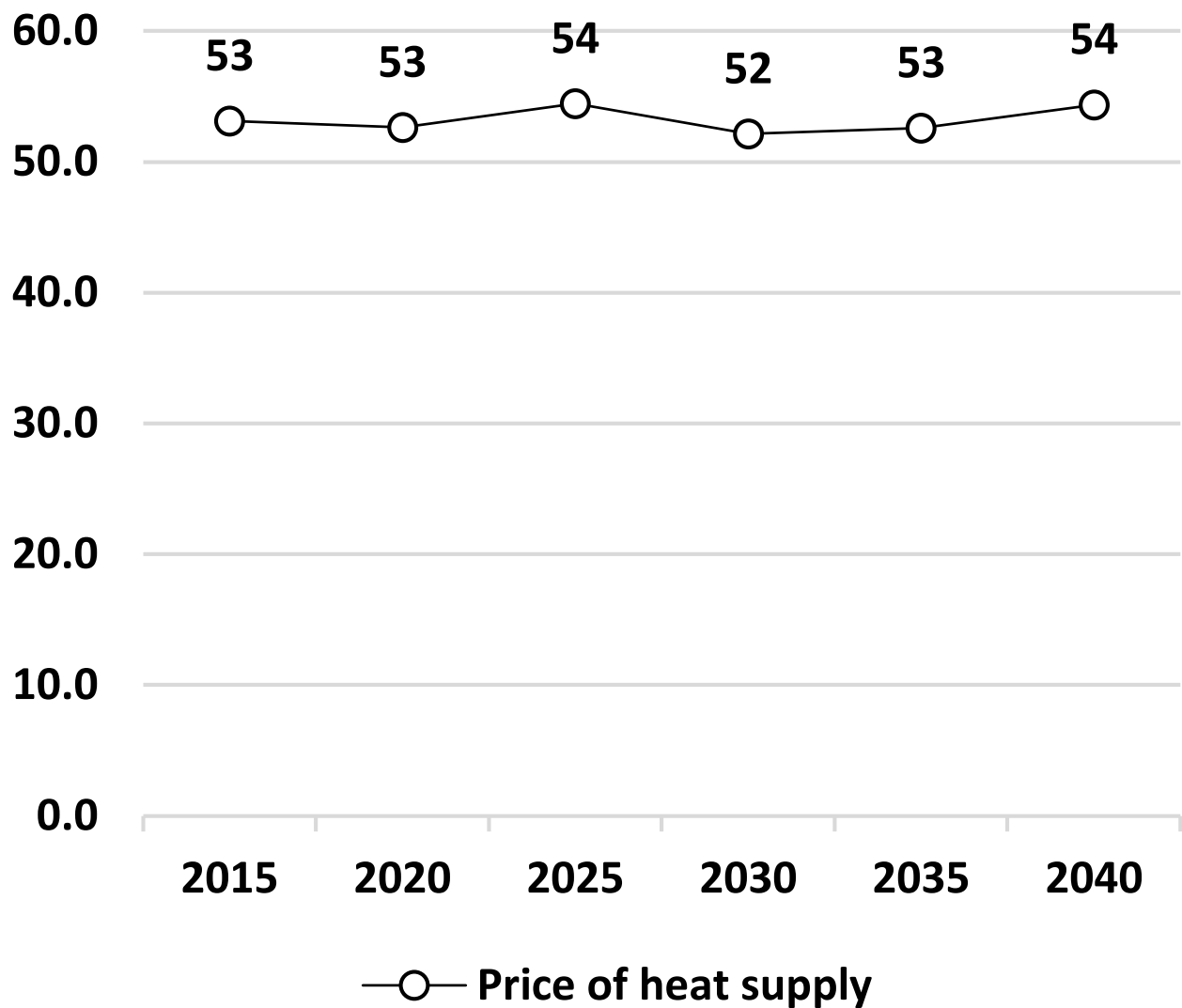
### Heat production (GWh heat)



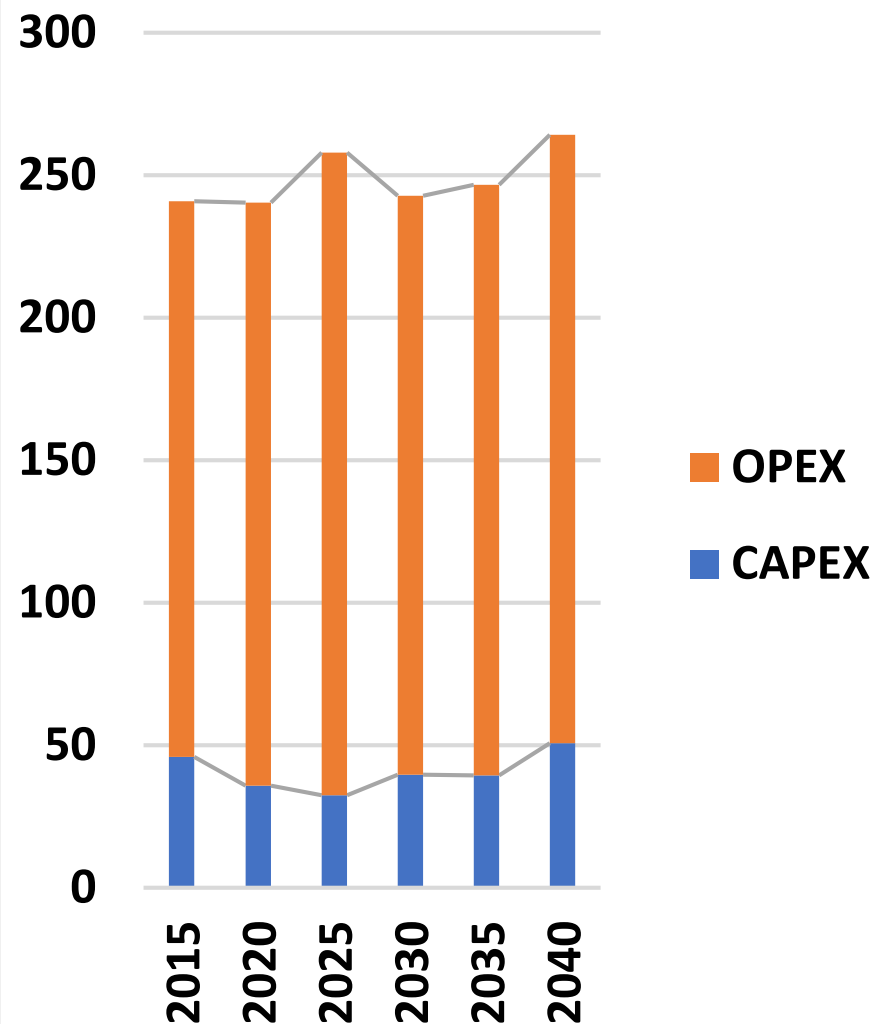
### CO2 Emissions in heat-only unit



### Unit costs in €/MWh (sales)



### Total Cost of heat production (in M€)





## Uncertainties – lack of information

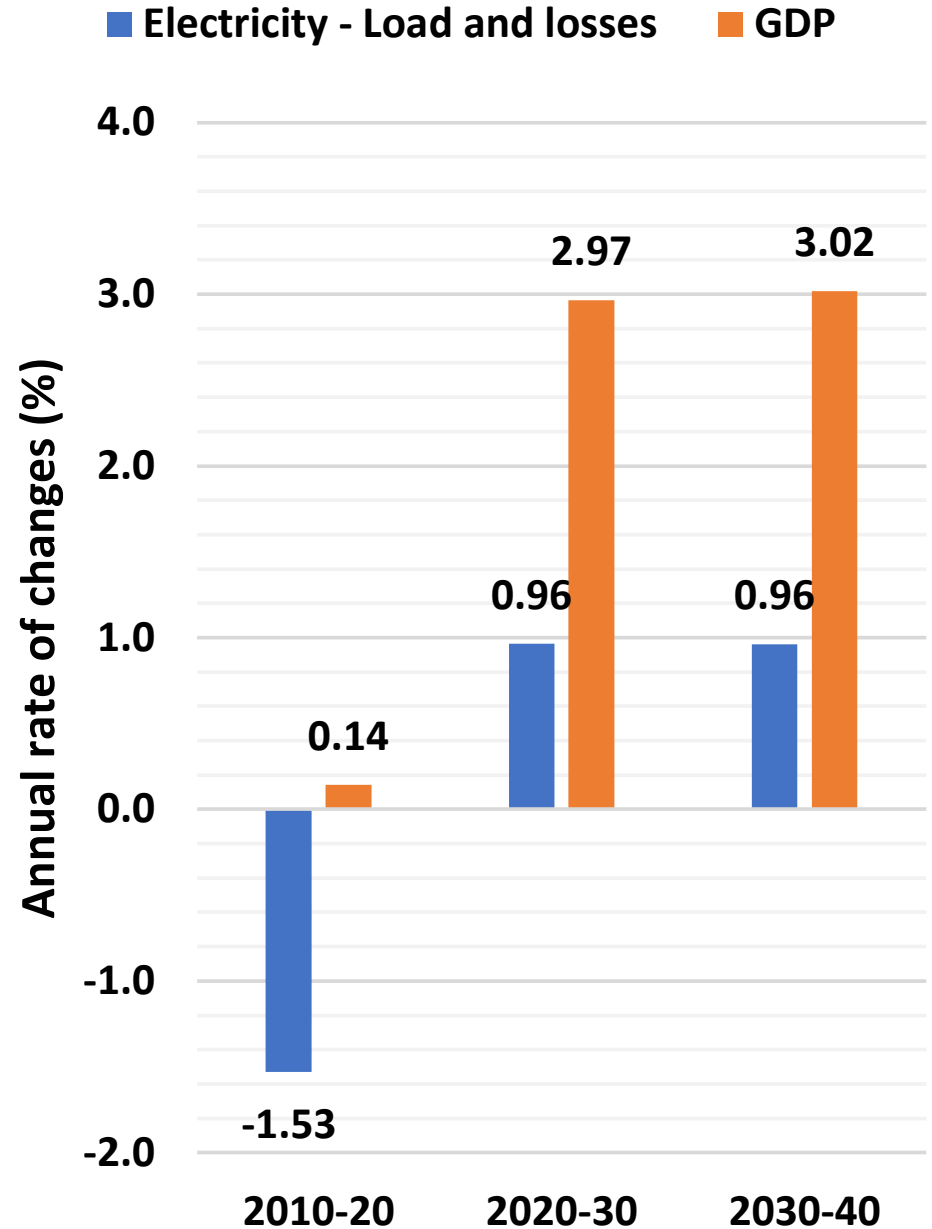
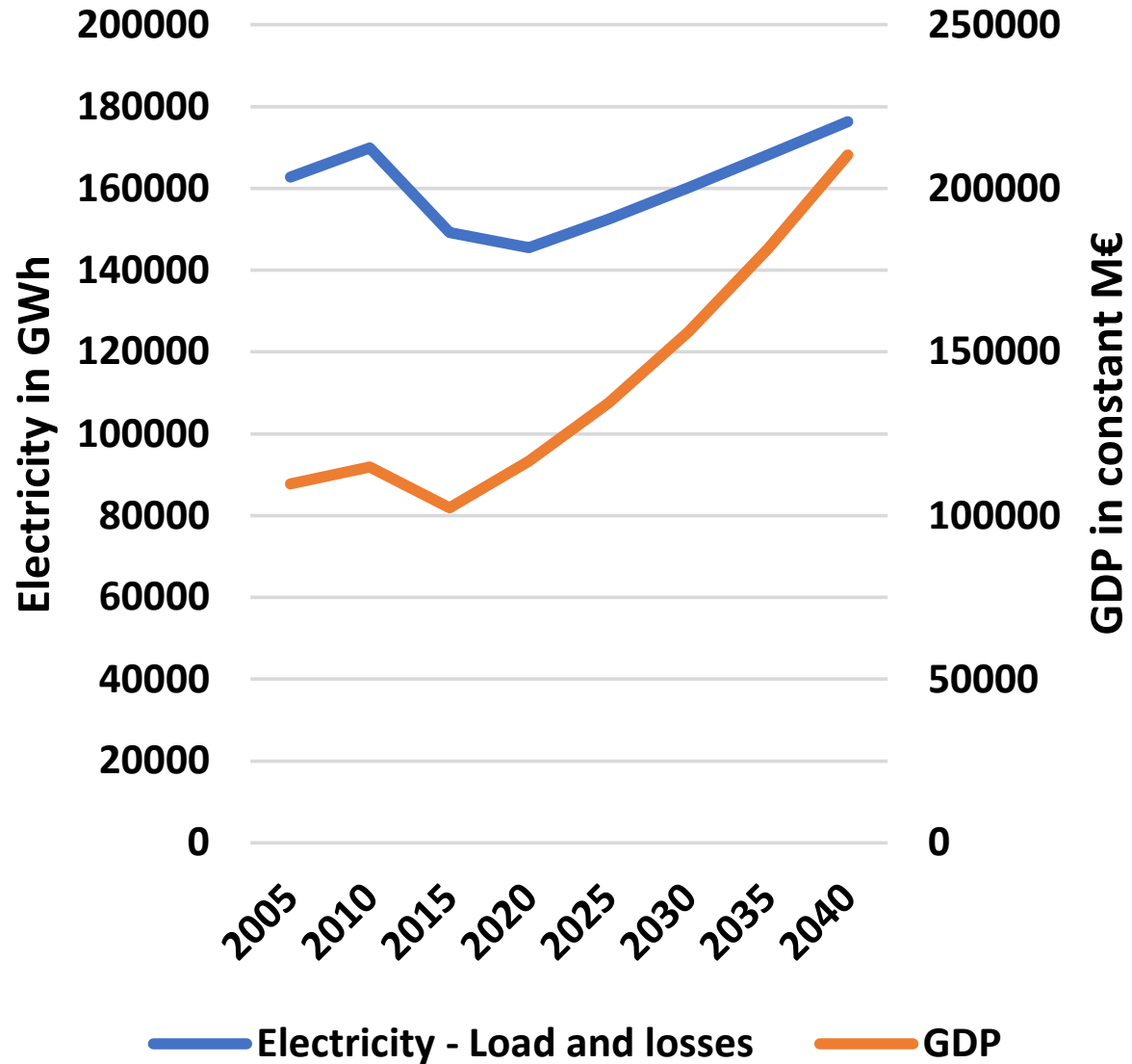
- Lignite plants:
  - Apart from the opted-out plants (Morava, Kolubara A Units 3 & 5), the remaining old lignite fleet will be refurbished or retired?
  - Cost of lignite data – confirm or modify our data
  - The case of Kolubara B is problematic – long history of failed investment; commissioning by 2025 unrealistic and financial closure very uncertain
  - Similar uncertainties surround Kostolac B Unit 3
- Gas CHP plants used for co-generation: apart from the 1 CCGT (Panchevo), which is to be commissioned this year, are there other investment under consideration?
- Why CCGT investment is excluded?
- RES development plan and support still uncertain

## Outlook

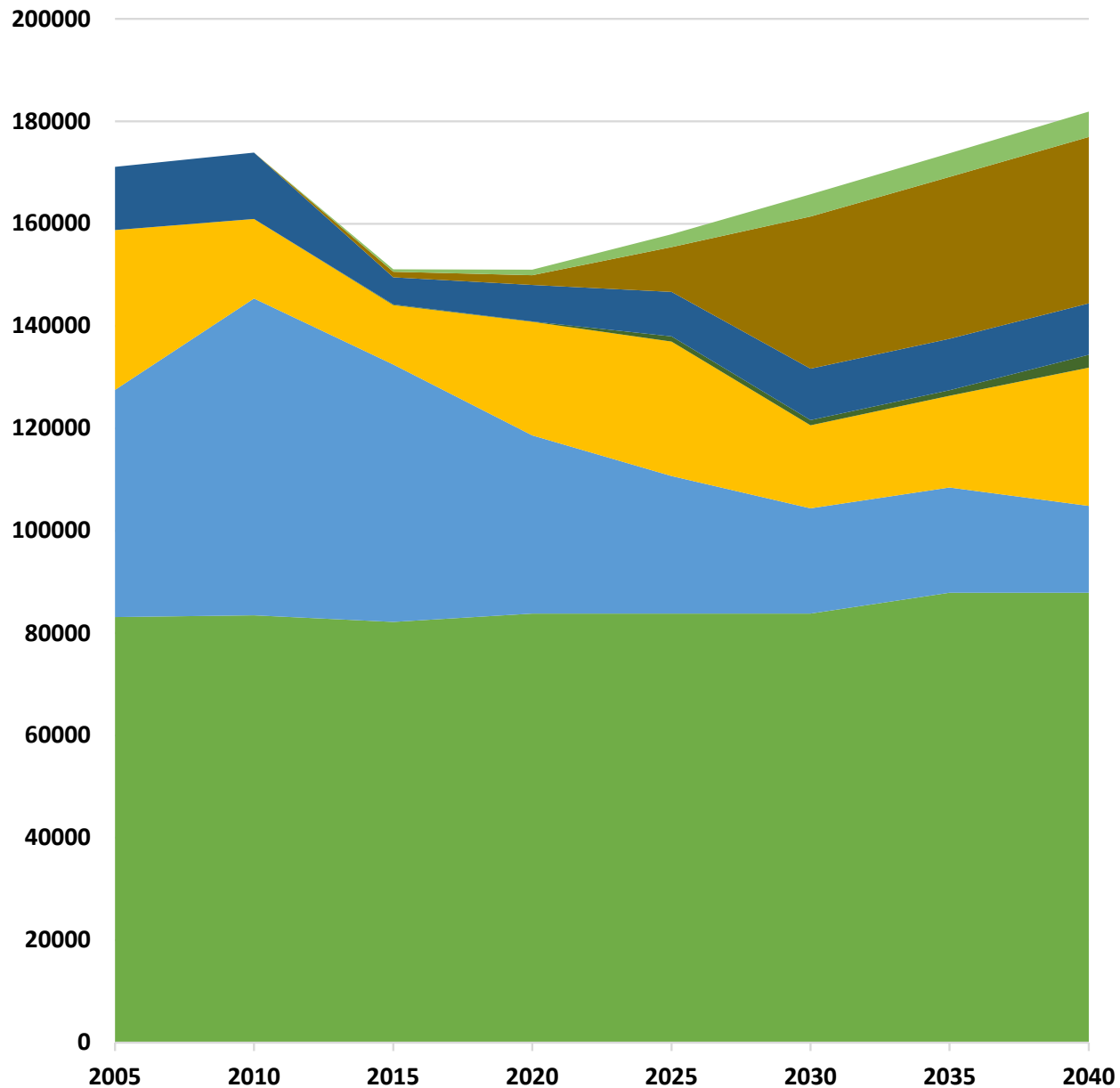
- Under BAU conditions, the country relies on lignite and further investment in lignite, therefore carbon pricing will imply a major disturbance
- The investment plan is ambitious, but highly uncertain
- The absence of gas development weakens flexibility and balancing hindering RES prospects
- It is unlikely to see increasing exports based on lignite exempted from carbon pricing

# Ukraine - Baseline scenario projections

# Demand for electricity

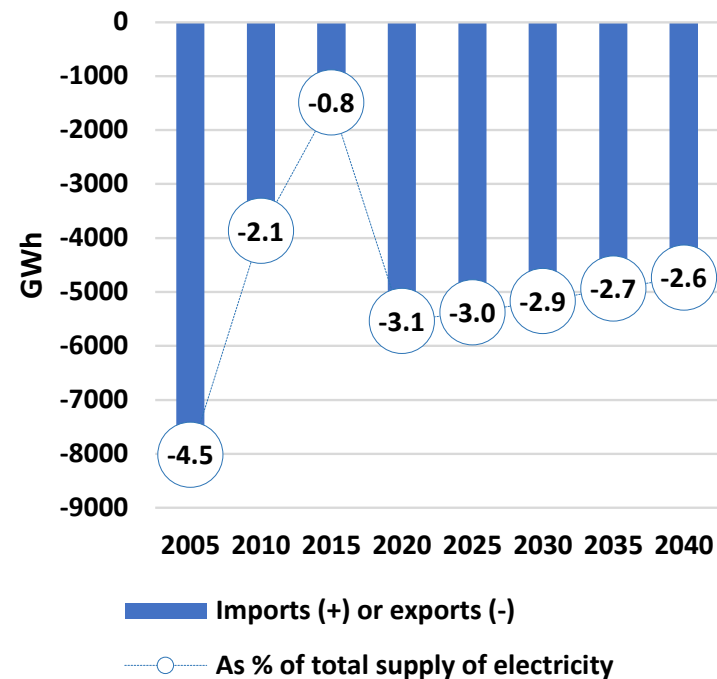


### Power generation (GWh-net)

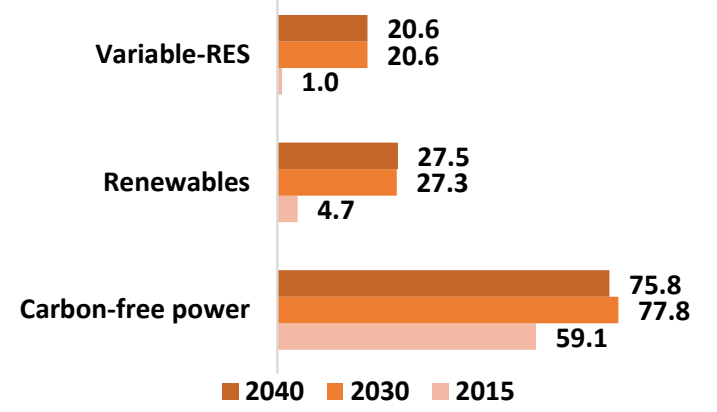


- Solar
- Wind
- Hydro
- Biomass
- Gas and oil
- Coal
- Nuclear

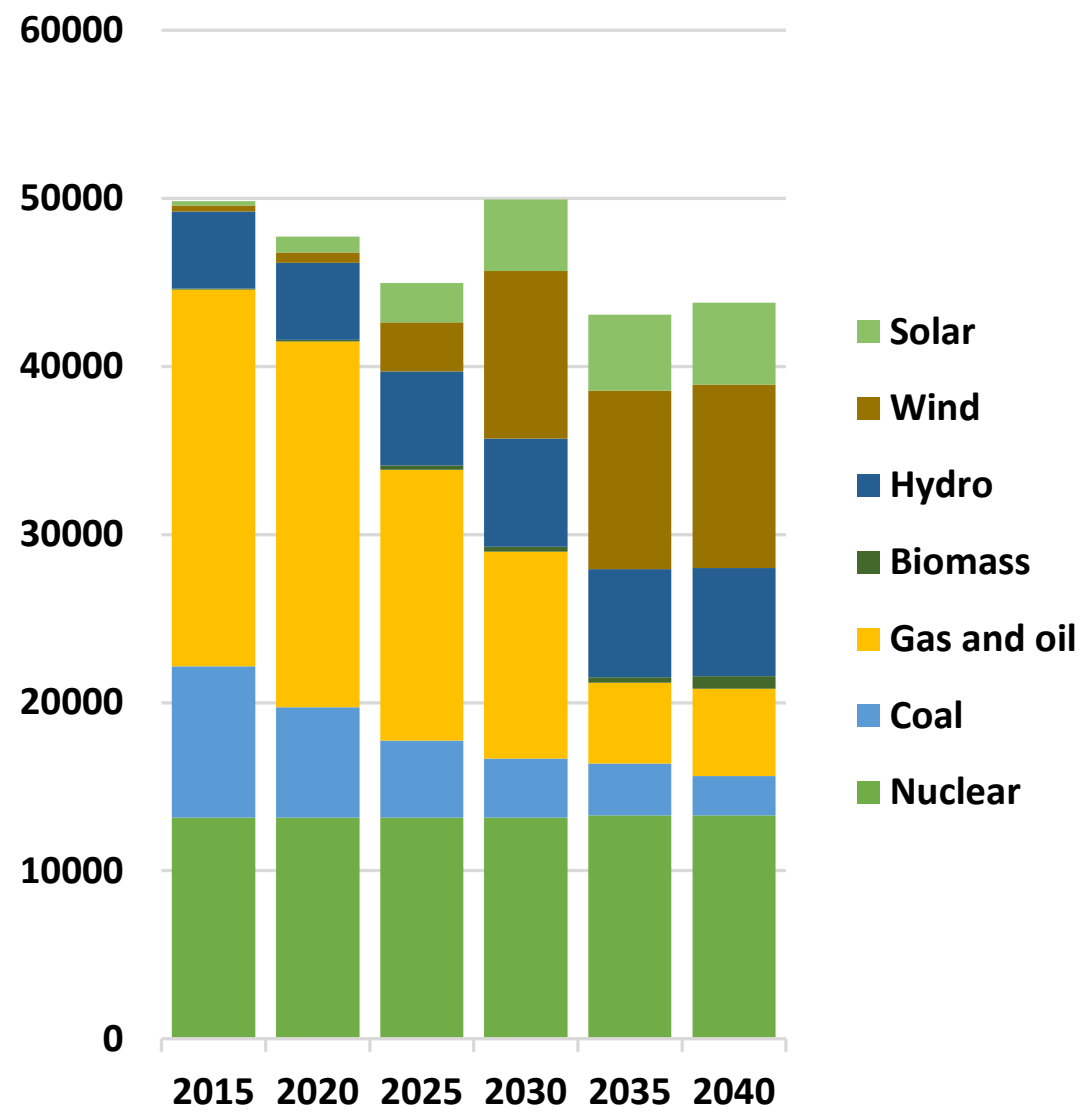
### Net imports of electricity



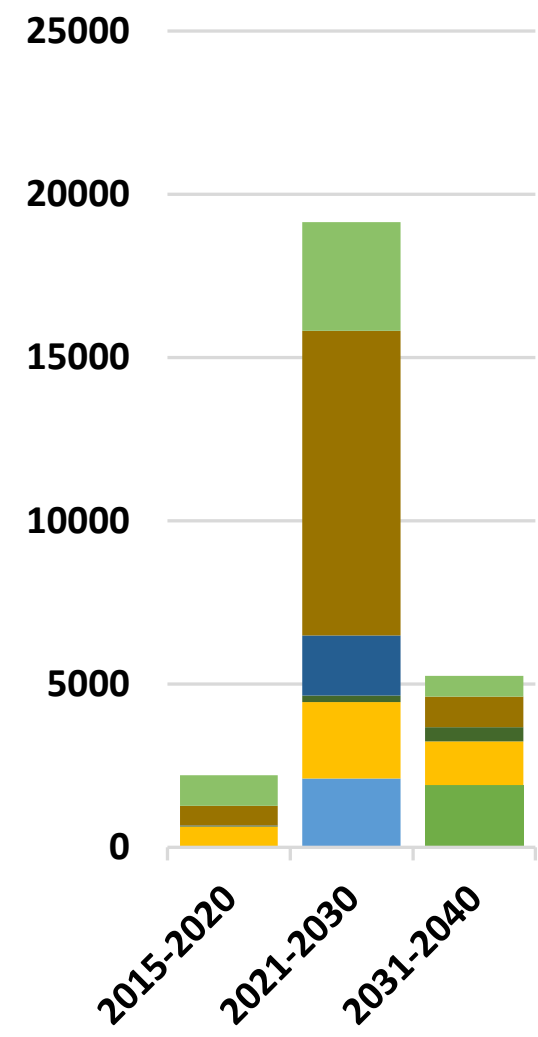
### Indicators (shares - %)



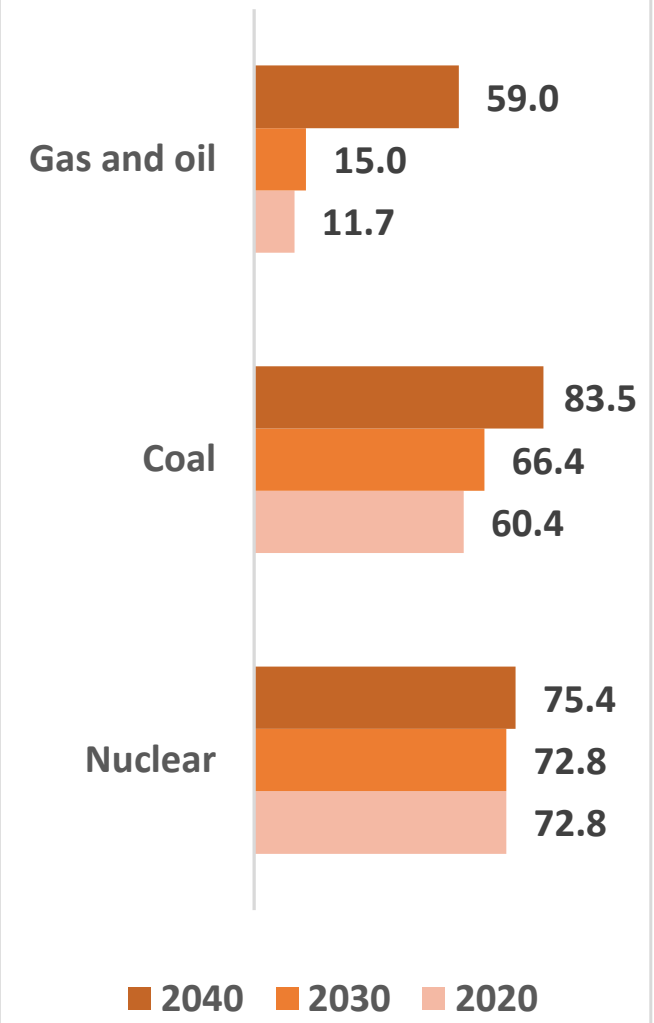
### Operating capacities (MW)



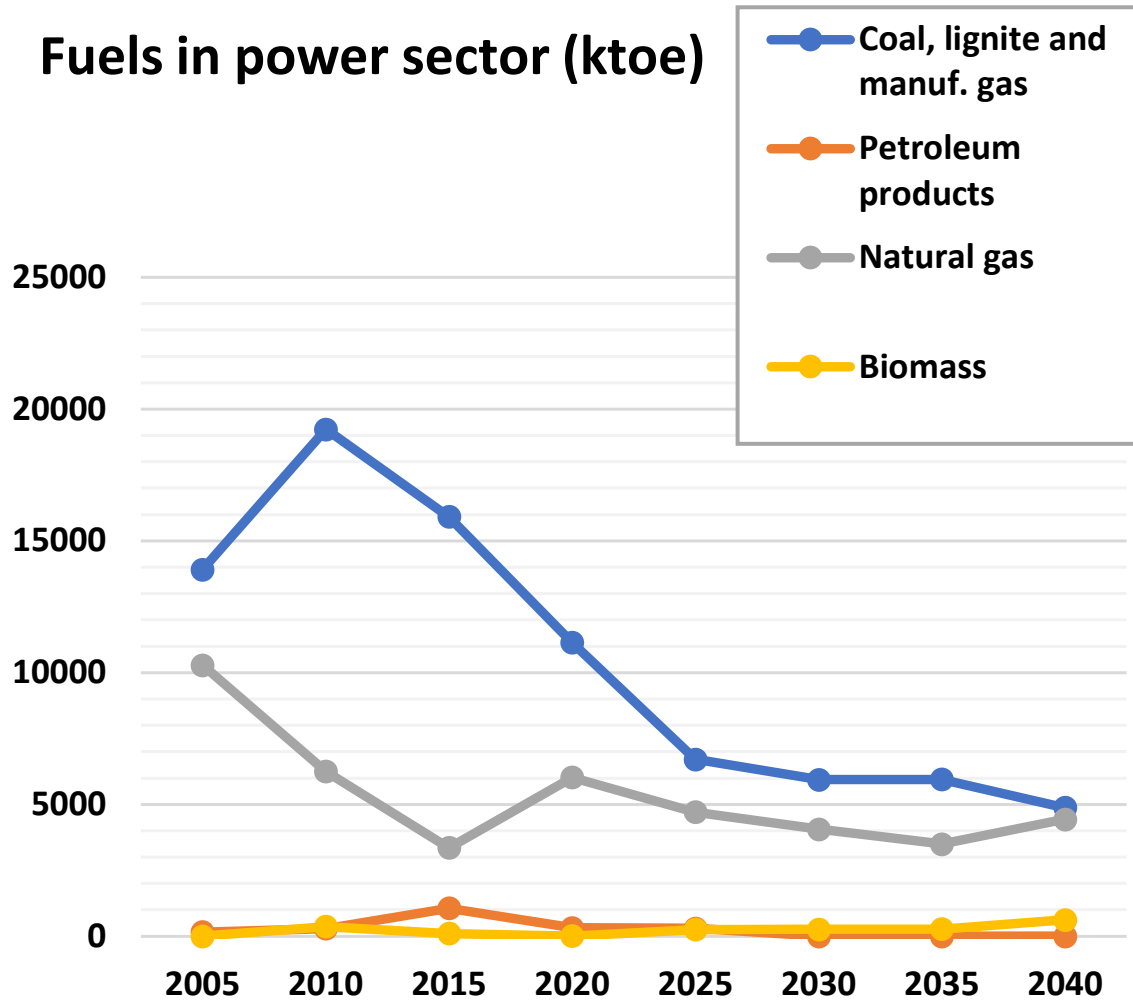
### Capacity expansion (MW)



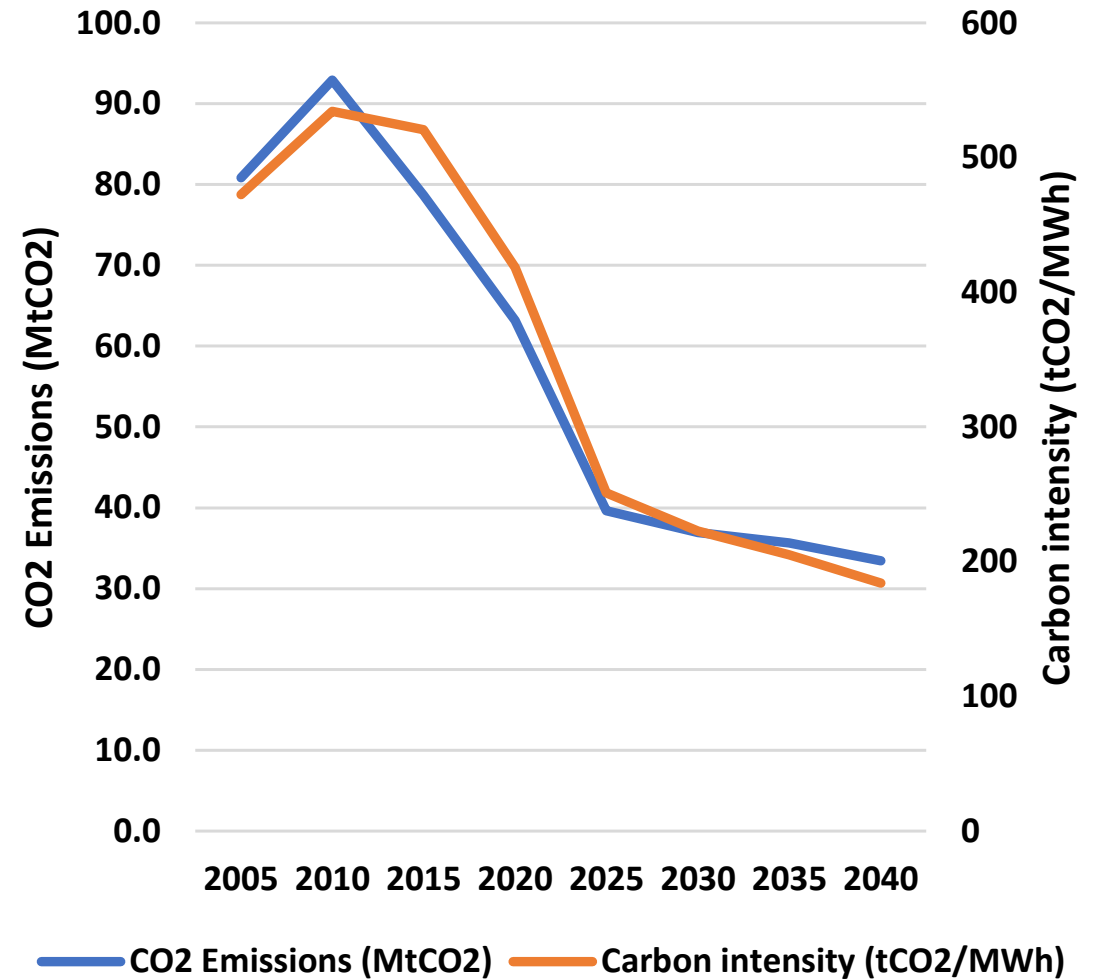
### Rate of use of capacity (%)



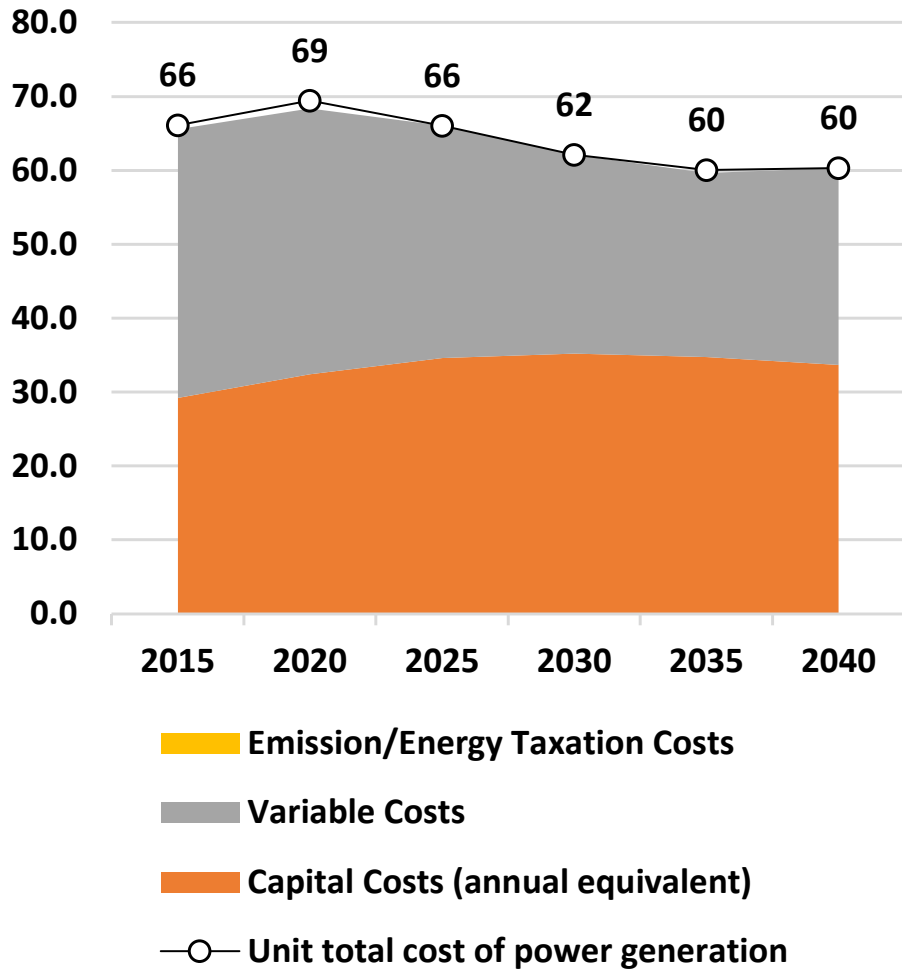
### Fuels in power sector (ktoe)



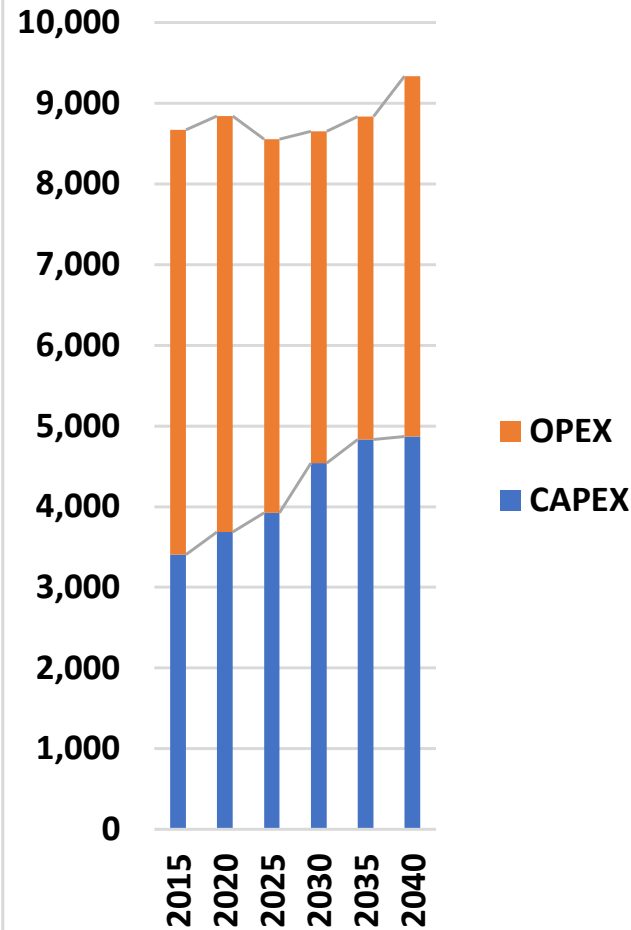
### CO2 Emissions in power generation



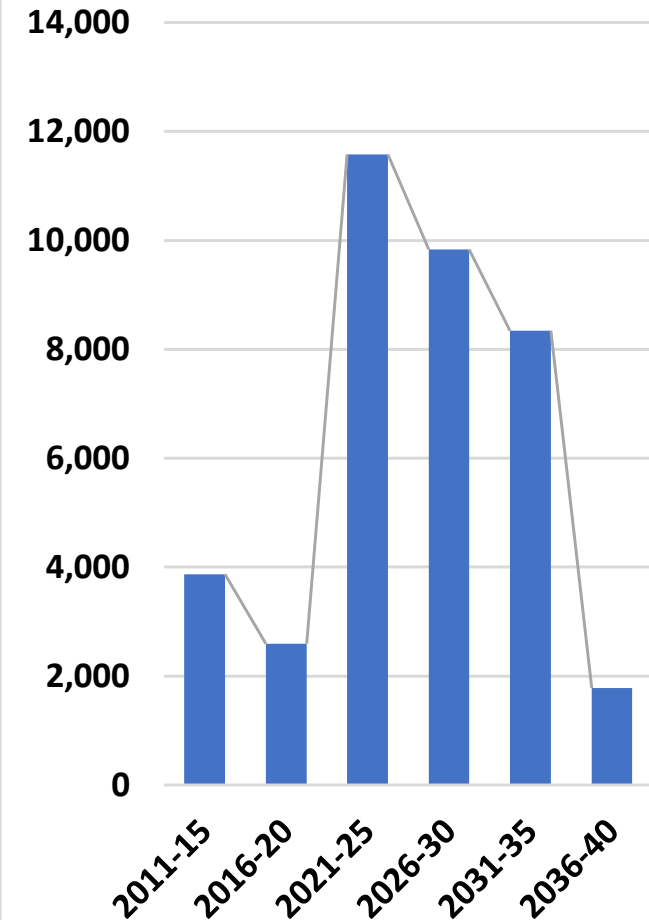
### Unit costs in €/MWh (sales)



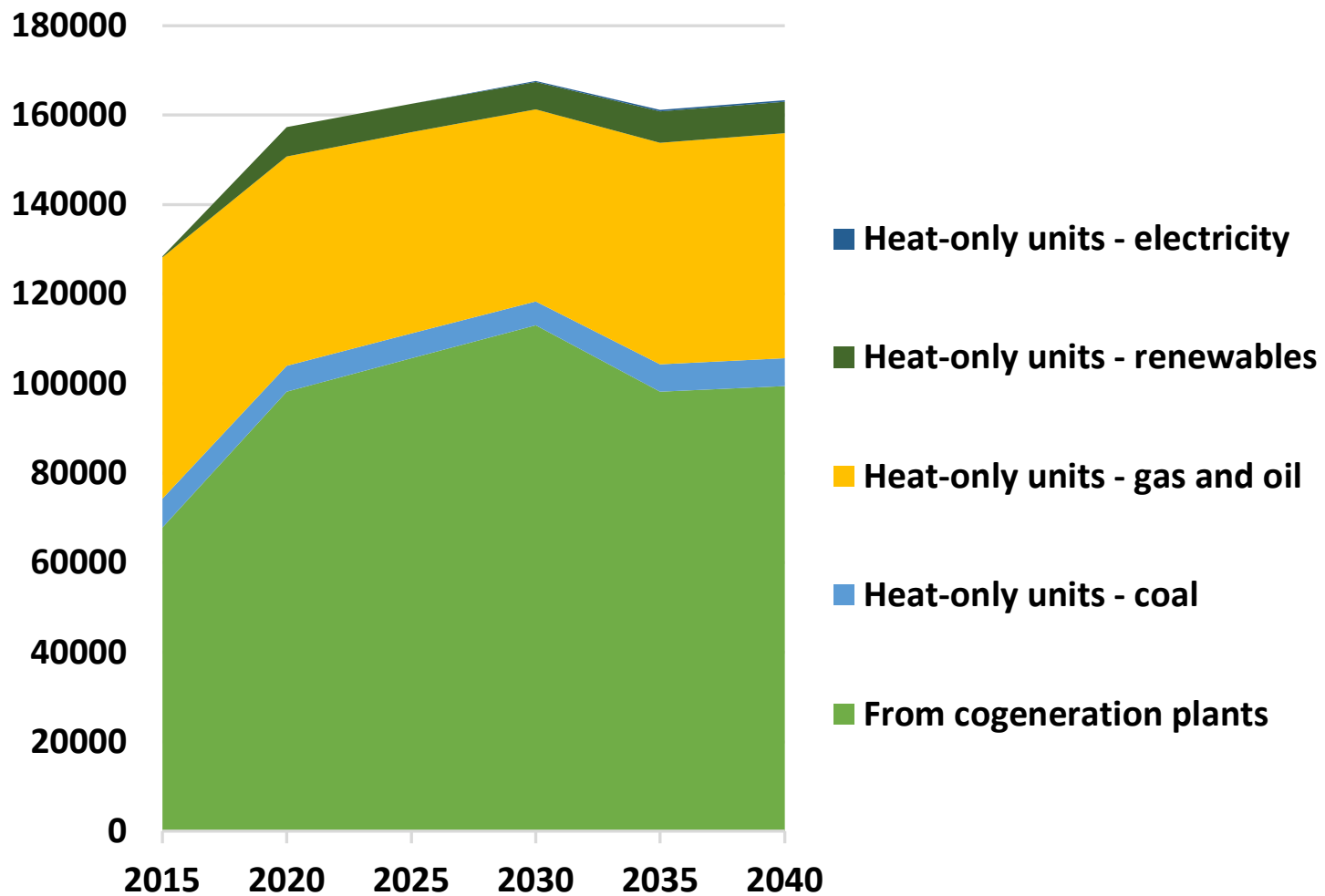
### Total Cost of Electricity supply (in M€)



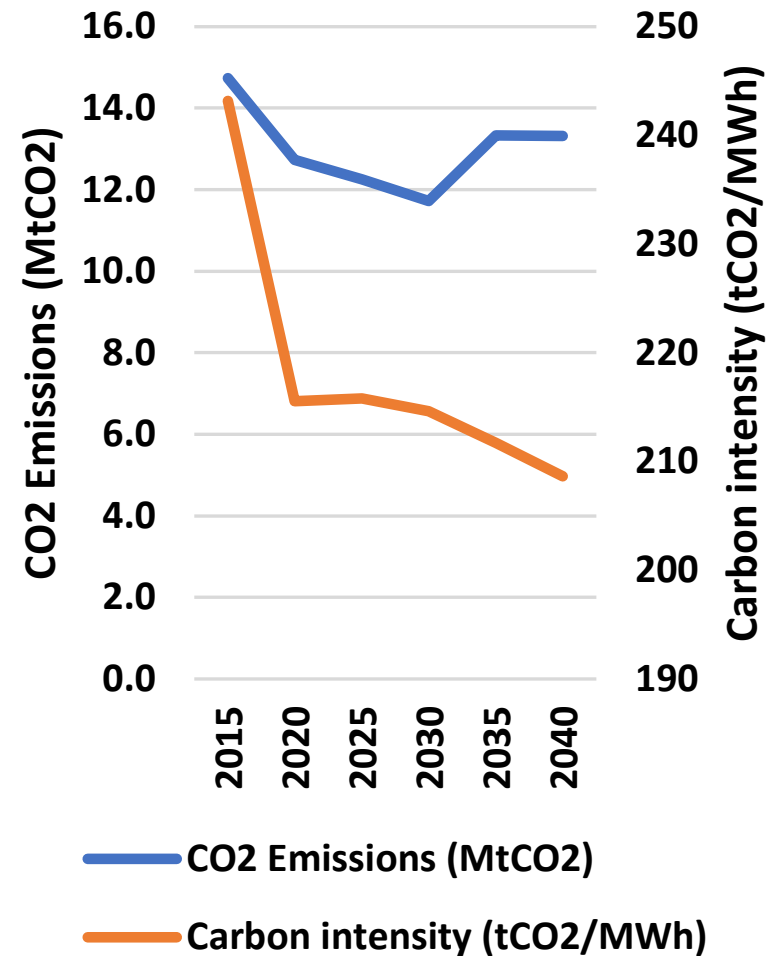
### Investment expenditures in power plants (in M€)



## Heat production (GWh heat)

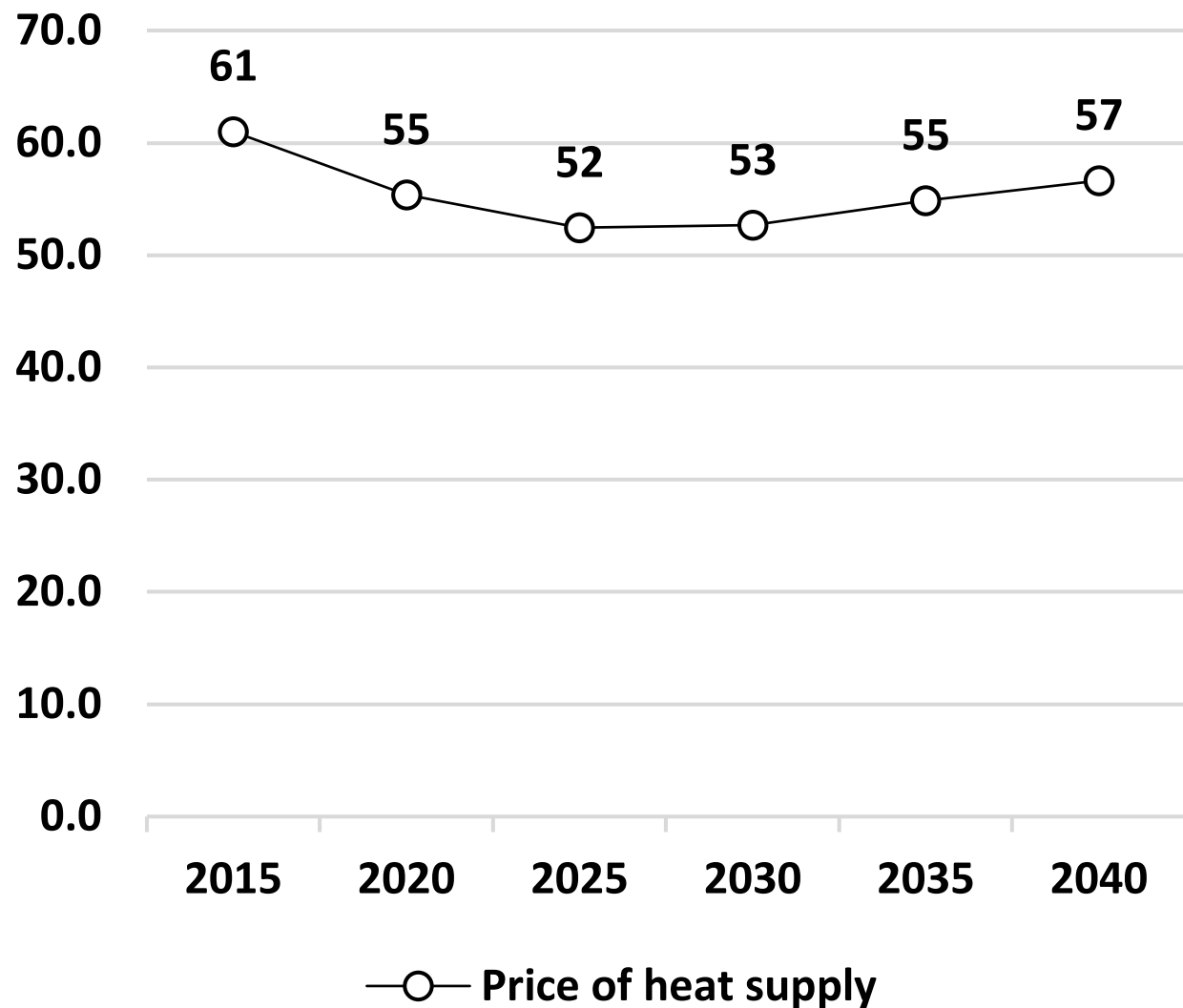


## CO2 Emissions in heat-only unit

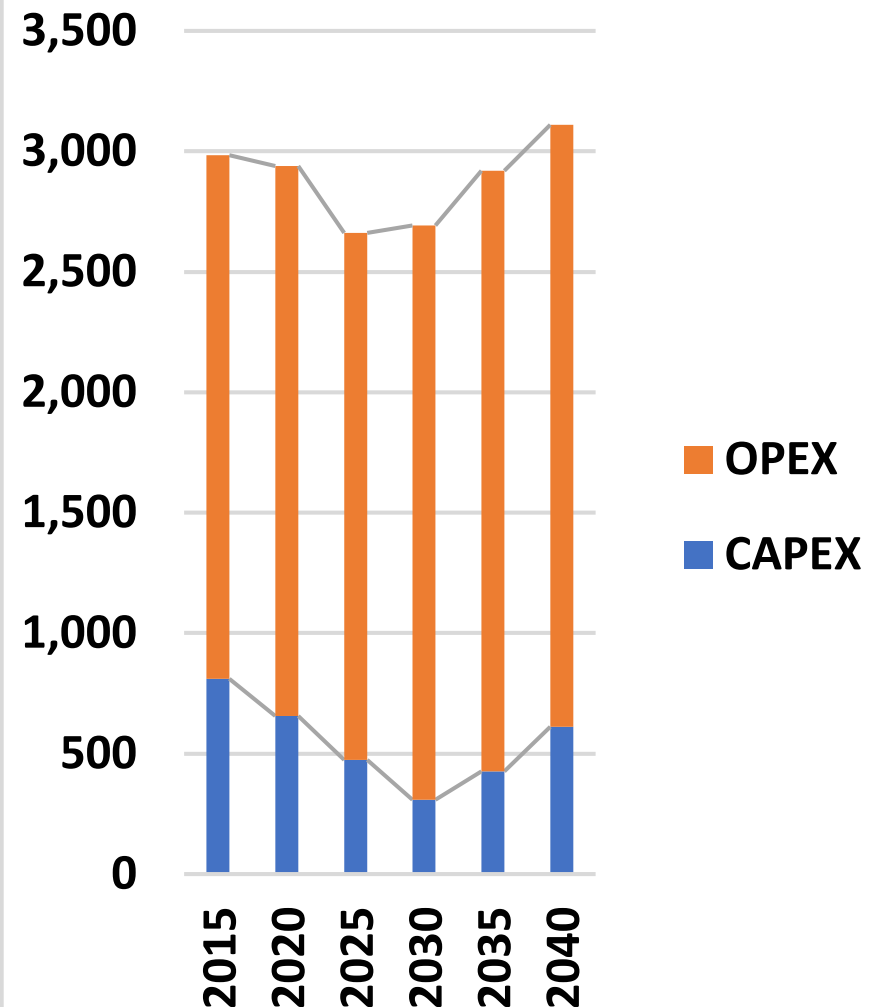




### Unit costs in €/MWh (sales)



### Total Cost of heat production (in M€)



## Uncertainties – lack of information

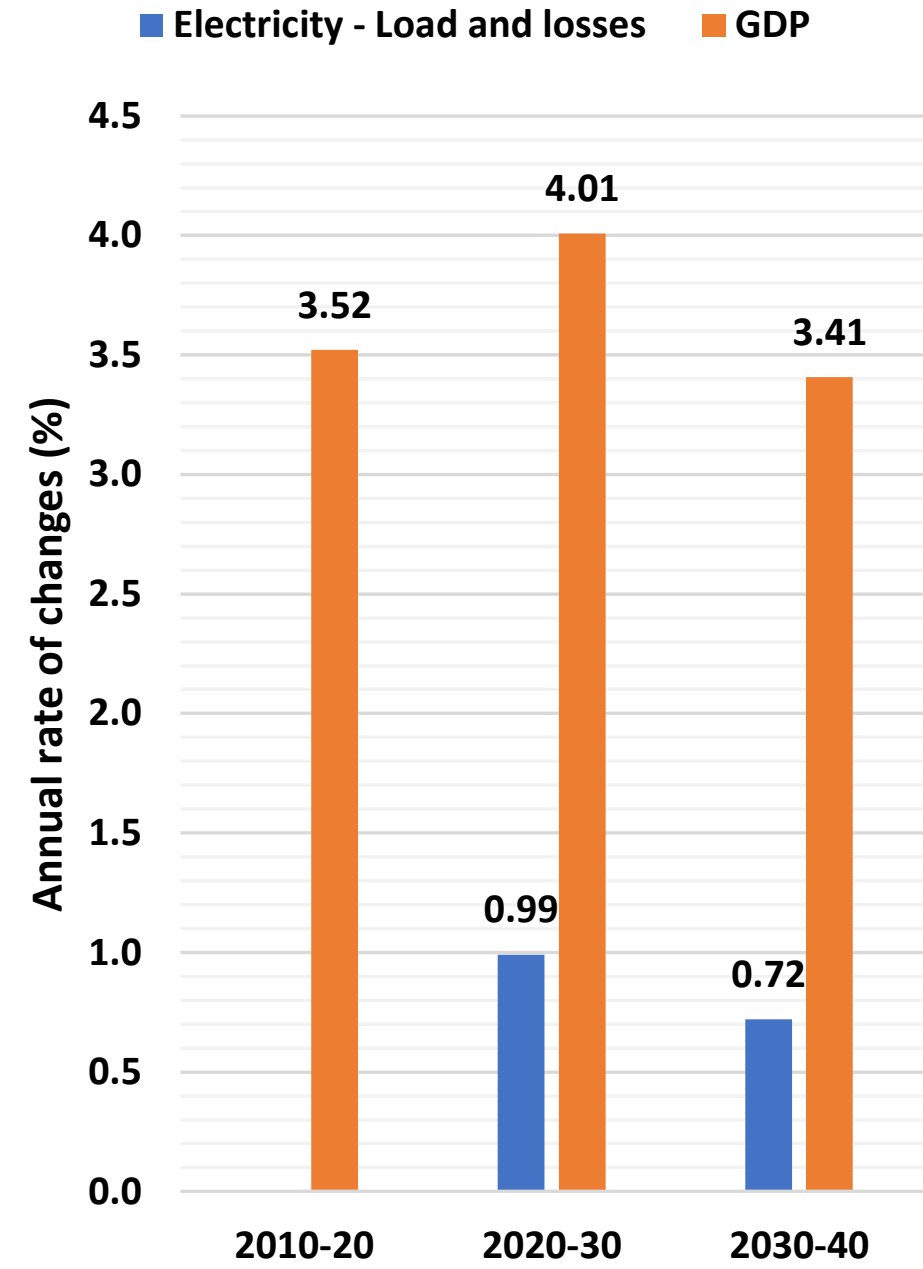
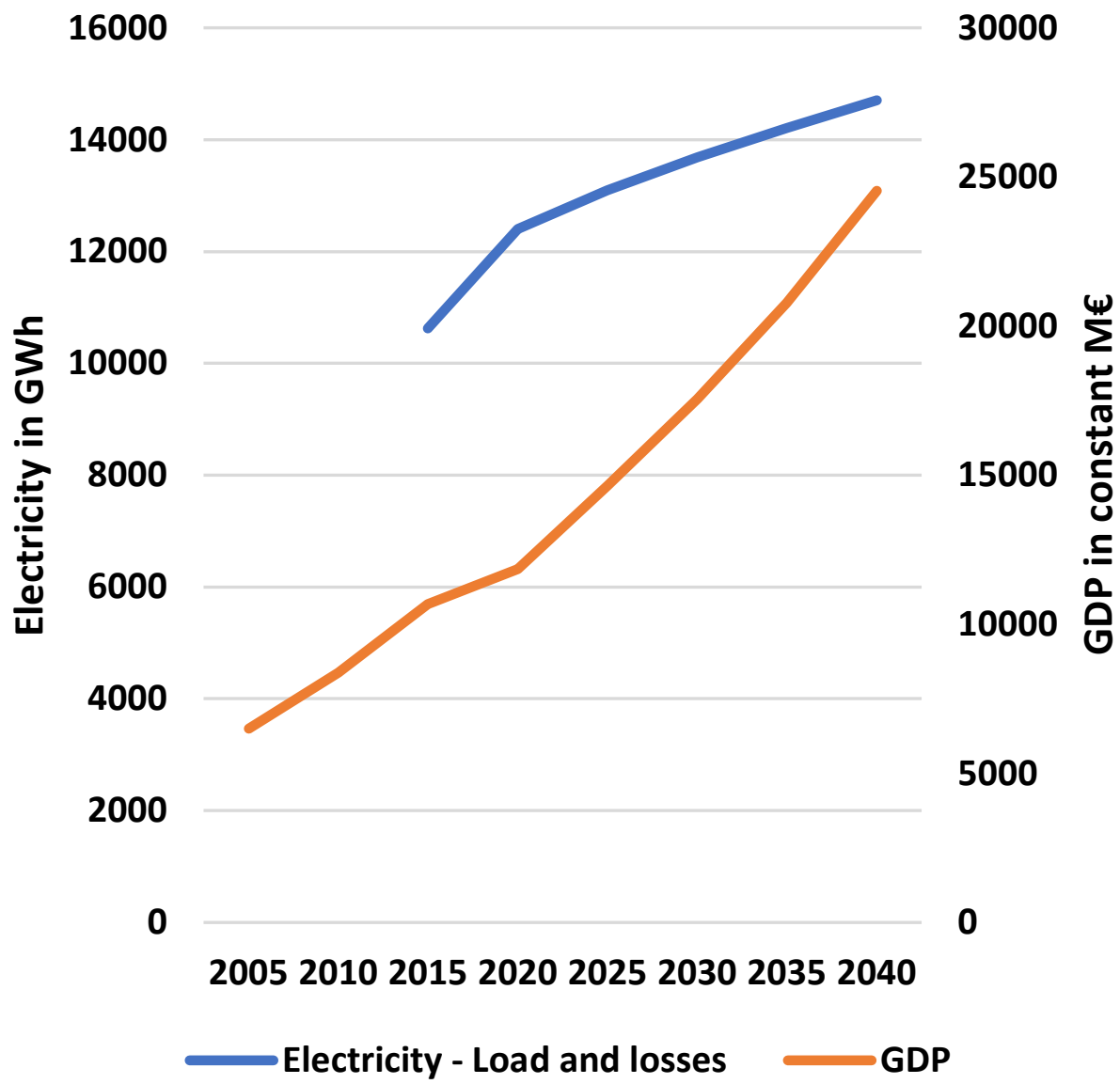
- Extension of lifetime of nuclear fleet – refurbishment costs and exact dates of retirement must be specified. Are there prospects for new nuclear investment?
- Gradual removal of subsidies, is it an ongoing policy?
  - Gas prices
  - Coal prices
  - Consumer prices of electricity
- According to DTEK's comments coal capacity for 2018 is 17GW, while in our data coal-fired capacity and oil-fired is 12,5GW
- Verify whether the switch of burning fuel (coal and gas) is a common practice in the Ukrainian system?
- A significant part of the plant fleet is subject to IED and has entered a limited operating regime. Are there new investments in coal plants planned so as to replace them? (e.g. BURSHTYN 13, Slavyansk 6 coal plant)
- Unclear which is the coal replacement strategy
  - Coal plants are very old and inefficient
  - At present, coal plants operate with frequent shut downs with huge cost implications
  - Coal is of course incompatible with carbon emission strategy
- Unclear the investment possibilities to increase efficiency of gas firing generation, including for CHP
- At present, poor balancing and reserves, domestically, which hinders further development of variable RES
- What to retain as realistic plans for RES and hydro?

## Outlook

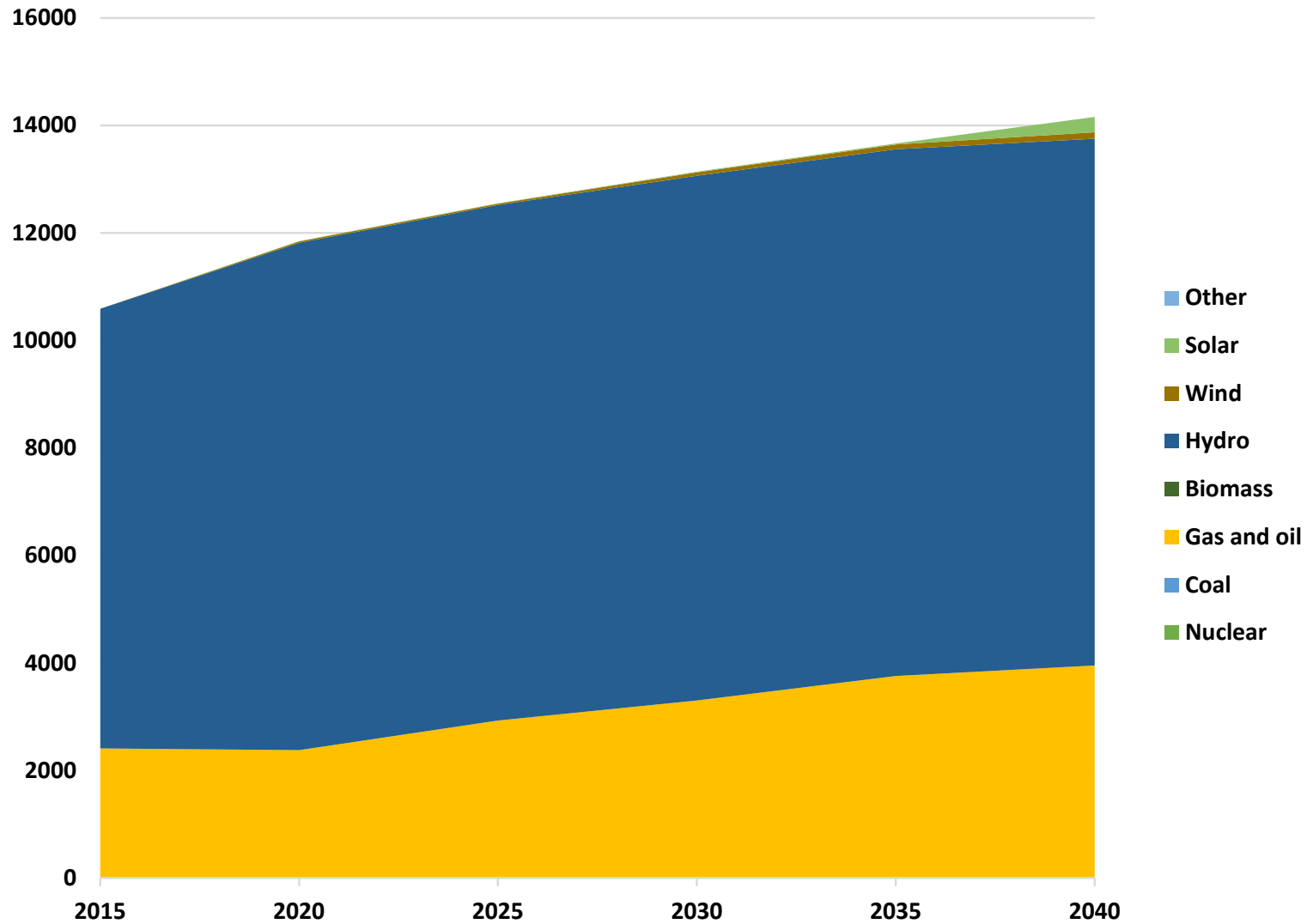
- Old power plant fleet implies operational inefficiencies and an uncertain future for the power mix
- Although the country has ample resources to flexibly adapt the system to carbon pricing, investment difficulties and poor reserves raise significant uncertainties
- The coal strategy has to be clarified and revised
- Cost and price subsidies counteract efficiency and emission reduction objectives
- Market and system integration with the EU to be clarified

# Georgia - Baseline scenario projections

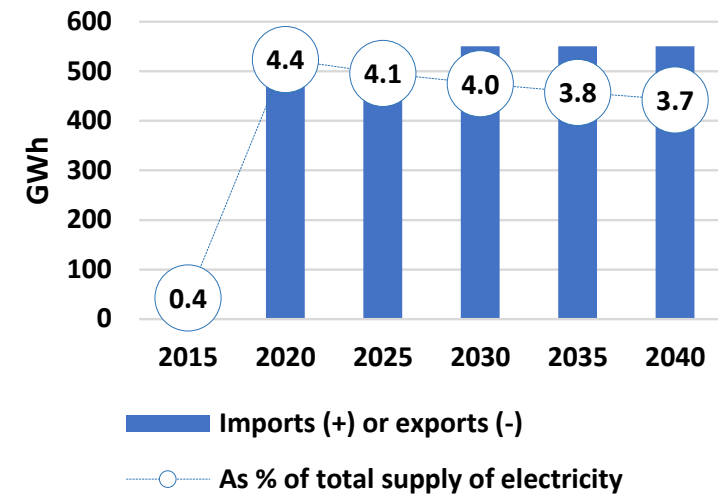
# Demand for electricity



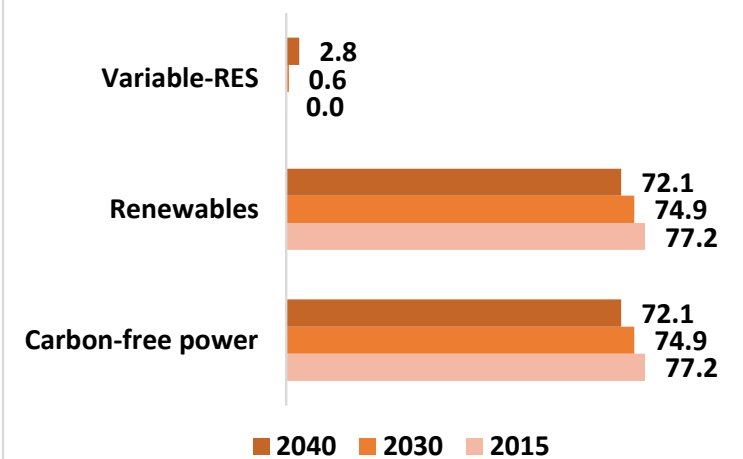
### Power generation (GWh-net)



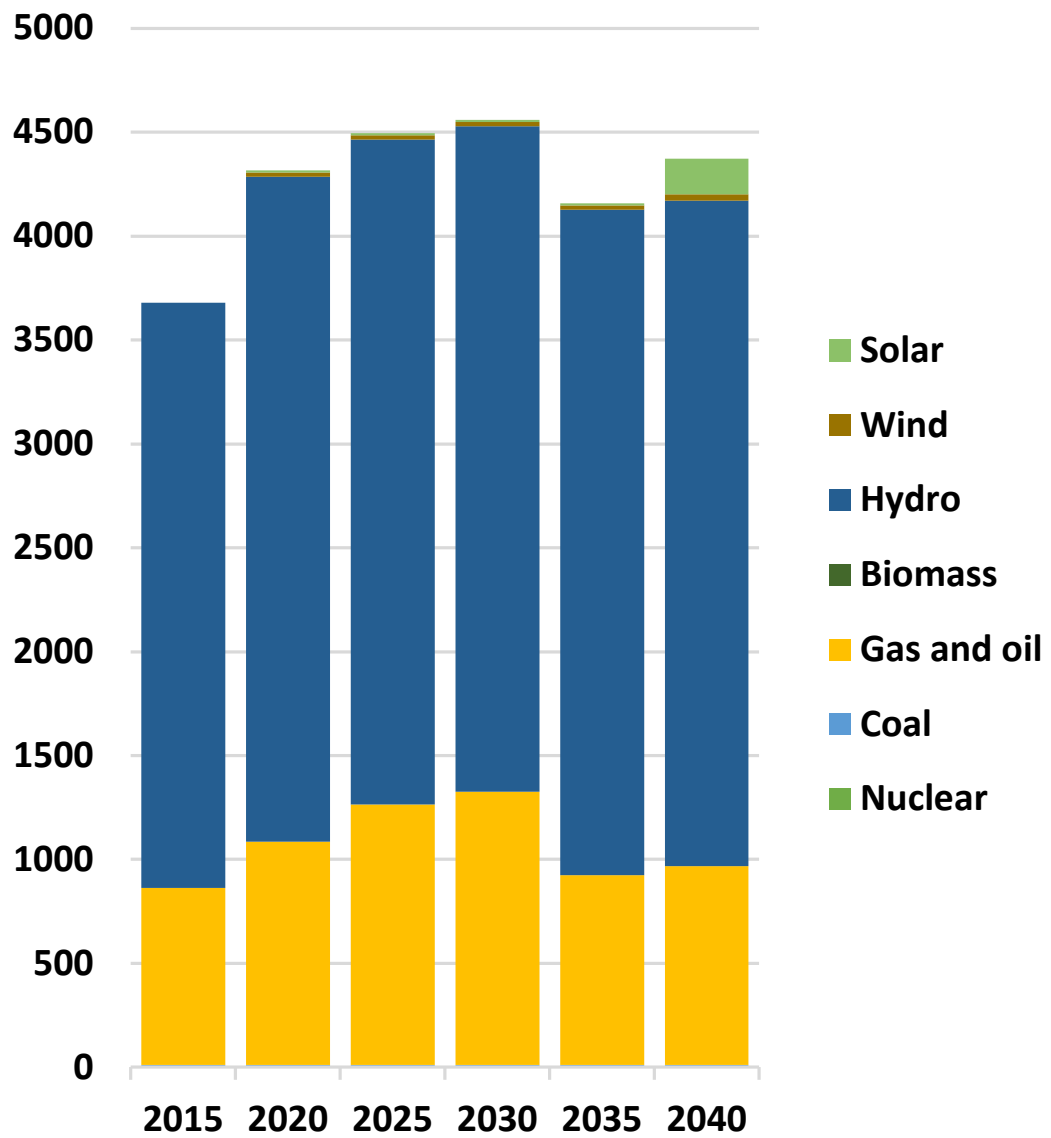
### Net imports of electricity



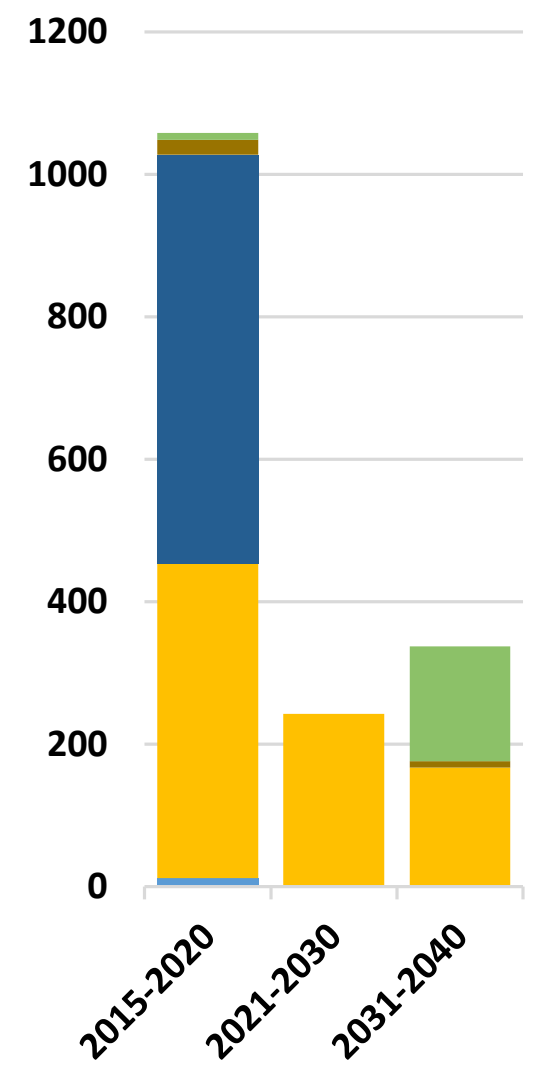
### Indicators (shares - %)



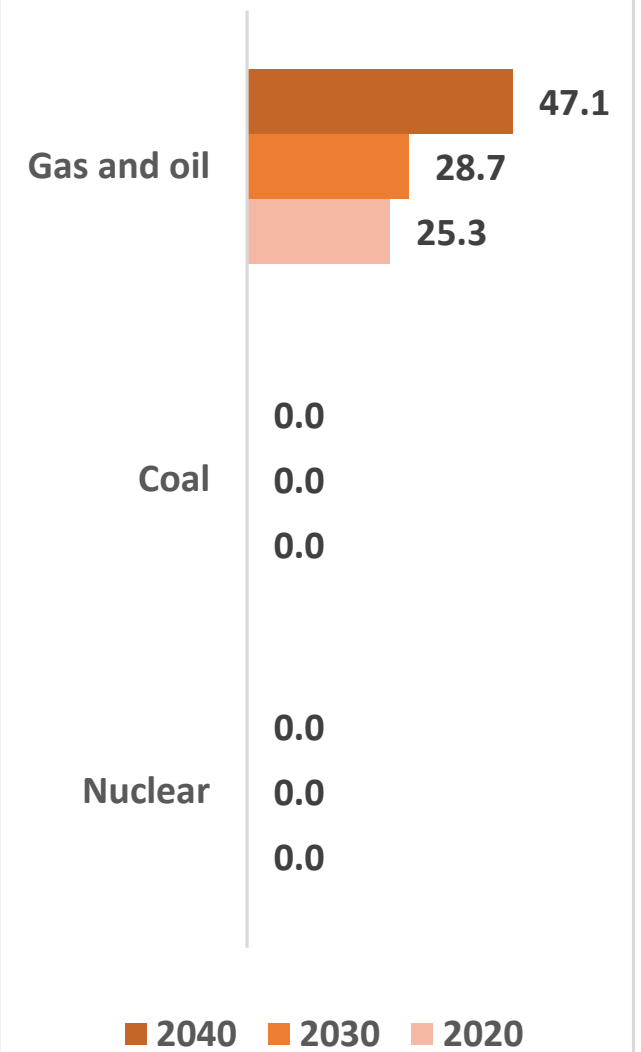
### Operating capacities (MW)



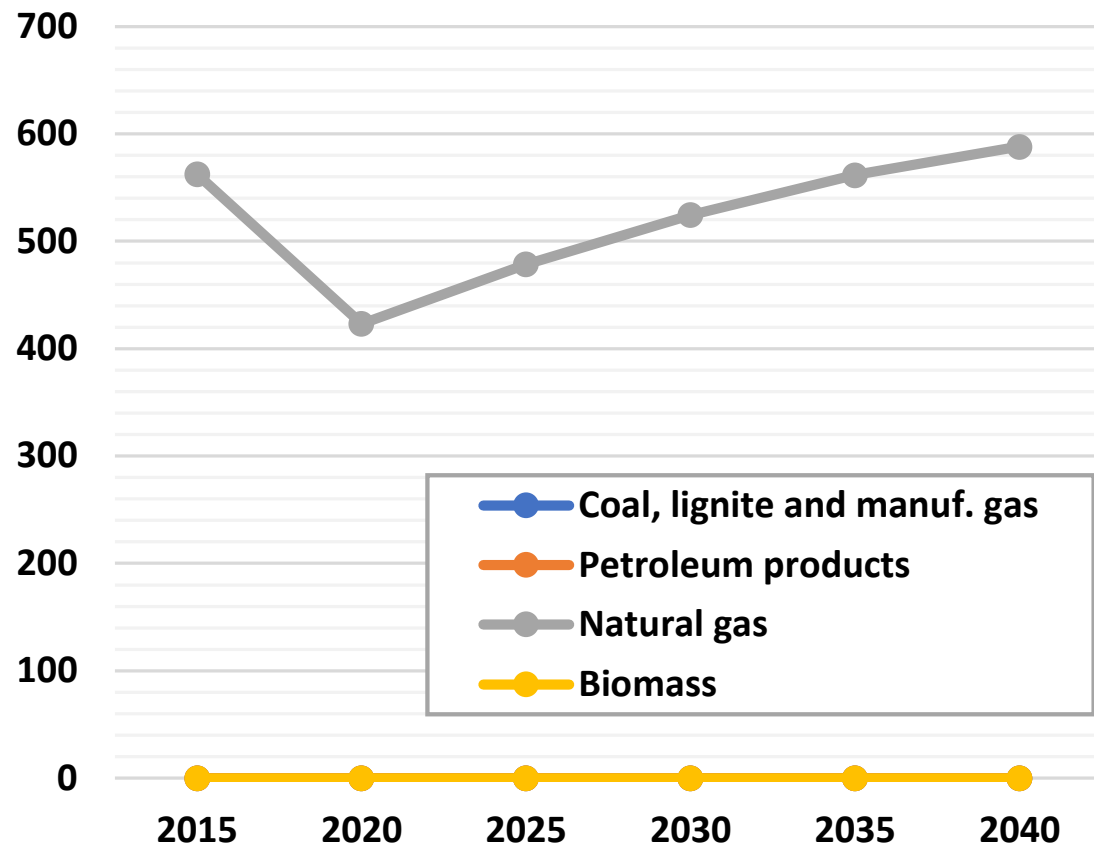
### Capacity expansion (MW)



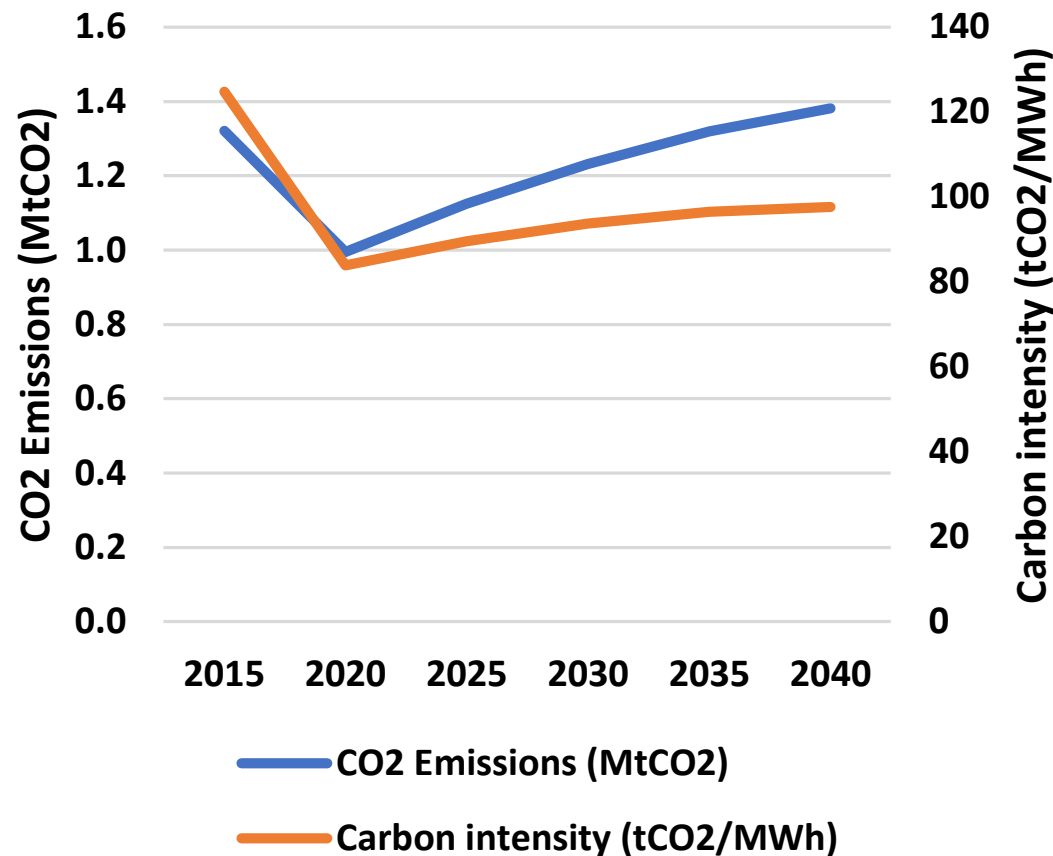
### Rate of use of capacity (%)



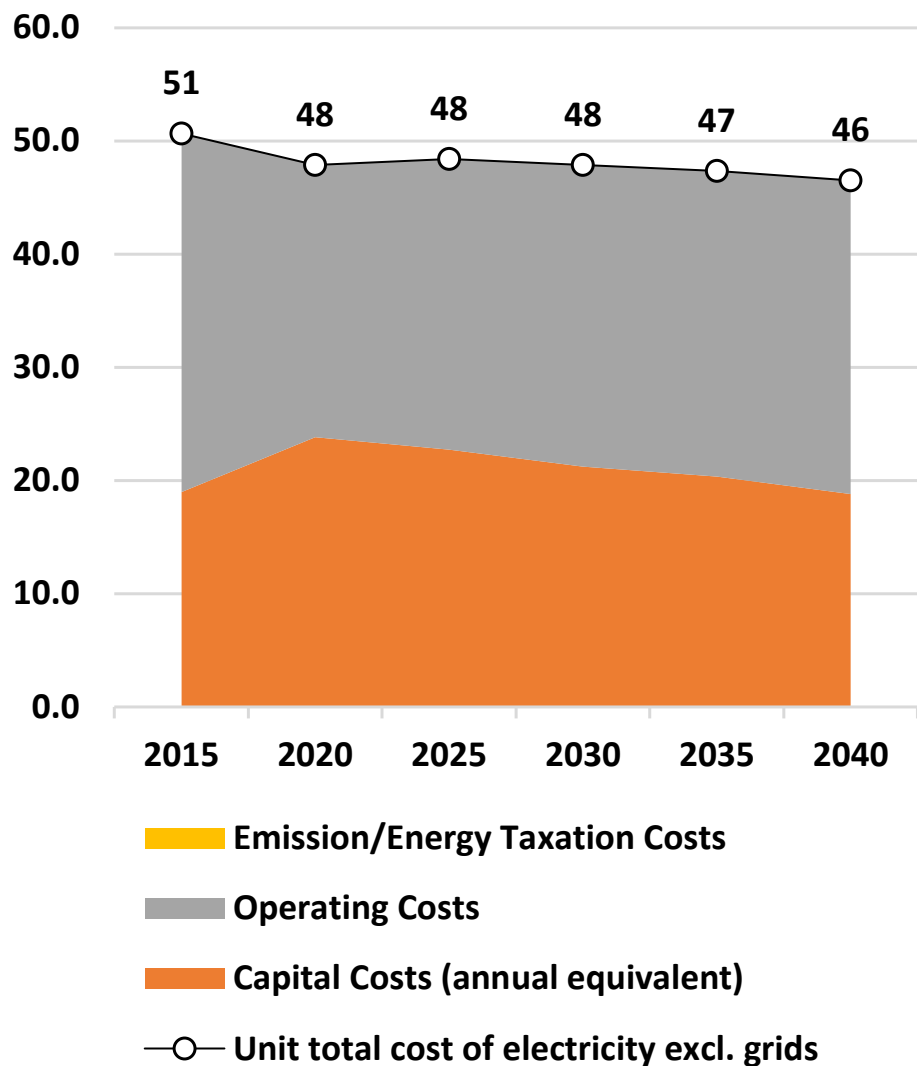
### Fuels in power sector (ktoe)



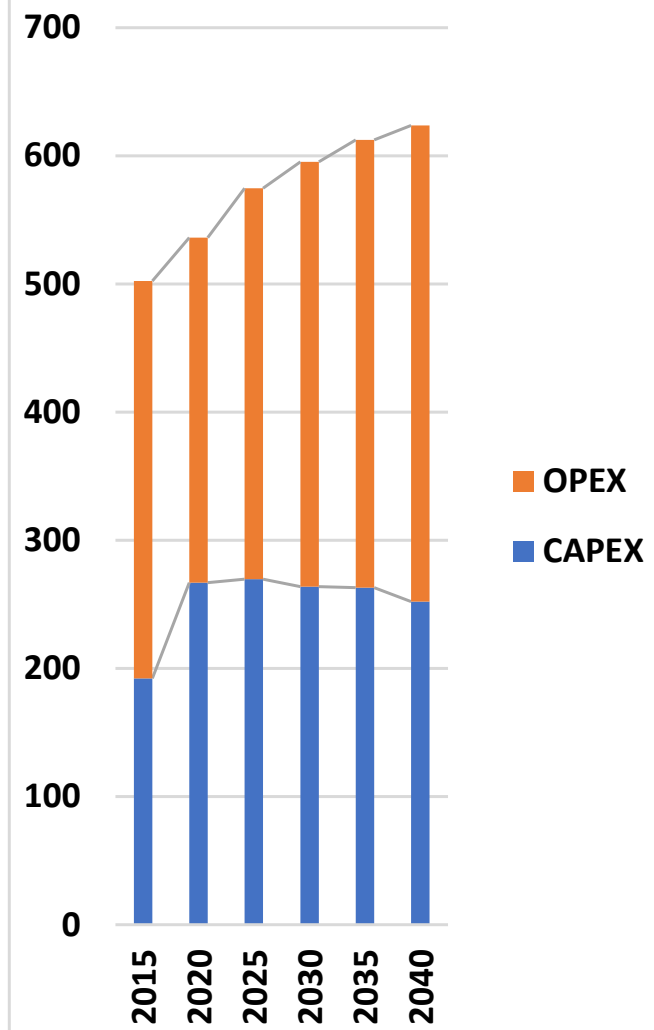
### CO2 Emissions in power generation



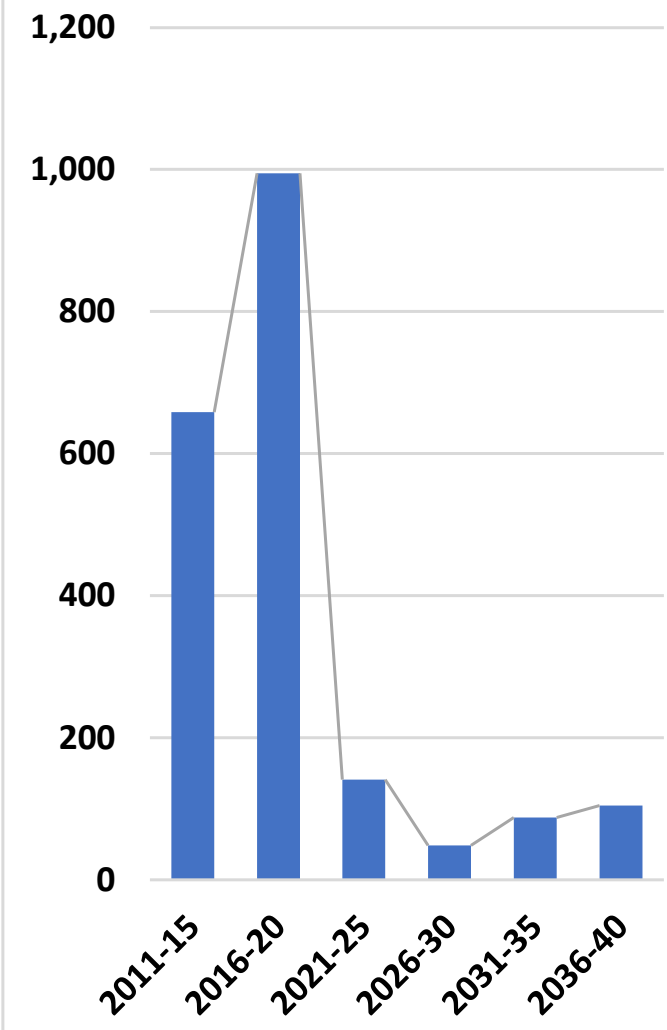
### Unit costs in €/MWh (sales)



### Total Cost of Electricity supply (in M€)

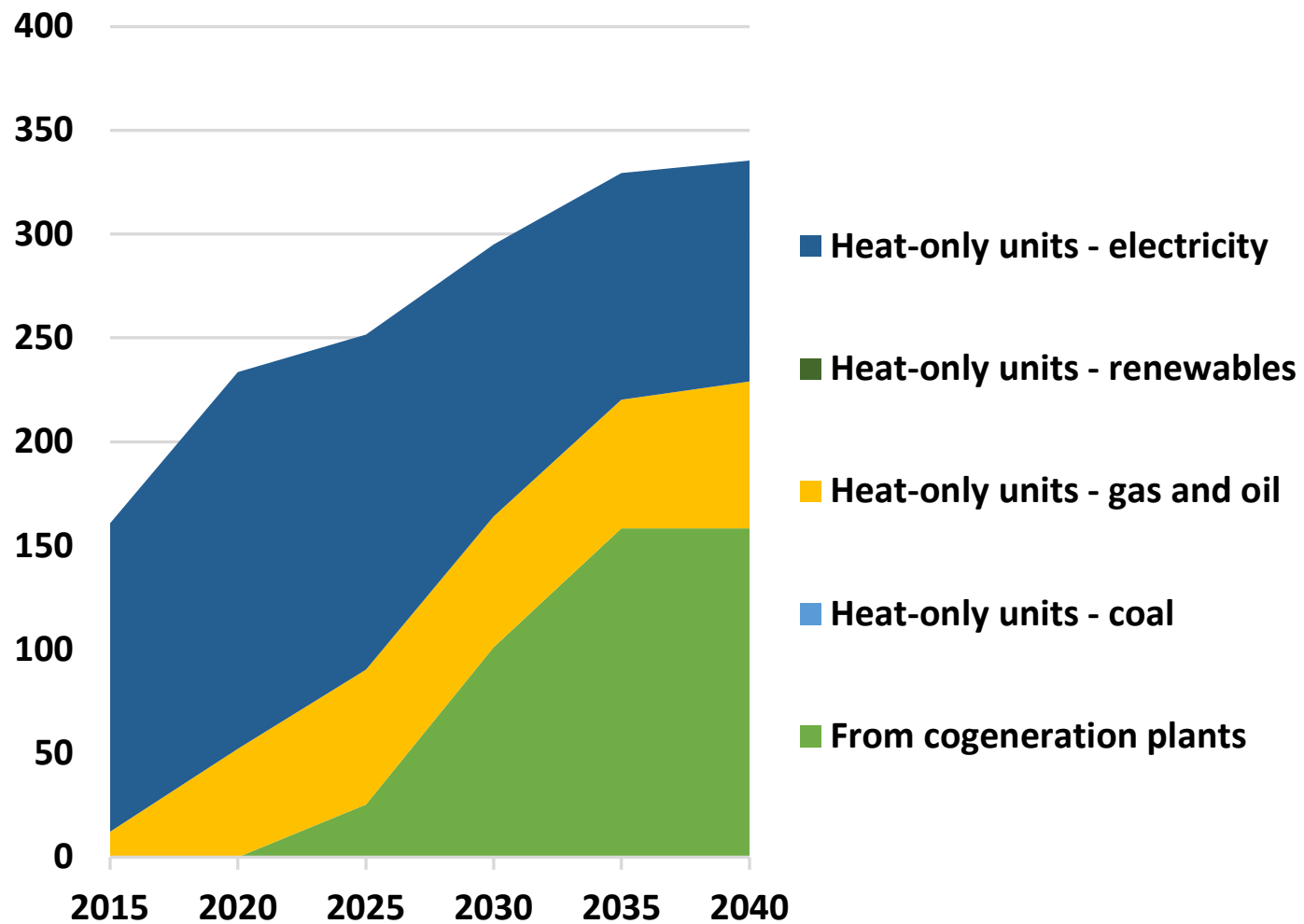


### Investment expenditures in power plants (in M€)

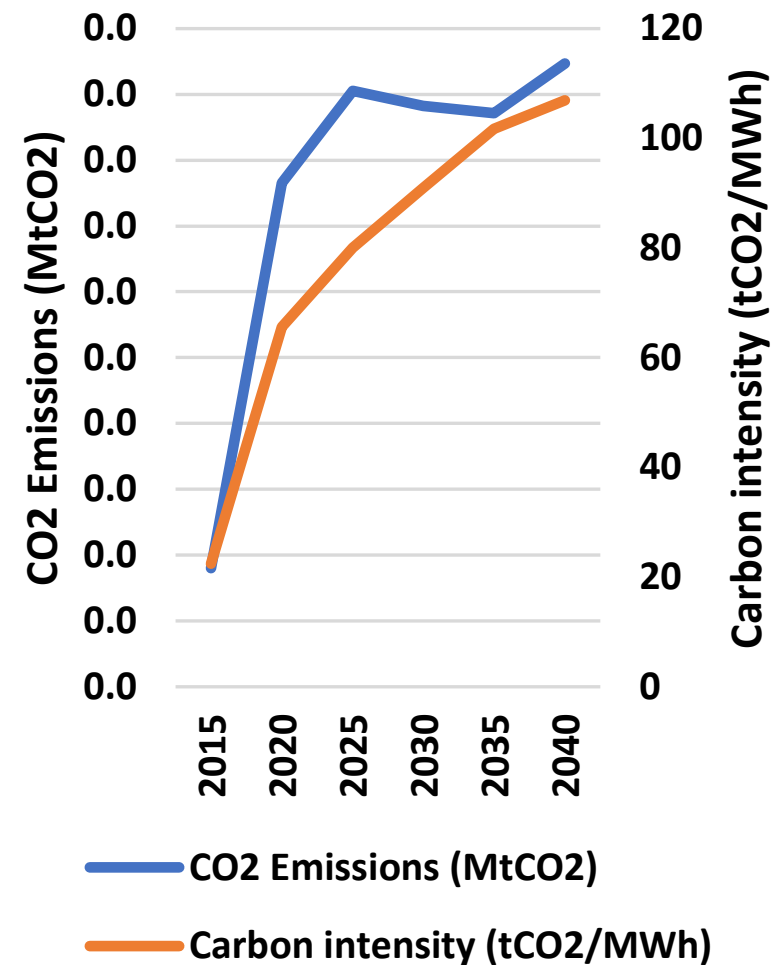




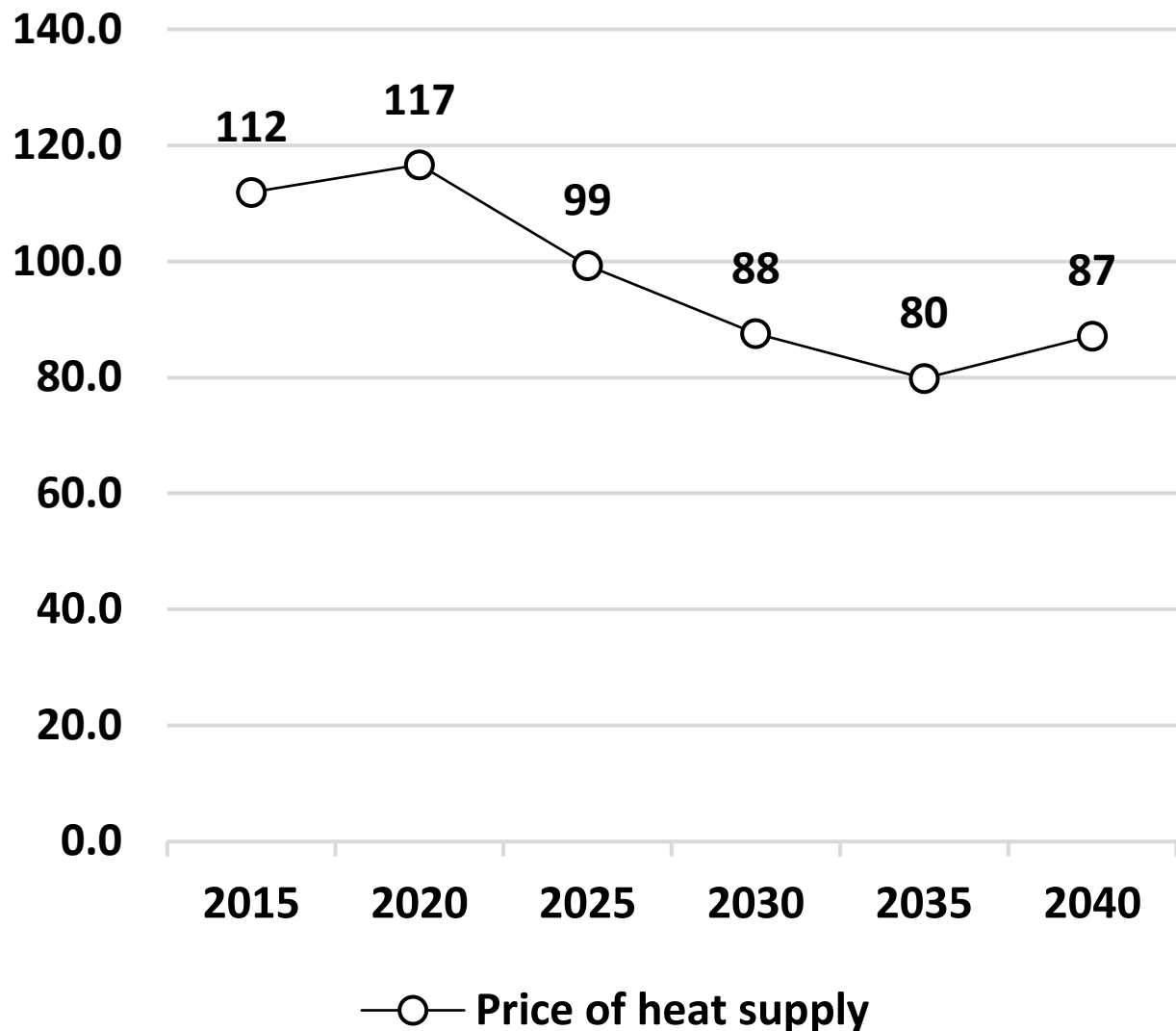
## Heat production (GWh heat)



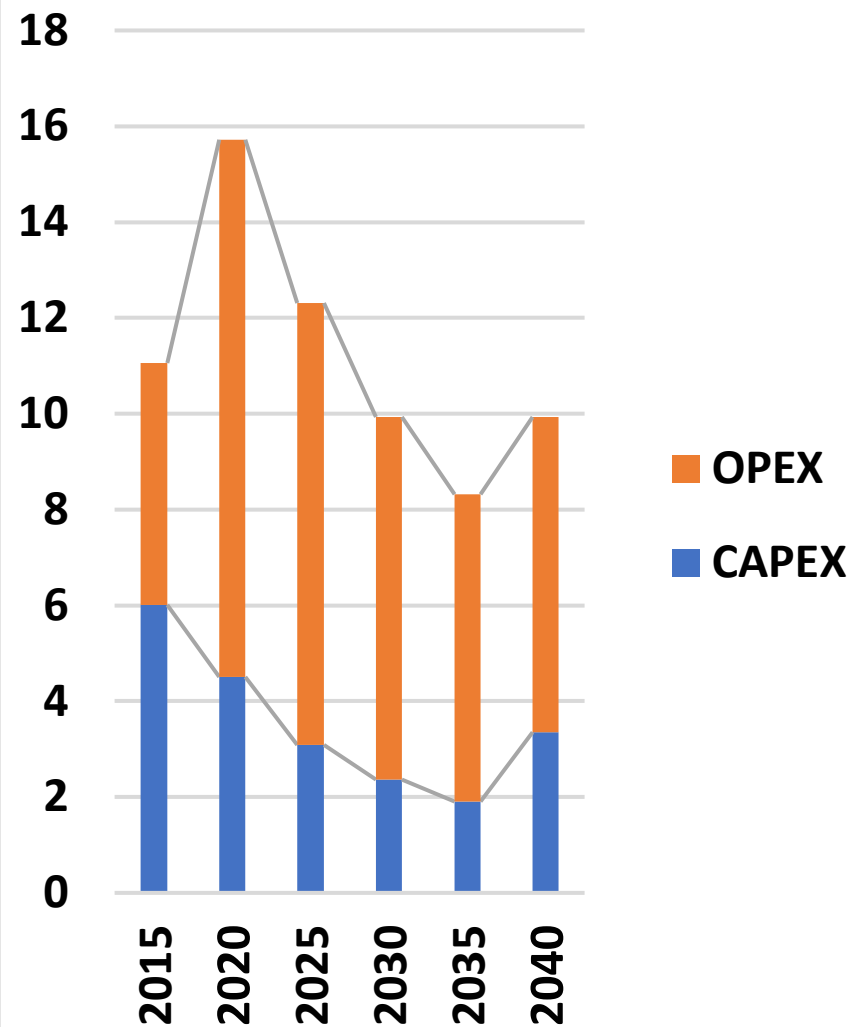
## CO2 Emissions in heat-only unit



### Unit costs in €/MWh (sales)



### Total Cost of heat production (in M€)



## Uncertainties – lack of information

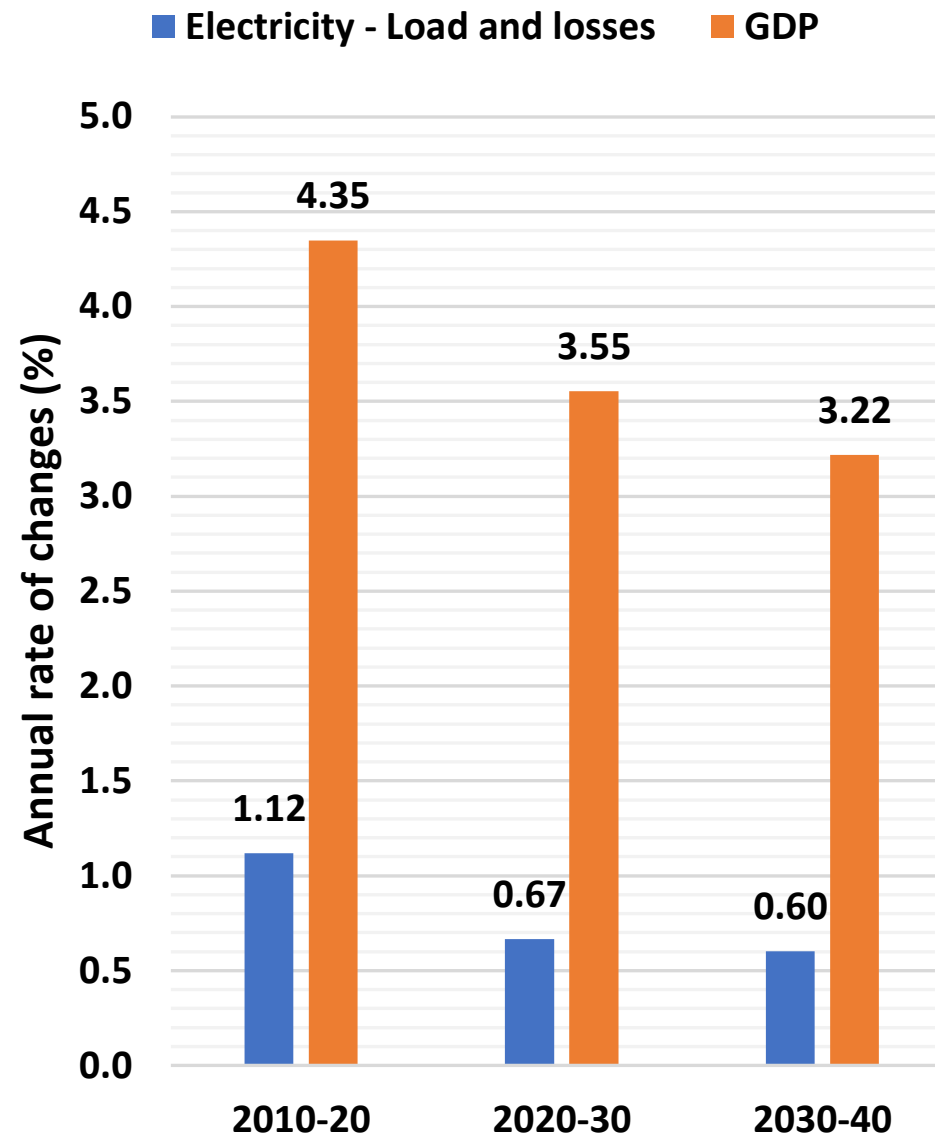
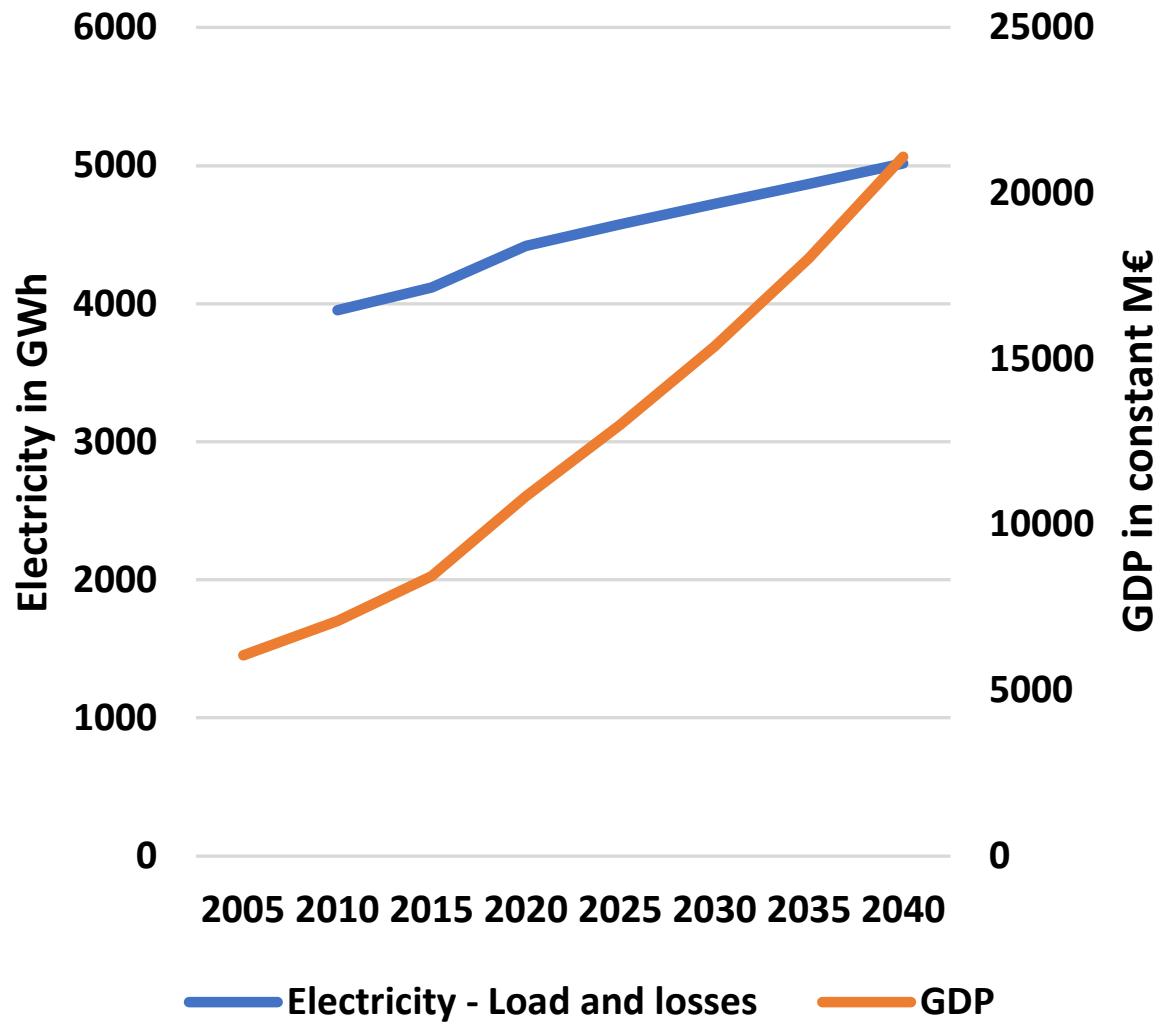
- Investments in hydro power plants: Georgia has a significant potential (over 3GW) in new hydro PP. Which of these investments are realistic?
- According to Georgia's Clean Program, significant investments in variable RES (Wind & Solar PV) are expected to take place within this decade; yet the maximum potential and baseline projection of RES filled in the assumptions file is significantly lower
- Hydro availability shows significant variation on a seasonal level, creating the need for balancing on a seasonal basis, which is currently covered by interconnectors. In the context of increasing RES penetration, will Georgia's system be using interconnectors to provide balancing or use some other type of resource?

## Outlook

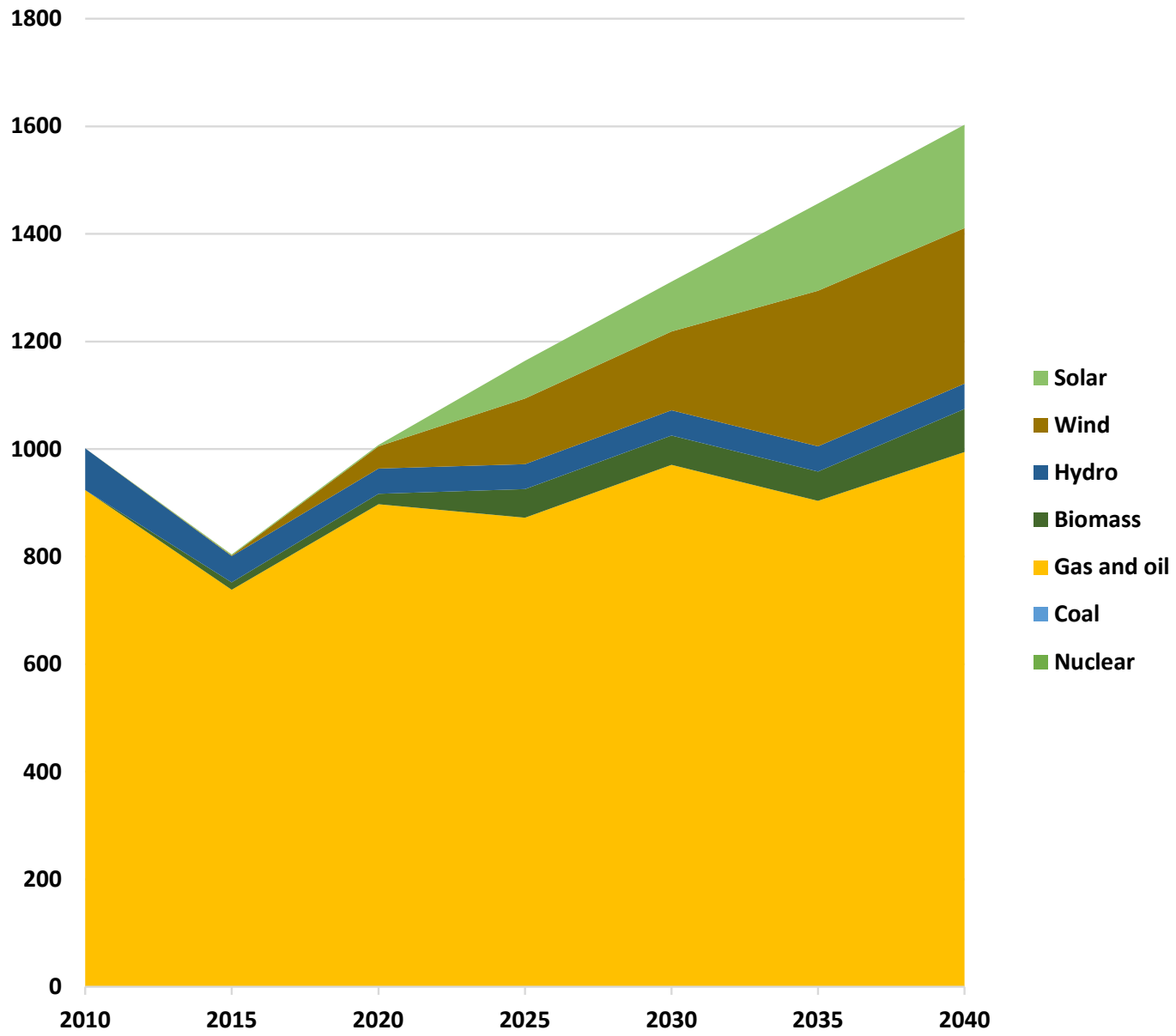
- A system largely based on renewables and thus resilient to carbon pricing
- Balancing and reserves may be an issue to consider in relation to development of variable RES
- Increase of efficiency in gas use is a valid target
- Good prospects for electricity prices

# Moldova - Baseline scenario projections

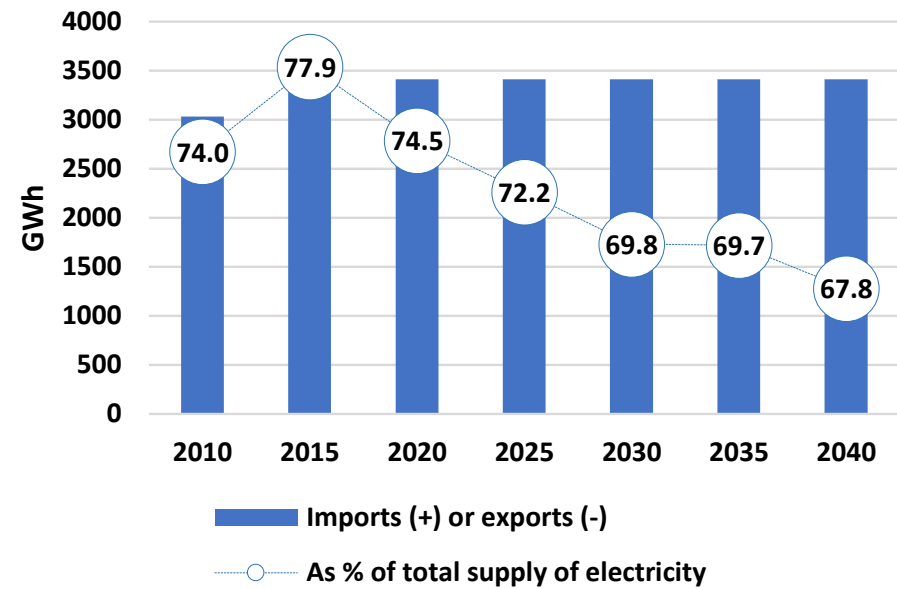
## Demand for electricity



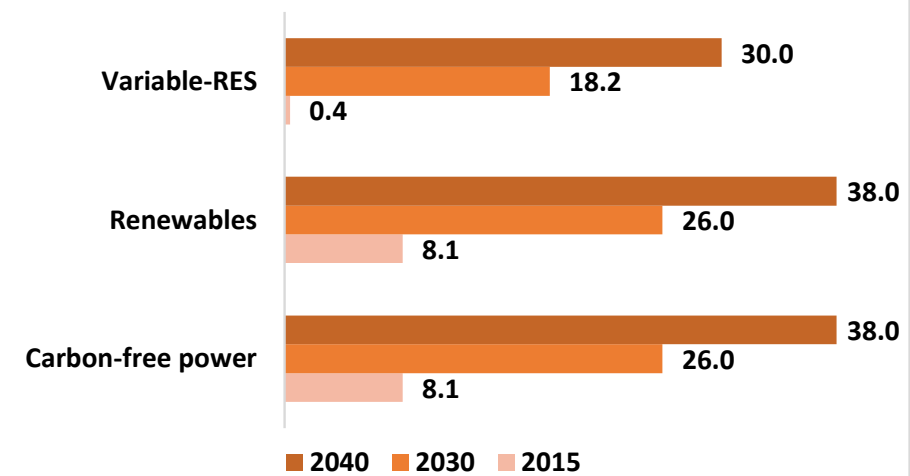
### Power generation (GWh-net)



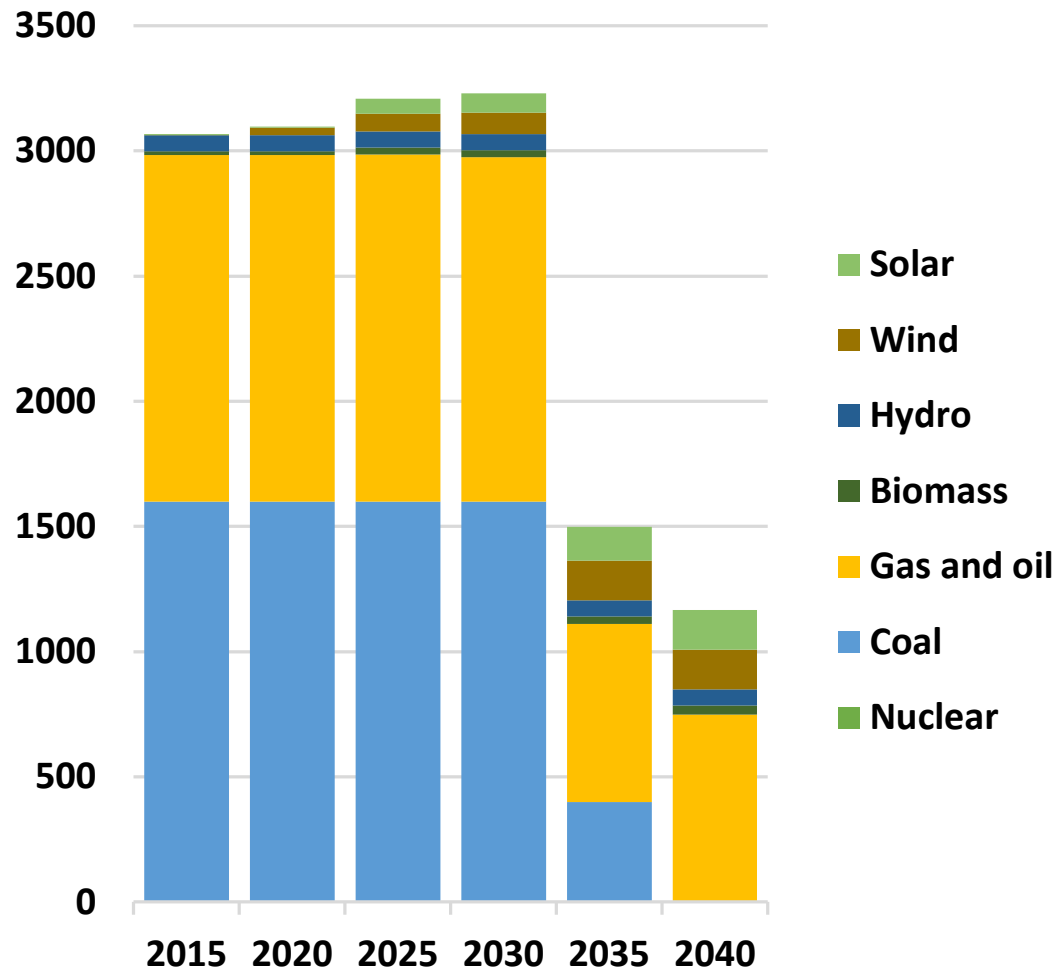
### Net imports of electricity



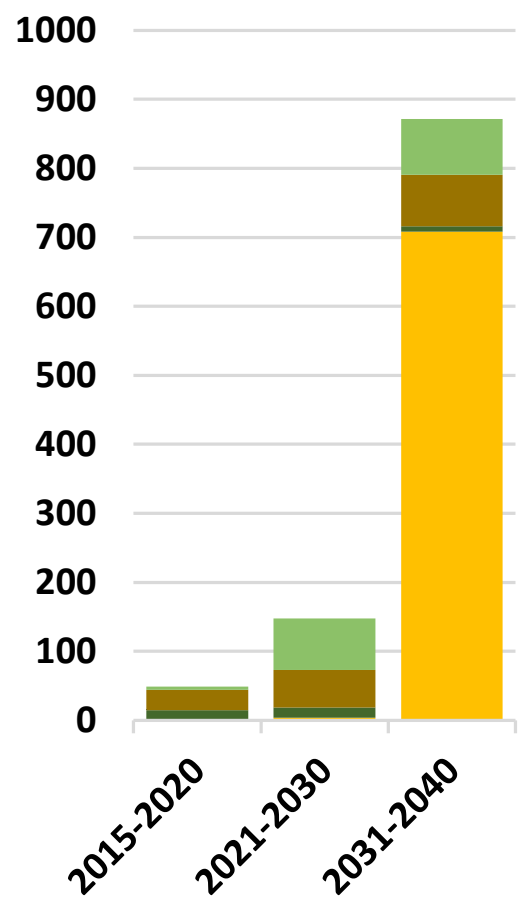
### Indicators (shares - %)



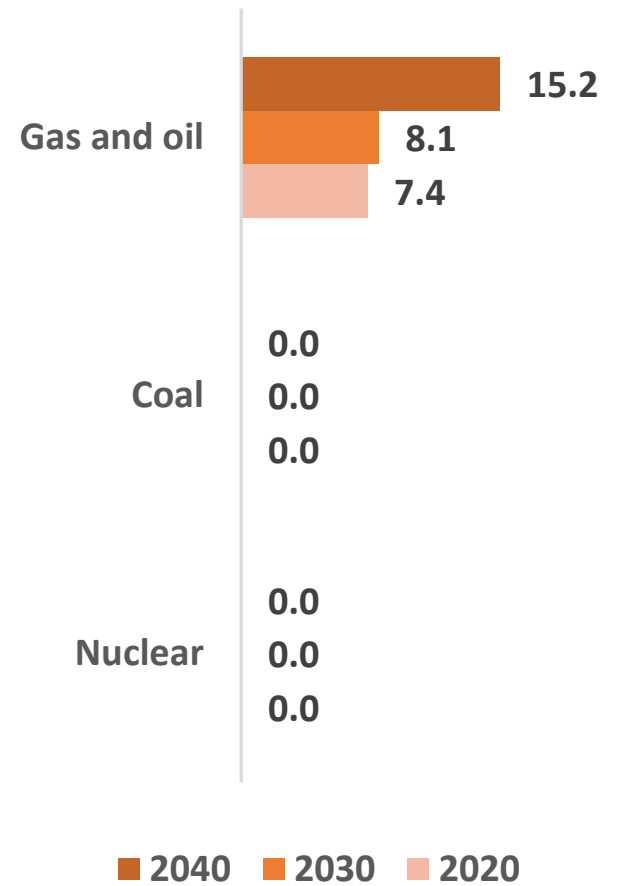
### Operating capacities (MW)



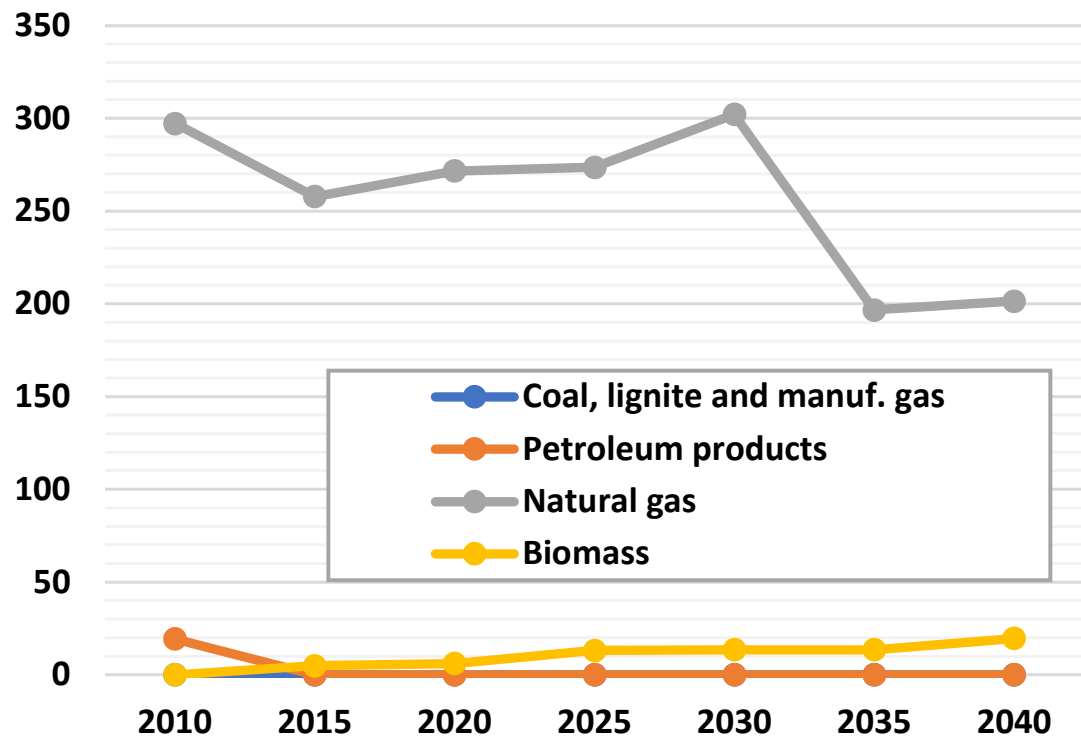
### Capacity expansion (MW)



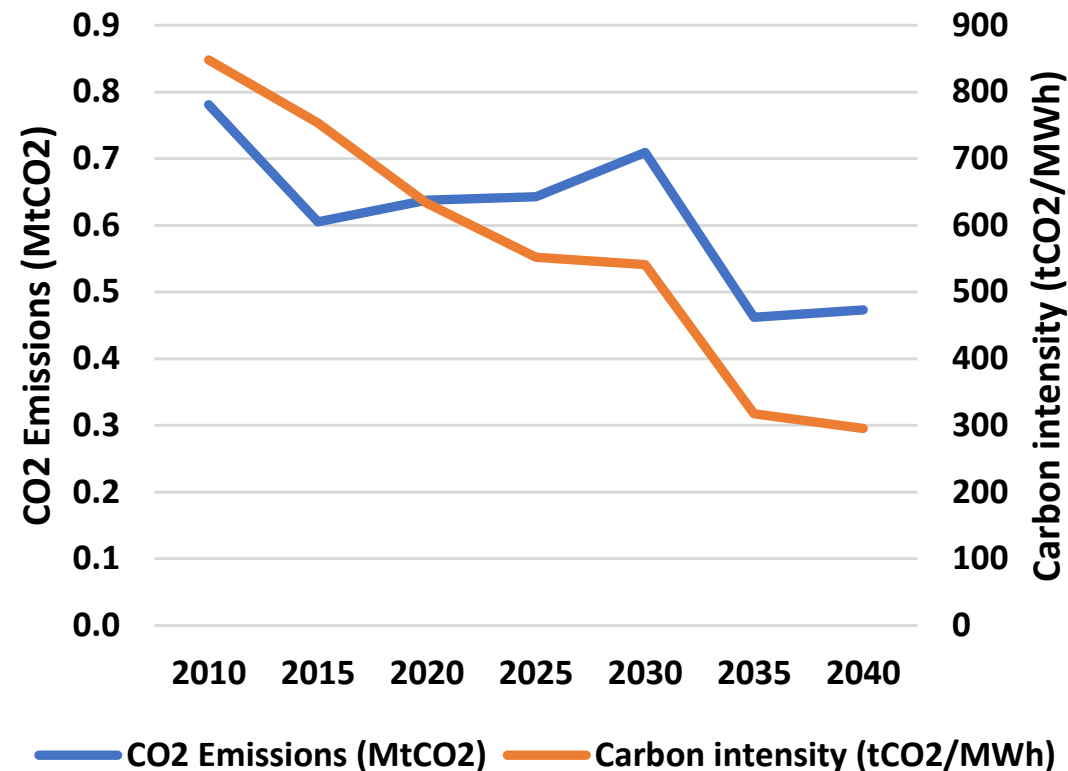
### Rate of use of capacity (%)



### Fuels in power sector (ktoe)

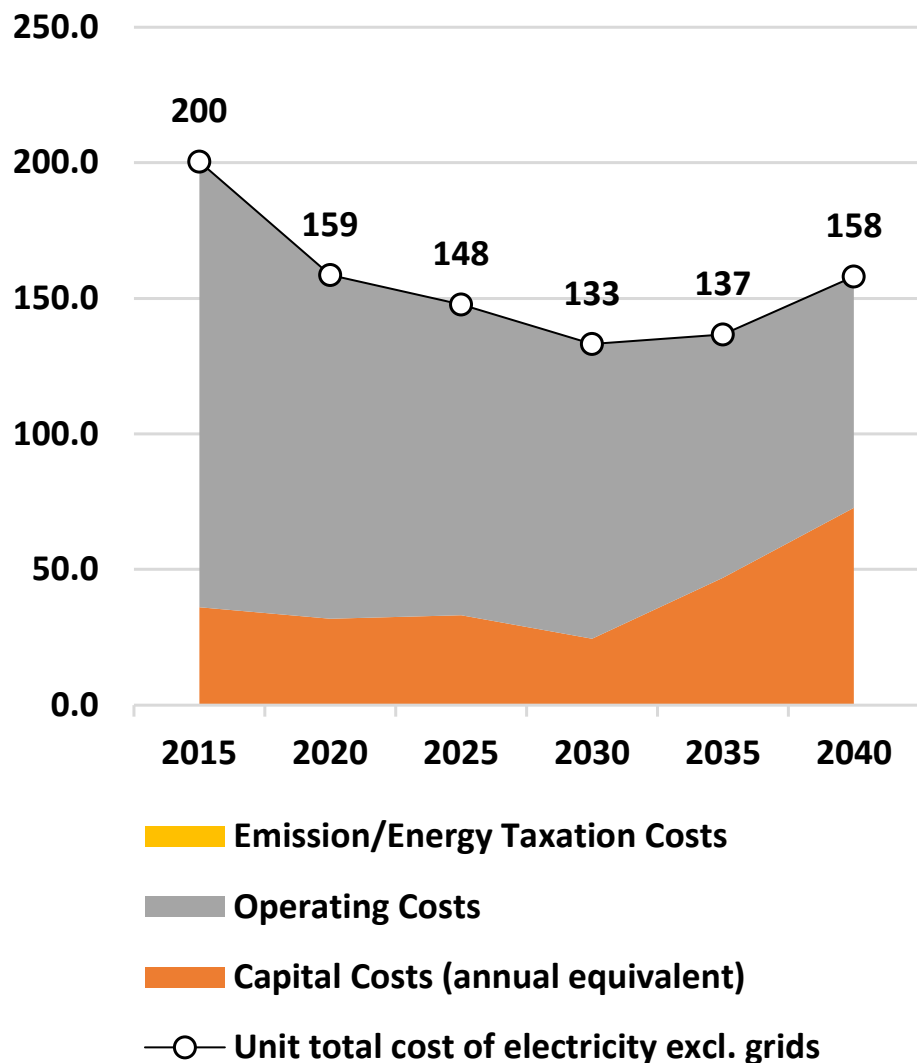


### CO2 Emissions in power generation

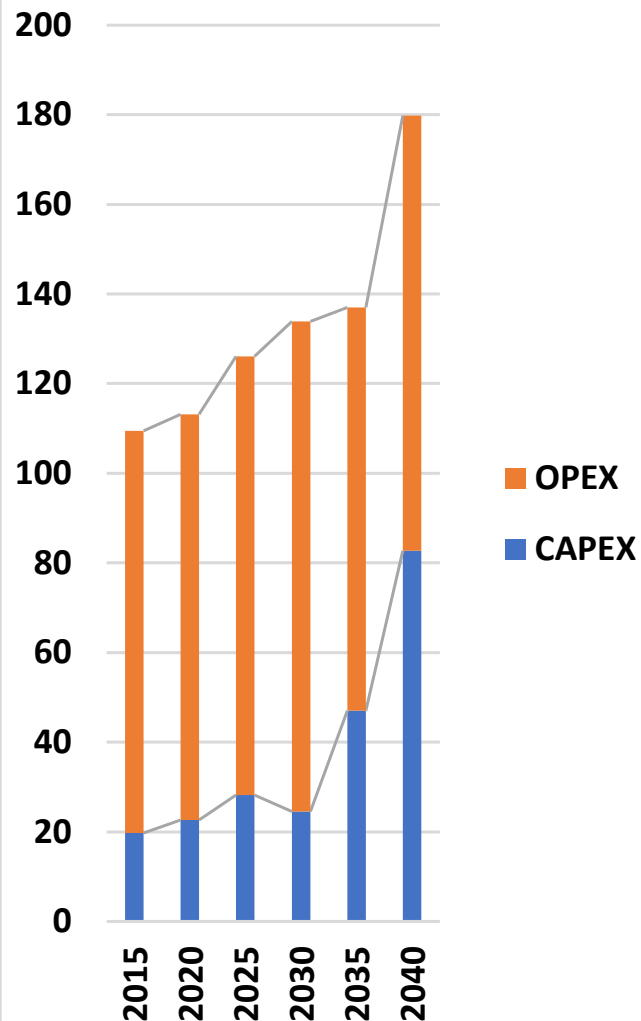




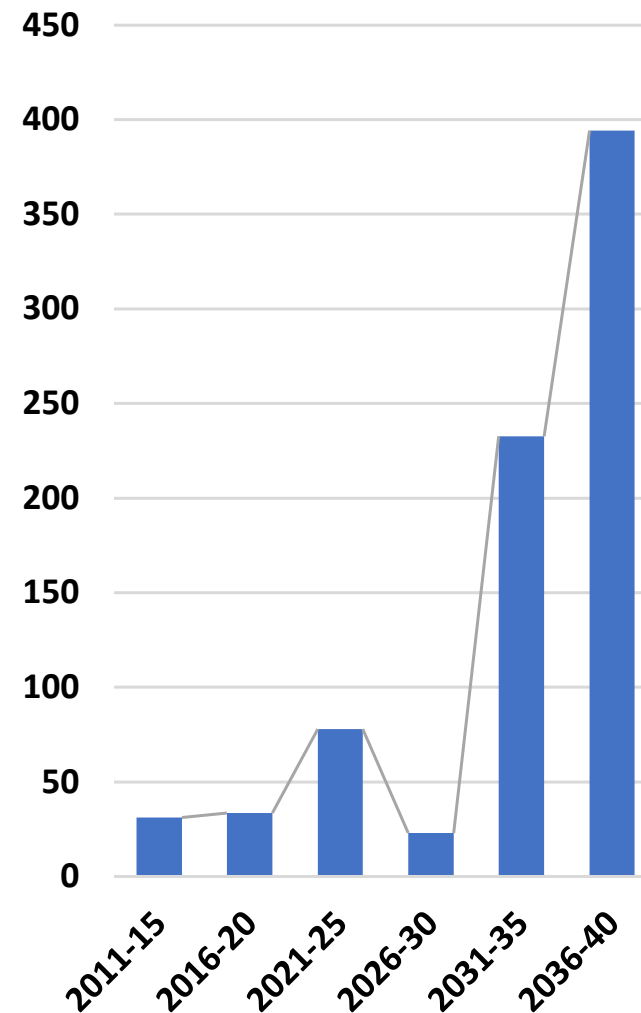
### Unit costs in €/MWh (sales)



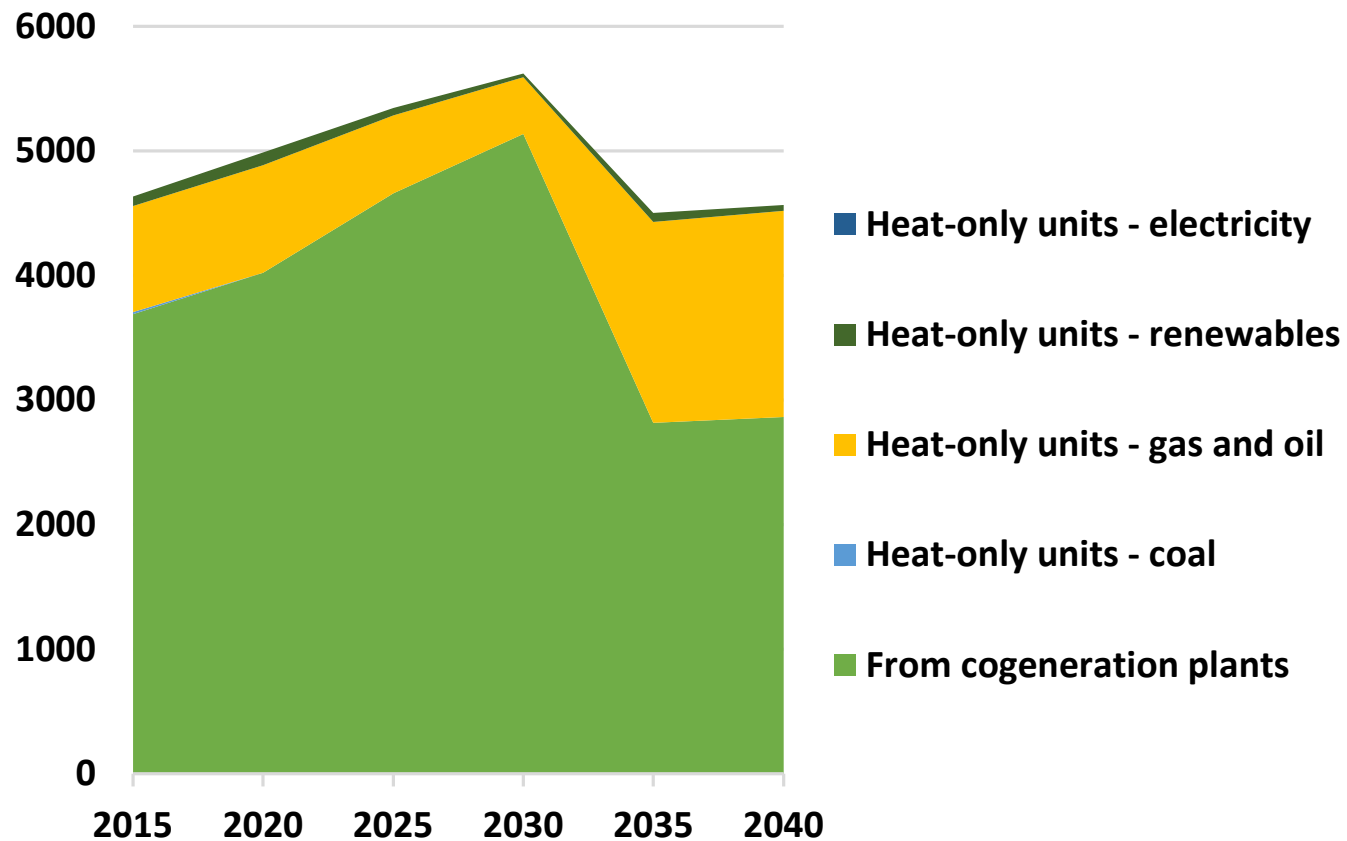
### Total Cost of Electricity supply (in M€)



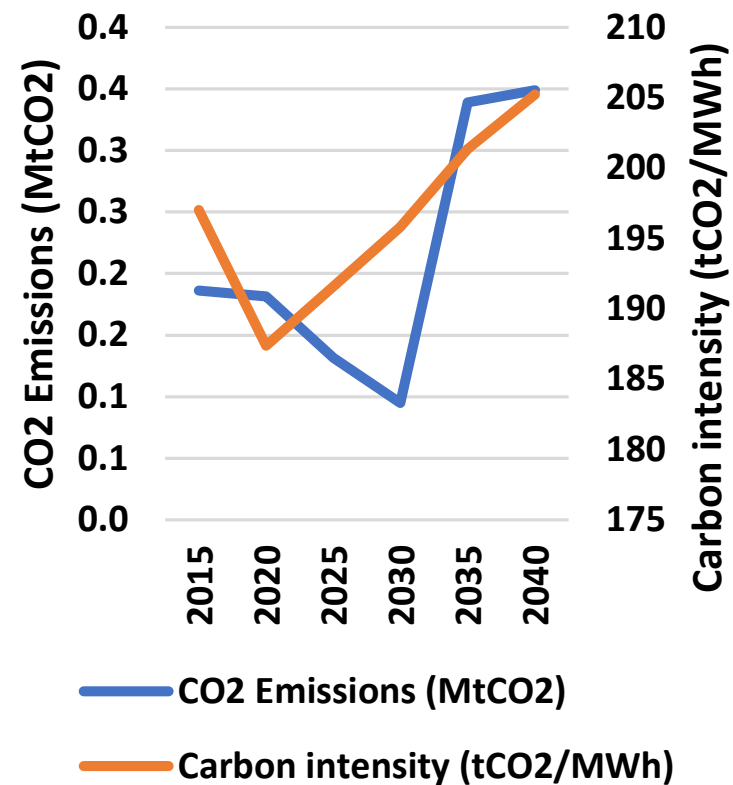
### Investment expenditures in power plants (in M€)



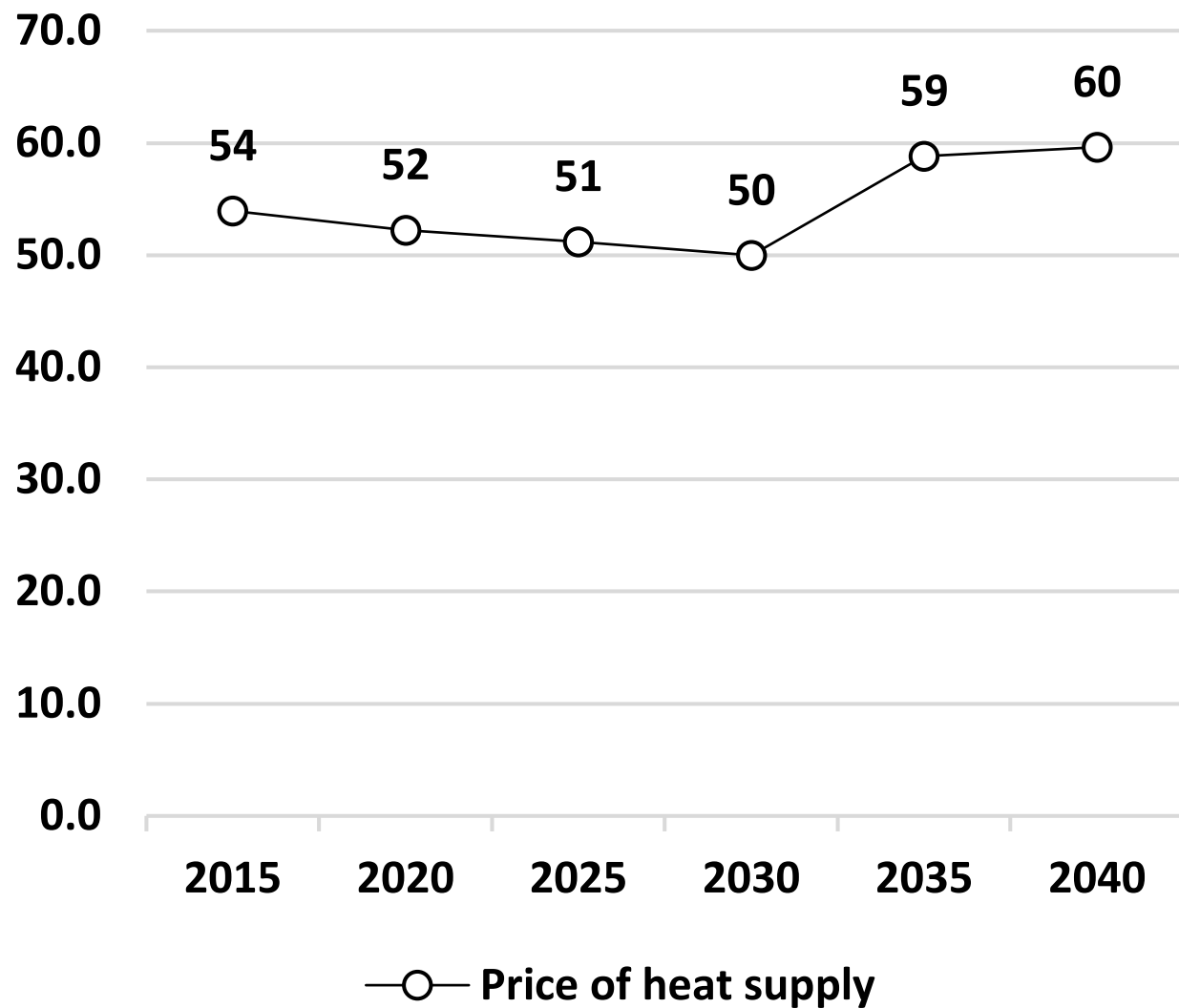
### Heat production (GWh heat)



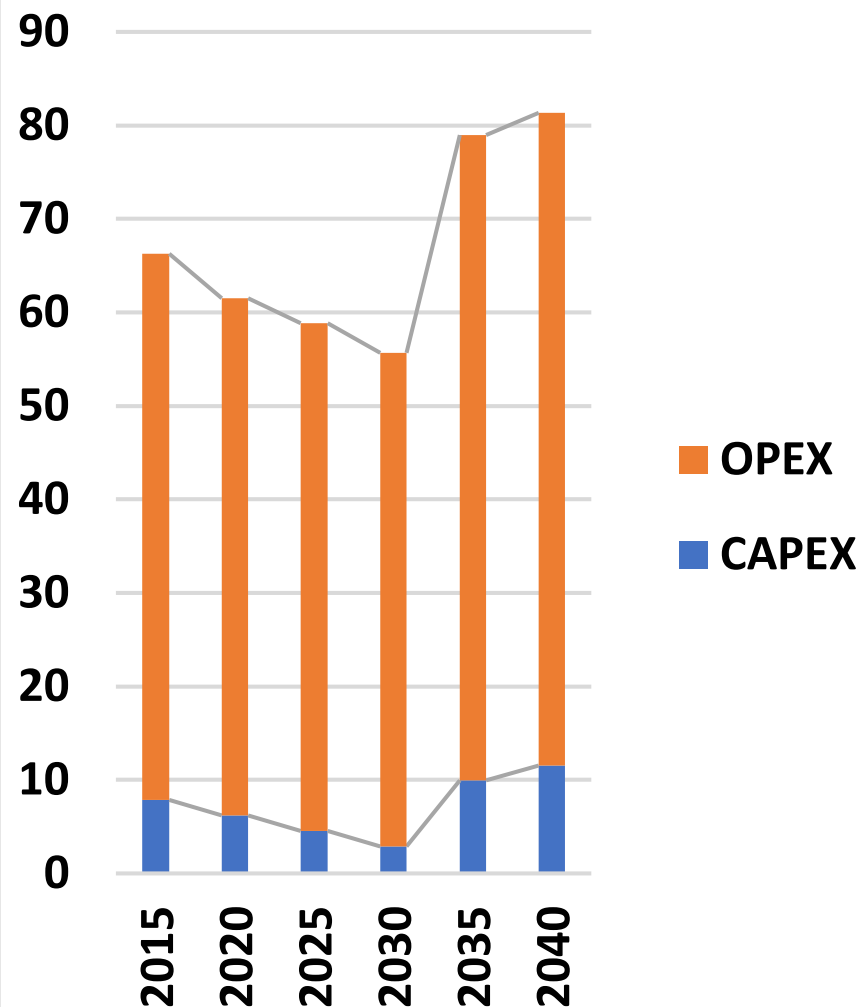
### CO2 Emissions in heat-only unit



## Unit costs in €/MWh (sales)



## Total Cost of heat production (in M€)



## Uncertainties – lack of information

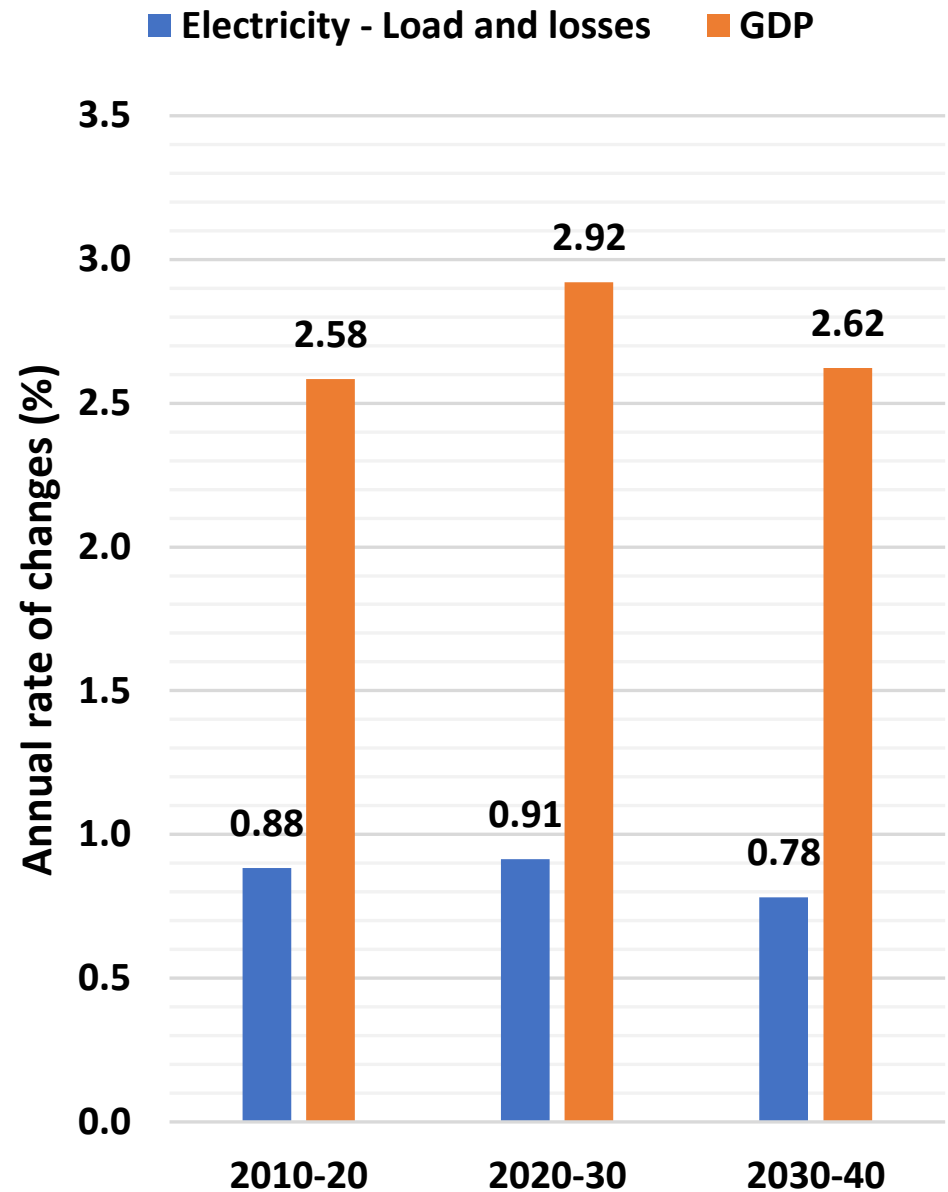
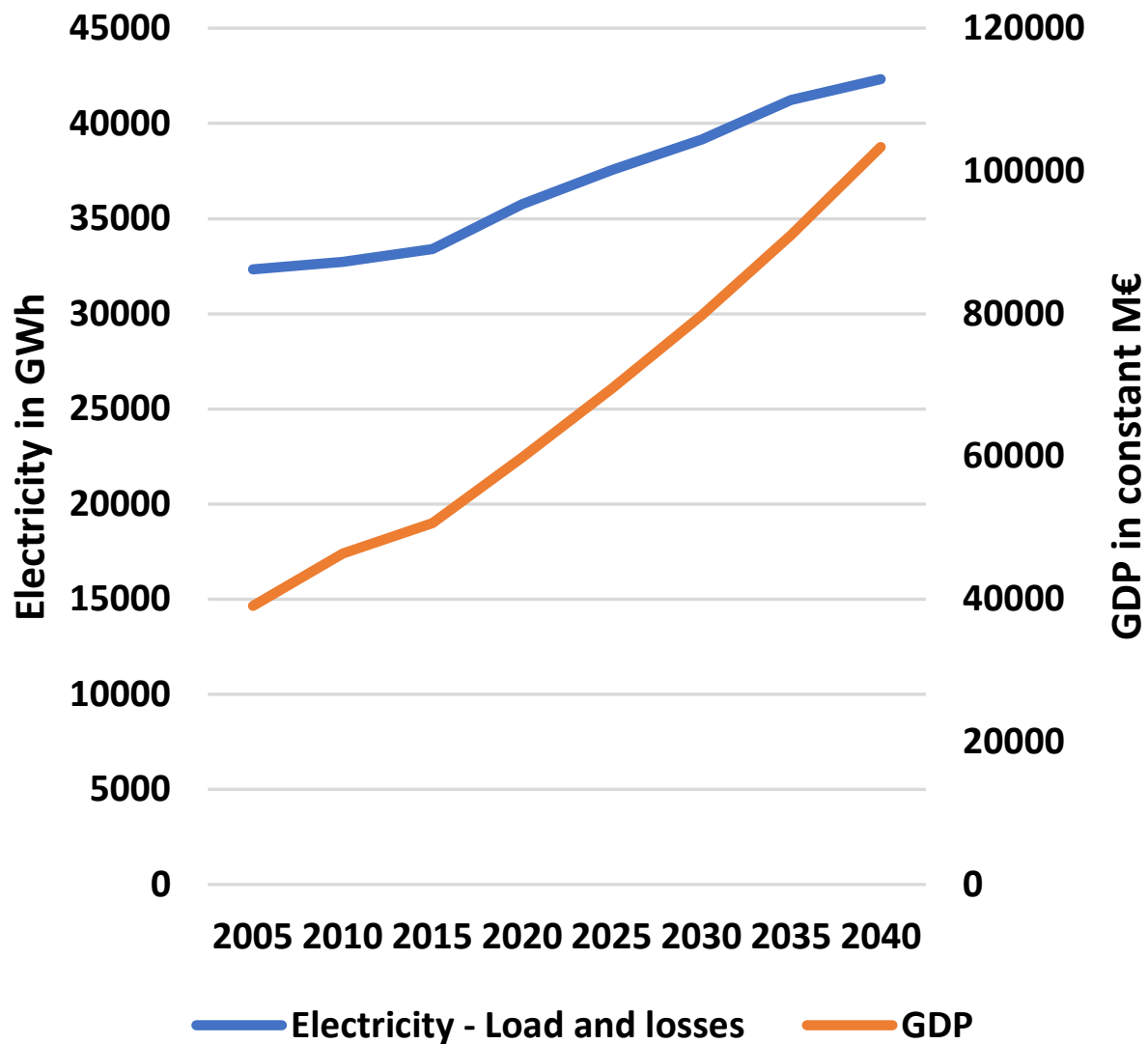
- Coal plants providing cold reserve: what is their future?
- As the system is much depending on electricity imports, future back up from domestic reserves is uncertain and costly, in particular after the retirement of old capacities
- What is the strategy for reserve power?
- Is it possible to see in the future large investment in peak devices only for reserve purposes?
- Development of RES is uncertain

## Outlook

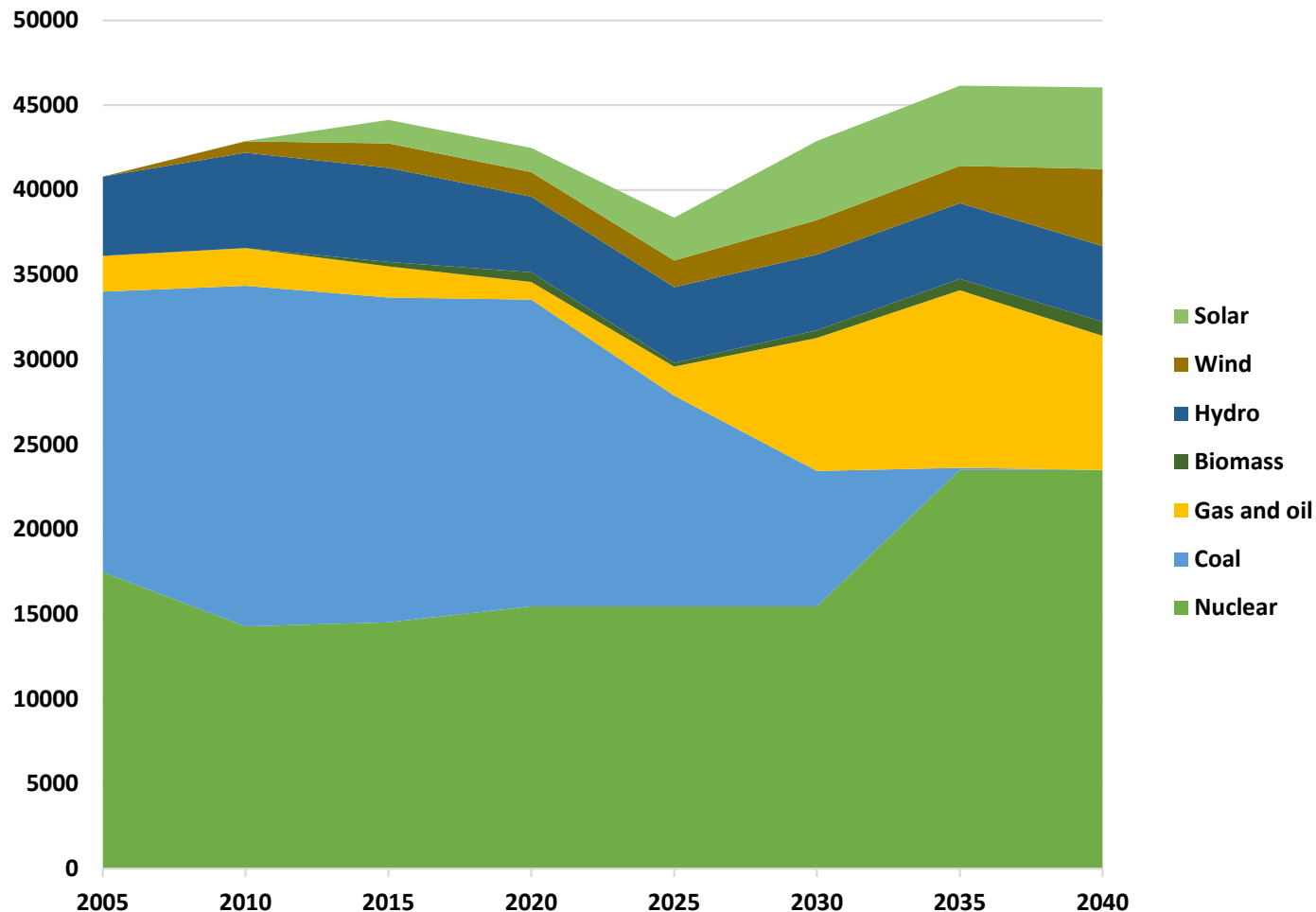
- A system largely depending on electricity imports
- Domestic production based on gas requires further investment to increase efficiency
- Reserve capacities from domestic resources constitute a major issue for the future with heavy consequences for electricity prices
- Further reduction of emissions is uncertain, due to poor prospects for developing RES, under current policy conditions

# Bulgaria - Baseline scenario projections

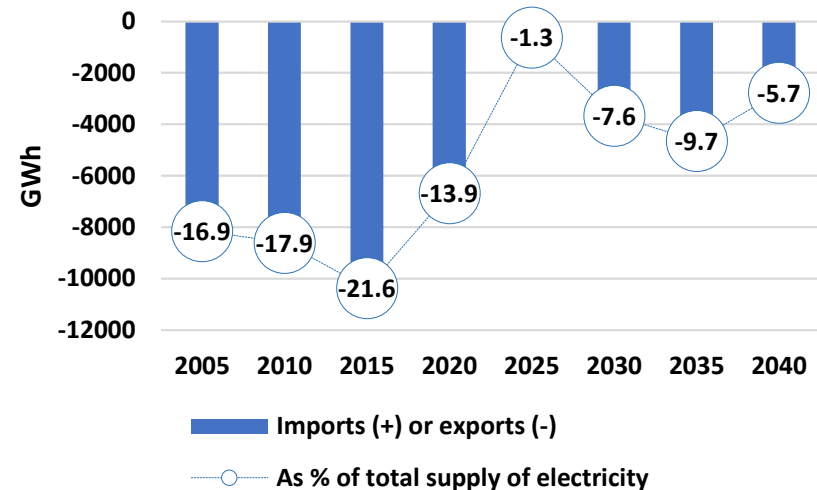
## Demand for electricity



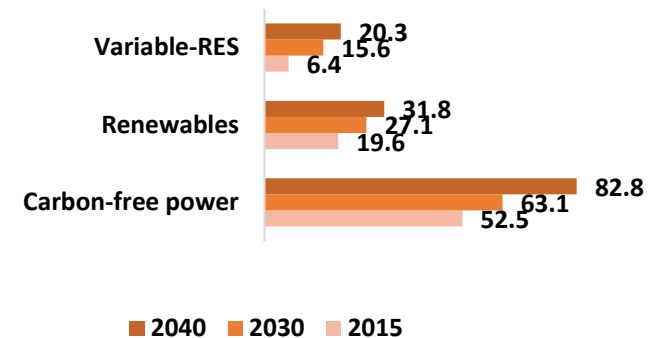
Power generation (GWh-net)



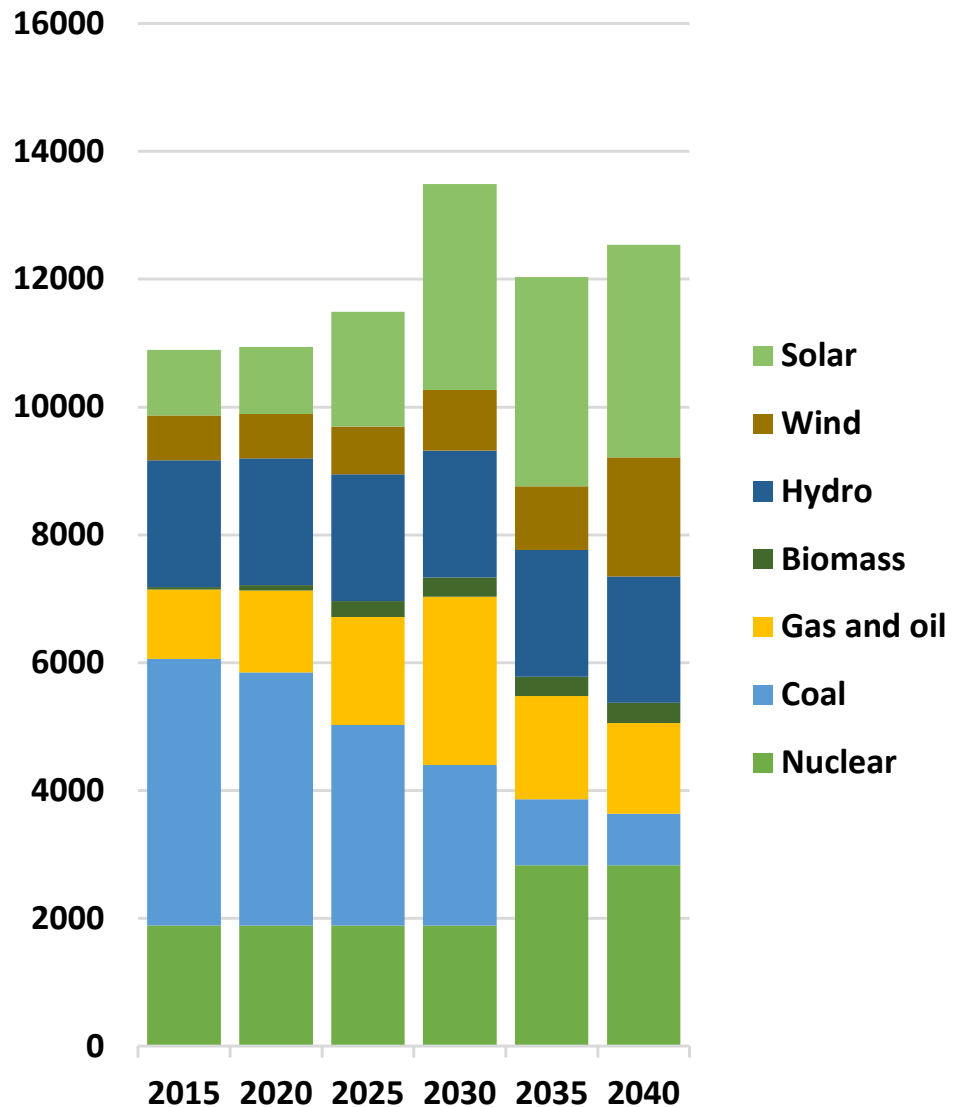
Net imports of electricity



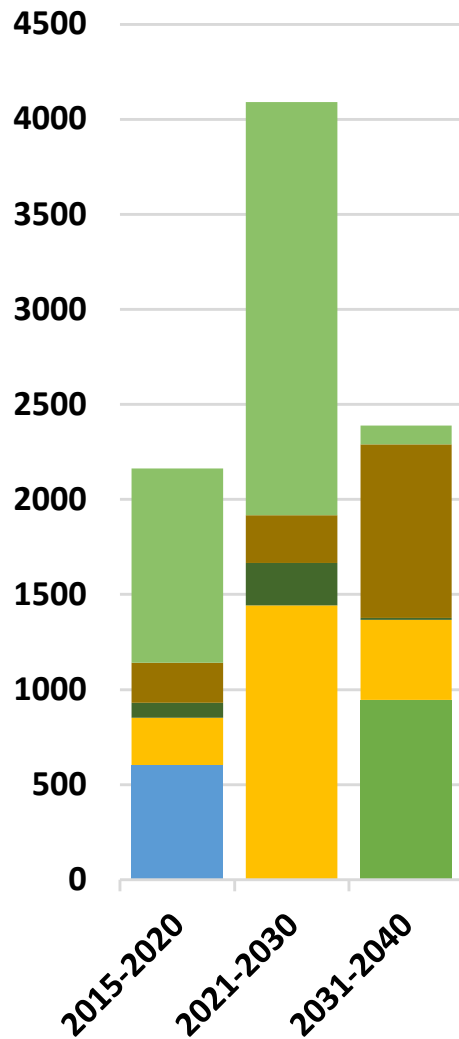
Indicators (shares - %)



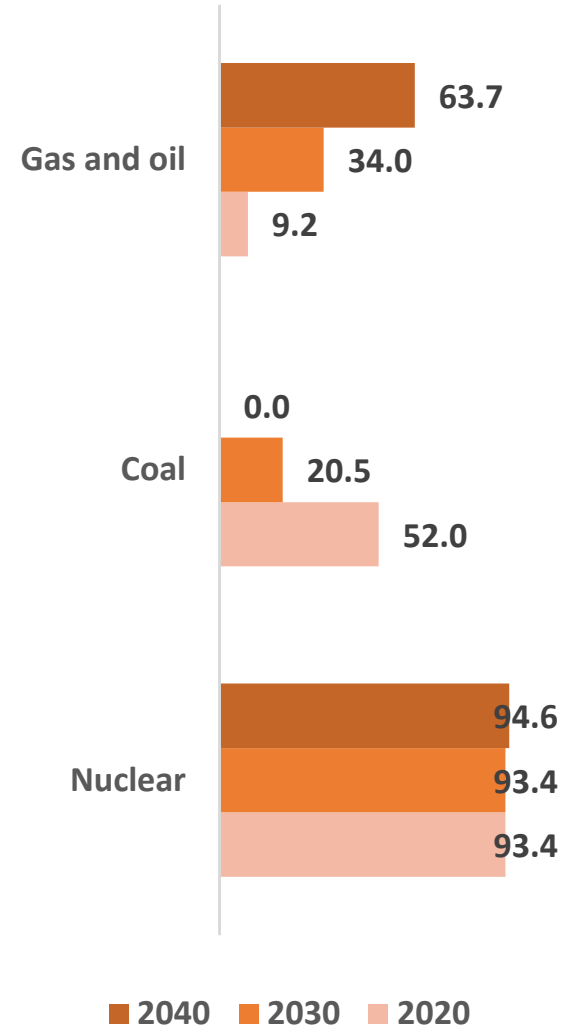
### Operating capacities (MW)



### Capacity expansion (MW)

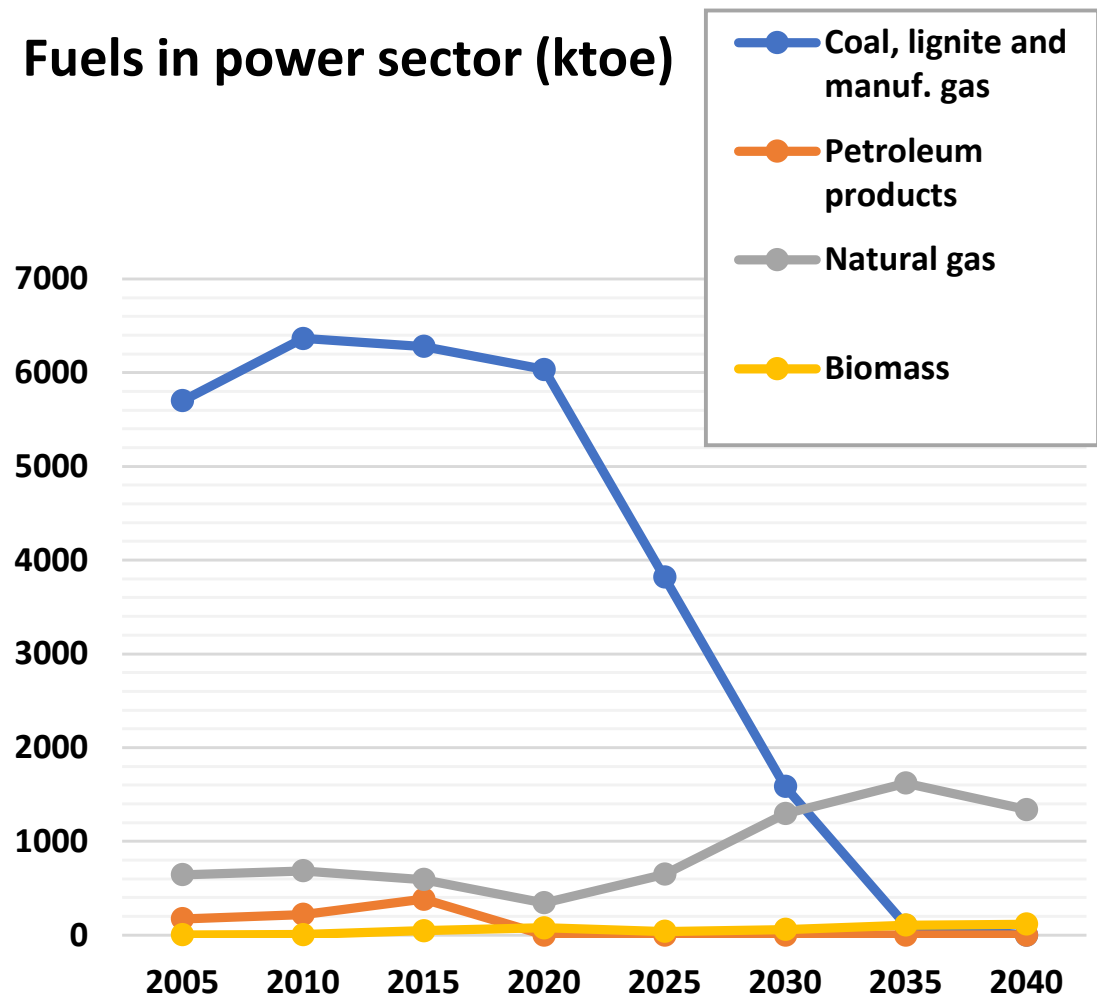


### Rate of use of capacity (%)

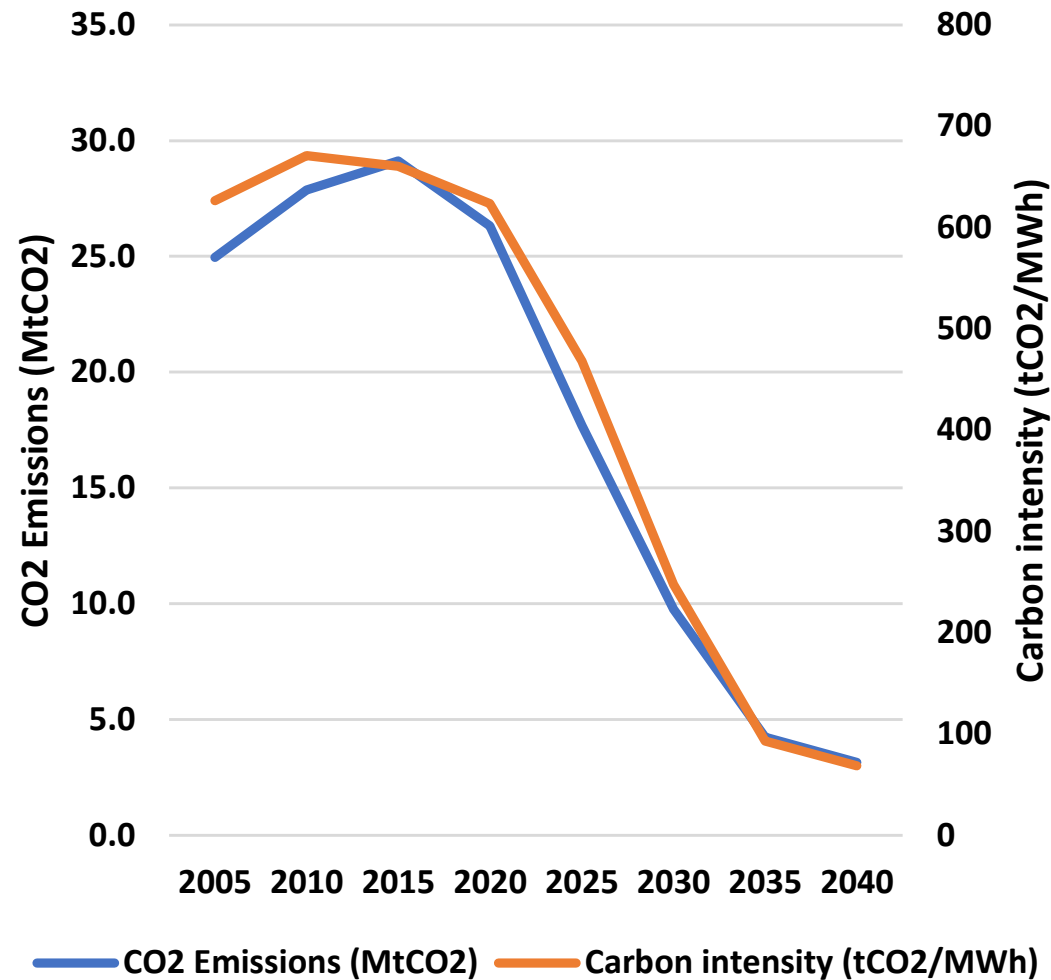




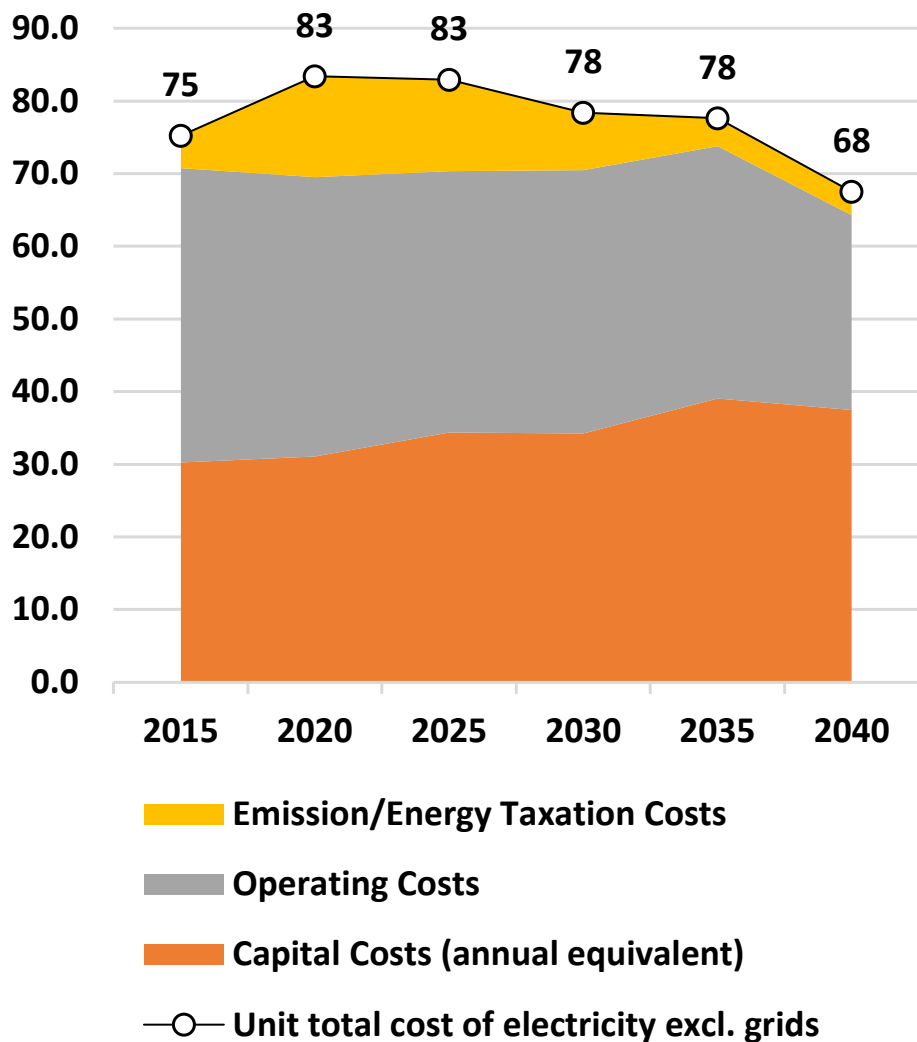
Fuels in power sector (ktoe)



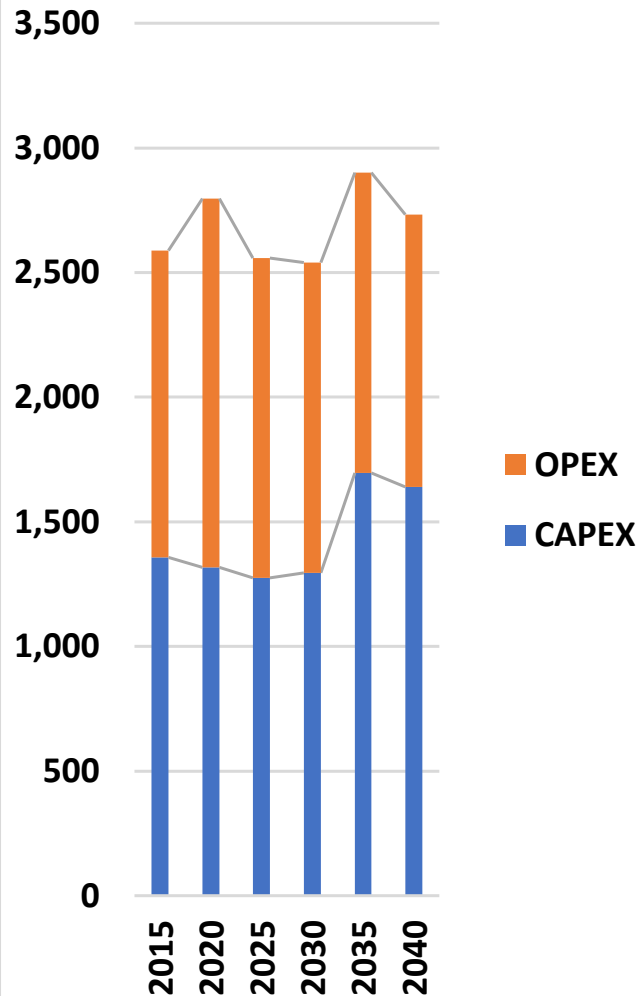
CO2 Emissions in power generation



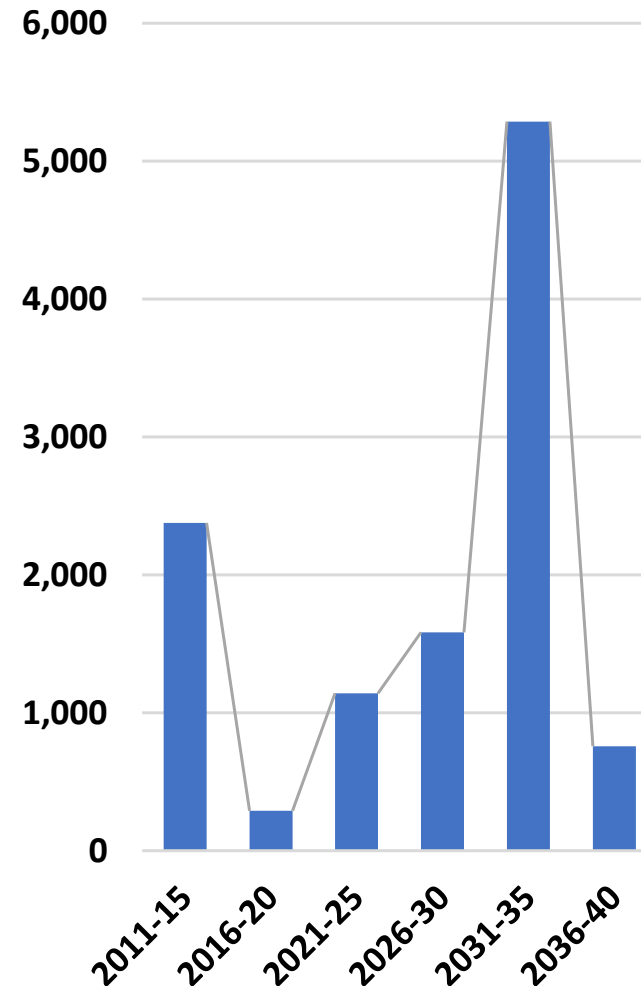
### Unit costs in €/MWh (sales)



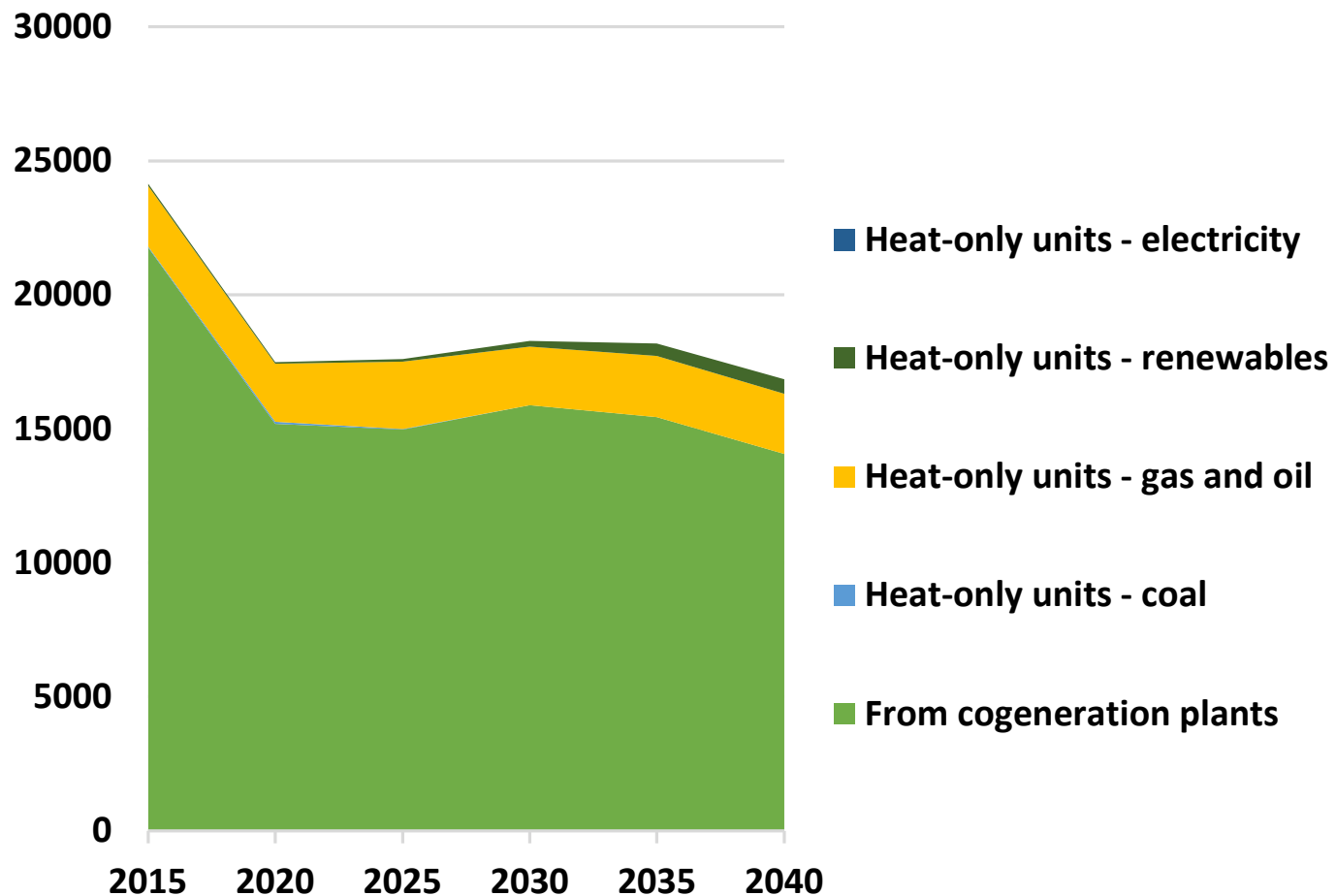
### Total Cost of Electricity supply (in M€)



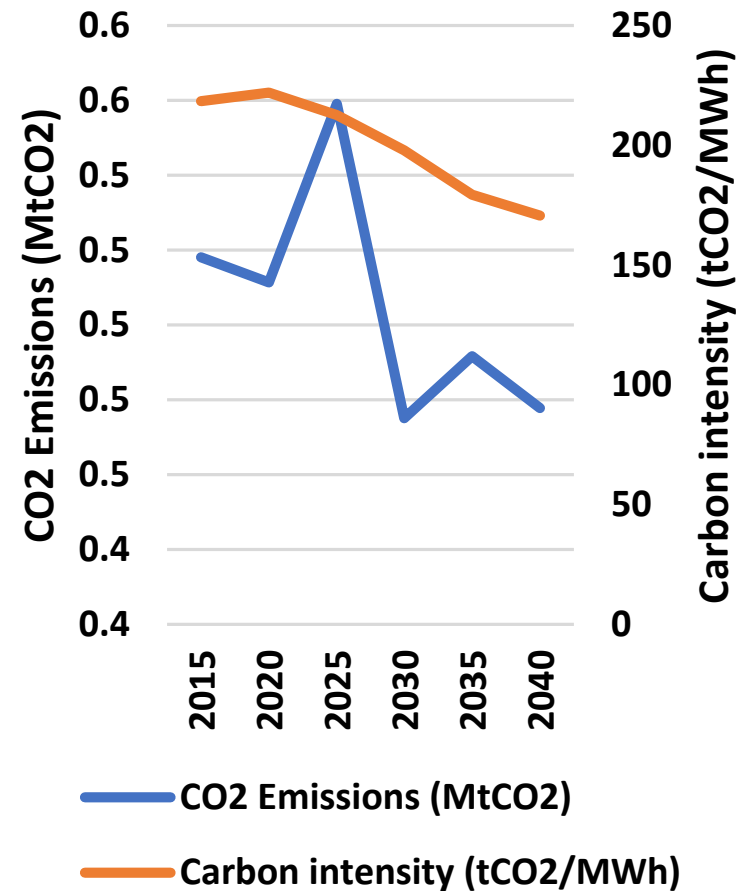
### Investment expenditures in power plants (in M€)



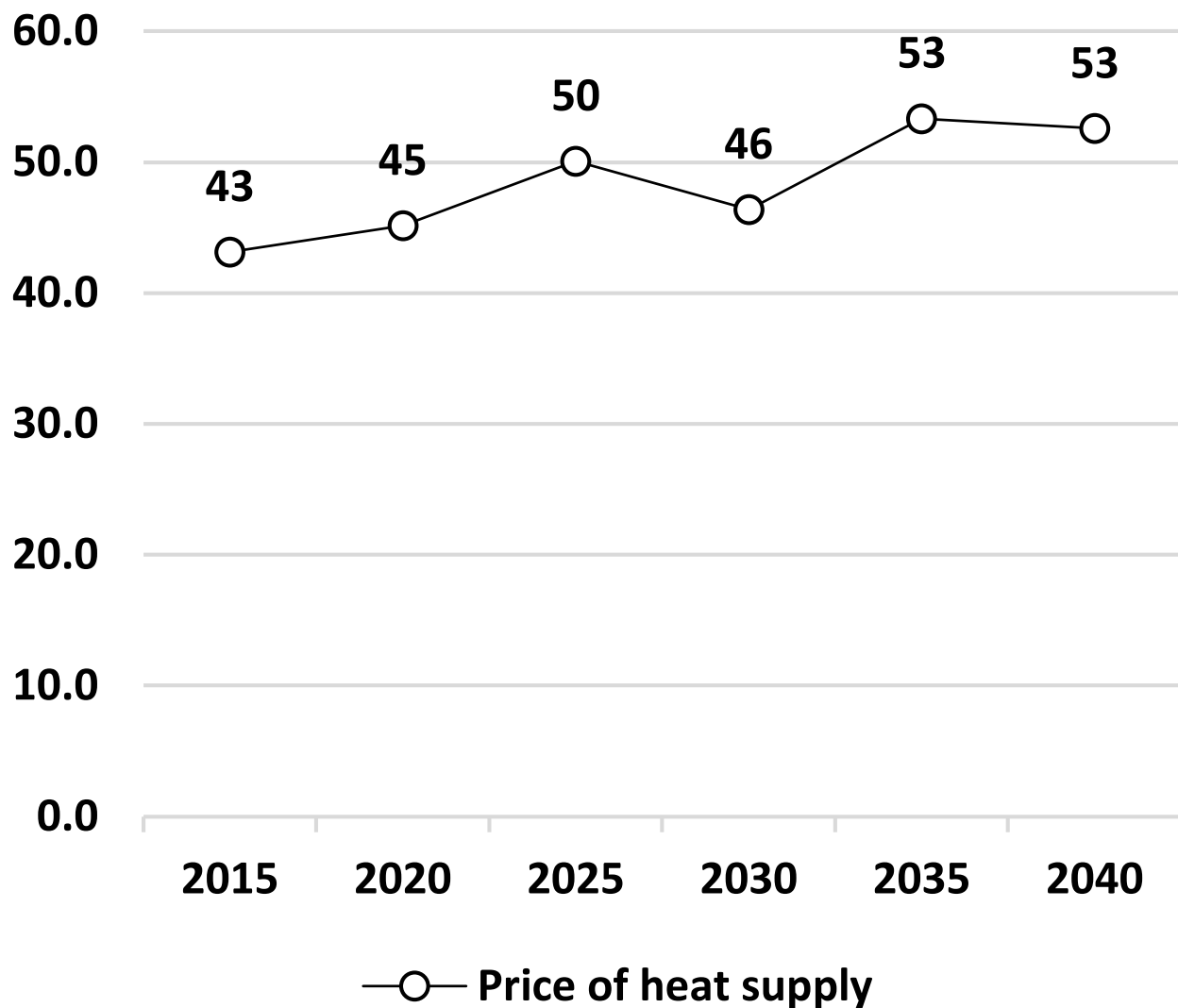
### Heat production (GWh heat)



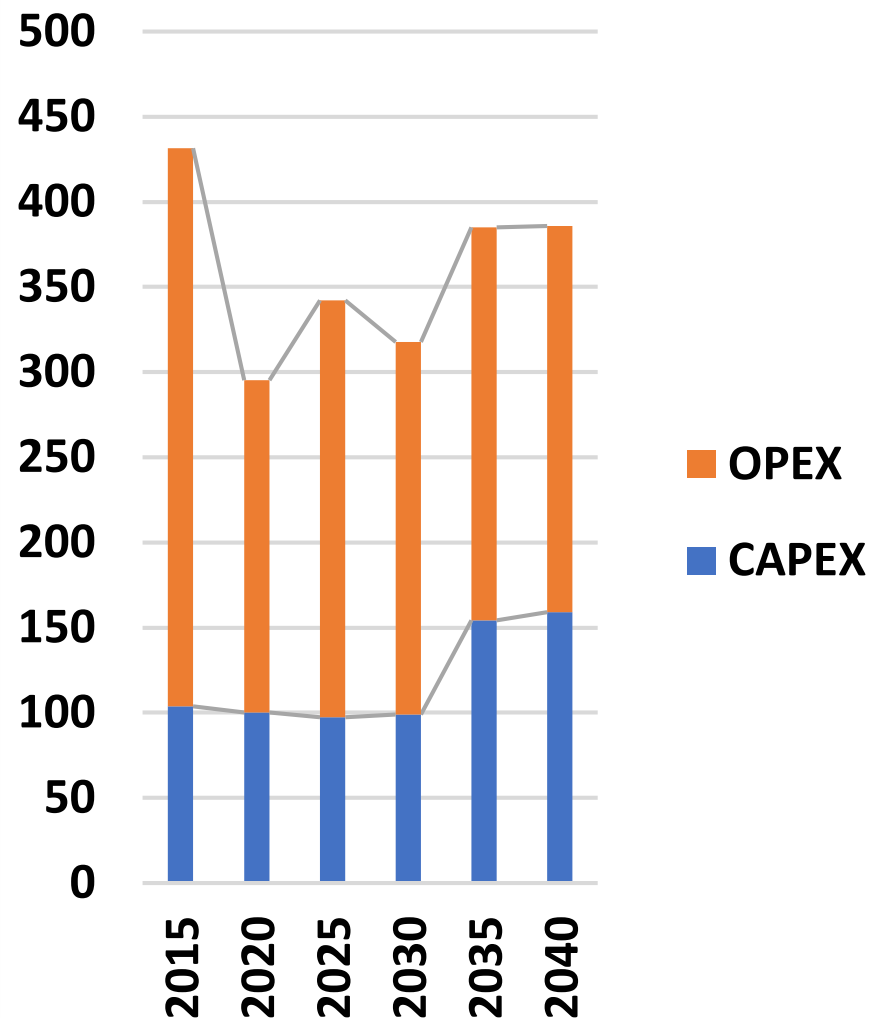
### CO2 Emissions in heat-only unit



### Unit costs in €/MWh (sales)

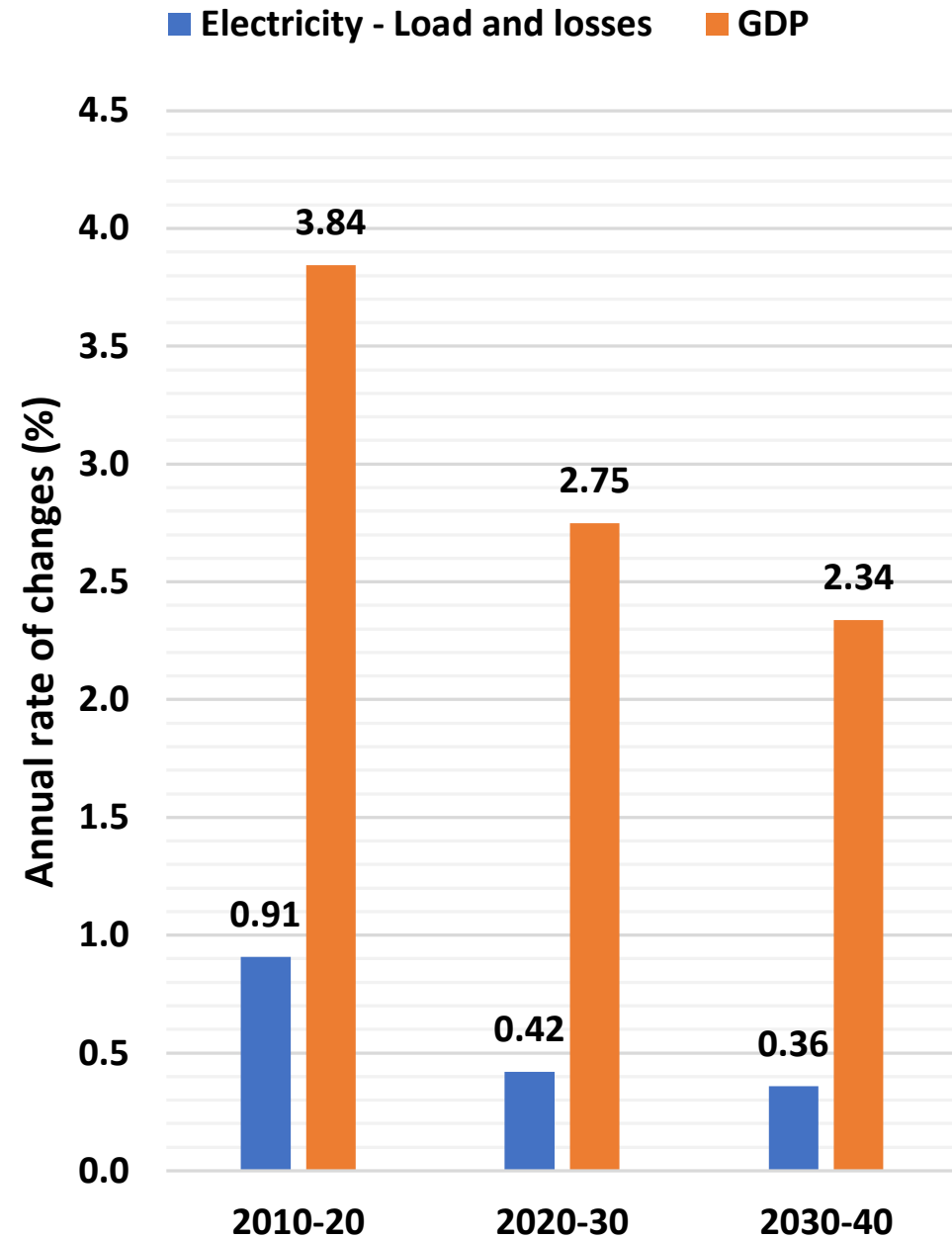
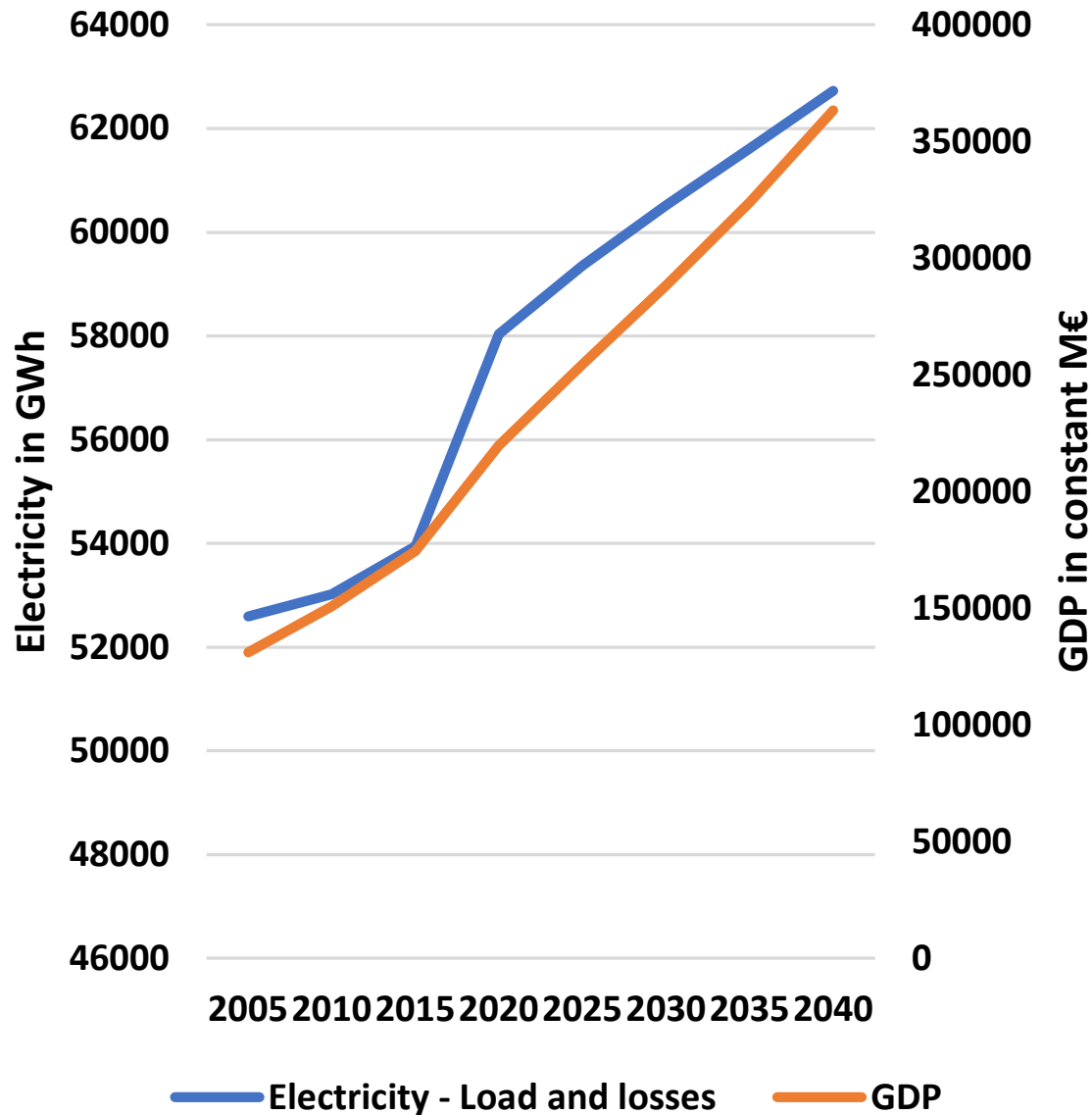


### Total Cost of heat production (in M€)

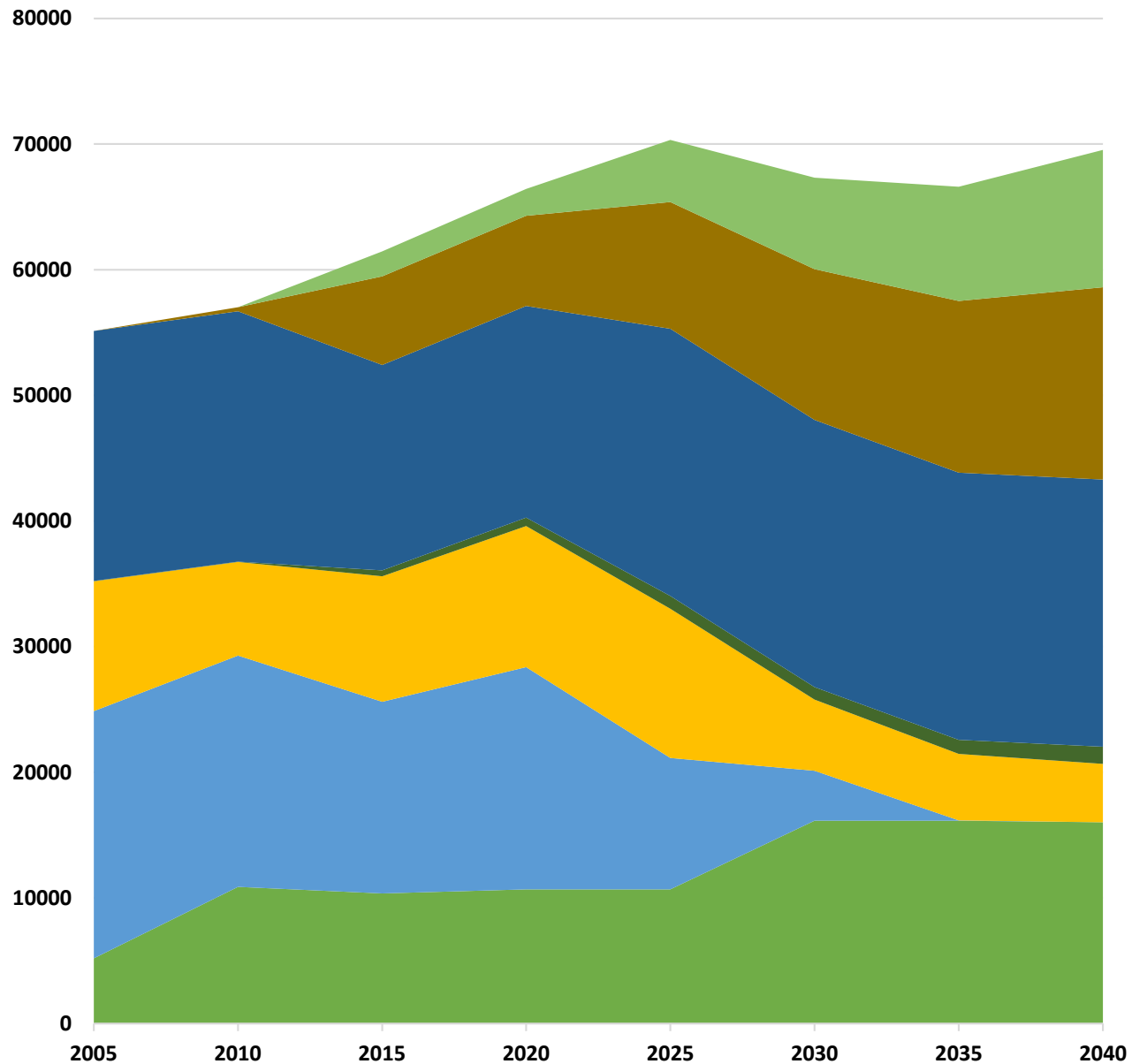


# Romania - Baseline scenario projections

## Demand for electricity

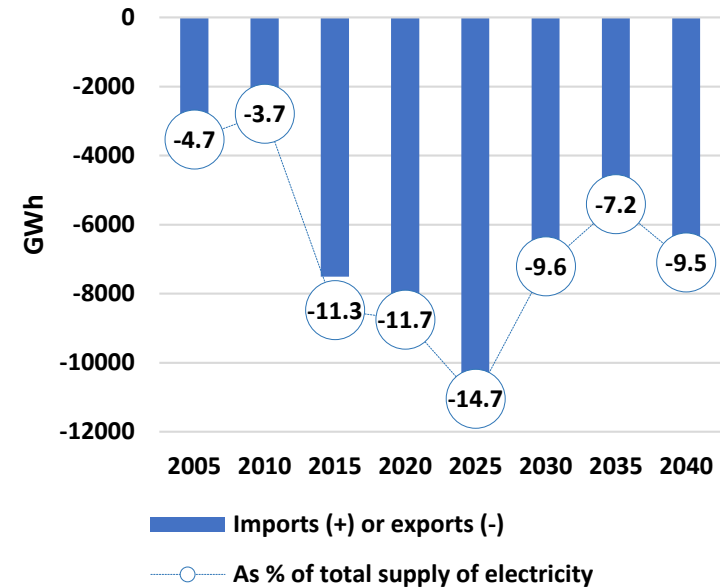


### Power generation (GWh-net)

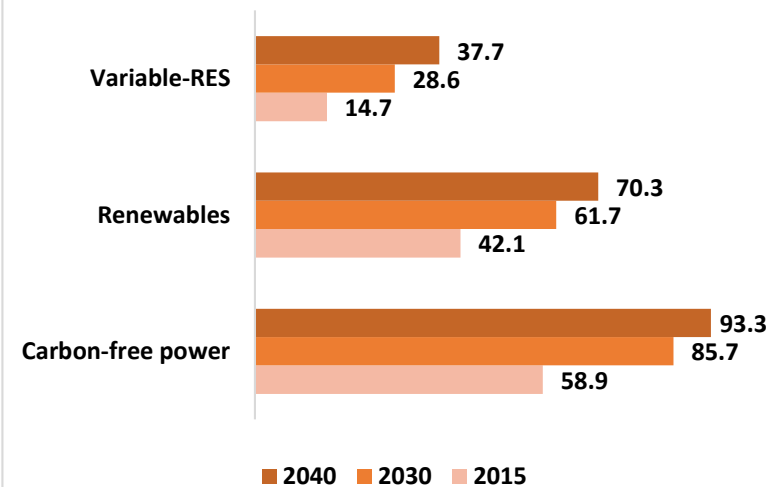


- Solar
- Wind
- Hydro
- Biomass
- Gas and oil
- Coal
- Nuclear

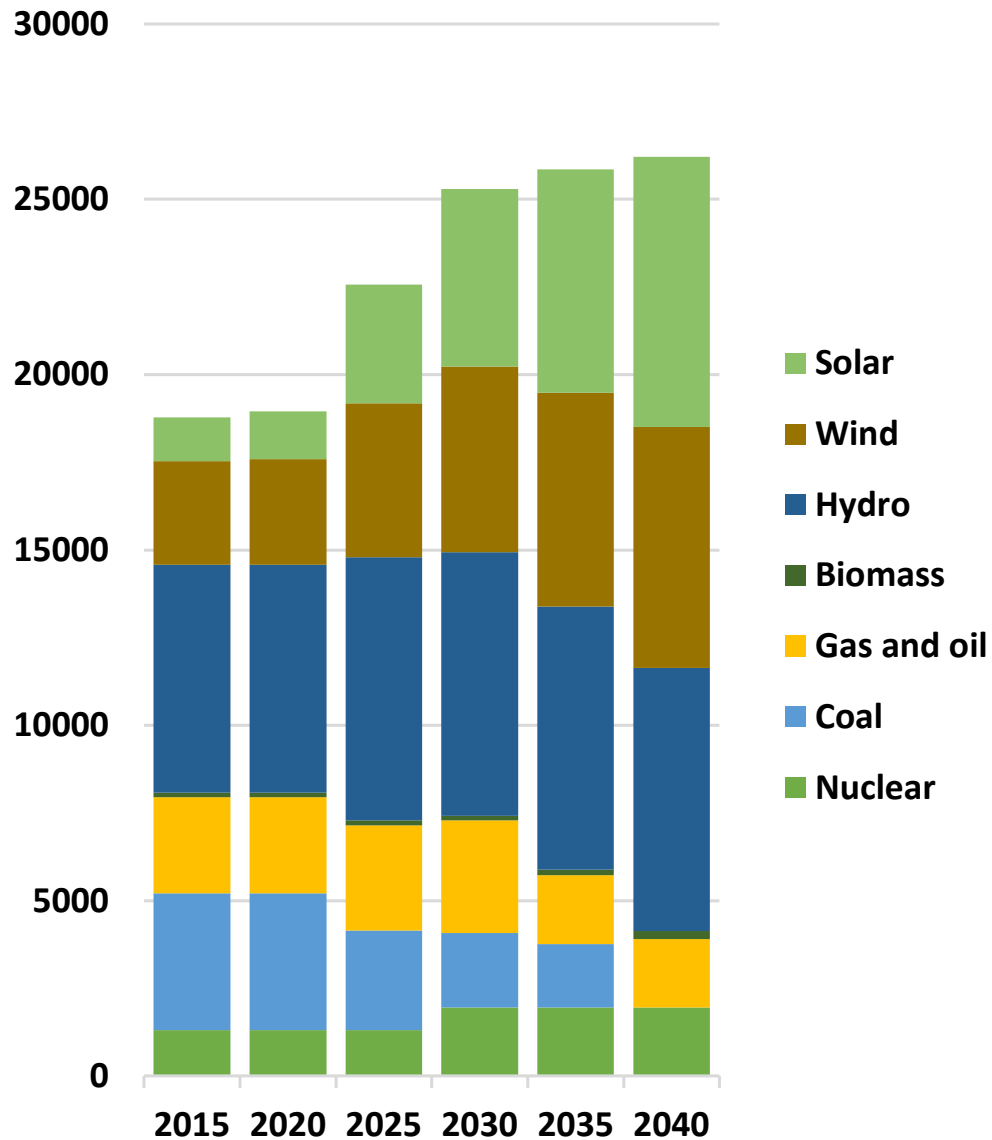
### Net imports of electricity



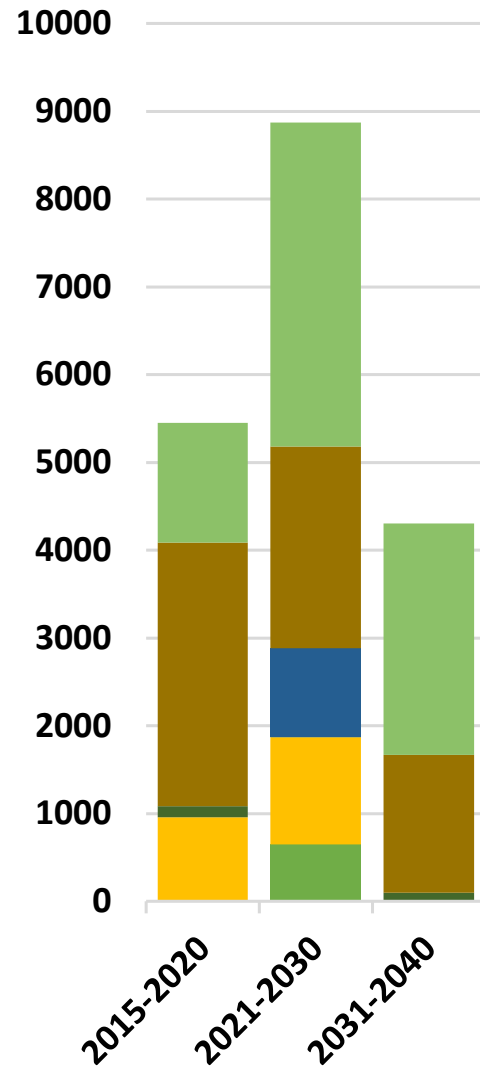
### Indicators (shares - %)



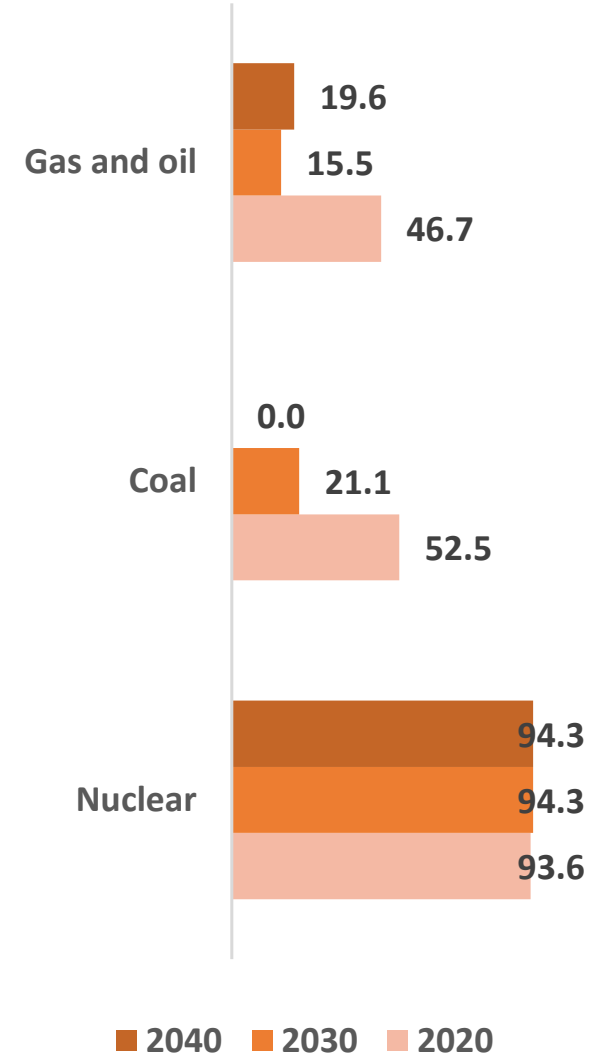
### Operating capacities (MW)



### Capacity expansion (MW)

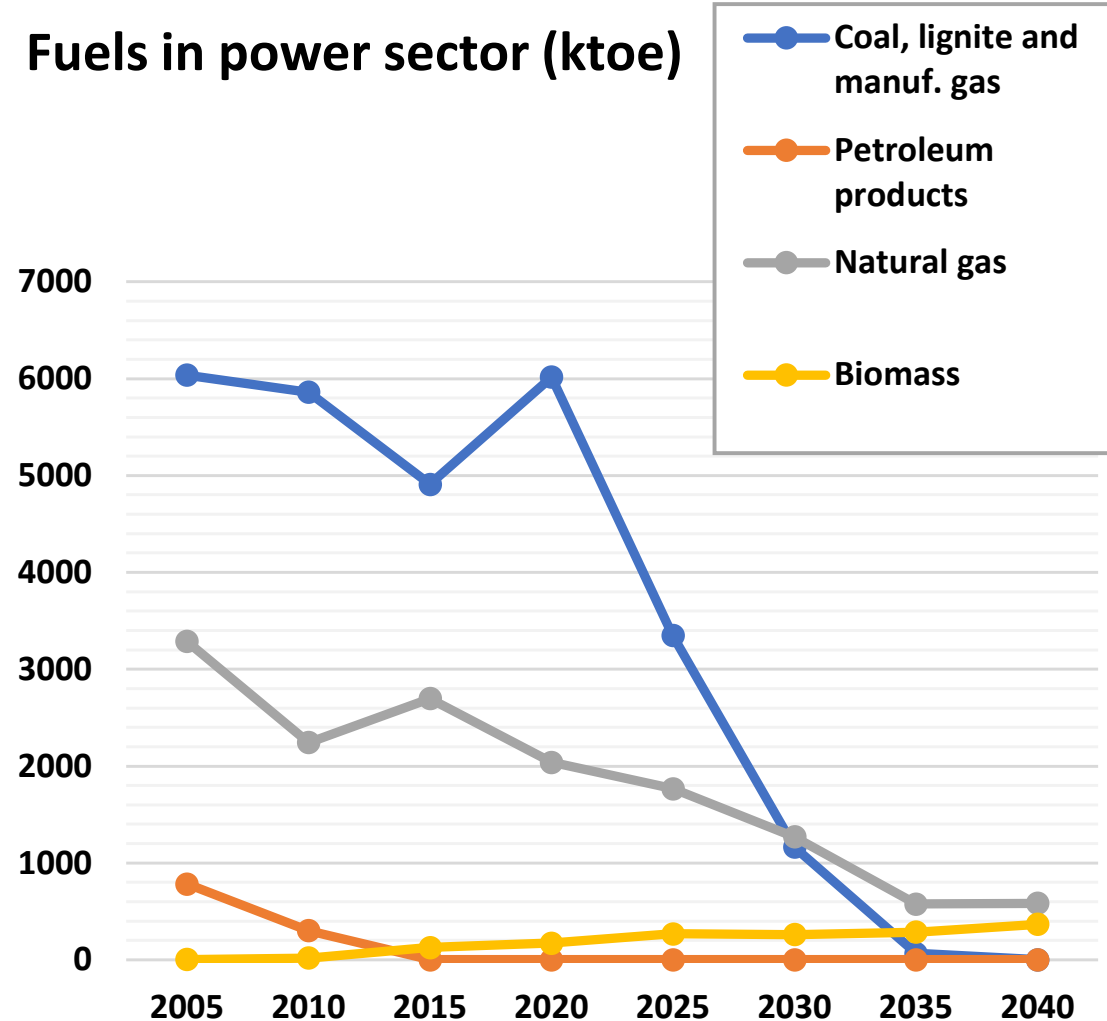


### Rate of use of capacity (%)

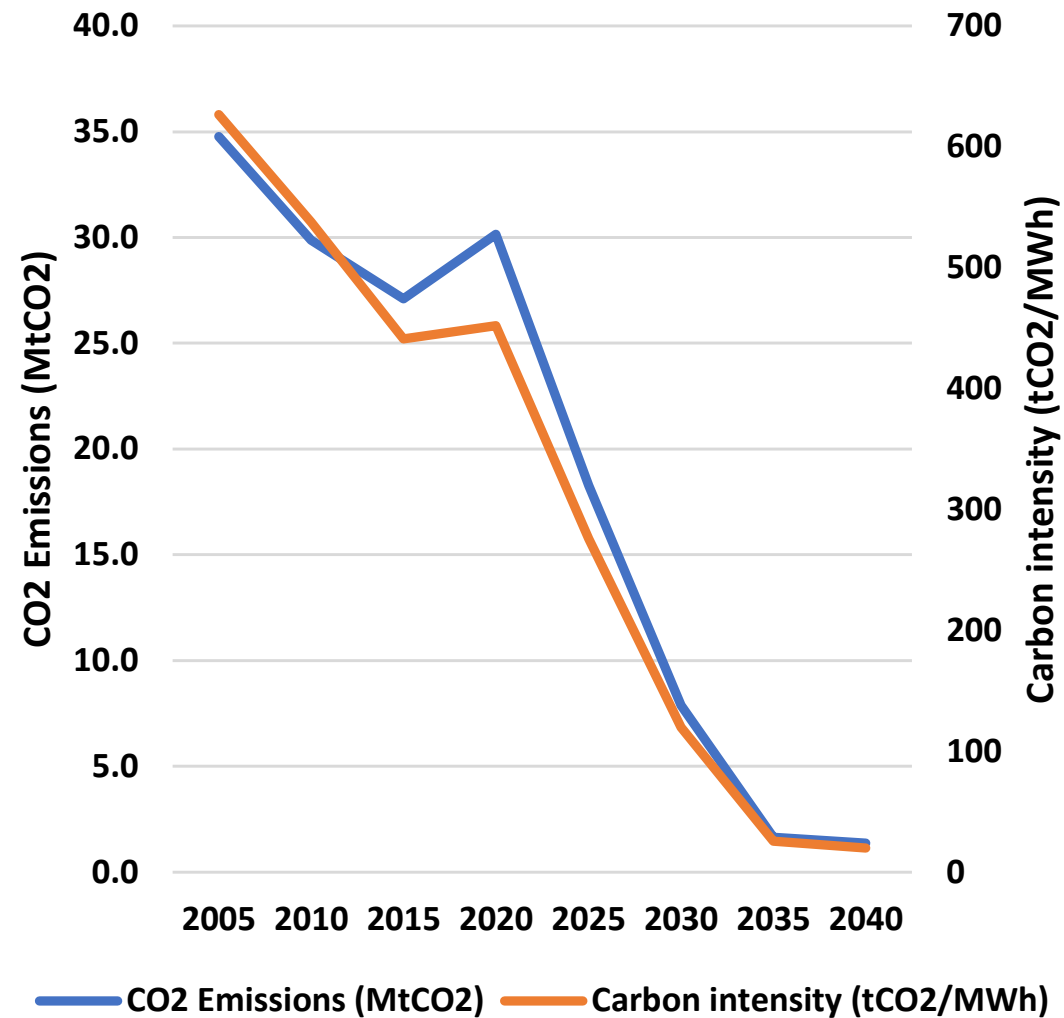




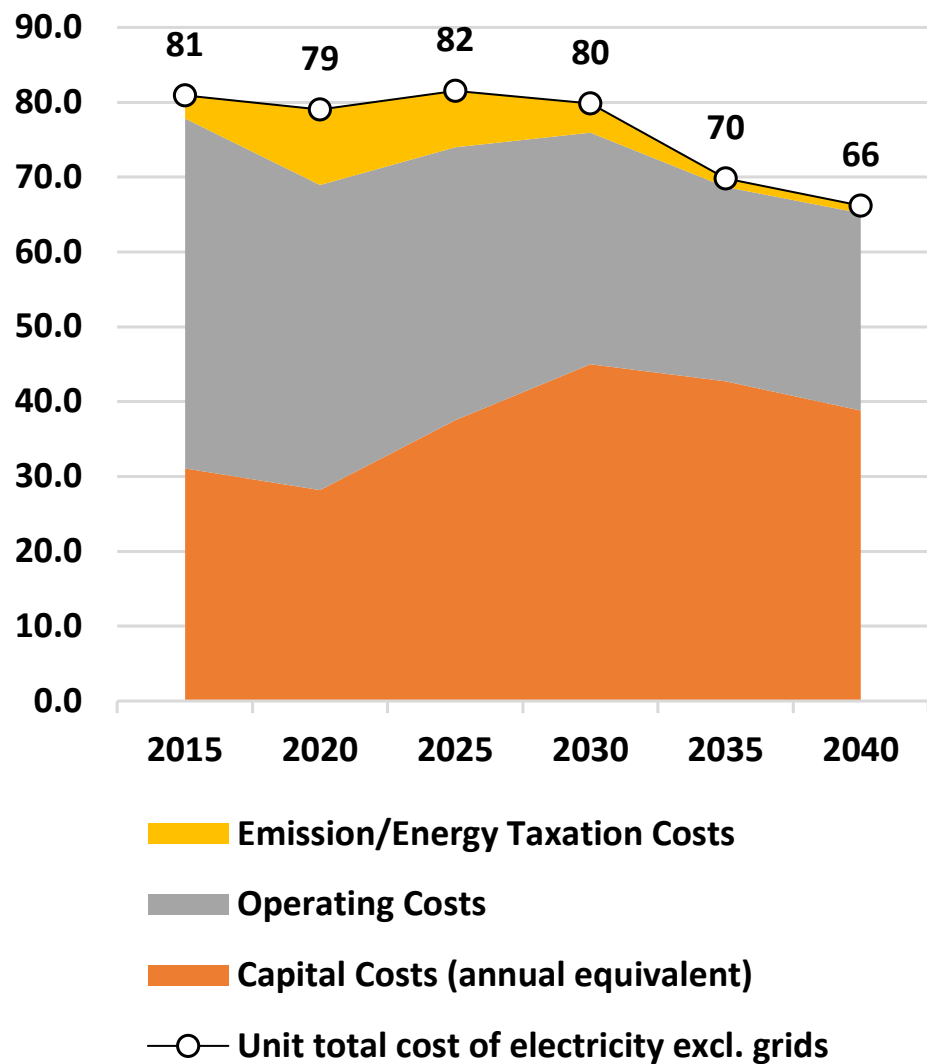
### Fuels in power sector (ktoe)



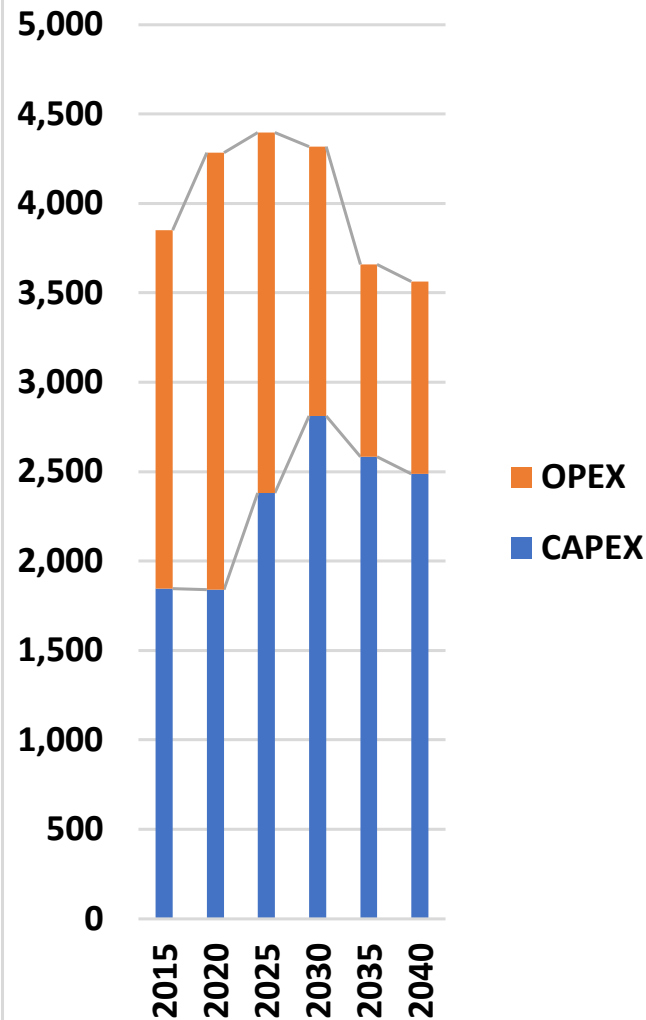
### CO2 Emissions in power generation



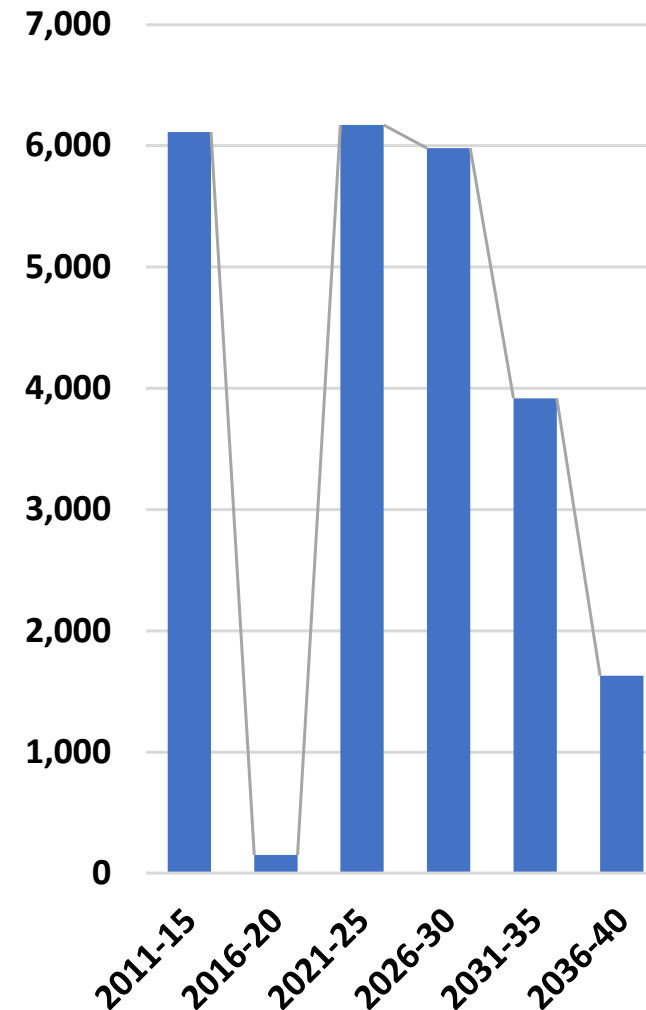
### Unit costs in €/MWh (sales)



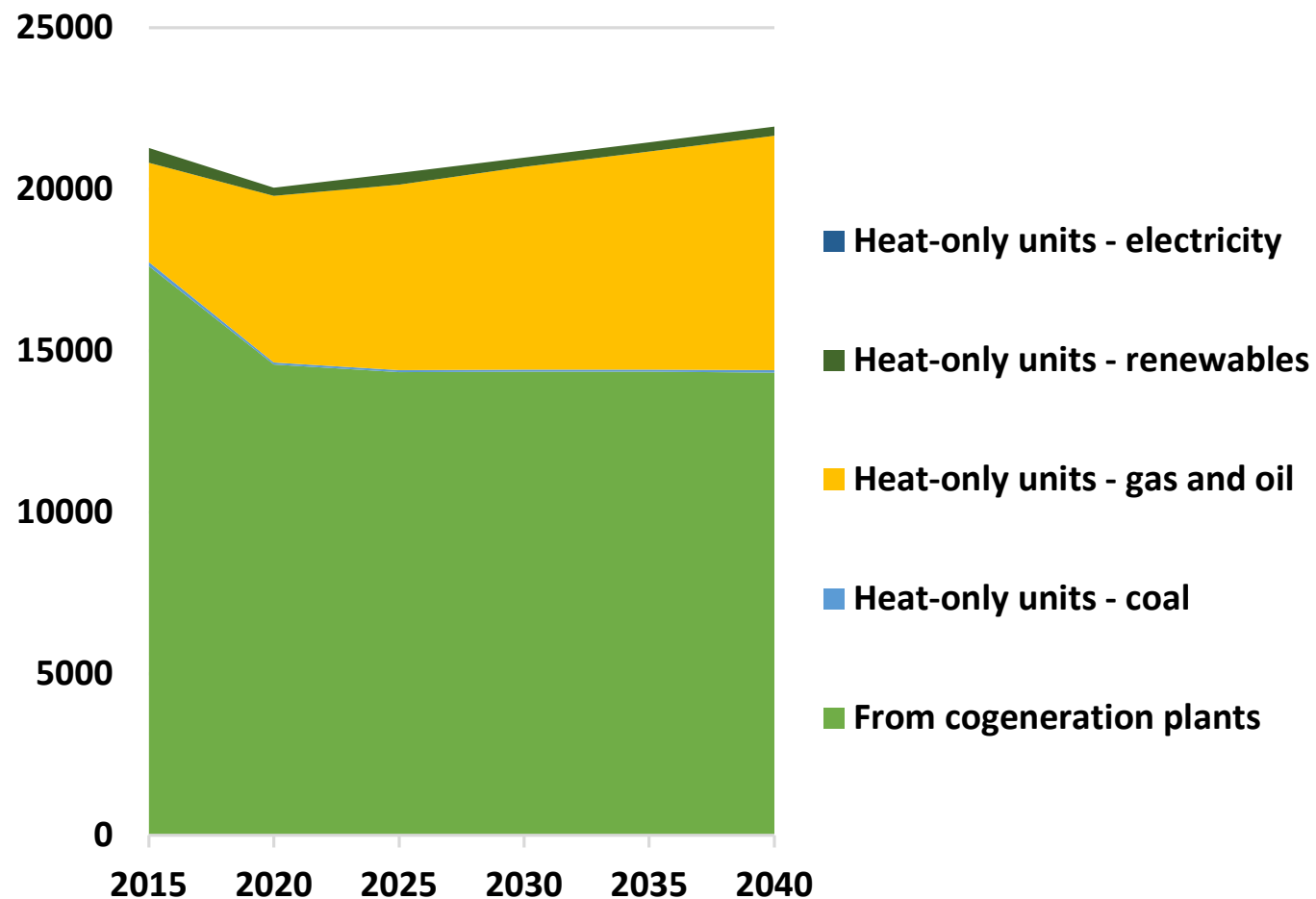
### Total Cost of Electricity supply (in M€)



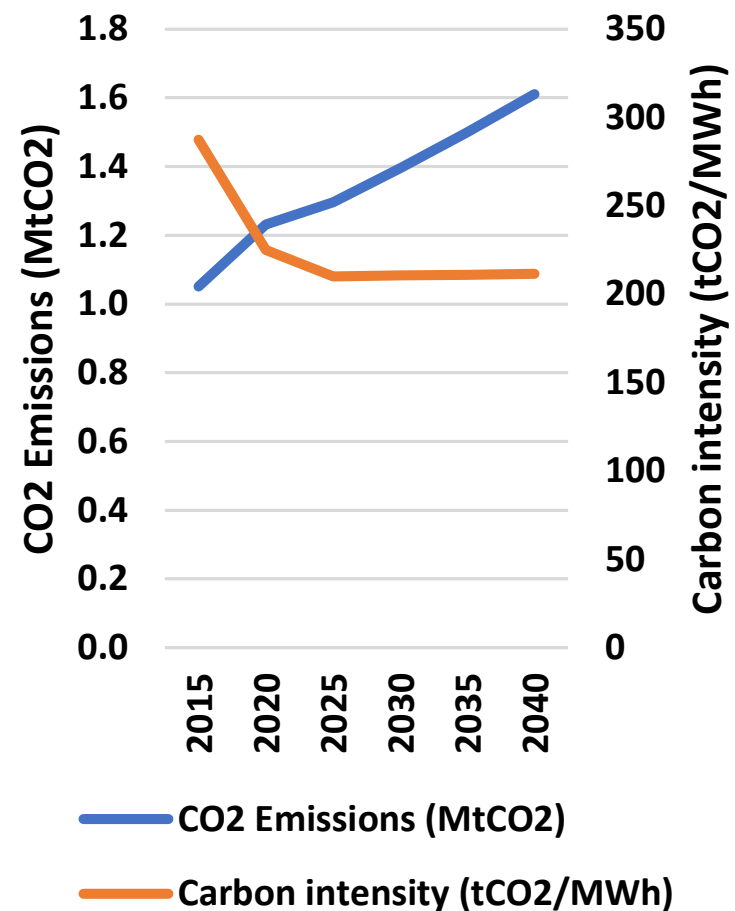
### Investment expenditures in power plants (in M€)



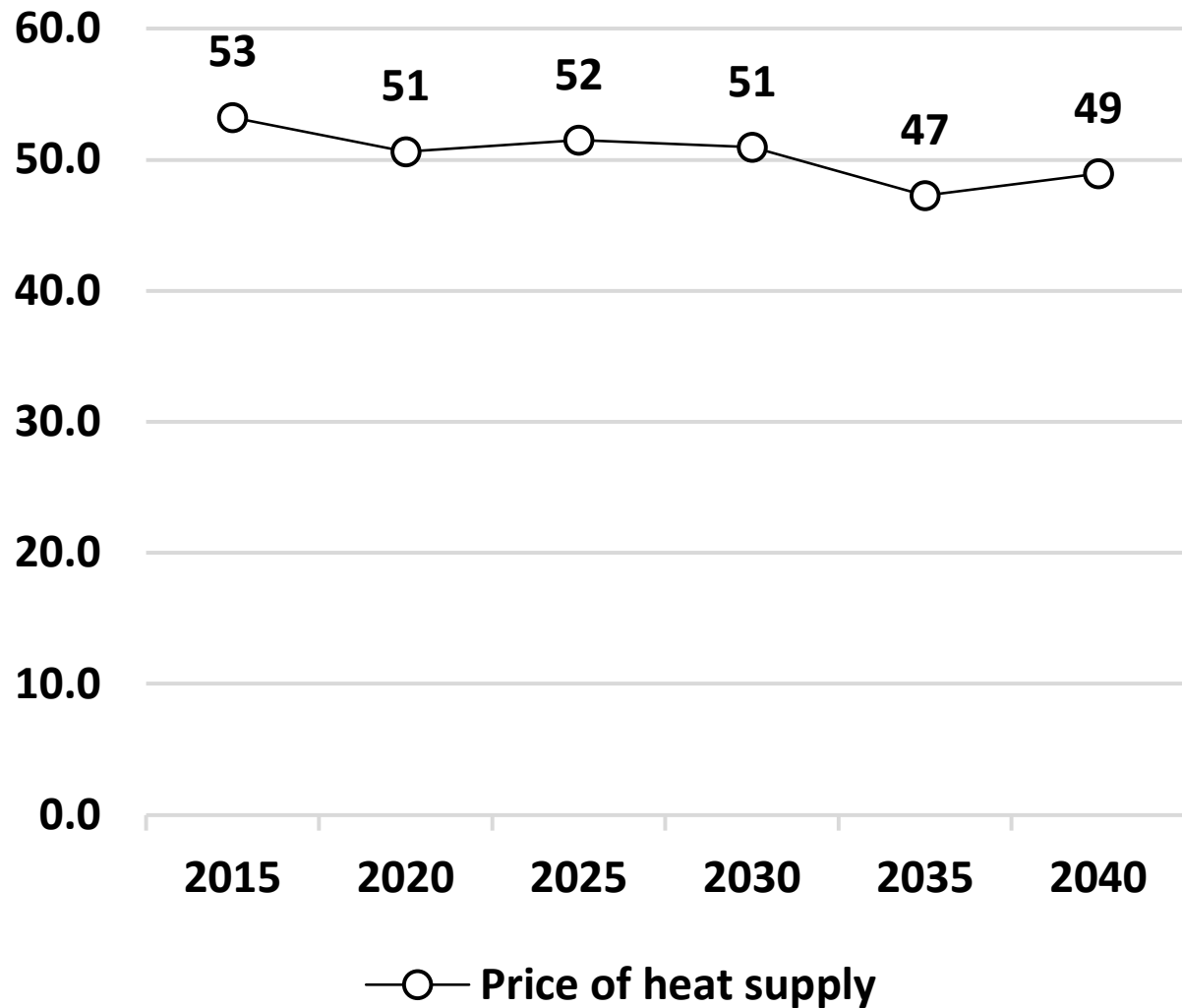
## Heat production (GWh heat)



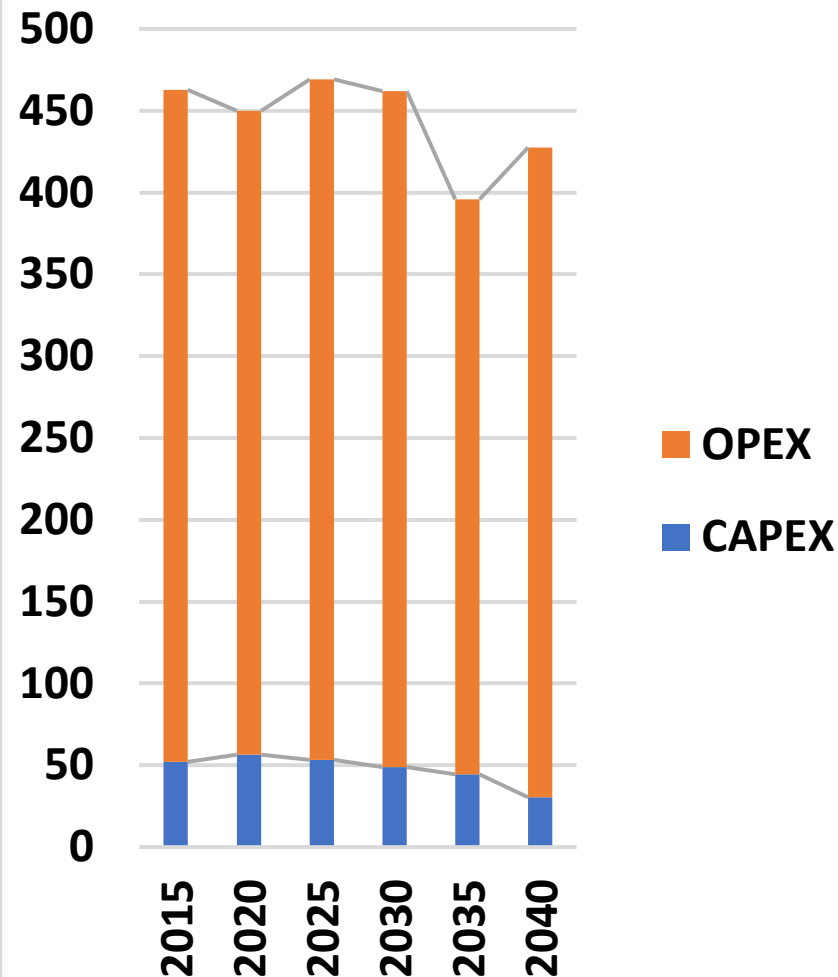
## CO2 Emissions in heat-only unit



### Unit costs in €/MWh (sales)

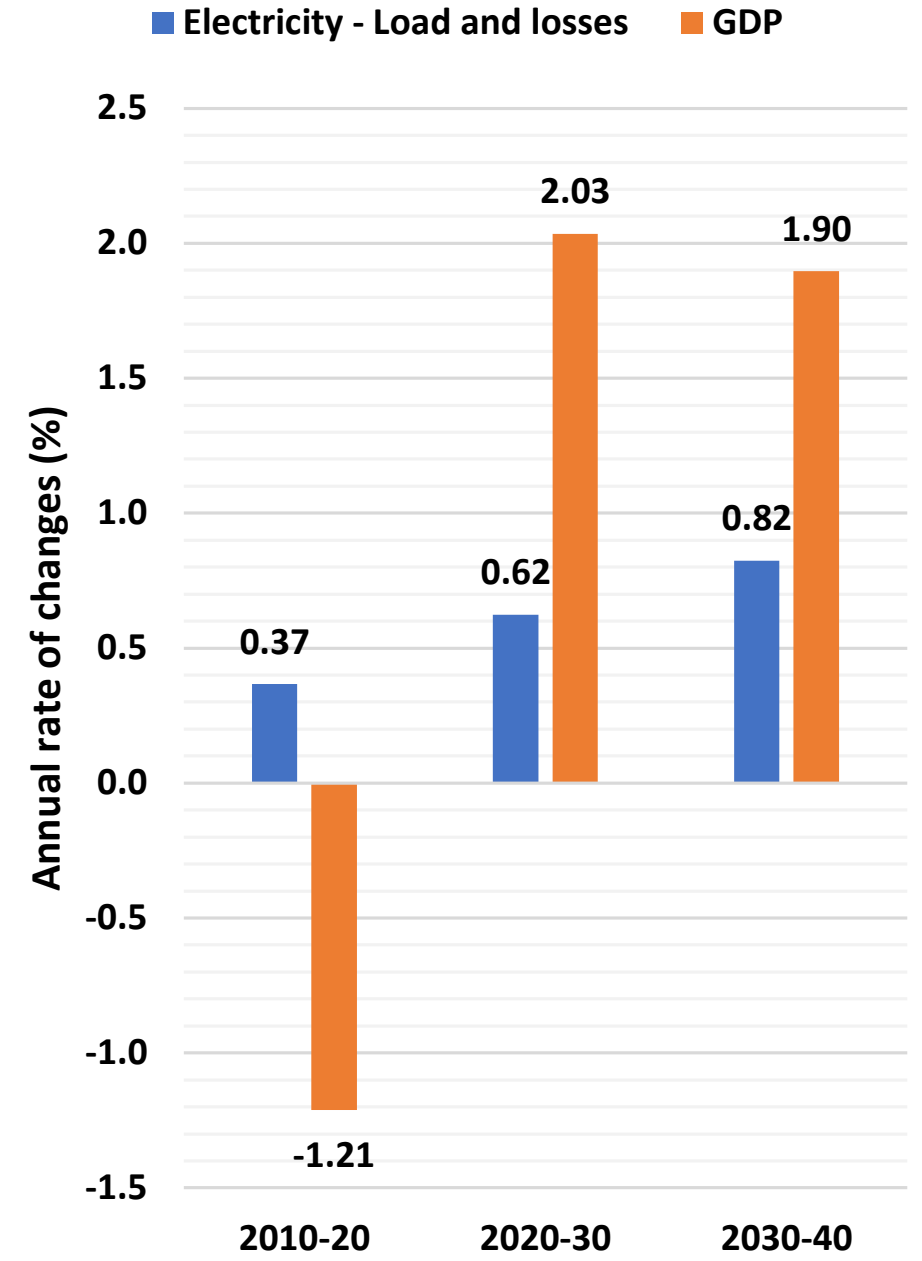
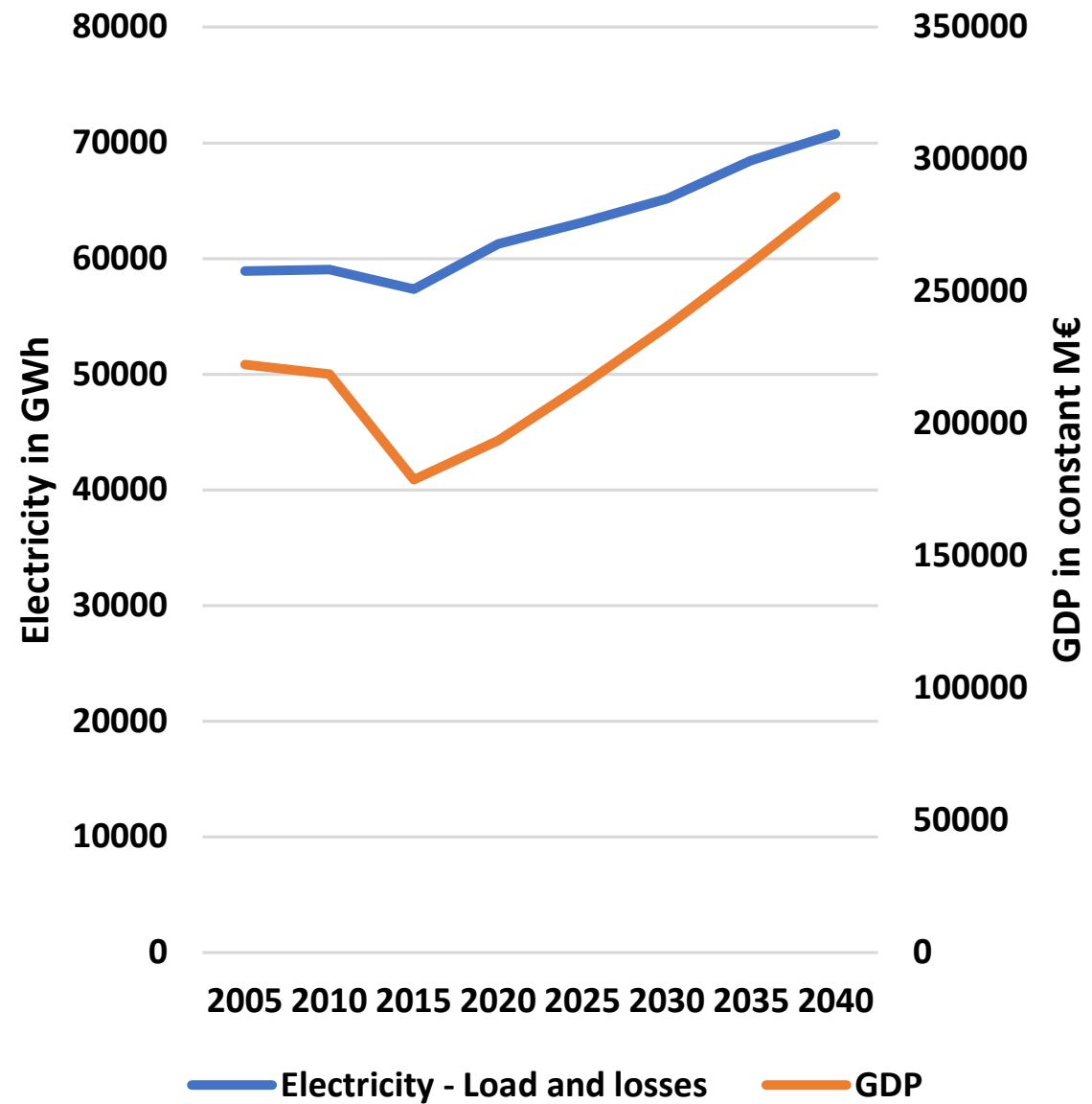


### Total Cost of heat production (in M€)

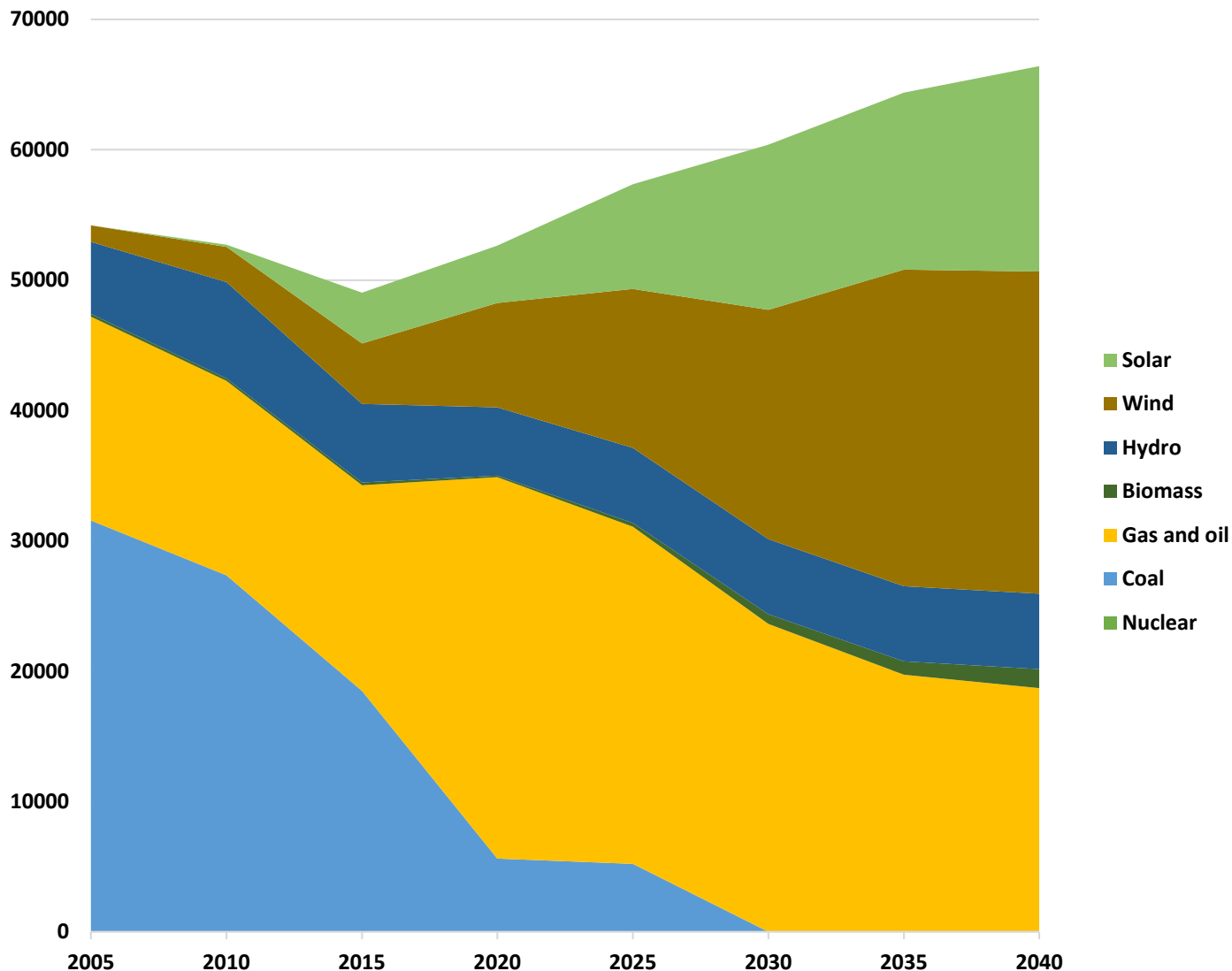


# Greece - Baseline scenario projections

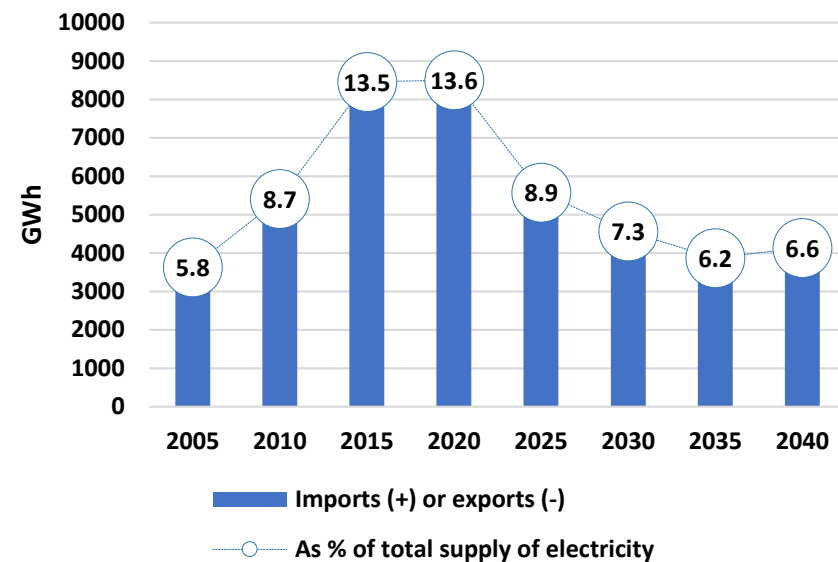
### Demand for electricity



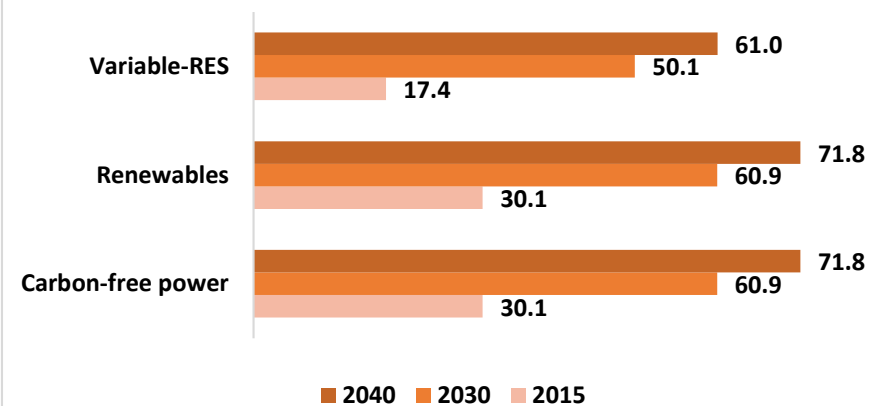
Power generation (GWh-net)



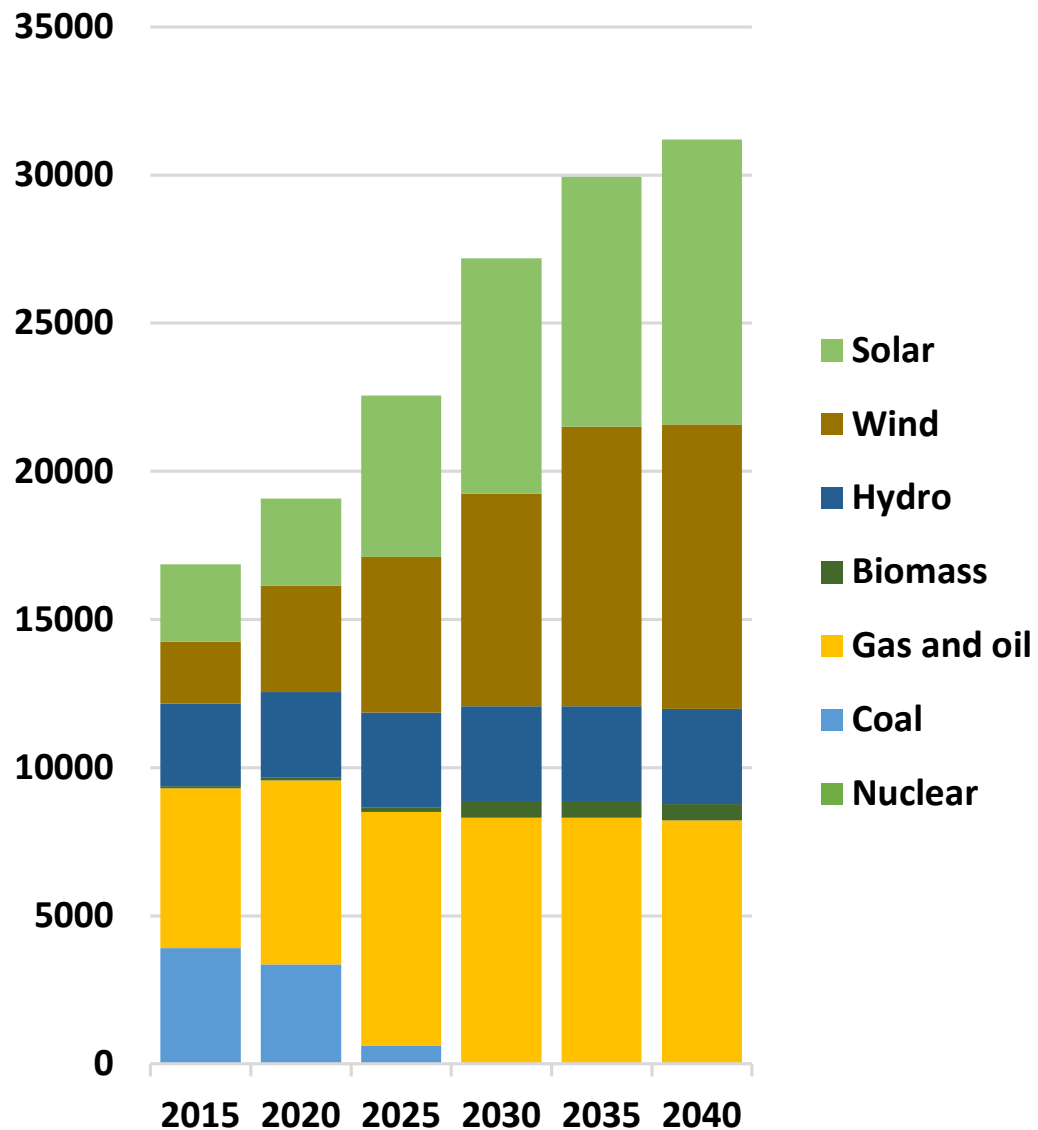
Net imports of electricity



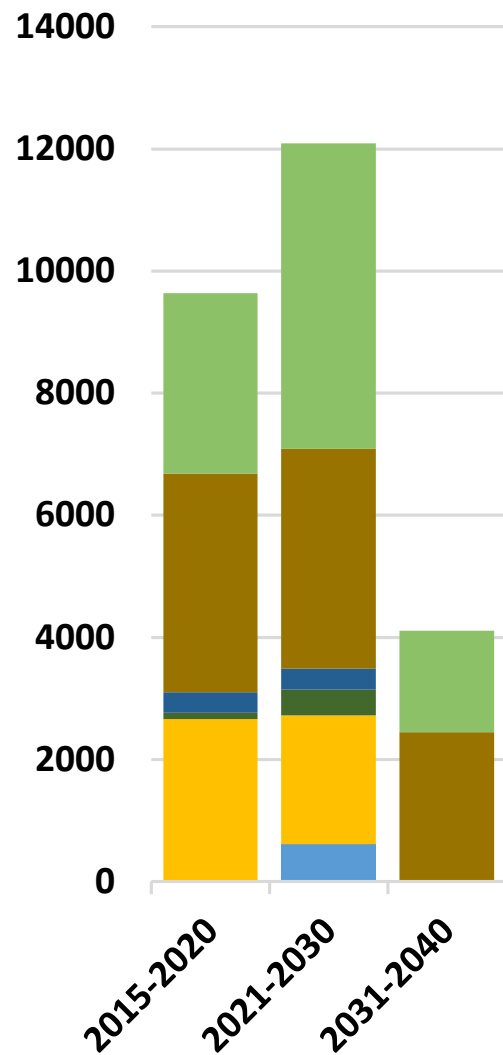
Indicators (shares - %)



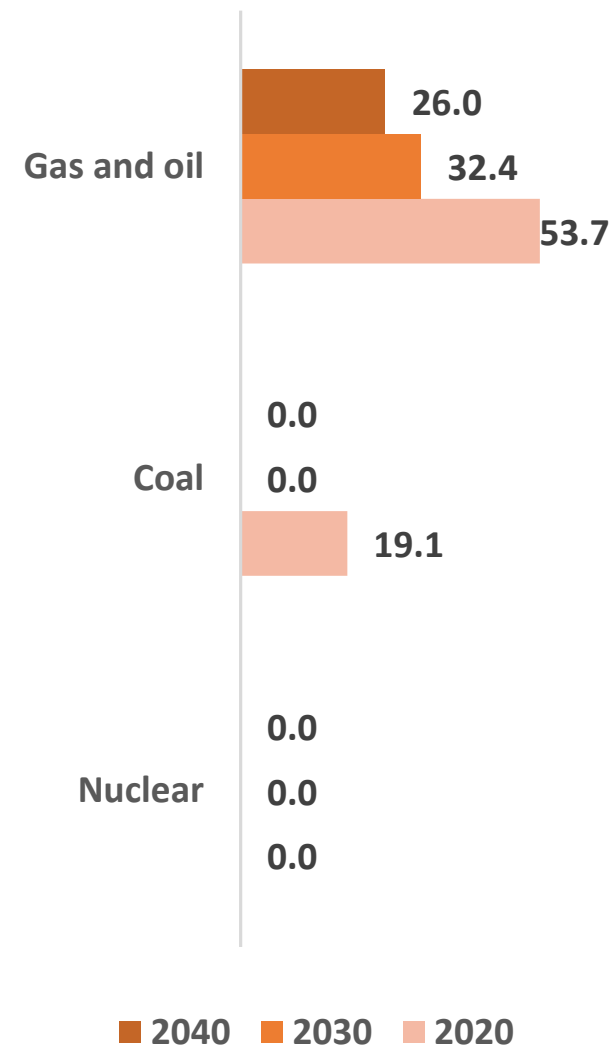
### Operating capacities (MW)



### Capacity expansion (MW)

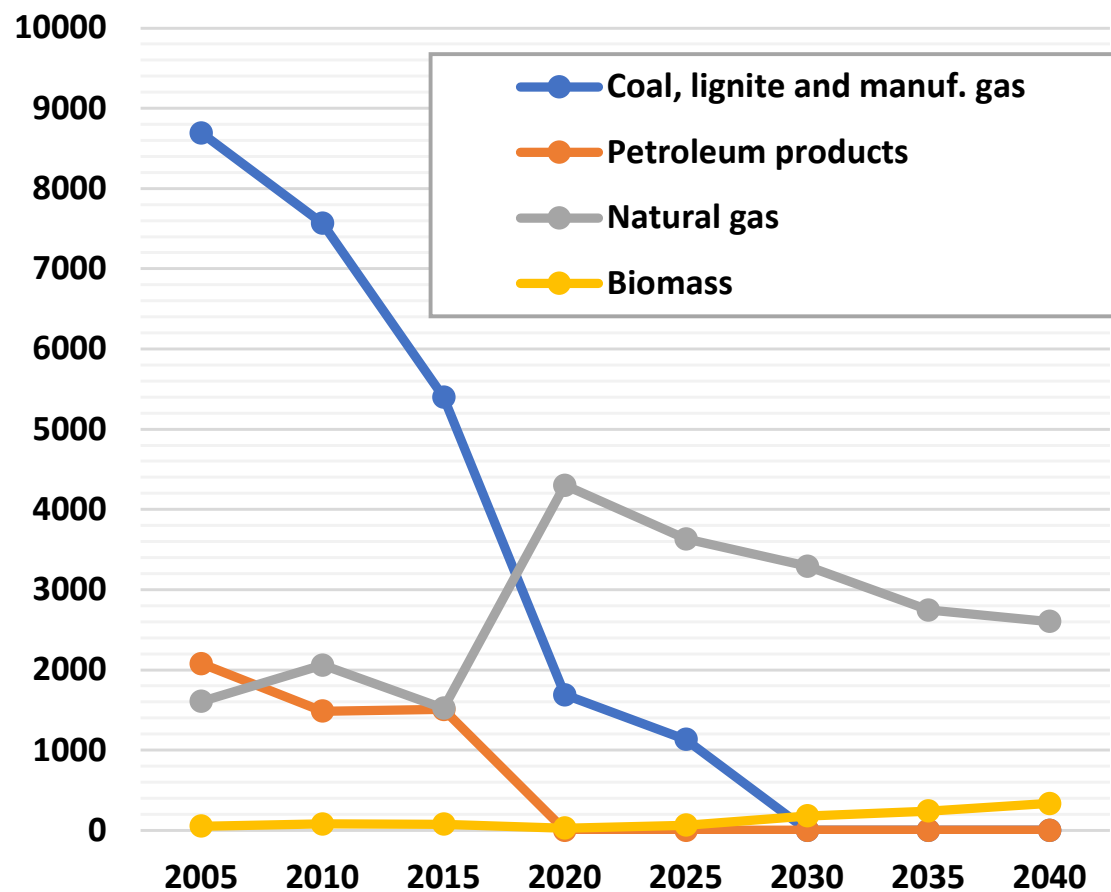


### Rate of use of capacity (%)

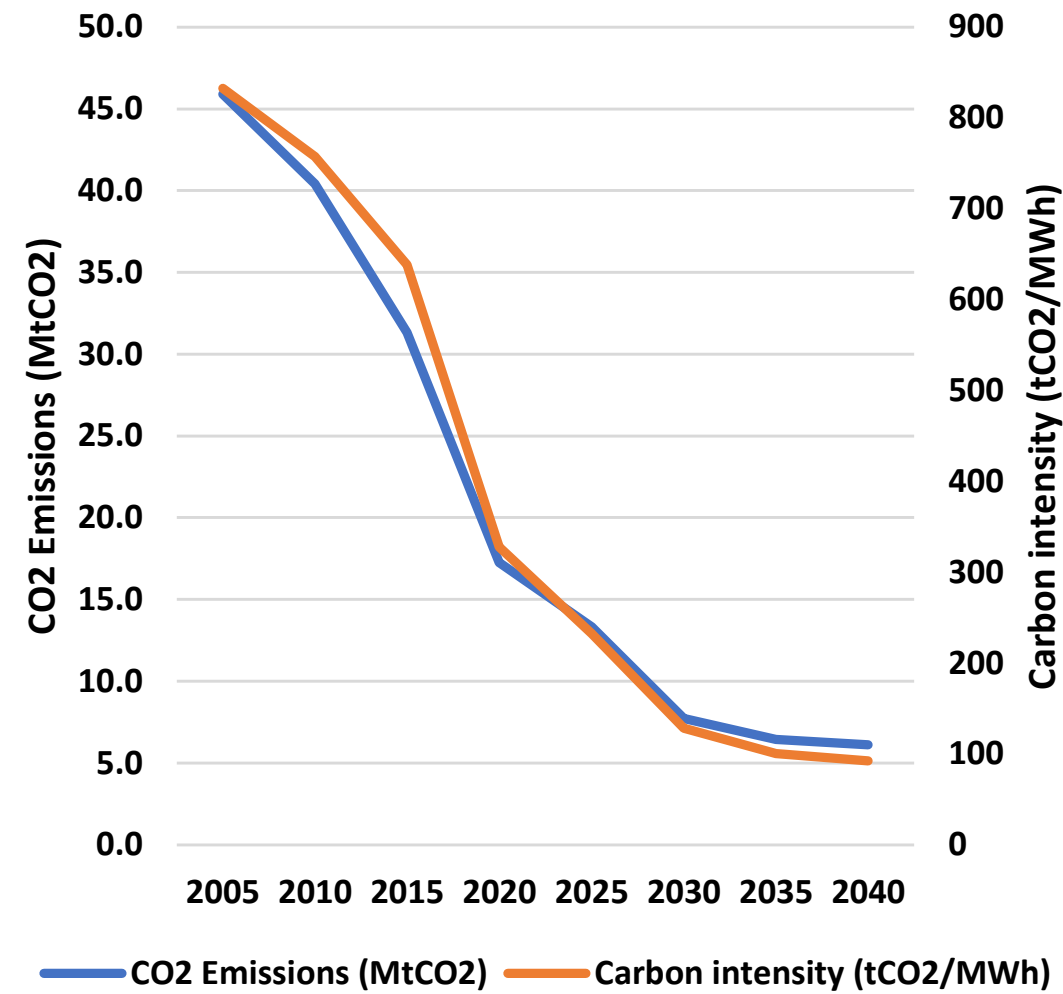




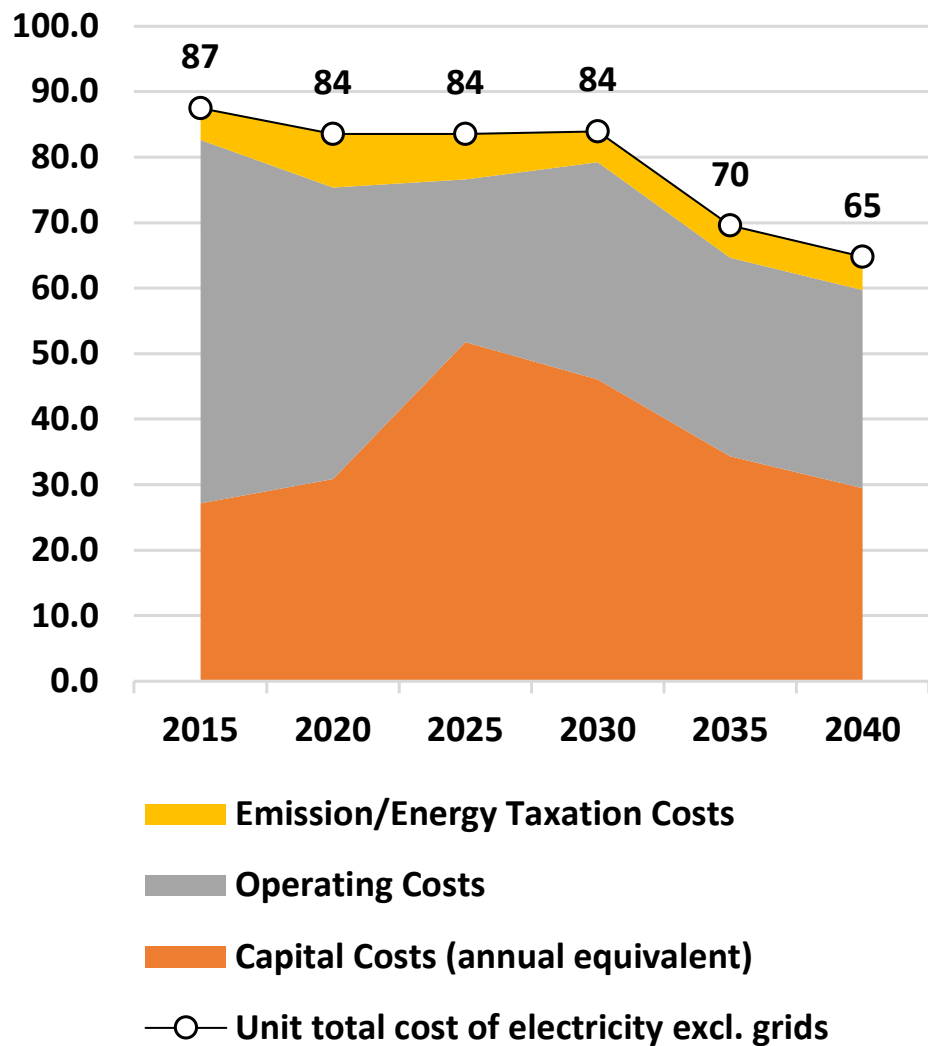
### Fuels in power sector (ktoe)



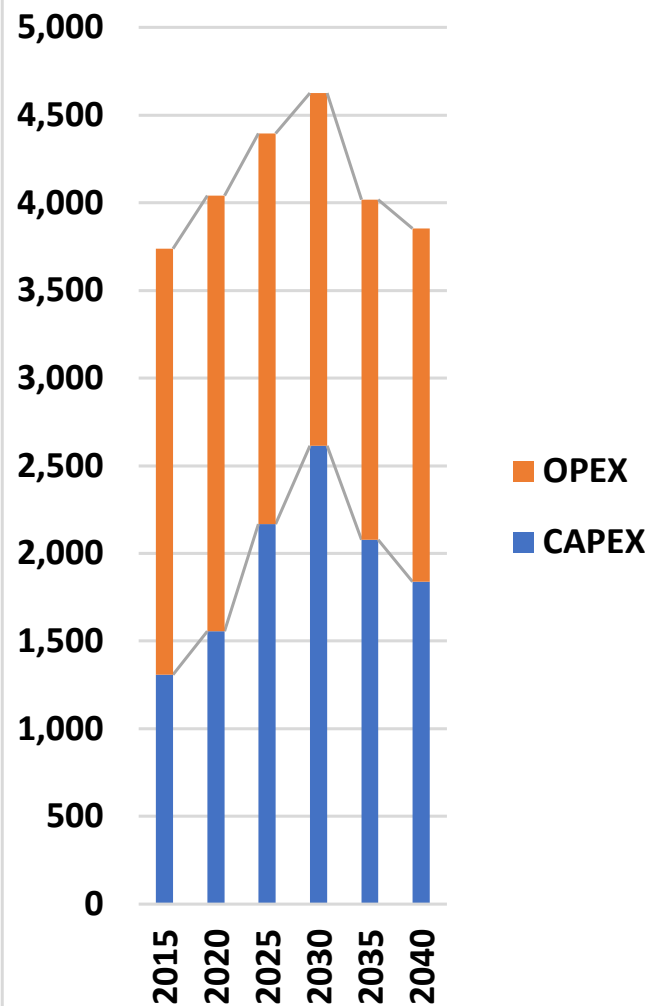
### CO2 Emissions in power generation



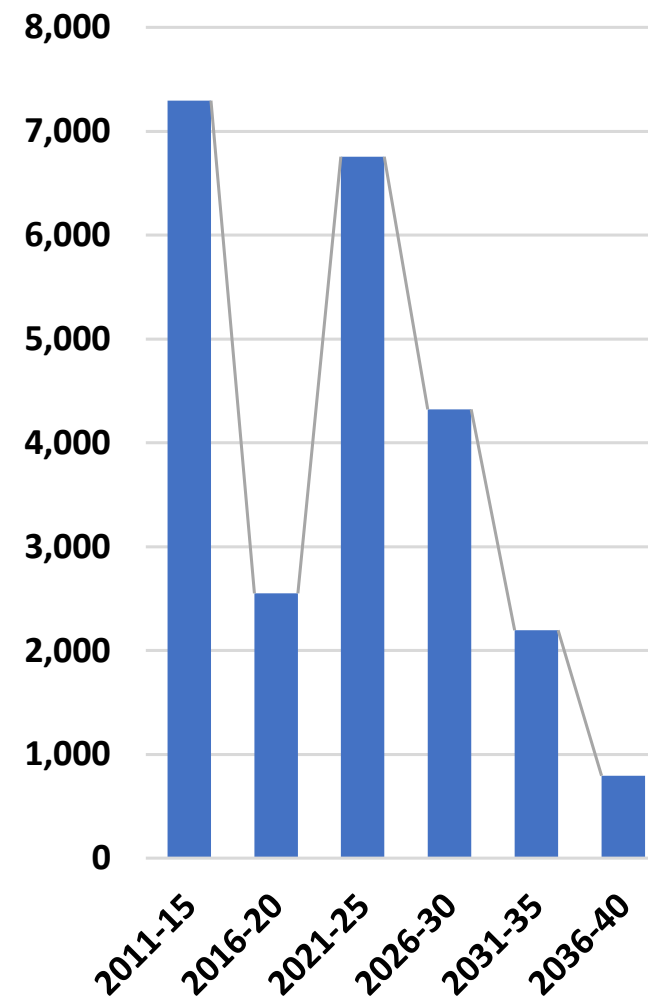
### Unit costs in €/MWh (sales)



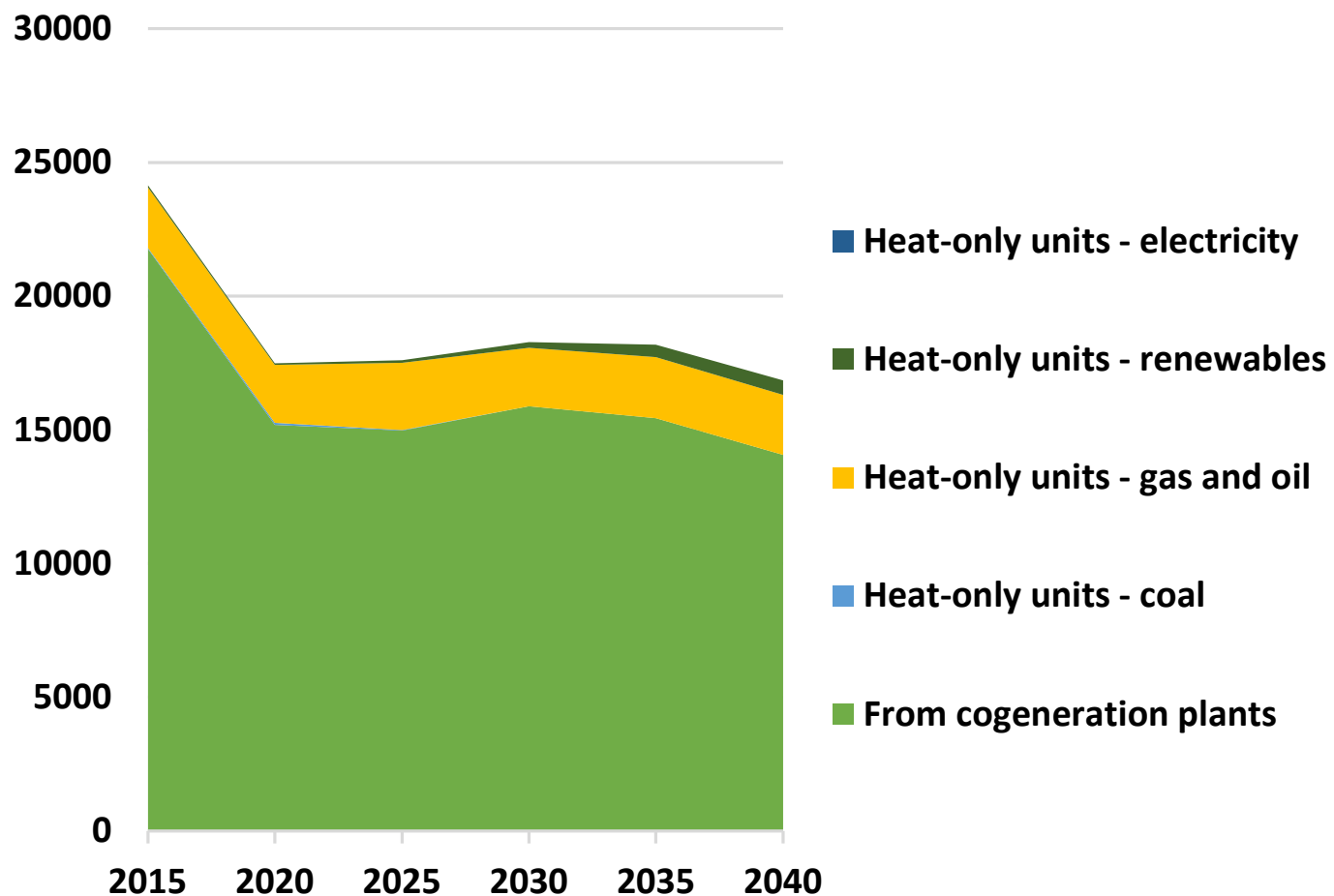
### Total Cost of Electricity supply (in M€)



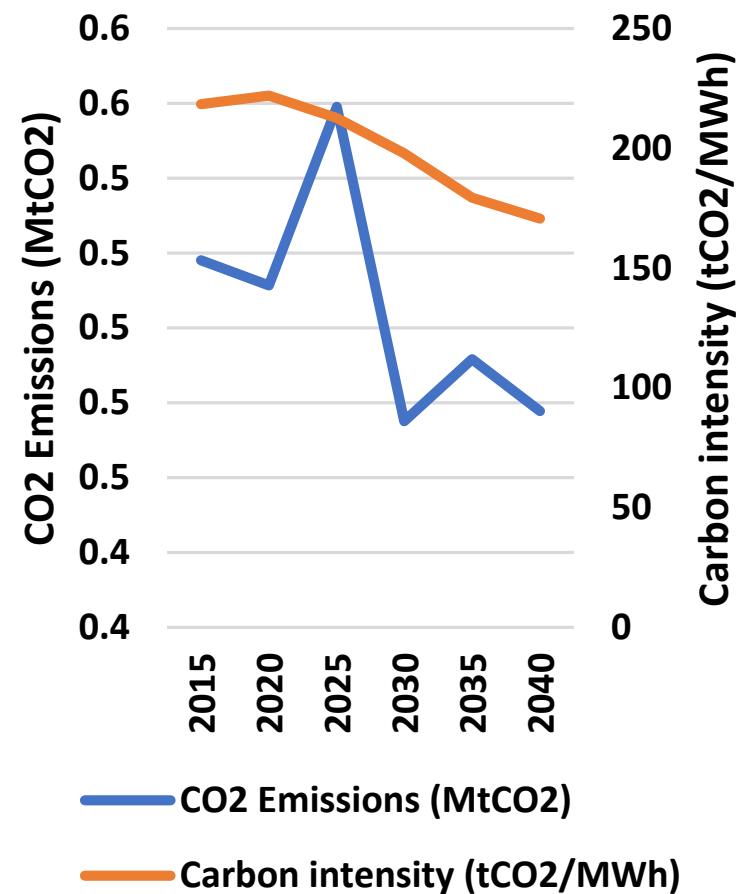
### Investment expenditures in power plants (in M€)



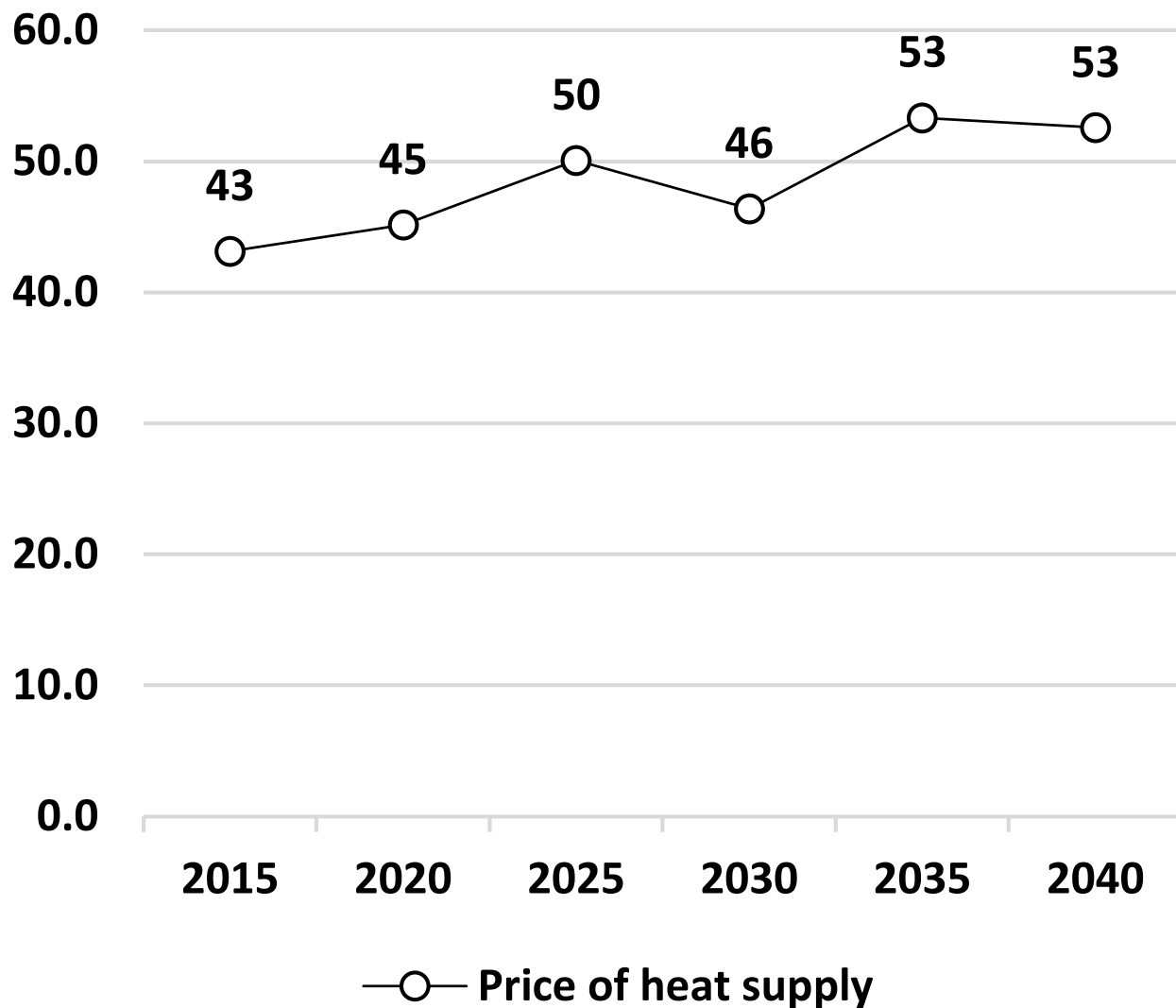
## Heat production (GWh heat)



## CO2 Emissions in heat-only unit



## Unit costs in €/MWh (sales)



## Total Cost of heat production (in M€)

