# Energy Demand and Supply Projections for SE Europe and the Eastern Mediterranean

EnTC ENERGY TRANSITION CONSULTANTS


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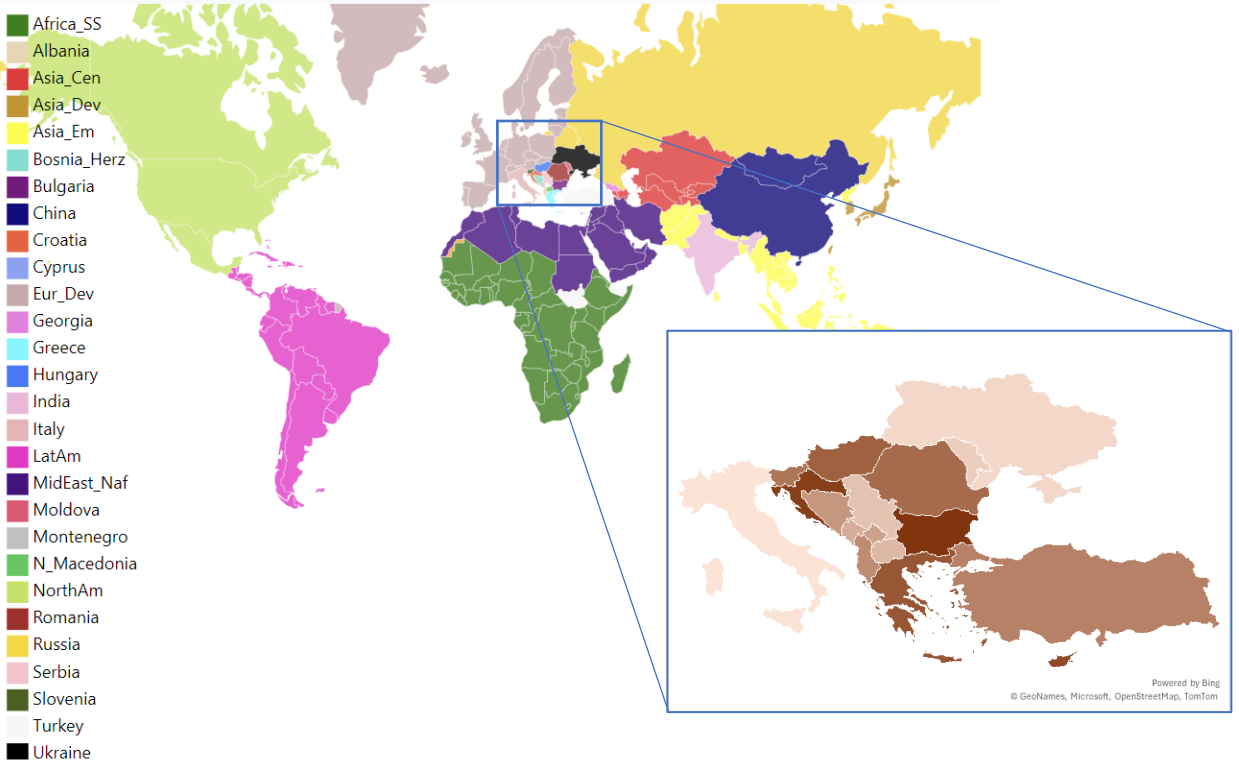
# Contents

# Methodology

KINESYS+ modelling framework

## A Global multi-regional energy system model



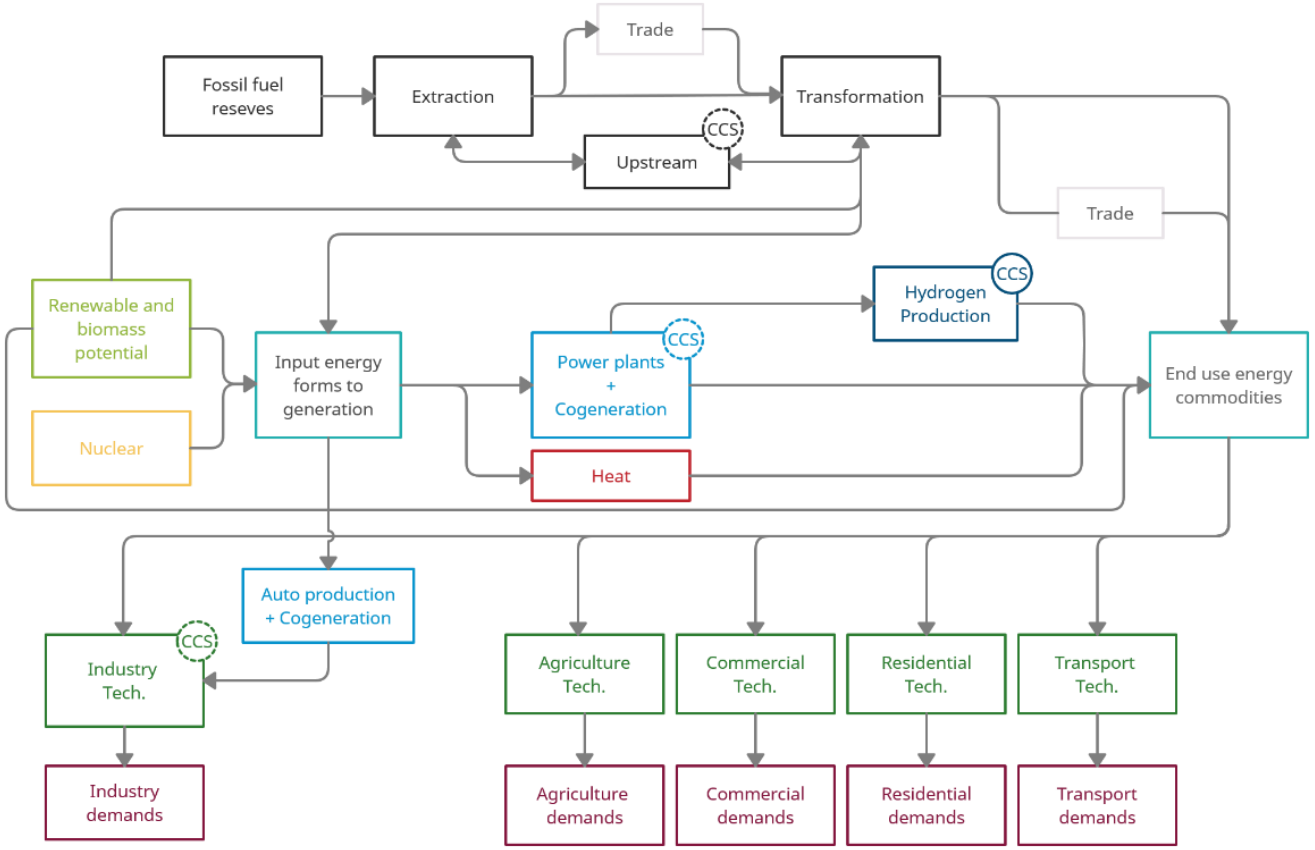

- Based on **TIMES (The Integrated MARKAL EFOM System)** model generator.

Technology Collaboration Programme by iea

etsap

- The **TIMES** model generator is a bottom-up, technology rich, least cost optimization model generator that combines a technical engineering approach and an economic approach used for **the exploration of possible energy futures based on contrasted scenarios**.

# Energy System Representation




## Level of detail

- Explicit description of more than one thousand technologies and one hundred commodities in each model region, interrelated in a Reference Energy System.
- Representation of power plants at a plant level (for those with a capacity above 50MW)
- Representation of gas pipelines.
- Includes industrial process GHG emissions.
- REZoning tool data for the RES potential.
- Driven by a set of 42 demands for energy services in all sectors: agriculture, residential, commercial, industry, and transportation.

Coverage: energy flows and energy-related emissions per sector (electricity generation, transportation, residential, commercial buildings, agriculture, industry) per service (space heating, passenger transport etc.) and for the whole energy system (from primary energy to final energy).

# Scenarios' Naratives

## With Existing Measures (WEM)

continuation of current efforts and policies, capturing a $CO_2$ trajectory at the sectoral level derived from the national strategies, National Energy and Climate Plans and UNFCCC submissions of the countries, without additional mitigation ambition.

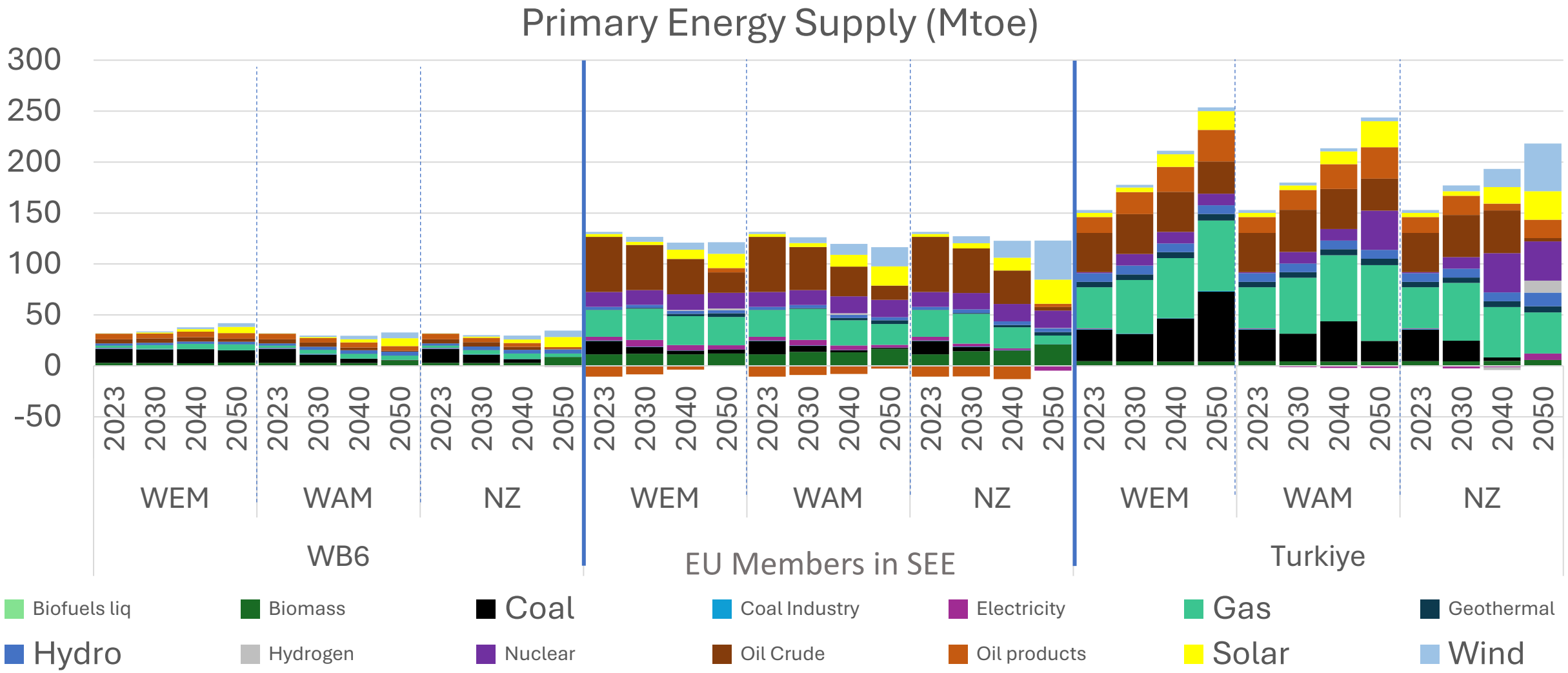
## With Additional Measures (WAM)

enhanced efforts still within a non-net-zero framework; it applies more ambitious but still realistic sectoral $CO_2$ reductions, based on the "with additional measures" ambitions of countries reported in the NECP and UNFCCC submissions.

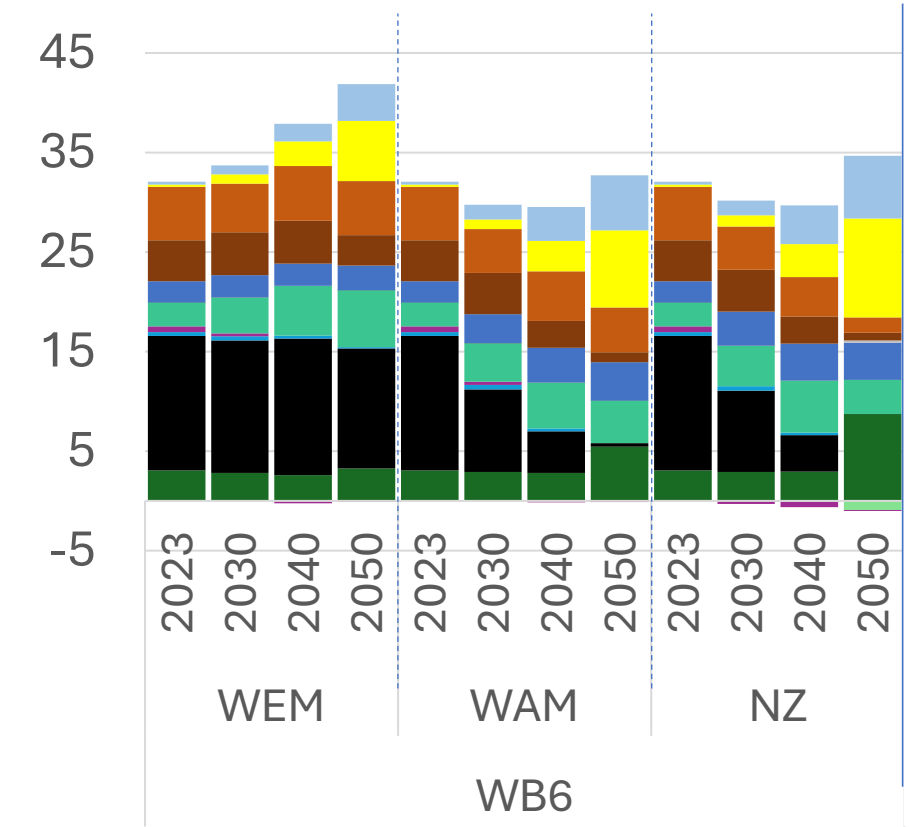
## Net Zero (NZ)

builds upon the sectoral goals of WAM applying an overarching constraint of achieving net zero emissions at the national level for each of the targeted countries, thereby forcing a system-wide transformation in line with long-term climate neutrality targets.

# Key Insights - PES



# Key Insights - PES



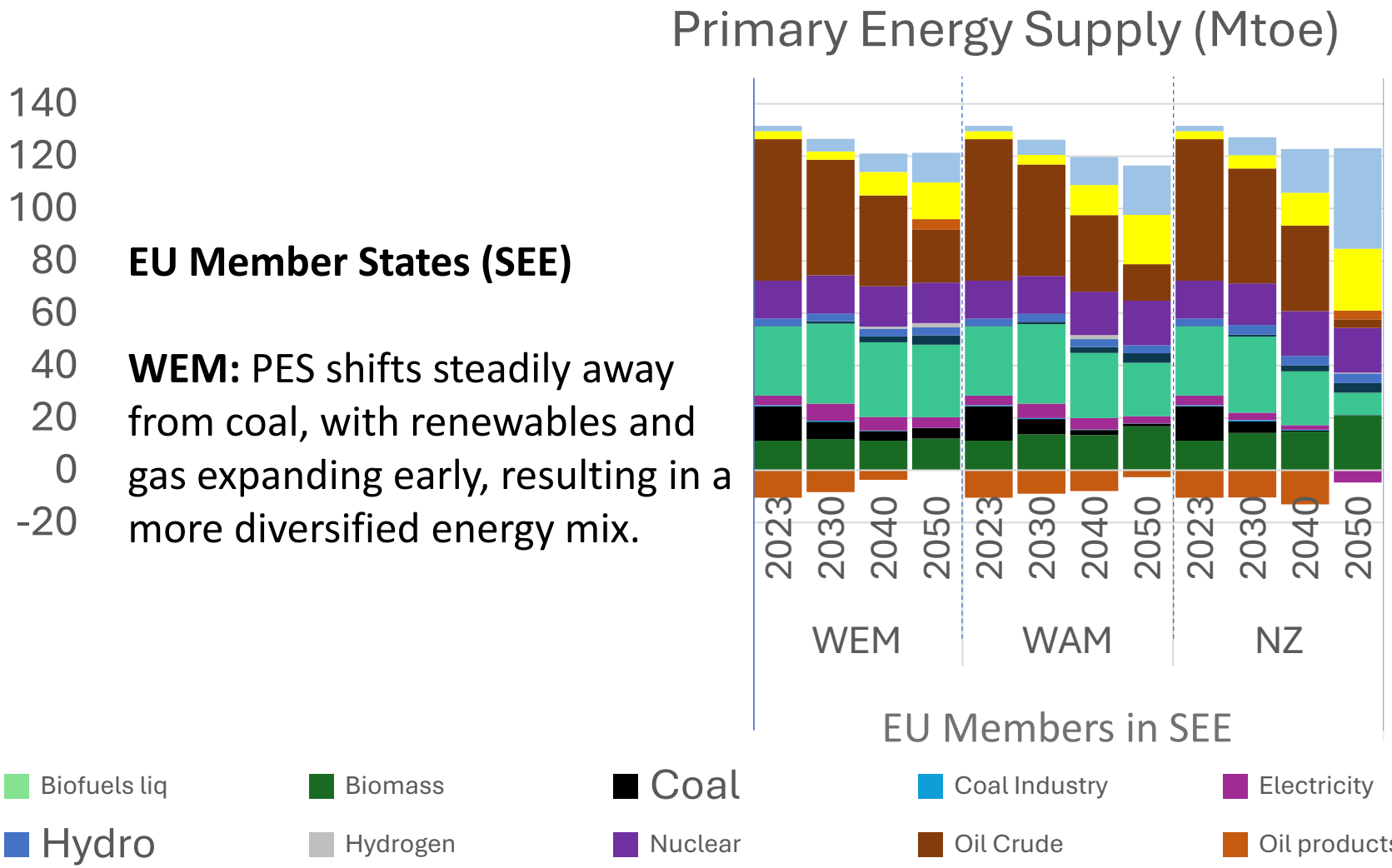

**WB6 Countries**

**WEM**: Coal remains a major pillar of primary energy supply, while renewables grow slowly and gas emerges as a supplementary fuel.
**WAM**: Coal use declines markedly, with strong expansion of wind and solar, though gas remains relatively high as a transitional energy source.
**NZ**: Coal is fully phased out by 2050, replaced by renewables, particularly wind, solar, hydro, and biomass, while gas plays a reduced but persistent role.

# Key Insights - PES

**EU Member States (SEE)**

**WEM:** PES shifts steadily away from coal, with renewables and gas expanding early, resulting in a more diversified energy mix.




**WAM:** Faster decline of coal and oil accelerates the dominance of renewables and other low-carbon sources, reinforcing early decarbonisation trends.

**NZ:** Coal is virtually eliminated by 2050, with wind, solar, hydro, and nuclear jointly dominating primary energy supply and underpinning deep decarbonisation.

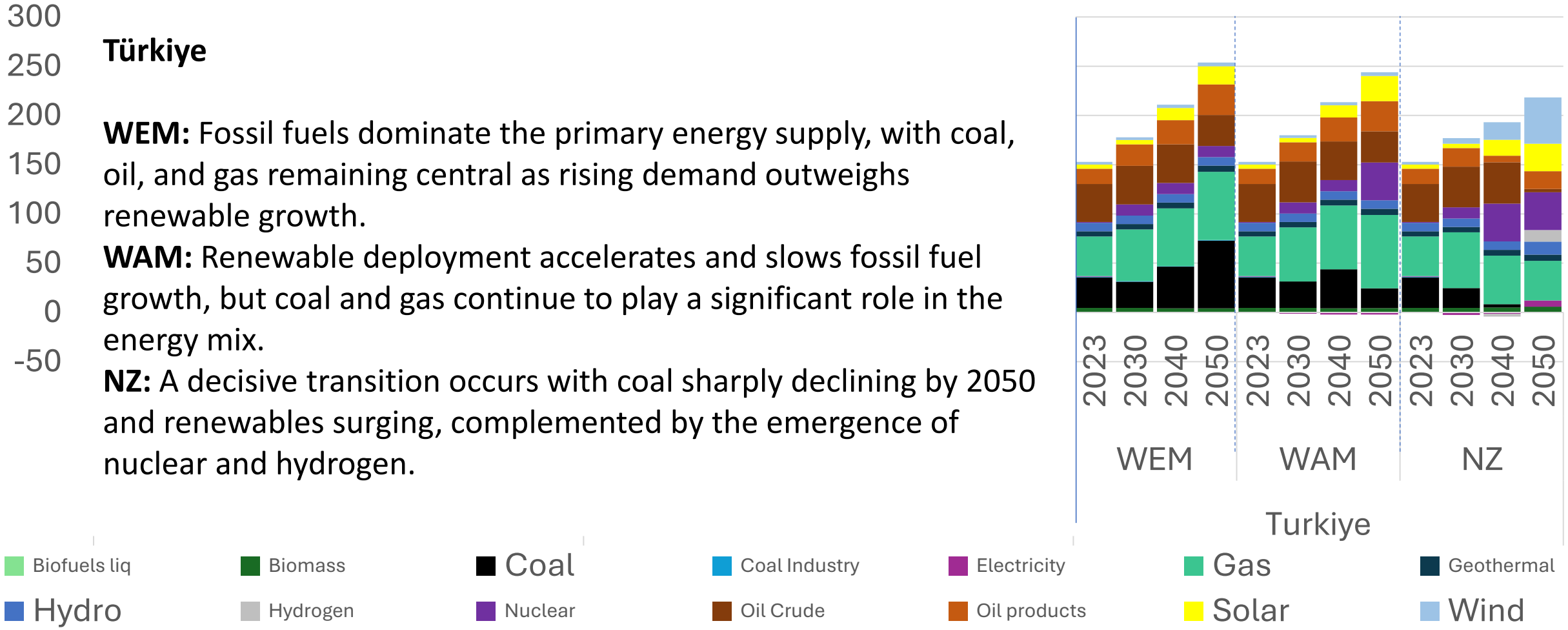
# Key Insights - PES

**Türkiye**

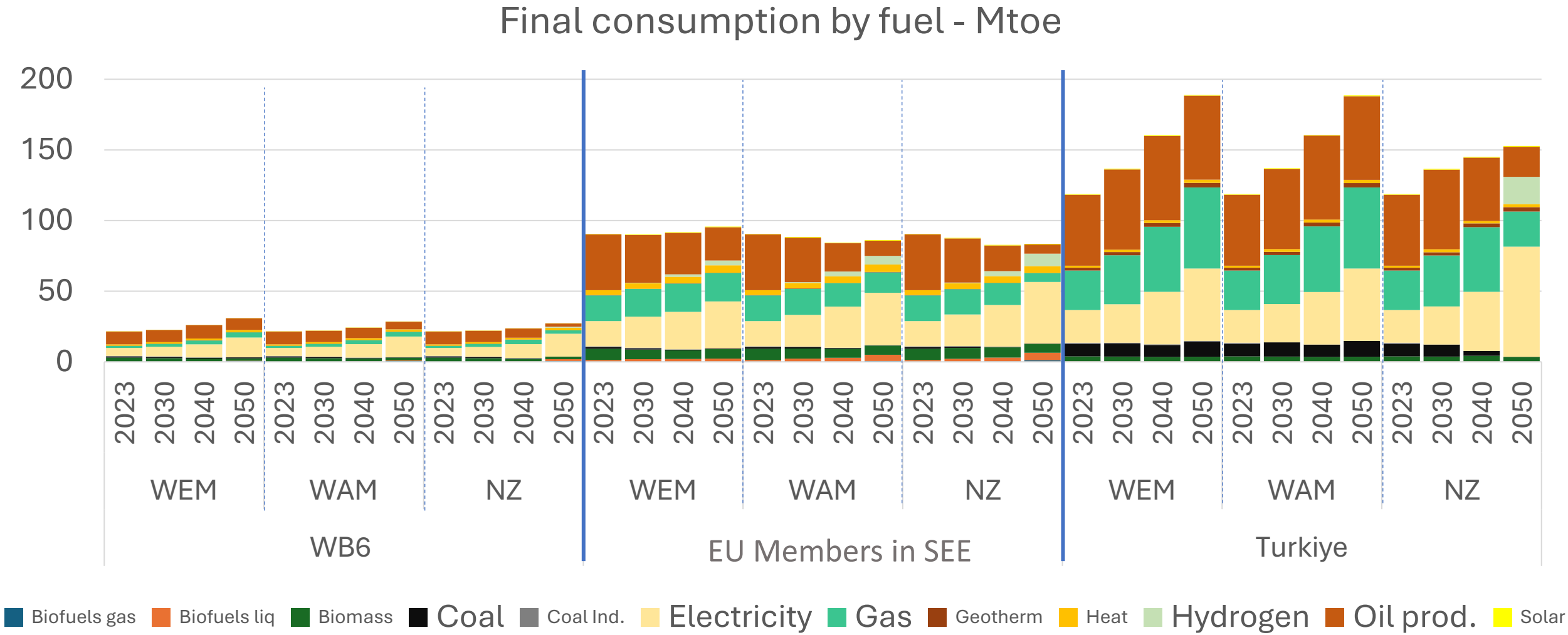
**WEM:** Fossil fuels dominate the primary energy supply, with coal, oil, and gas remaining central as rising demand outweighs renewable growth.

**WAM:** Renewable deployment accelerates and slows fossil fuel growth, but coal and gas continue to play a significant role in the energy mix.

**NZ:** A decisive transition occurs with coal sharply declining by 2050 and renewables surging, complemented by the emergence of nuclear and hydrogen.

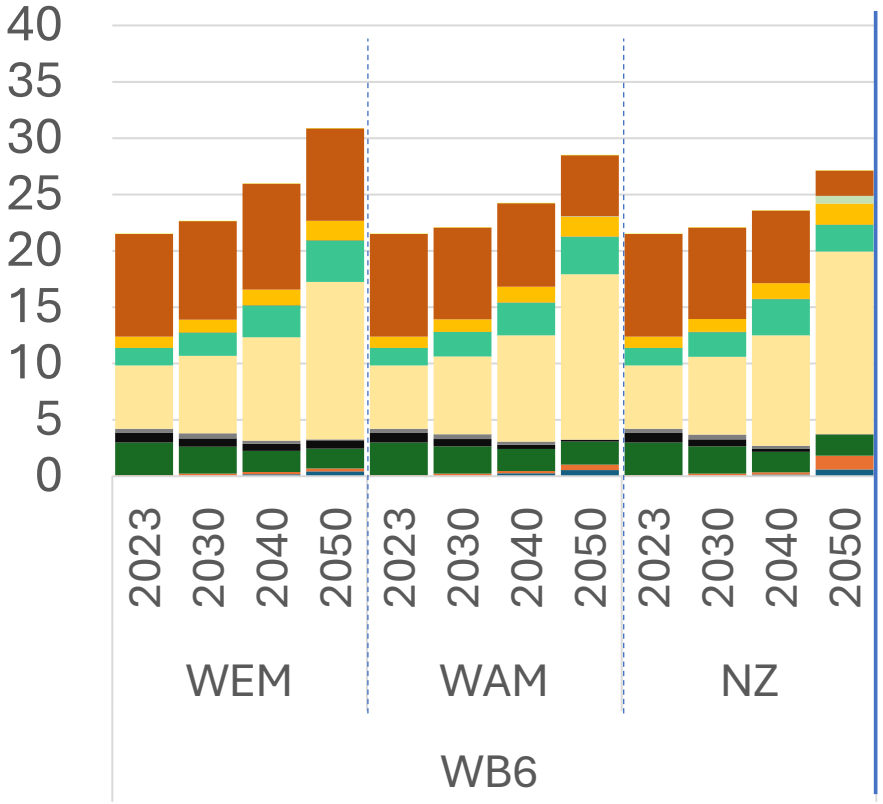


# Key Insights - Final Energy Consumption



# Key Insights - Final Energy Consumption

Final consumption by fuel - Mtoe




**WB6 Countries**

**WEM:** Final energy consumption continues to rely on oil products and coal, with gradual growth in electricity and gas**.**

**WAM:** Electricity consumption rises faster and coal use declines substantially, while oil products begin to fall and biomass remains broadly stable.

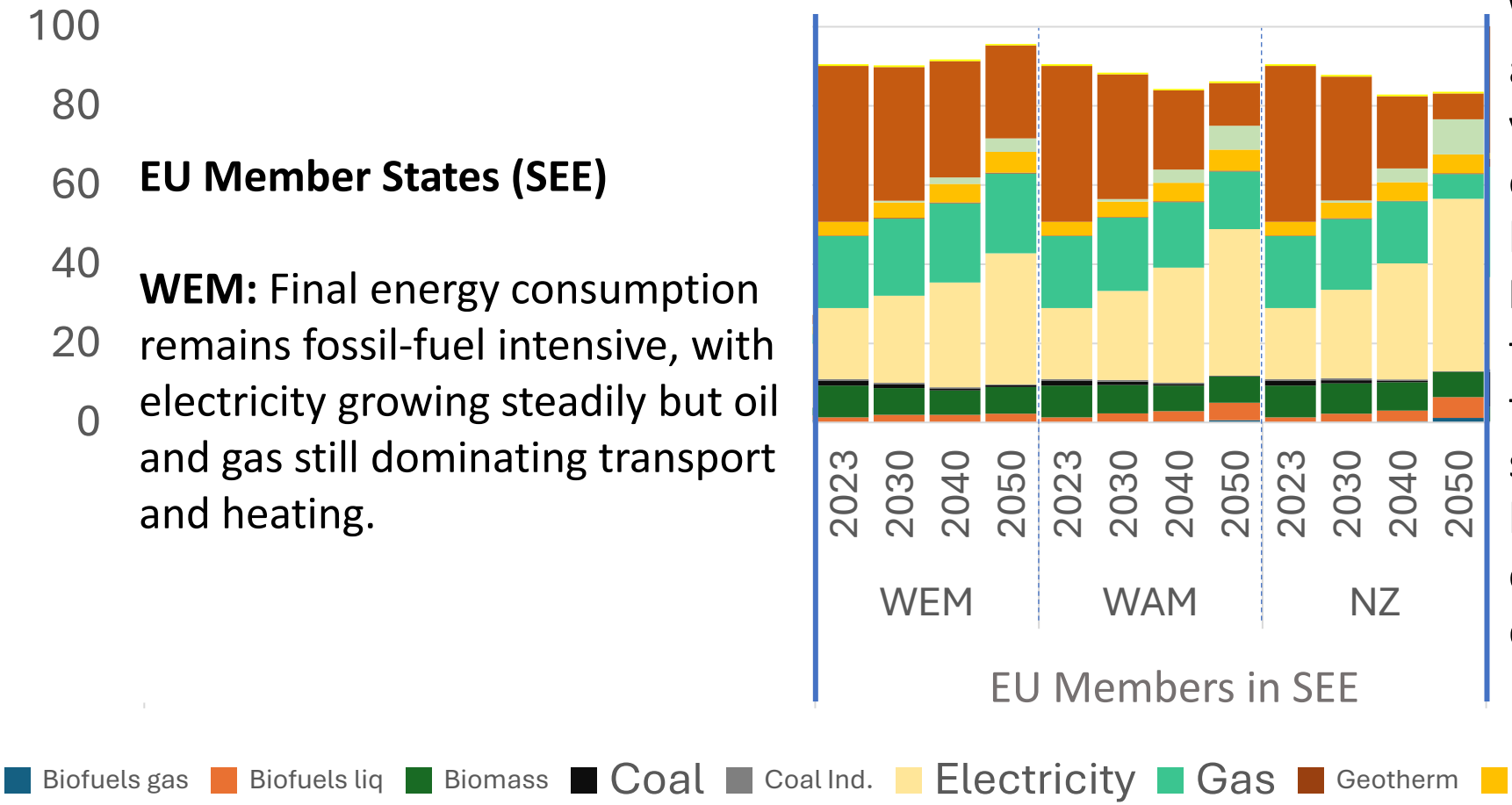
**NZ:** Electricity nearly triples by 2050, coal is reduced to zero, hydrogen starts to emerge, and oil products decline steadily as electrification deepens.

Biofuels gas | Biofuels liq | Biomass | Coal | Coal Ind. | Electricity | Gas | Geotherm | Heat | Hydrogen | Oil prod. | Solar

# Key Insights - Final Energy Consumption

**EU Member States (SEE)**

**WEM:** Final energy consumption remains fossil-fuel intensive, with electricity growing steadily but oil and gas still dominating transport and heating.




**WAM:** Electrification accelerates and fossil fuel use declines more visibly, with biofuels expanding and early hydrogen uptake beginning in hard-to-abate sectors.

**NZ:** Deep electrification drives the transition, with electricity more than doubling by 2050, coal and oil sharply reduced, and hydrogen and biofuels becoming significant components of final energy demand.

# Key Insights - Final Energy Consumption

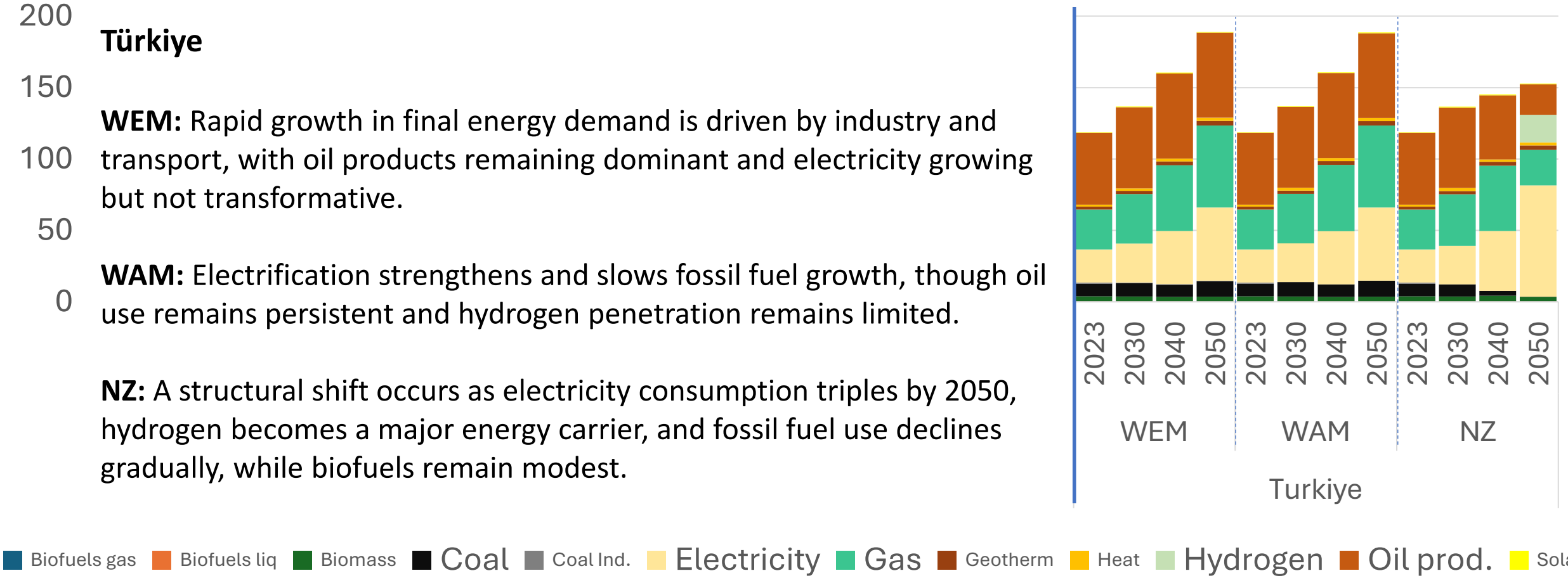
Final consumption by fuel - Mtoe

**Türkiye**

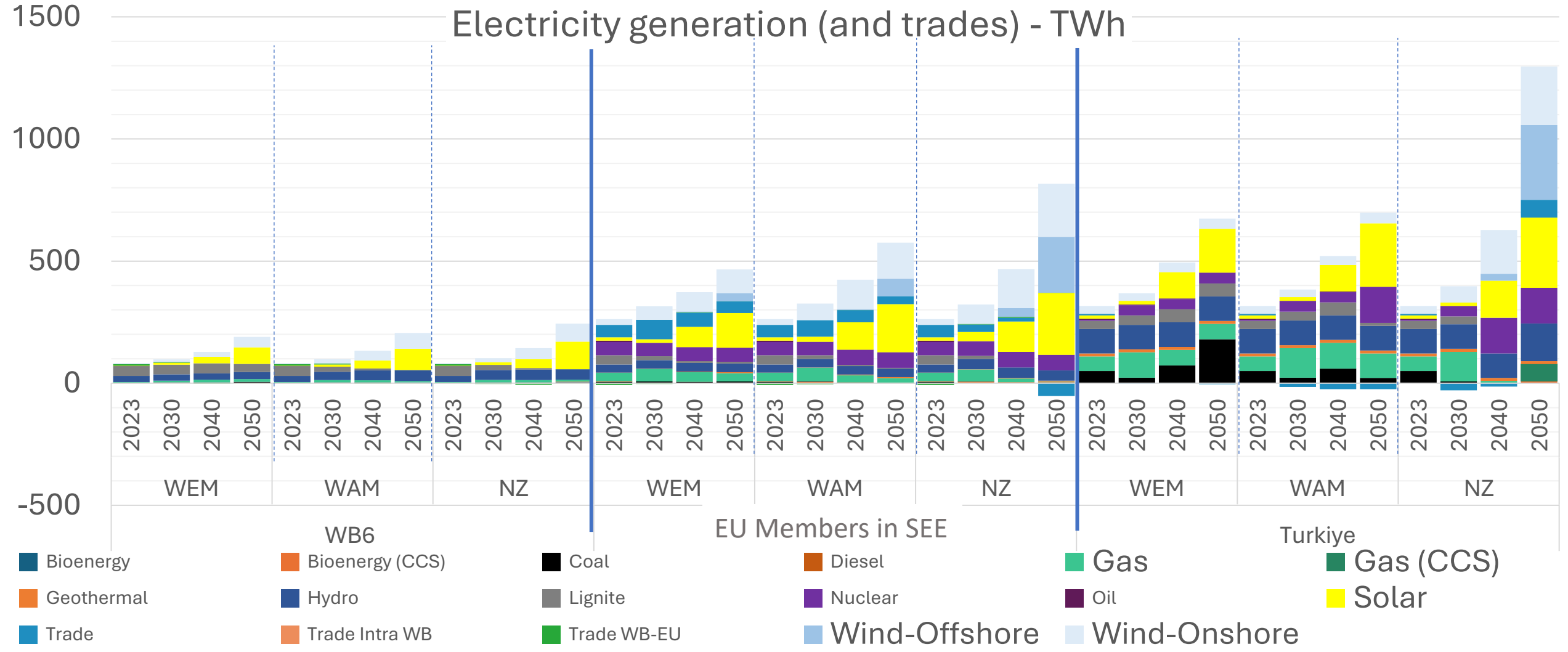
**WEM:** Rapid growth in final energy demand is driven by industry and transport, with oil products remaining dominant and electricity growing but not transformative.

**WAM:** Electrification strengthens and slows fossil fuel growth, though oil use remains persistent and hydrogen penetration remains limited.

**NZ:** A structural shift occurs as electricity consumption triples by 2050, hydrogen becomes a major energy carrier, and fossil fuel use declines gradually, while biofuels remain modest.



# Key Insights – Electricity Generation (GWh)



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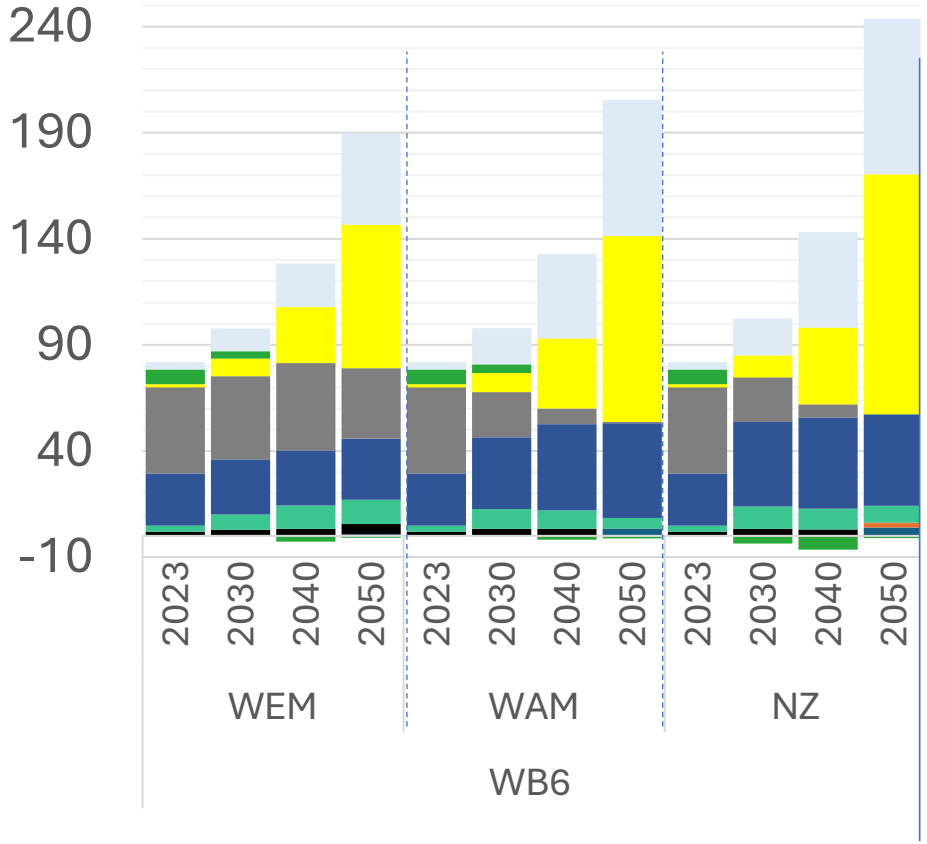



**WB6 Countries**

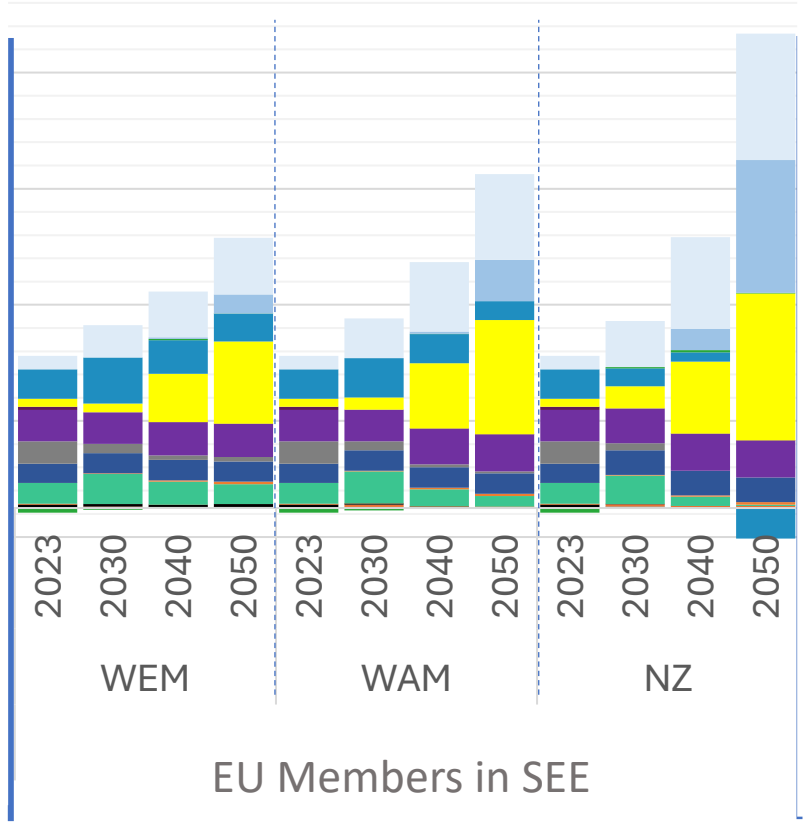
**WEM:** Electricity generation remains dominated by lignite and hydro, with penetration of wind and solar after 2040.
**WAM:** Coal use declines markedly as wind and solar scale up, while gas plays a transitional role.
**NZ:** Lignite and coal are fully phased out by 2050, hydro remains dominant, wind and solar expand rapidly, gas remains until 2050.

Bioenergy
Bioenergy (CCS)
Coal
Diesel
Gas
Gas (CCS)
Geothermal
Hydro
Lignite
Nuclear
Oil
Solar
Trade
Trade Intra WB
Trade WB-EU
Wind-Offshore
Wind-Onshore

# Key Insights – Electricity Generation (GWh)

**EU Member States (SEE)**

**WEM:** Coal and lignite decline steadily, while wind and solar expand strongly and nuclear remains a stable backbone of electricity generation.




**WAM:** Faster coal phase-out and accelerated renewable deployment significantly reduce the role of fossil generation, reinforcing power-sector decarbonisation.
**NZ:** Coal and lignite are virtually eliminated by 2050, replaced by very large-scale wind and solar, complemented by nuclear and bioenergy with CCS, delivering near-zero-emission electricity.

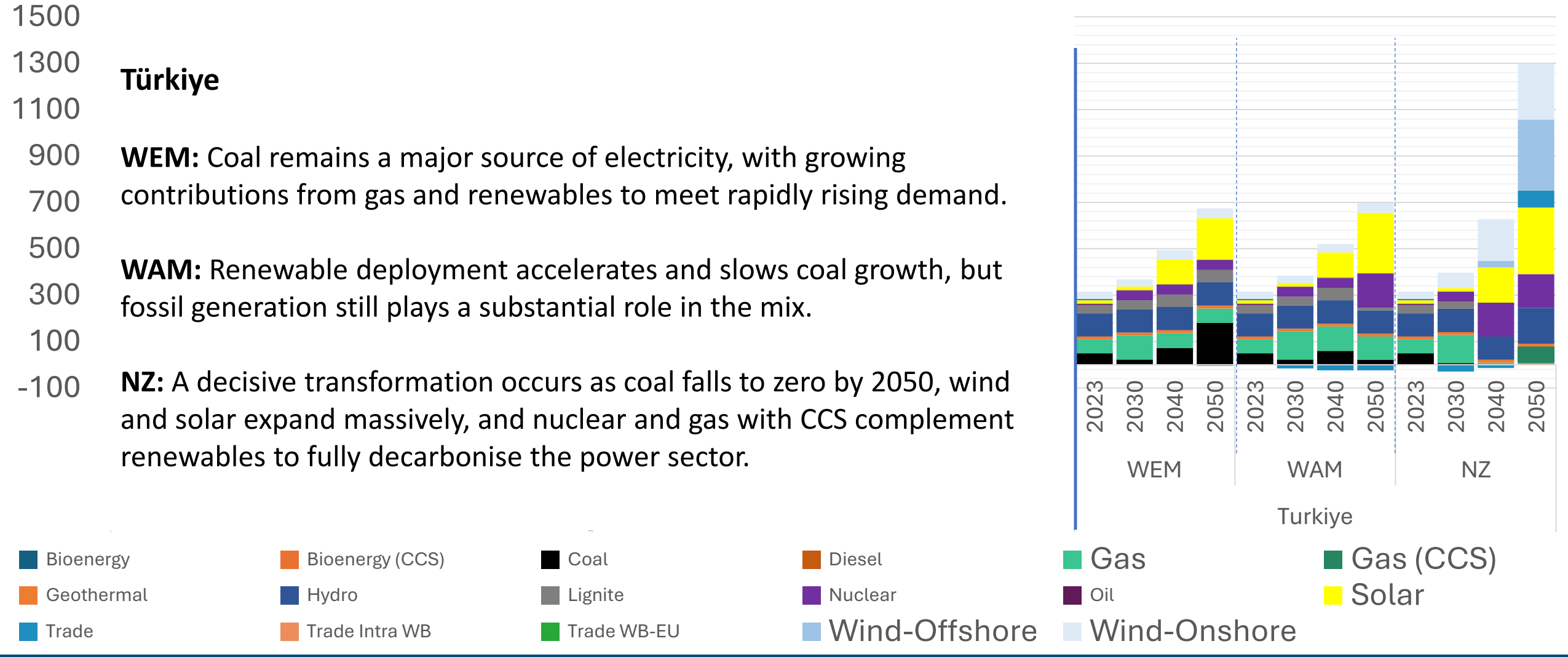
# Key Insights – Electricity Generation (GWh)

**Türkiye**

**WEM:** Coal remains a major source of electricity, with growing contributions from gas and renewables to meet rapidly rising demand.

**WAM:** Renewable deployment accelerates and slows coal growth, but fossil generation still plays a substantial role in the mix.

**NZ:** A decisive transformation occurs as coal falls to zero by 2050, wind and solar expand massively, and nuclear and gas with CCS complement renewables to fully decarbonise the power sector.



# Key Insights EU Member States in SEE

**WEM**

- Early and steady decline of coal and oil, with gas acting as a transitional fuel and renewables expanding.
- Electricity sector decarbonizes progressively.
- Import dependency declines gradually, reflecting efficiency gains and increasing domestic low-carbon generation.

**WAM**

- Accelerated phase-out of coal and faster renewable deployment.
- Stronger electrification and efficiency improvements stabilize final energy consumption.
- $CO_2$ emissions decline significantly across power, transport, and buildings.

**NZ**

- Near-complete elimination of coal and lignite by 2050, with renewables exceeding 90% of the energy mix.
- Power sector reaches near-zero emissions, supported by renewables, and CCS.
- Import dependency drops sharply, approaching energy autonomy under deep decarbonisation. Hydrogen appears as a fuel in industry.

# Key Insights Western Balkans (WB6)

**WEM**

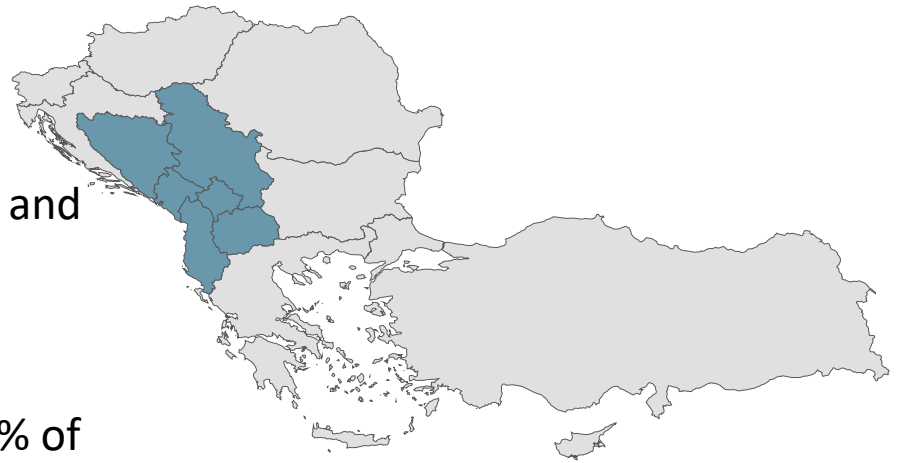
- Persistent reliance on coal and oil products.
- Energy demand rises with economic development, emissions remain high, weakly decoupled from GDP.
- Import dependency remains significant, with growing gas imports and continued oil reliance.

**WAM**

- Noticeable reduction in coal use and faster penetration of renewables.
- Emissions intensity declines, but fossil fuels still play a substantial role in industry and transport.
- Import dependency improves modestly, though gas imports continue to rise.

**NZ**

- Transformational shift with coal fully phased out and renewables reaching 80–90% of final energy by 2050.
- Electricity sector fully decarbonised, with net electricity exports emerging by mid-century.
- Import dependency falls substantially, and hydrogen uptake remains limited compared to EU SEE.



# Key Insights Türkiye

**WEM**

- Strong growth in energy demand driven by population, urbanisation, and industrial expansion.
- Fossil fuels dominate the energy mix, with coal, gas, and oil imports peaking at 60–70% of total supply by 2030.
- Emissions continue to rise, with only partial decoupling from economic growth.

**WAM**

- Visible diversification of the energy mix, with renewables expanding alongside continued fossil fuel use.
- Power sector emissions decline, but industry and transport remain heavily fossil-fuel dependent.
- Import dependency remains high, reflecting sustained demand growth and limited structural change.

**NZ**

- Near-complete decarbonisation of the power sector by 2050 (RES and nuclear).
- Renewables reach around 70% of gross final energy consumption, hydrogen and CCS emerging after 2040.
- Import dependency drops markedly, but becomes a regional hydrogen importer.

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