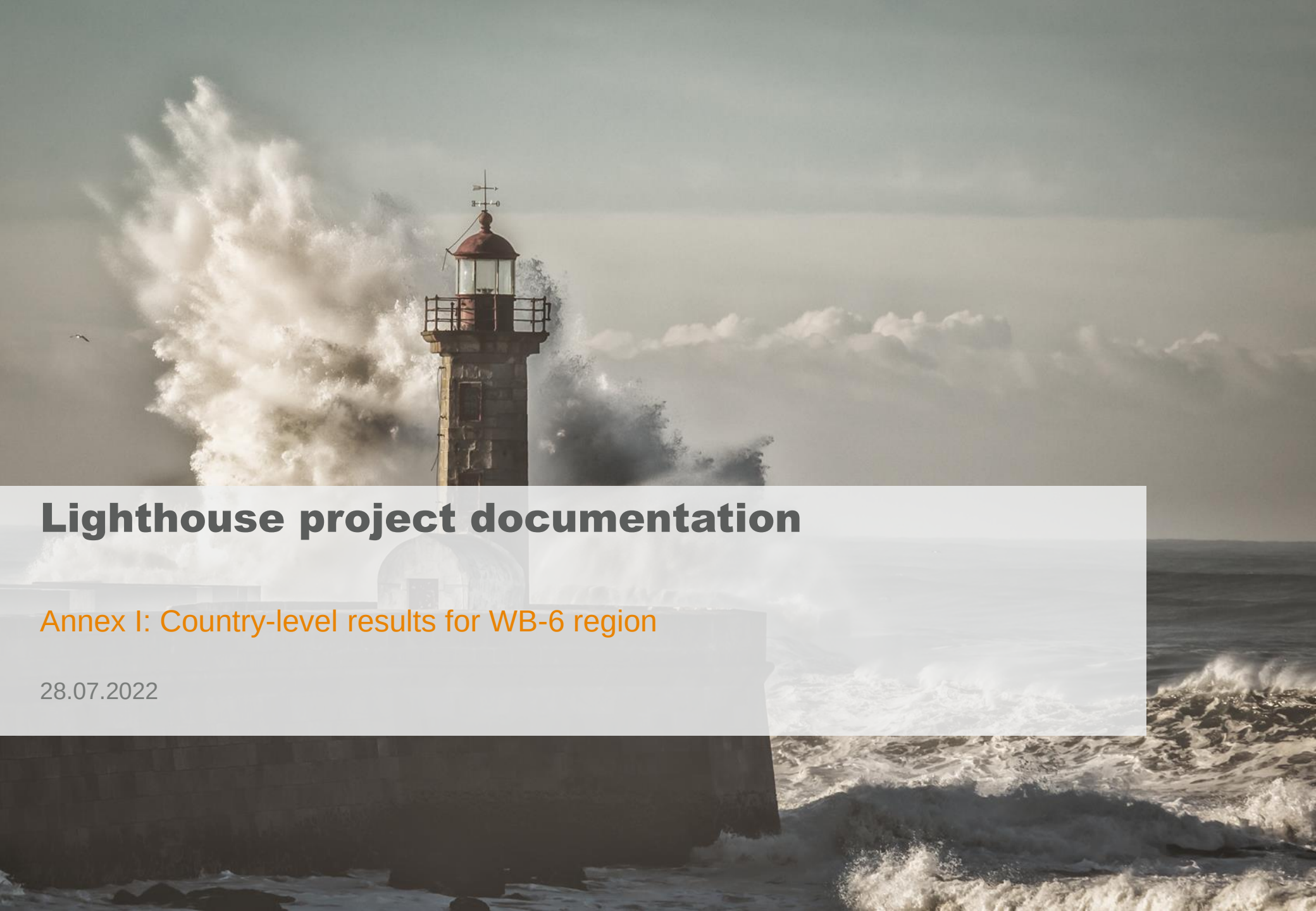


Lighthouse project documentation

Annex I: Country-level results for WB-6 region

28.07.2022

Contents

Annex I

Methodology & scenarios

Overview of scenario design

Three core scenarios were designed and analysed for all countries in the focus region WB-6 (AL, BA, MK, ME, RS, XK). They display the implications of two different decarbonisation pathways compared to a baseline without net-zero target for the power sector. Three sensitivities assess the impact of crucial parameters on the scenario outcome.

SCENARIOS	CORE	SENSITIVITIES		
		S2 H2 COSTS	S3 REDOX-FLOW BREAKTHROUGH	S4 THERMAL STORAGE BREAKTHROUGH
FOSSIL BASELINE	Baseline scenario with current ambition level and no increased decarbonisation efforts	Not relevant	Not relevant	Not relevant
GAS LOCK-IN (GL)	Earlier investments into gas plants, late retrofit to H2, no storages	Gas lock-in in a H2 risk scenario (increased H2 price over duration)	Not relevant	Not relevant
SMART TRANSITION (ST)	Smart transition with earlier H2-readiness and investments into storage technologies	Smart transition in a H2 risk scenario (increased H2 price over duration)	Smart transition with technological breakthrough of redox-flow batteries	Smart transition with technological breakthrough of thermal storages

Detailed results – country-level (WB-6 region)

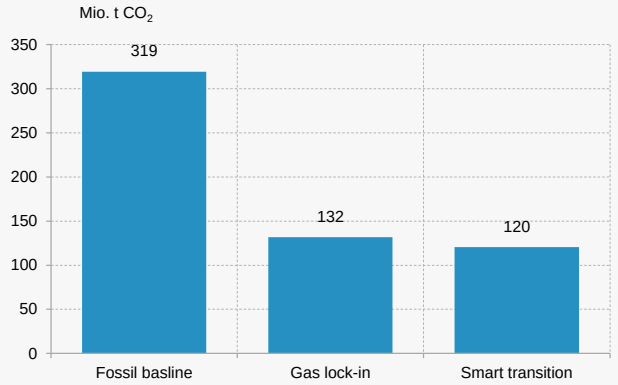
BA

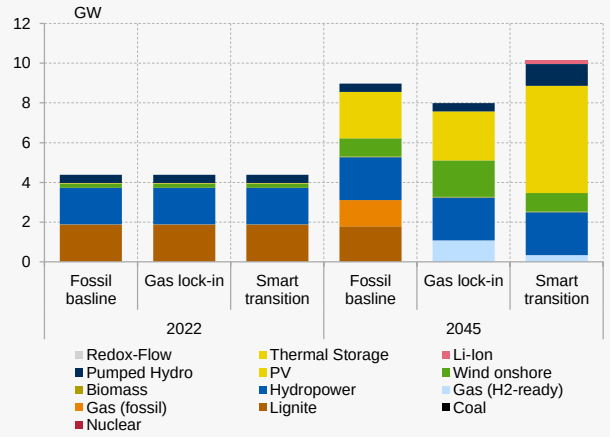
Overview of core scenario results (BA)

Within the core set of scenarios, the smart transition strategy shows similar incremental generation costs compared to baseline), main driver being lower exports due to a limitation of the country‘s lignite generation compared to baseline. A gas lock-in strategy increases the costs by 18%.

Cumulated CO_2 emissions

- Decarbonisation strategies overall save 59% CO_2 compared to baseline
- Smart transition saves additional 3%



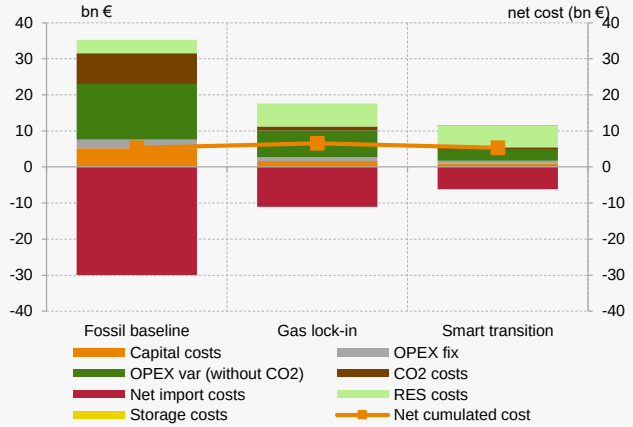


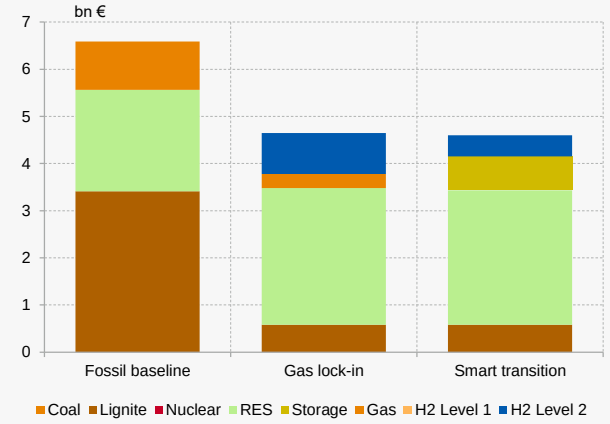
Capacities

- Net-zero scenarios deploy 4.5 GW & 6.5 GW of RES by 2045
- Storage scenario deploys less gas capacity and integrates more PV

Incremental generation costs

- ST shows similar net costs to baseline even though climate ambition is much higher
- Main driver isexports, fuel and CO_2 costs





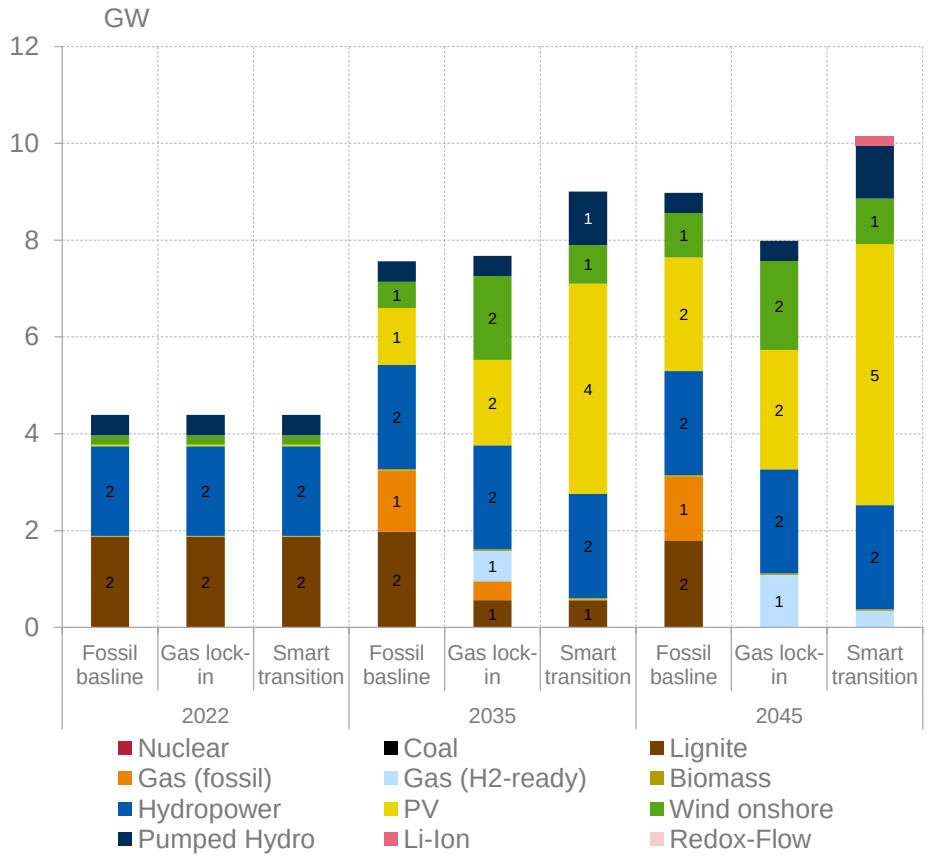
Investment costs

- Baseline investments to a large share go to fossil technology including lignite
- Net-zero scenarios strongly invest in RES

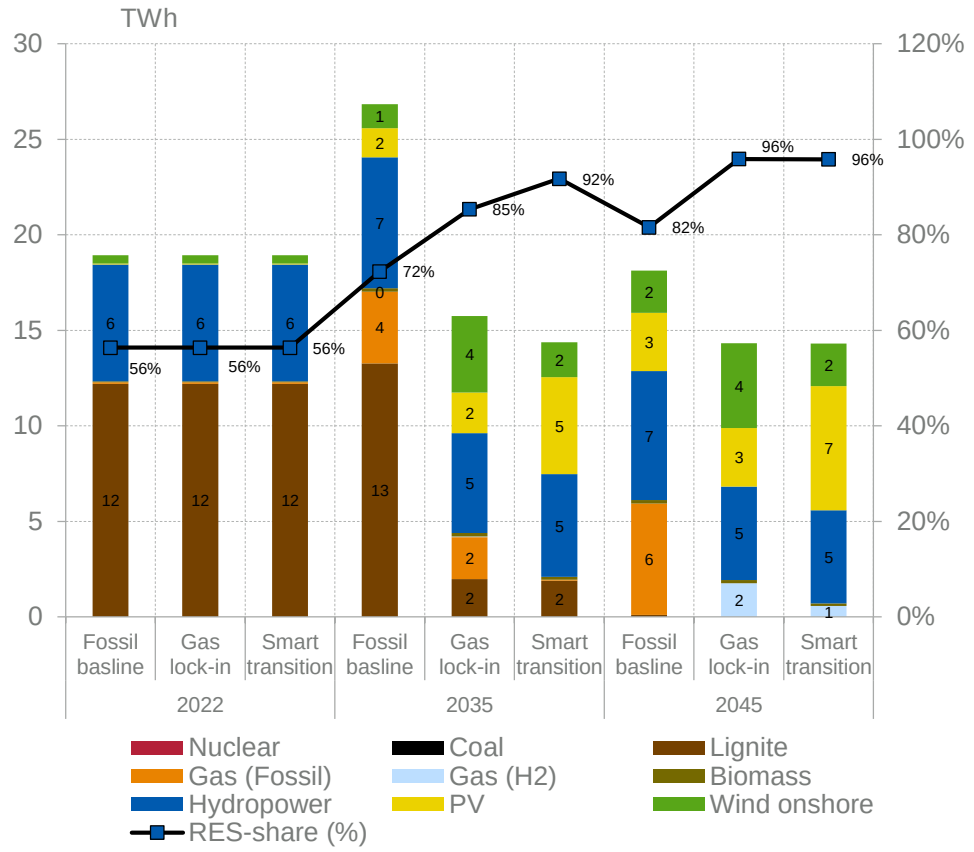
Generation & Capacity (BA)

The decarbonisation scenarios (GL, ST) see an accelerated reduction of lignite capacities, substituted by RES (& storages in the ST). Gas-based production is reduced significantly in the medium-term (down 50% in GL and >90% in ST by 2035) and replaced by hydrogen. Long-term, investments into storages can reduce H2-demand by >50%.

Capacity



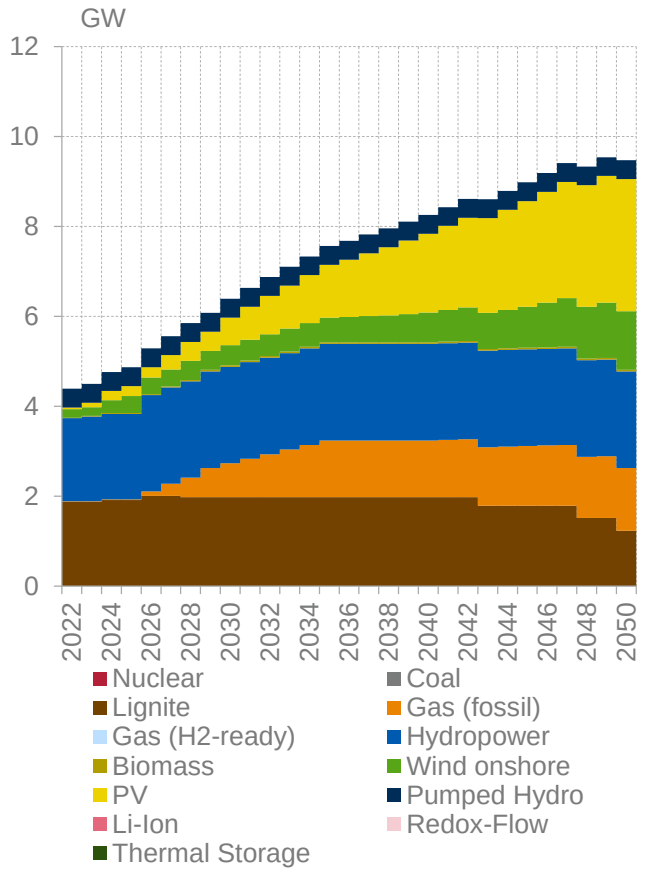
Generation



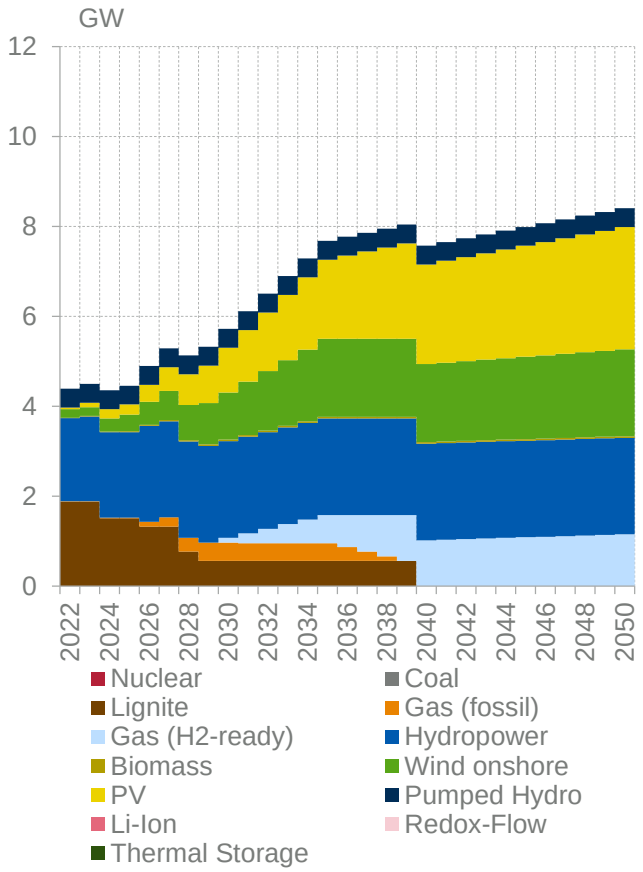
Capacity (BA)

In both decarbonisation scenarios, lignite capacities are replaced by increasing RES capacities. In the ST more than double of the GL PV capacities, complementary to storage expansion, are built in the long-term. Pumped hydro potential is fully utilised, while additional 3.9 GW of Li-Ion batteries are deployed.

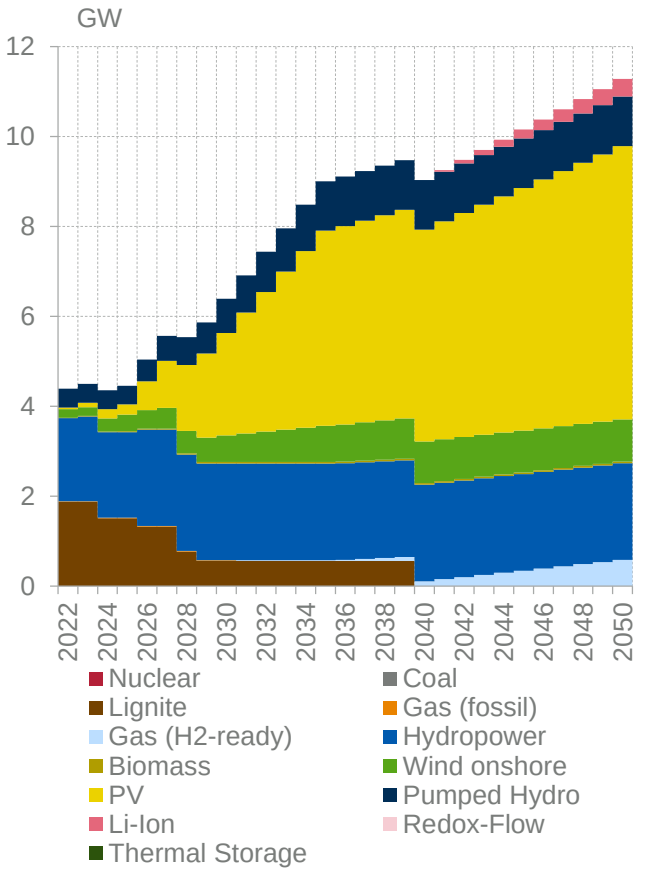
Fossil baseline



Gas lock-in



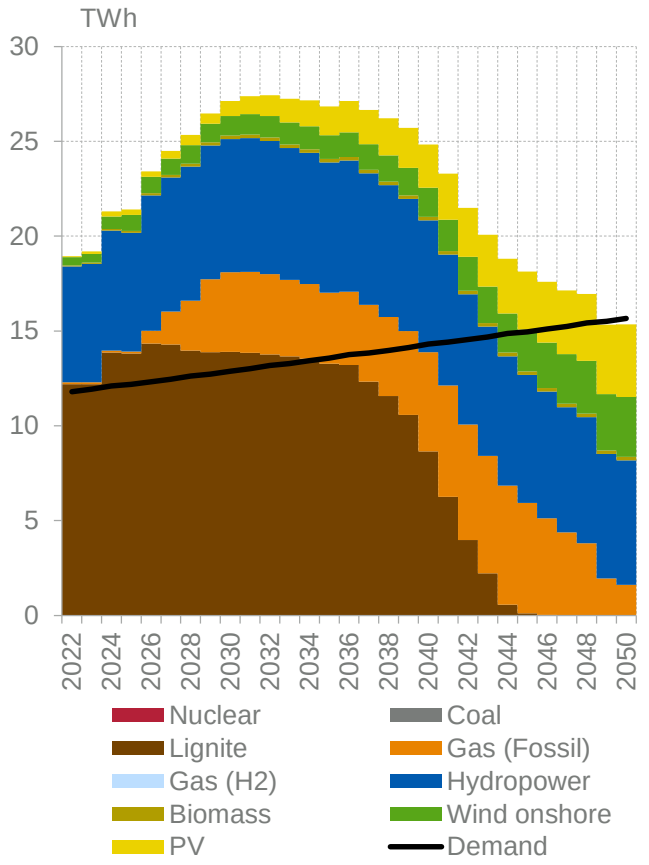
Smart transition



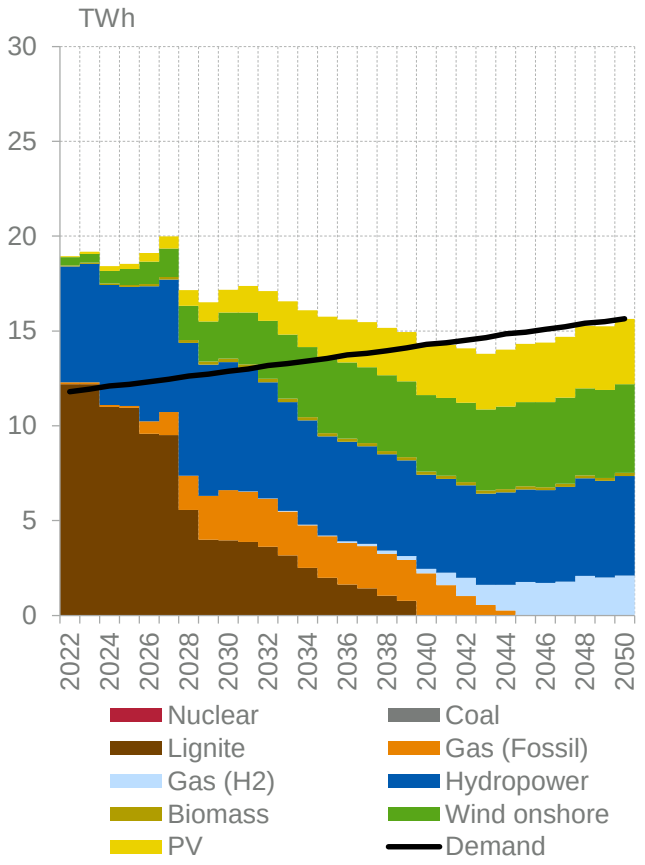
Generation (BA)

Earlier decomissioning and lower utilisation of lignite plants decreases exported power and is compensated mainly by renewables. Gas demand is reduced to a minimum required for remaining flexibility needs in the smart transition.

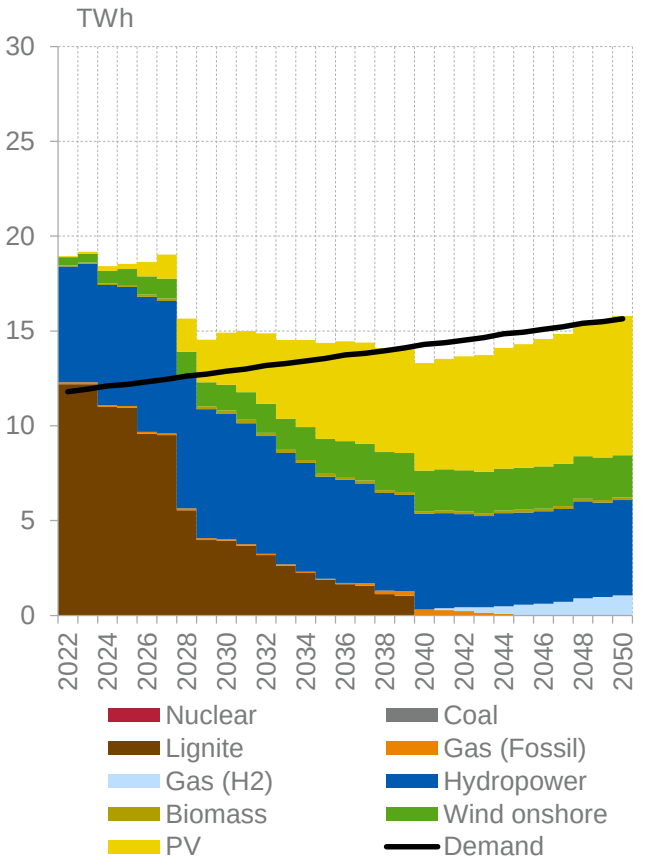
Fossil baseline



Gas lock-in



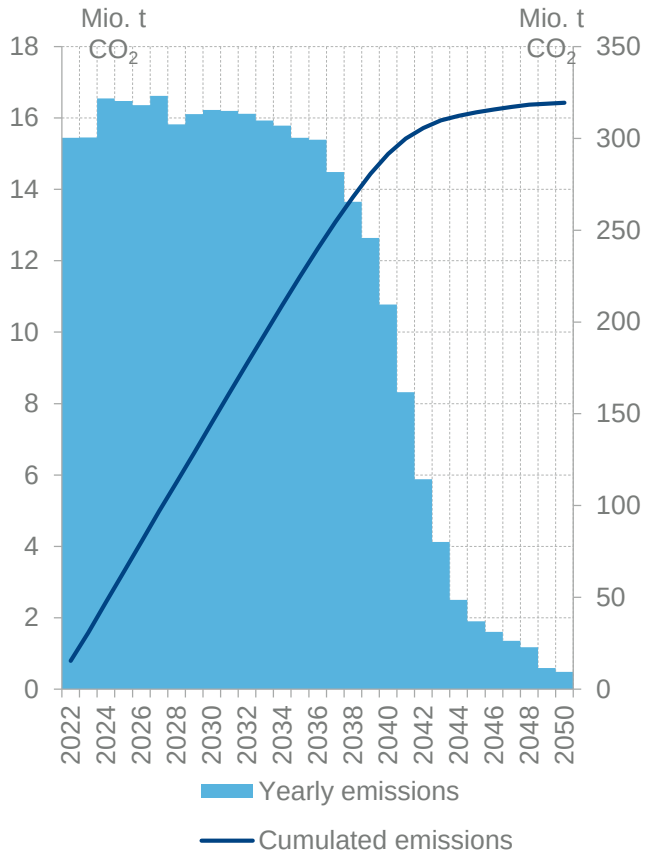
Smart transition



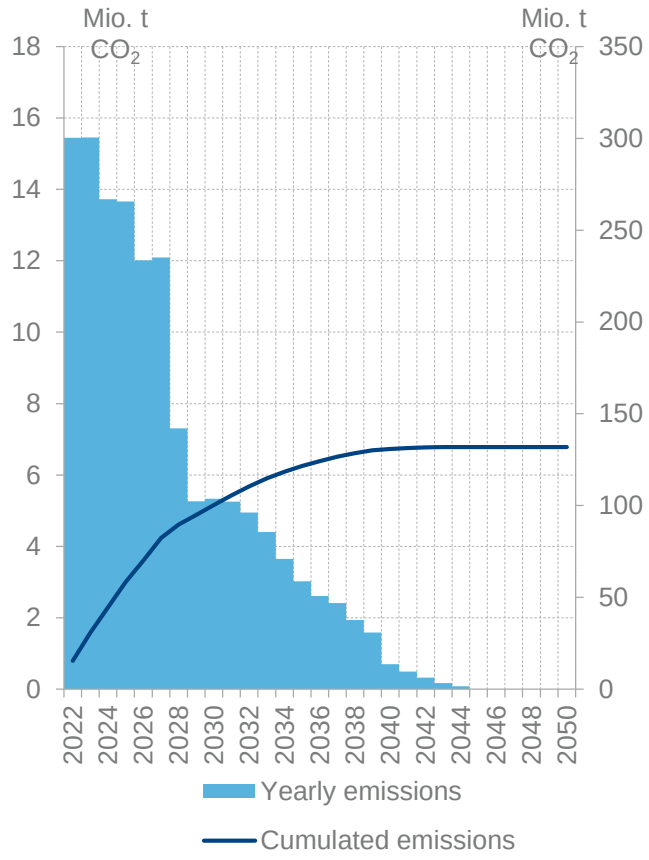
Emissions (BA)

Long-term cumulated emissions until 2050 are reduced by 59% in the GL and an additional 3% in the ST. The high-gradient decrease in the late 2020s in mainly driven by decomissioning of of lignite capacity in the respective timeframe. A complete decarbonisation of the power sector is achieved until 2045.

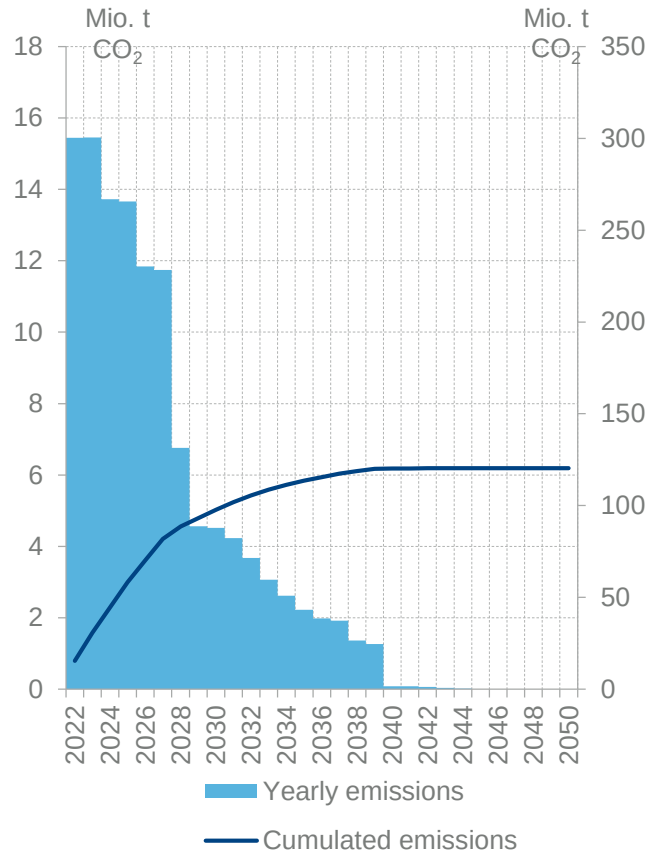
Fossil baseline



Gas lock-in



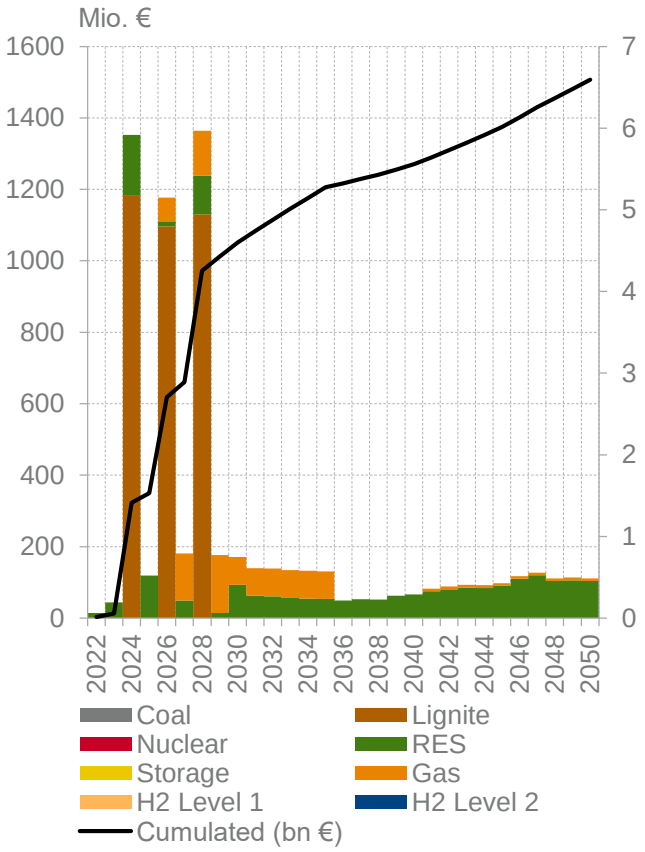
Smart transition



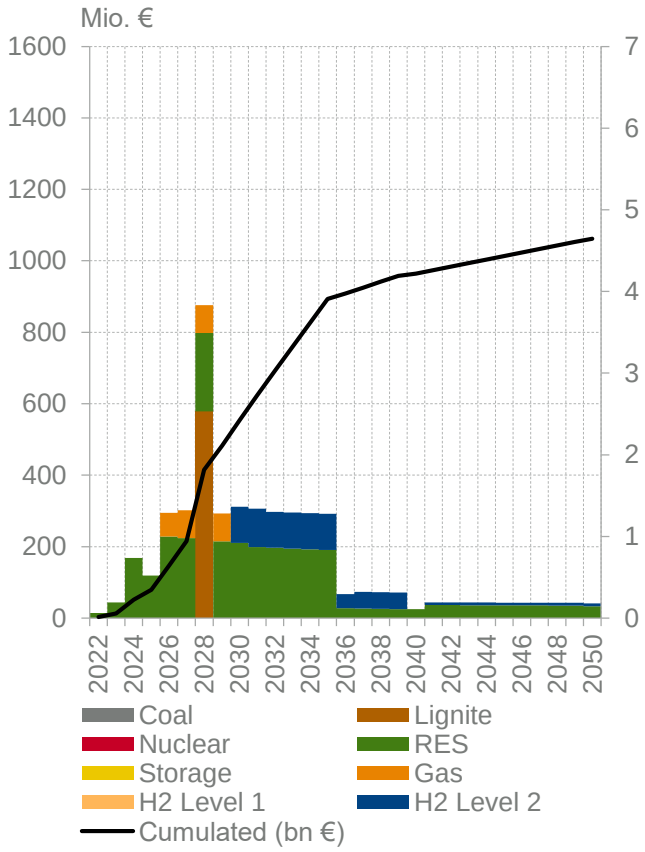
Investment costs (BA)

In total, lower investments are made in decarbonization scenarios in Bosnia & Herzegovina. Compared to baseline, ~30% can be saved by an early lignite exit. Instead, investments are channelled towards onshore wind and PV assets. A smart transition mitigates costs for H2-readiness retrofits, but increases investment needs for storages.

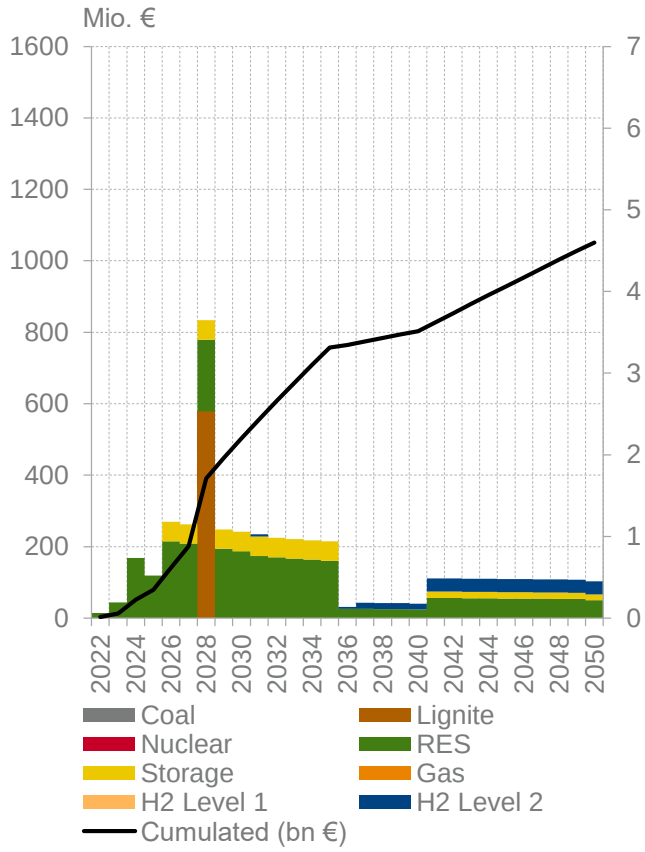
Fossil baseline



Gas lock-in



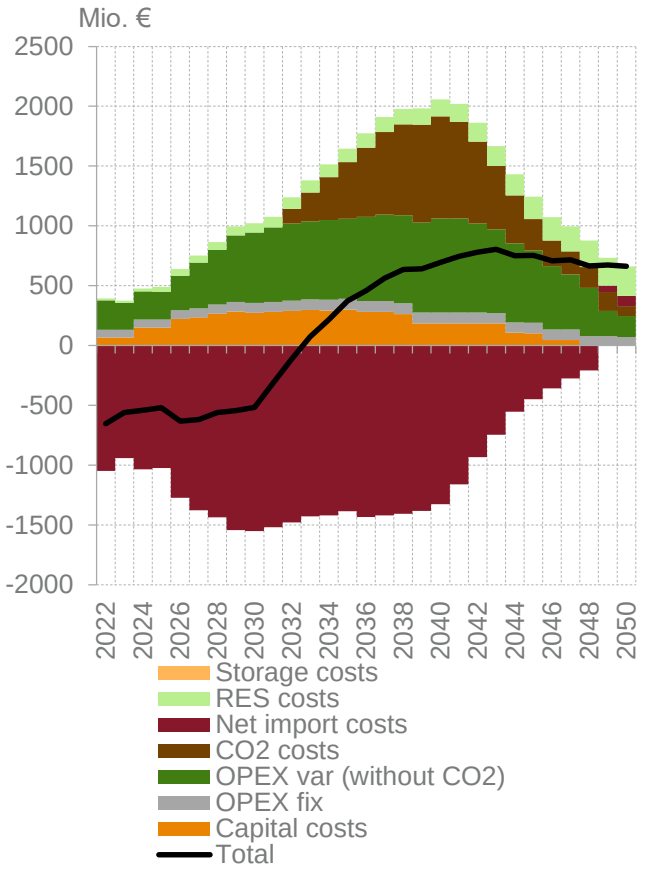
Smart transition



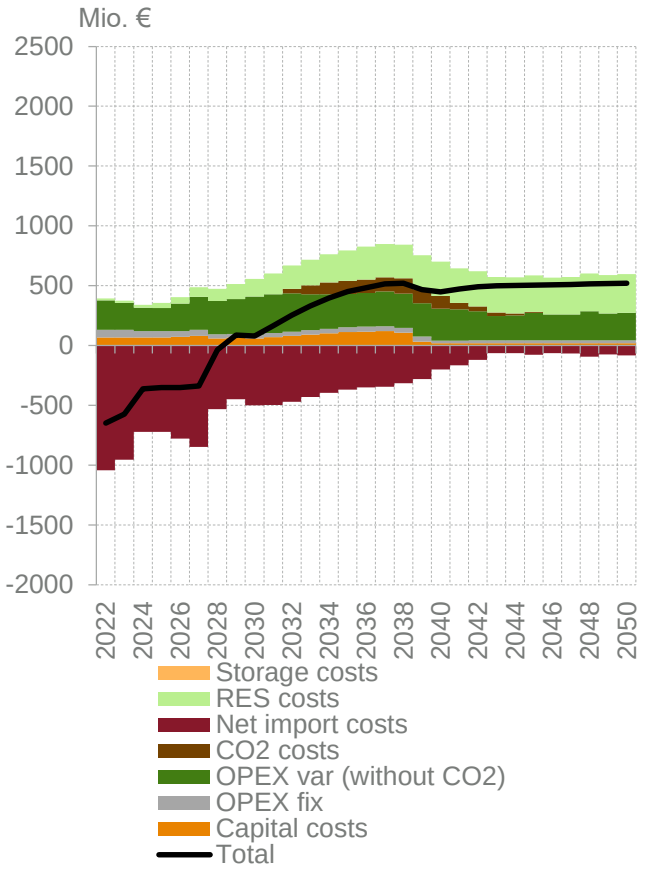
Incremental generation costs (BA)

In total, cumulated incremental generation costs until 2050 increase in the GL(18%) and remain the same in the ST). While import revenues decrease due to reduced lignite capacity & utilisation, savings in OPEX and CO_2 cost (due to lower lignite and gas-based production) are realised.

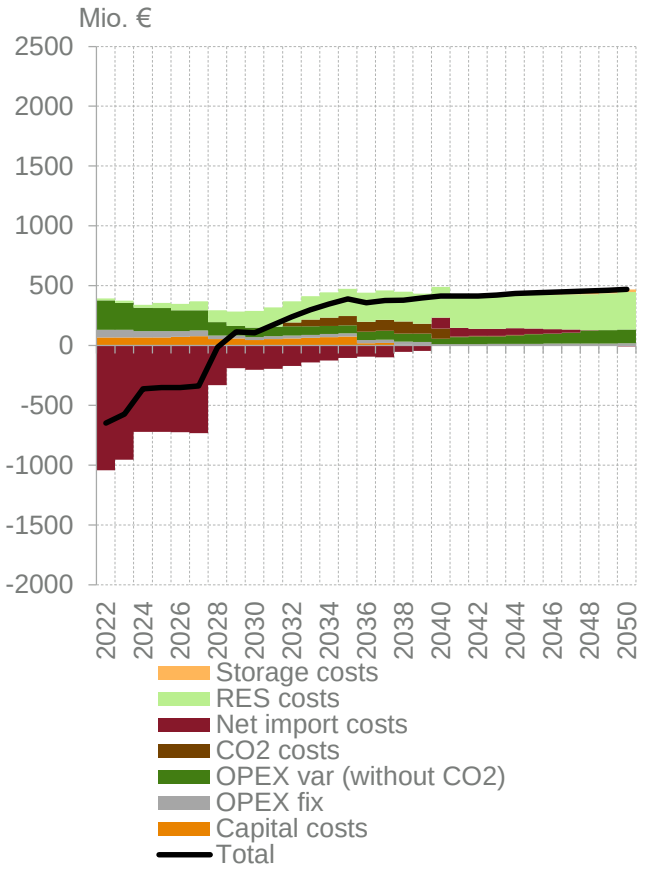
Fossil baseline



Gas lock-in



Smart transition



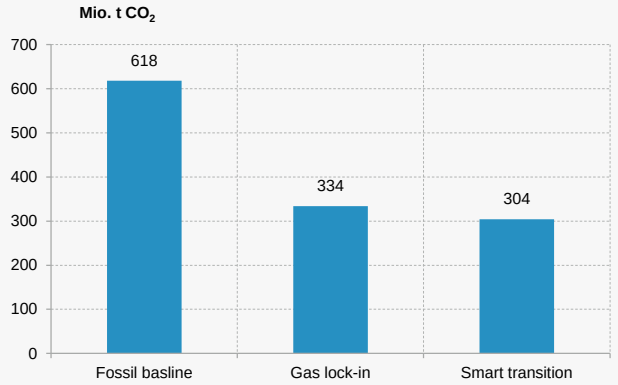
RS

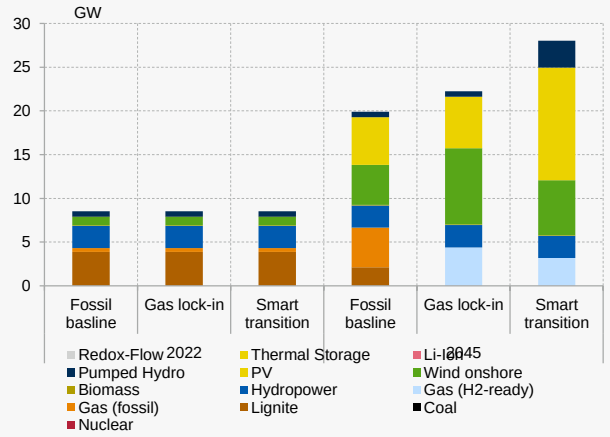
Overview of core scenario results (RS)

Within the core set of scenarios, the smart transition strategy shows potential for significant reduction in overall Incremental generation costs (~10% compared to baseline), driven by savings in OPEX and CO_2 costs.

Cumulated CO_2 emissions

- Decarbonisation strategies overall save 46% CO_2 compared to baseline
- Smart transition saves additional 5%



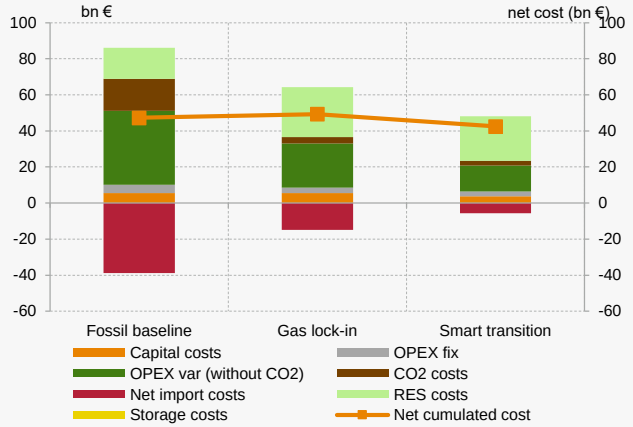


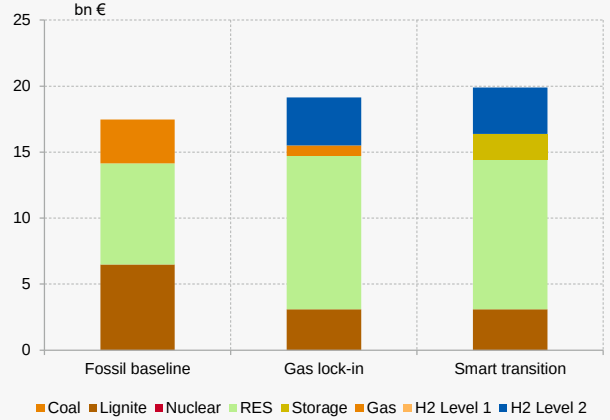
Capacities

- Net-zero scenarios deploy 14.5 GW & ~19 GW of RES by 2045
- Storage scenario deploys less gas capacity and integrates more PV

Incremental generation costs

- ST saves 10% vs. baseline even though climate ambition level is much higher. GL increases costs by 4%
- Main driver is fuel and CO_2 costs





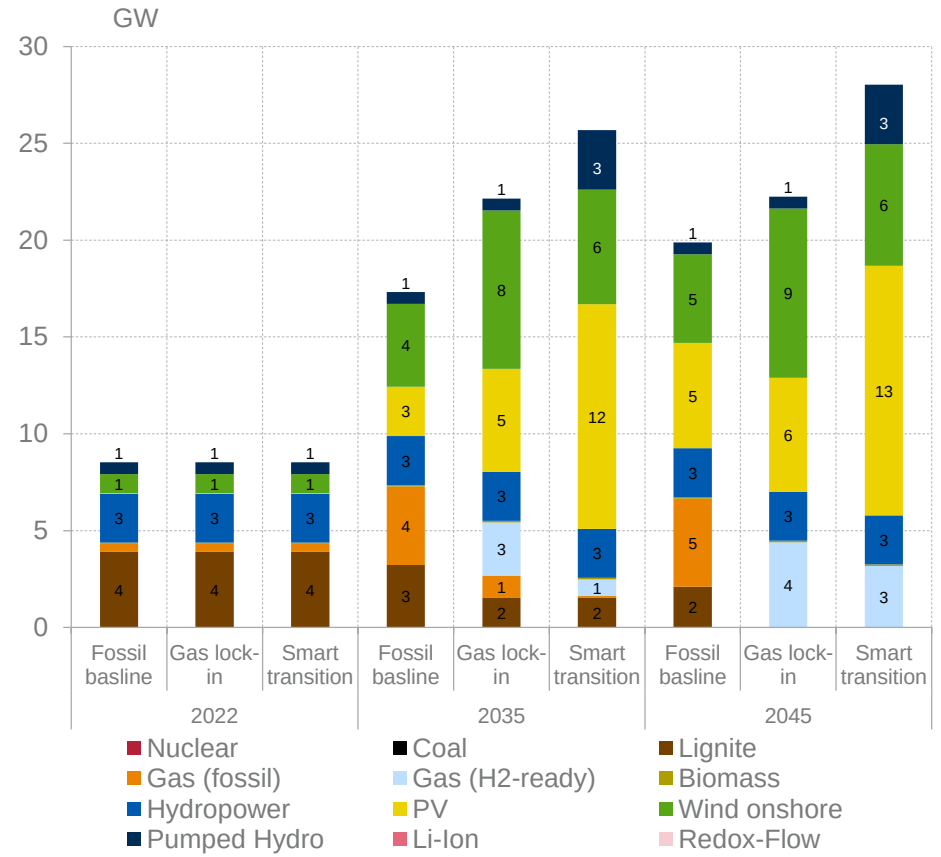
Investment costs

- Baseline investments to a large share go to fossil technology
- Net-zero scenarios strongly invest in RES

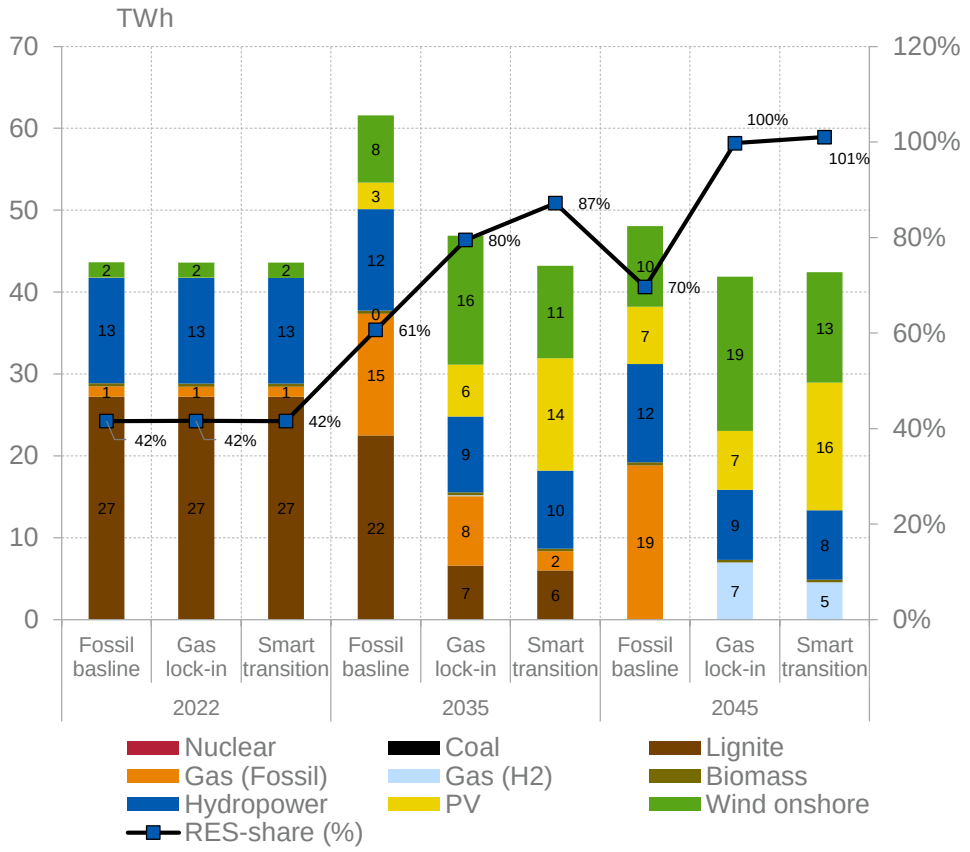
Generation & Capacity (RS)

The decarbonisation scenarios (GL, ST) see an accelerated reduction of lignite capacities, substituted by RES (& storages in the ST). Gas-based production is reduced significantly in the medium-term (down 45% in GL and 85% in ST by 2035) and replaced by hydrogen. Long-term, investments into storages can reduce H2-demand by 35%.

Capacity



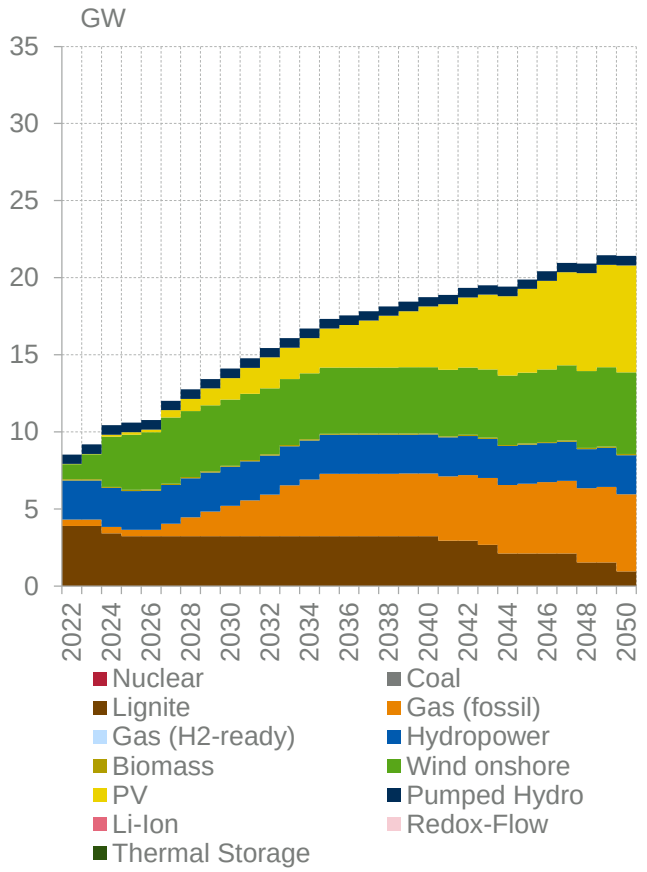
Generation



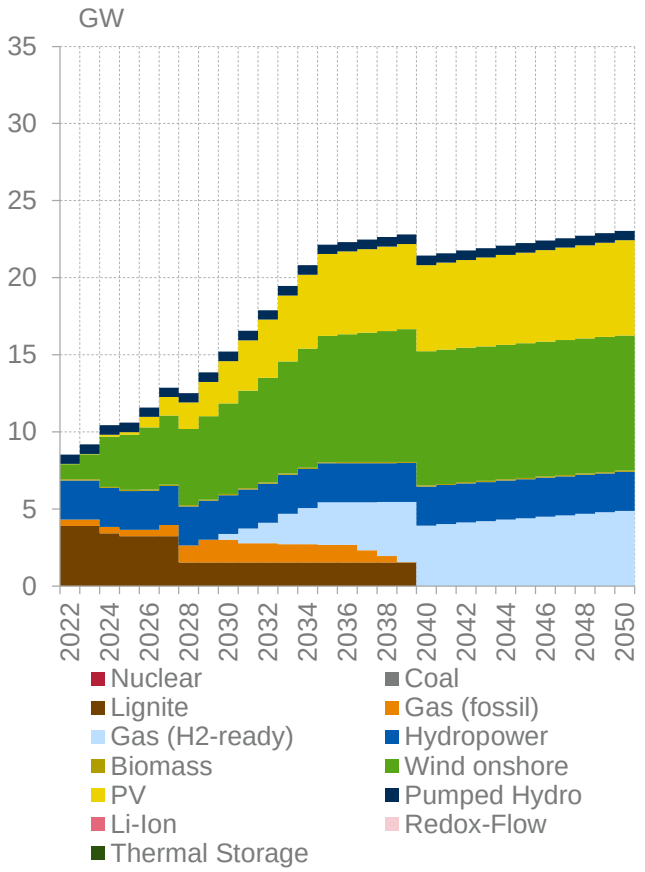
Capacity (RS)

In both decarbonisation scenarios, lignite capacities are replaced by increasing RES capacities. In the ST more than double of the GL PV capacities, complementary to storage expansion, are built in the long-term. Pumped hydro potential is fully utilised to cover storage demands.

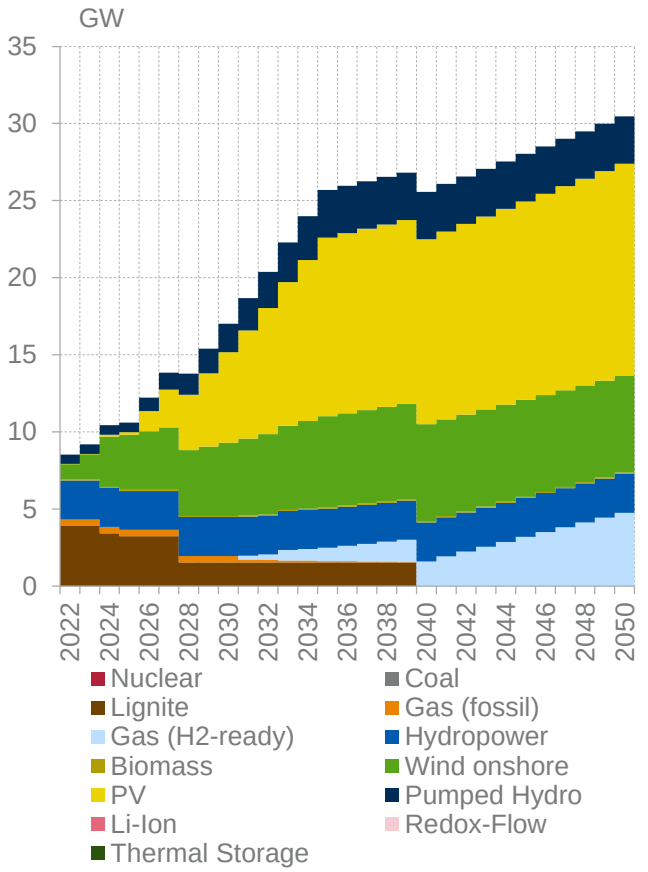
Fossil baseline



Gas lock-in



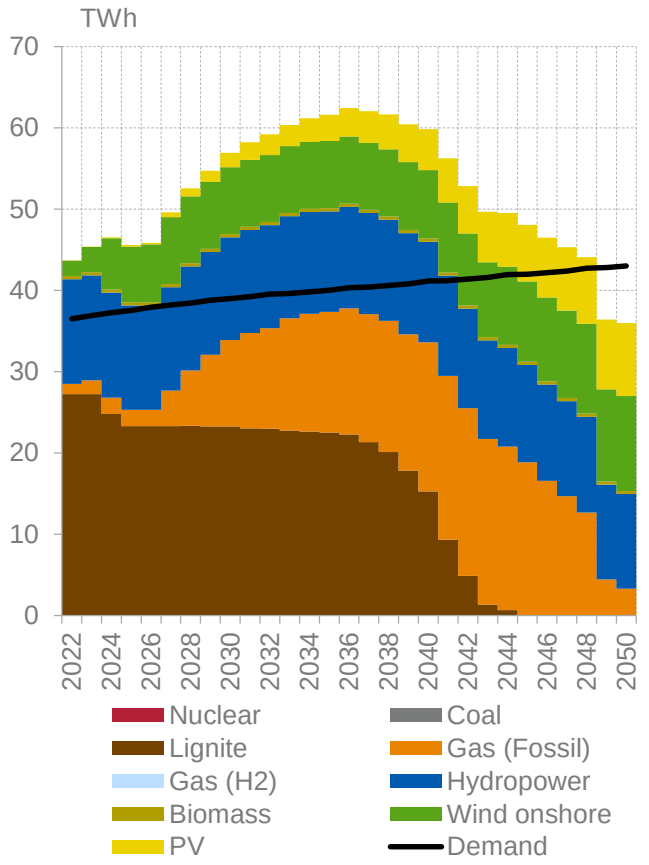
Smart transition



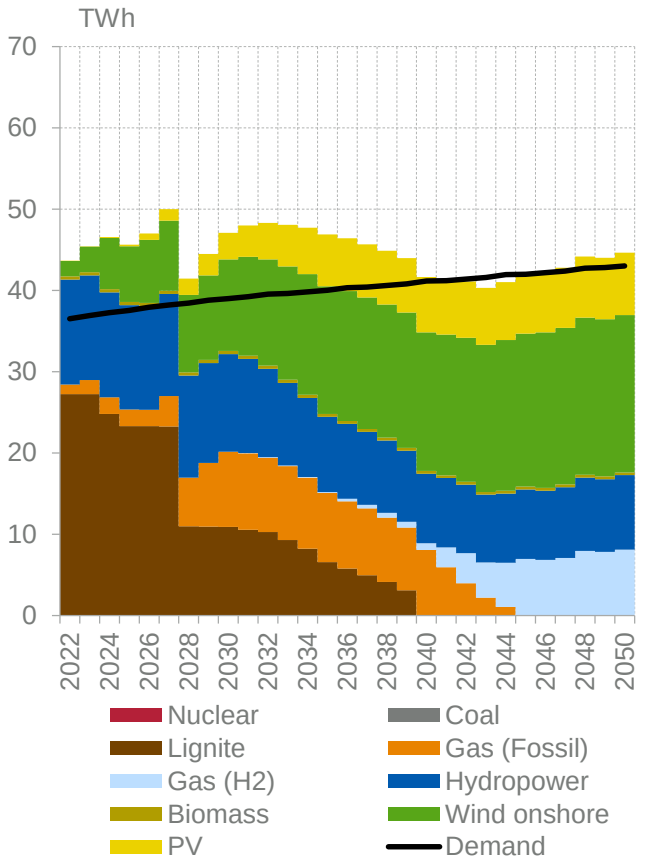
Generation (RS)

Earlier decomissioning and lower utilisation of lignite plants decreases exported power and is compensated by renewables and higher gas utilisation, especially in the medium-term.

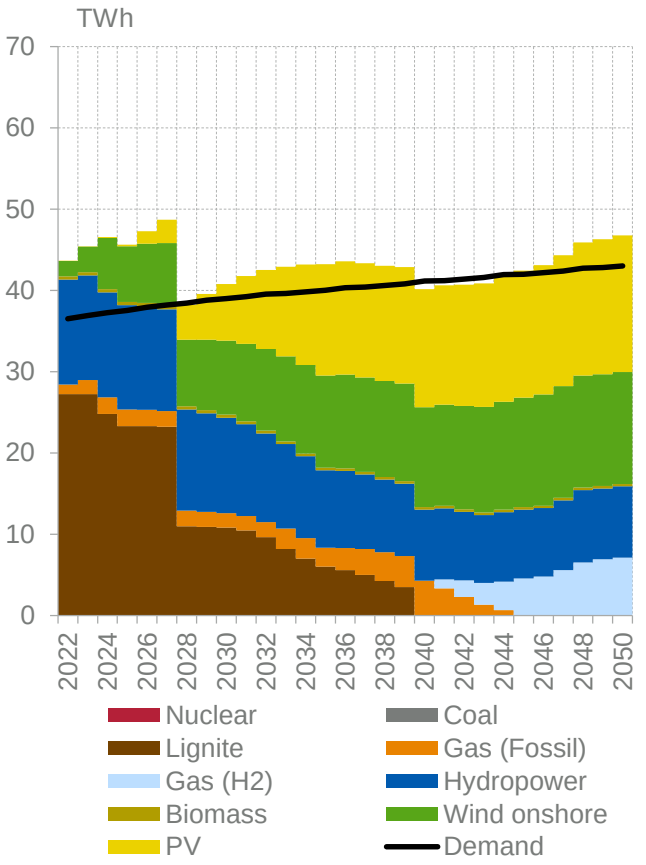
Fossil baseline



Gas lock-in



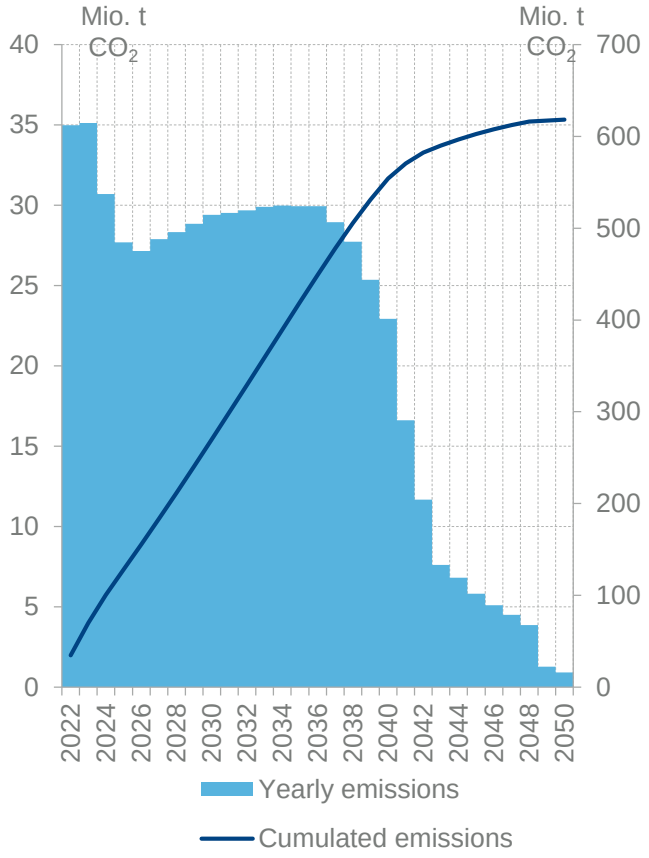
Smart transition



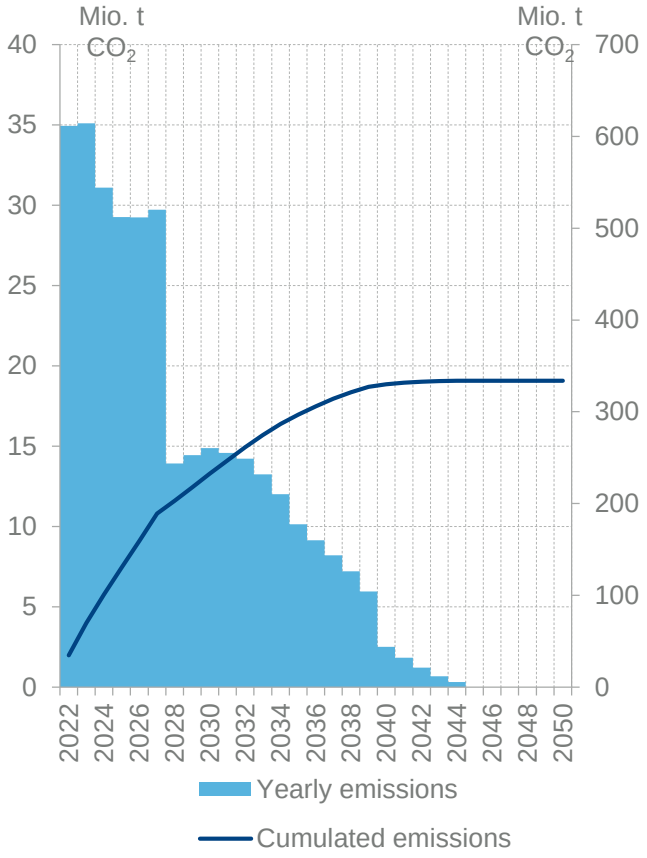
Emissions (RS)

Long-term cumulated emissions until 2050 are reduced by 46% in the GL and an additional 5% in the ST. The high-gradient decrease in the late 2020s in mainly driven by decomissioning of ~50% of lignite capacity in the respective timeframe. A complete decarbonisation of the power sector is achieved until 2045.

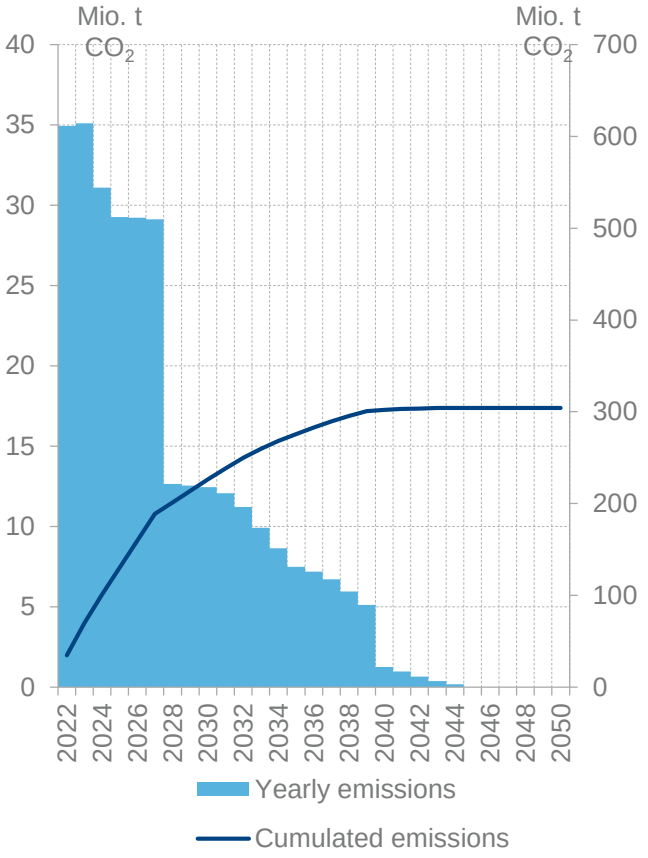
Fossil baseline



Gas lock-in



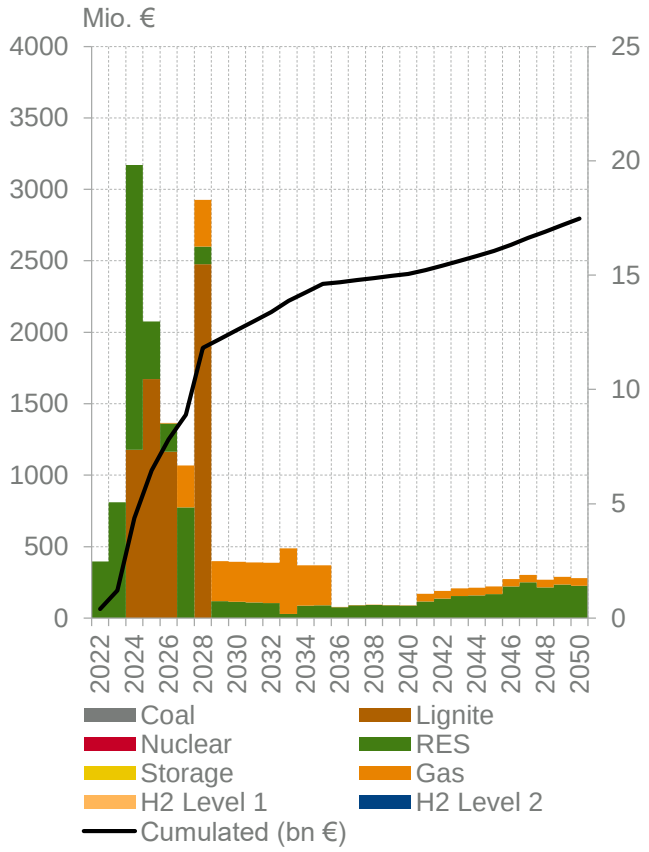
Smart transition



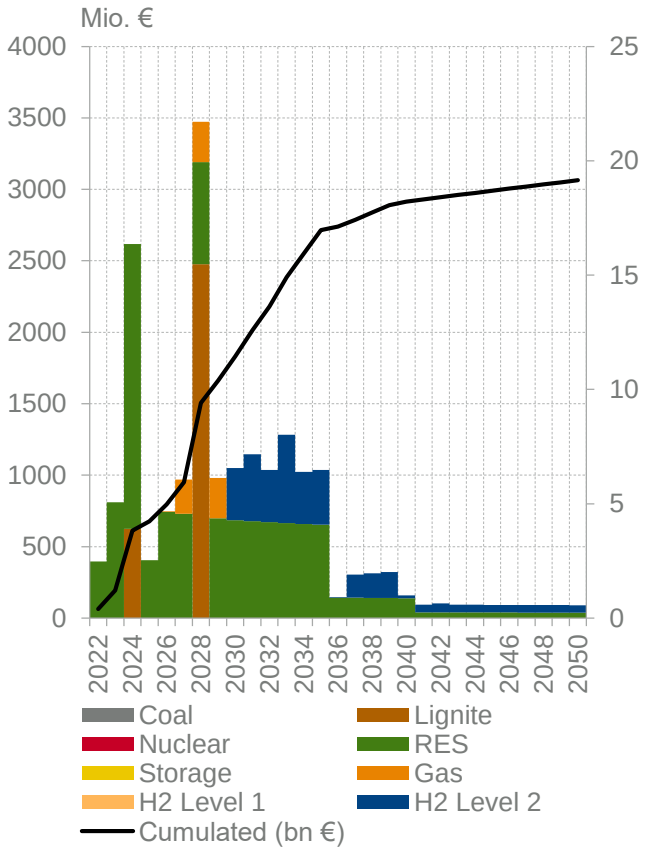
Investment costs (RS)

Total investment volumes are ~1.7 bn € or ~ 10% (GT) and ~ 2.4bn € or ~ 14% (ST) higher compared to the baseline scenario. Large part of additional RES and storage costs are compensated by mitigated lignite retrofit and gas costs. Investments are mainly channelled towards onshore wind and PV assets.

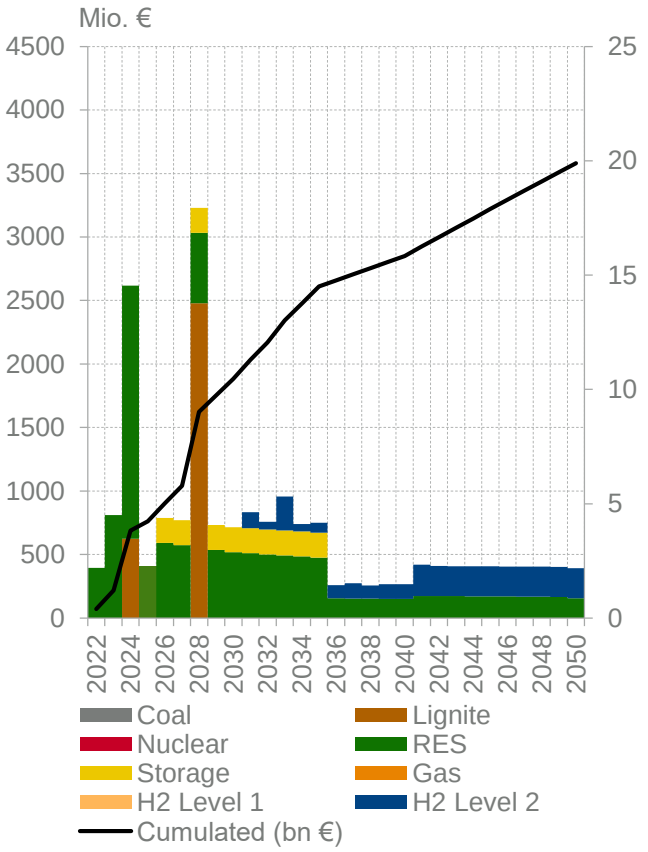
Fossil baseline



Gas lock-in



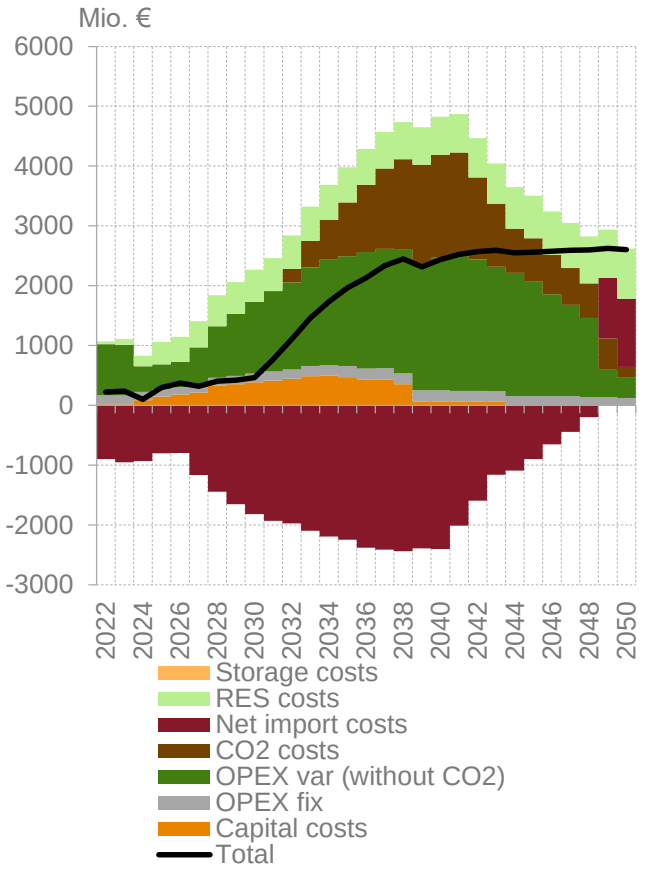
Smart transition



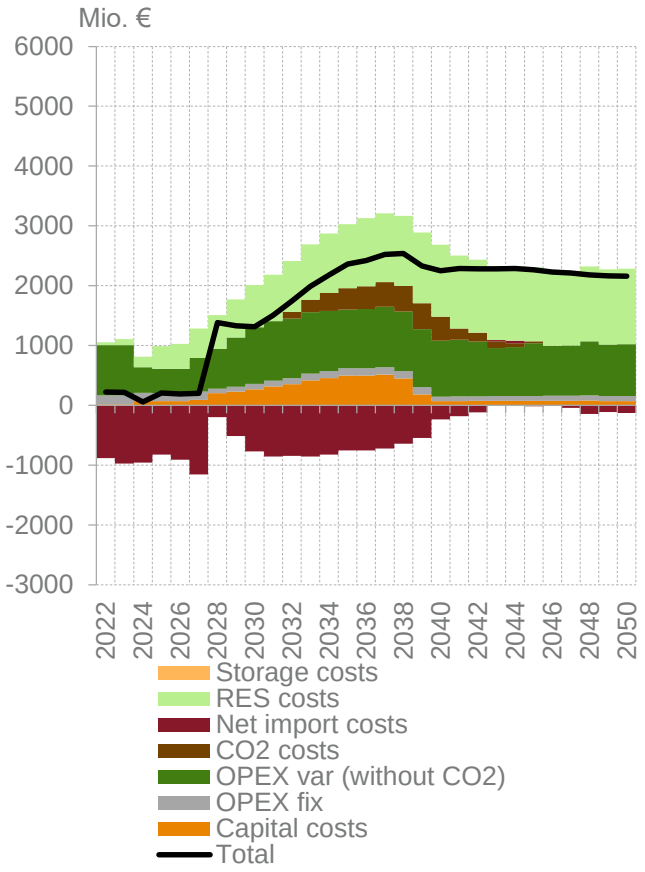
Incremental generation costs (RS)

In total, cumulated incremental generation costs until 2050 decrease in the smart transition (10%). By contrast, a reliance on gas in the medium term increases total costs by 4% over the considered timeframe.

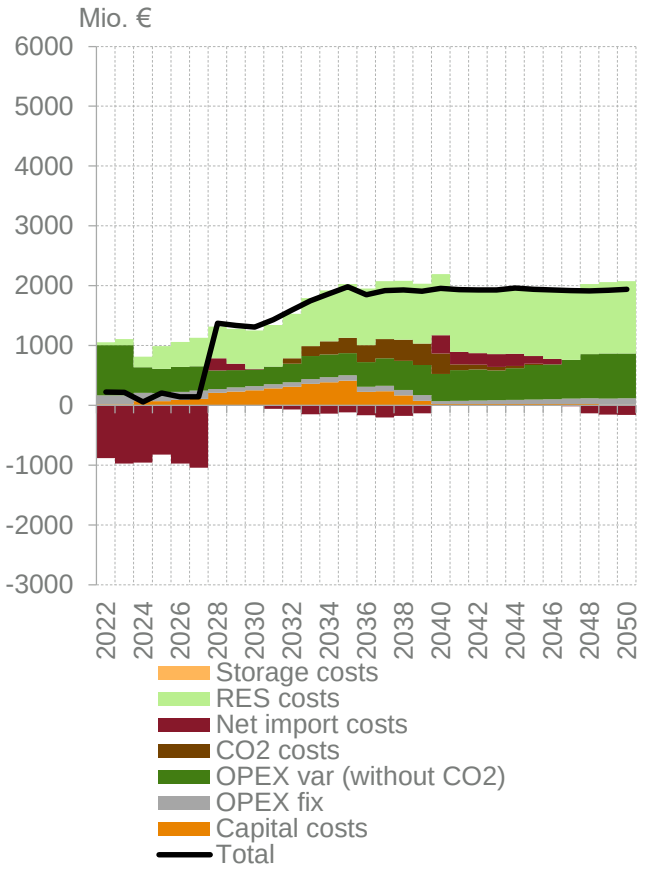
Fossil baseline



Gas lock-in



Smart transition



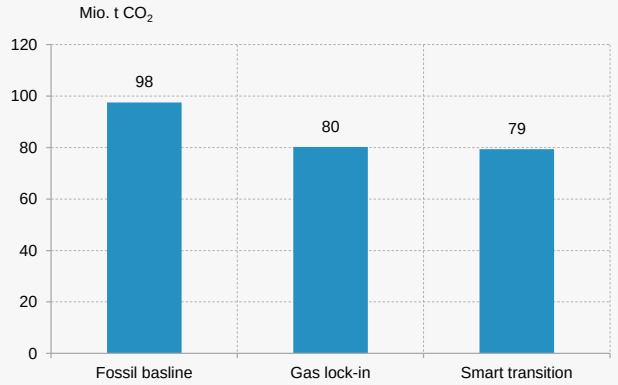
XK

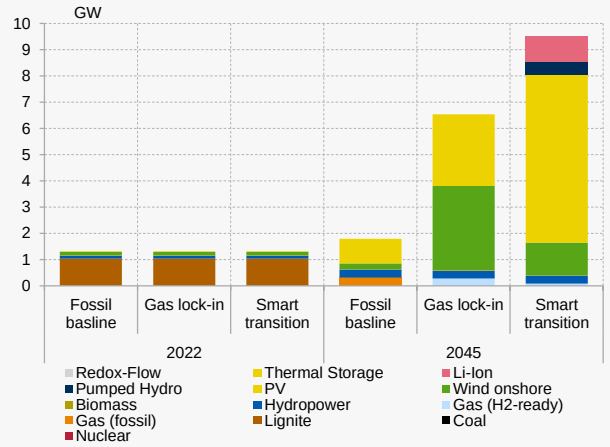
Overview of core scenario results (XK)

Within the core set of scenarios, the smart transition strategy shows potential for significant reduction in overall Incremental generation costs (~40% compared to baseline), driven by savings in OPEX and CO_2 costs.

Cumulated CO_2 emissions

- Decarbonisation strategies overall save 18% CO_2 compared to baseline
- Smart transition saves additional 1%



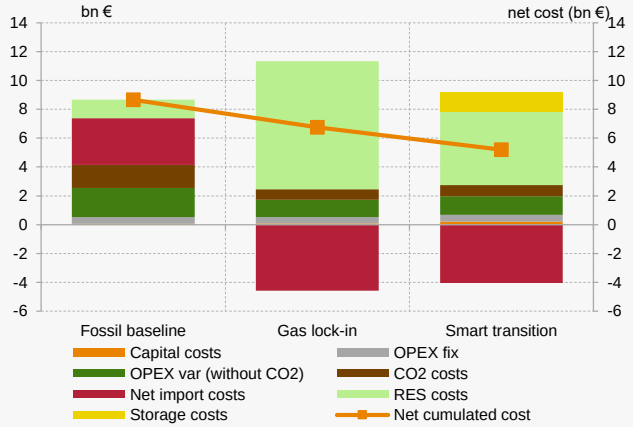


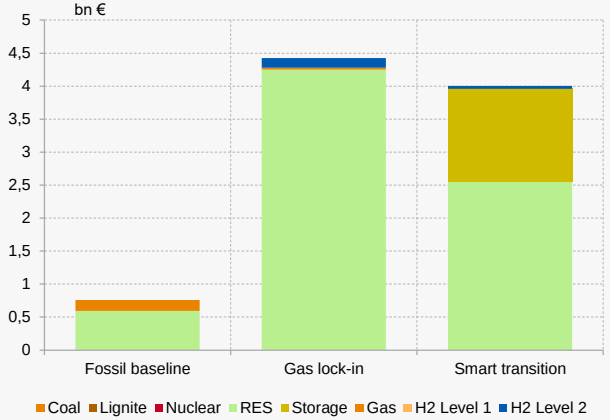
Capacities

- Net-zero scenarios deploy 6-8 GW of RES by 2045
- Storage scenario deploys less gas capacity and integrates more PV

Incremental generation costs

- Transition scenarios save 22% (40)% vs. baseline even though climate ambition level is much higher
- Main driver is fuel, CO_2 costs and exports





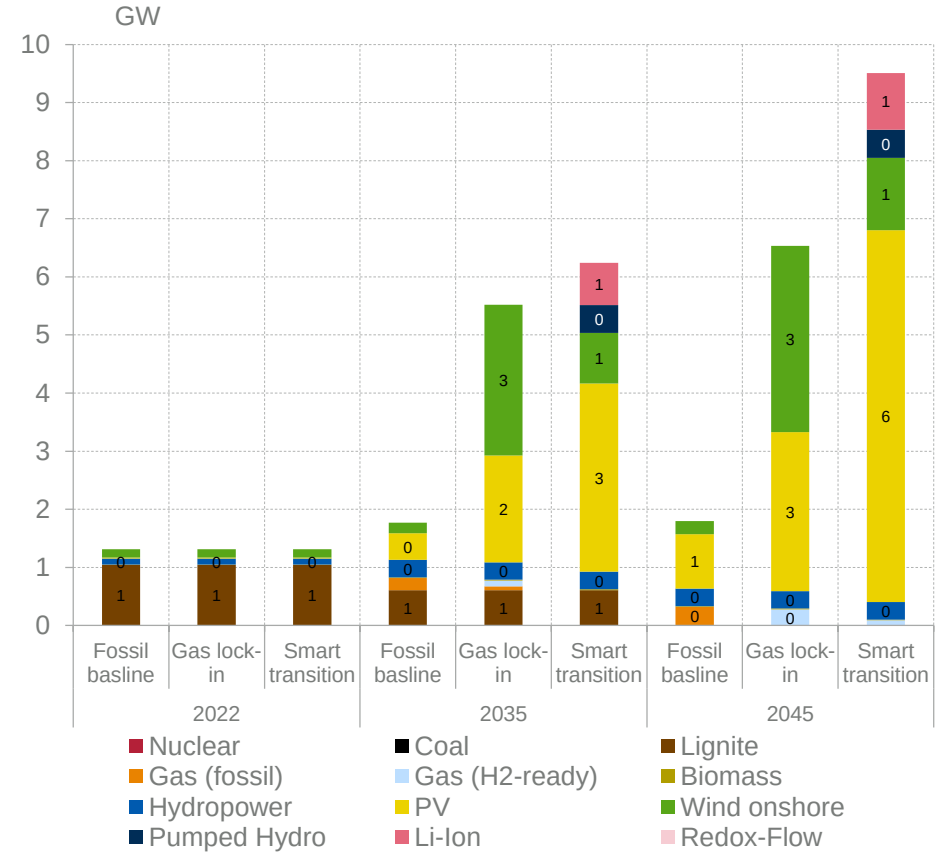
Investment costs

- Although total costs decrease, investment volumes increase
- Net-zero scenarios strongly invest in RES

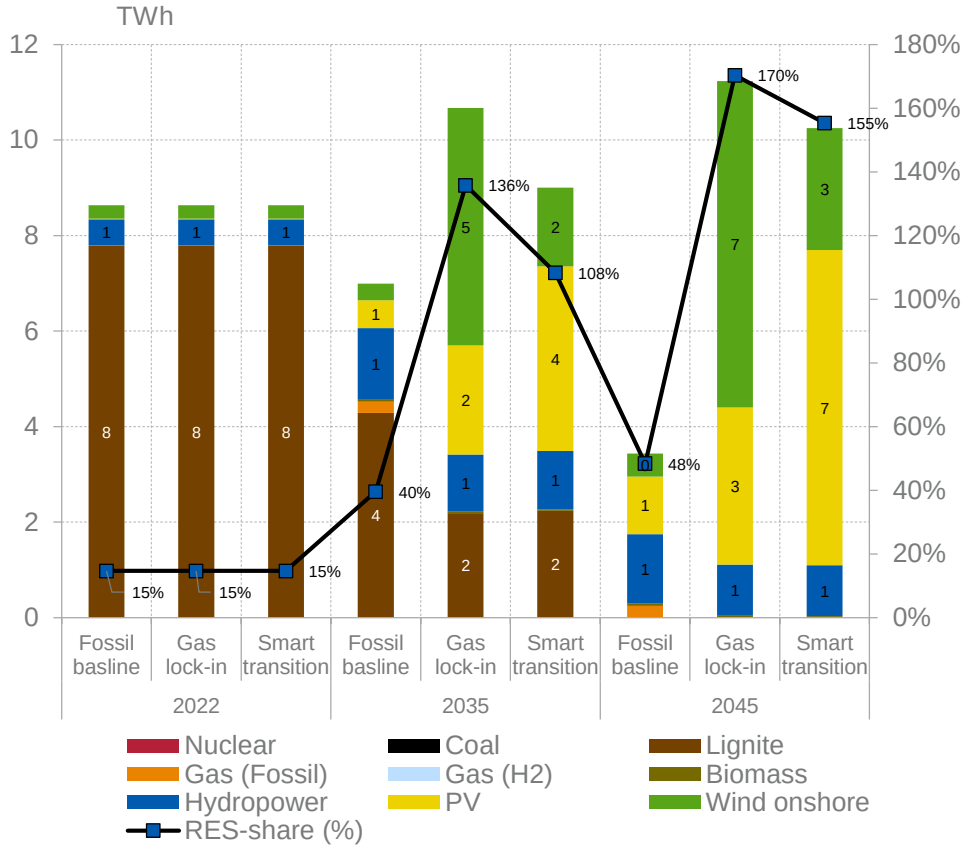
Generation & Capacity (XK)

The decarbonisation scenarios (GL, ST) see an accelerated reduction of lignite capacities, substituted by RES (& storages in the ST).

Capacity



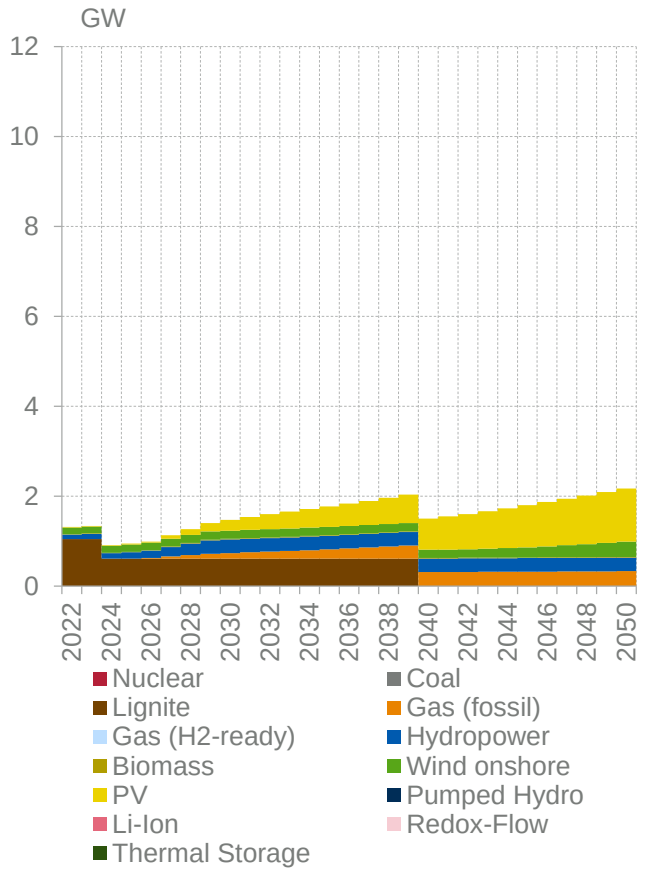
Generation



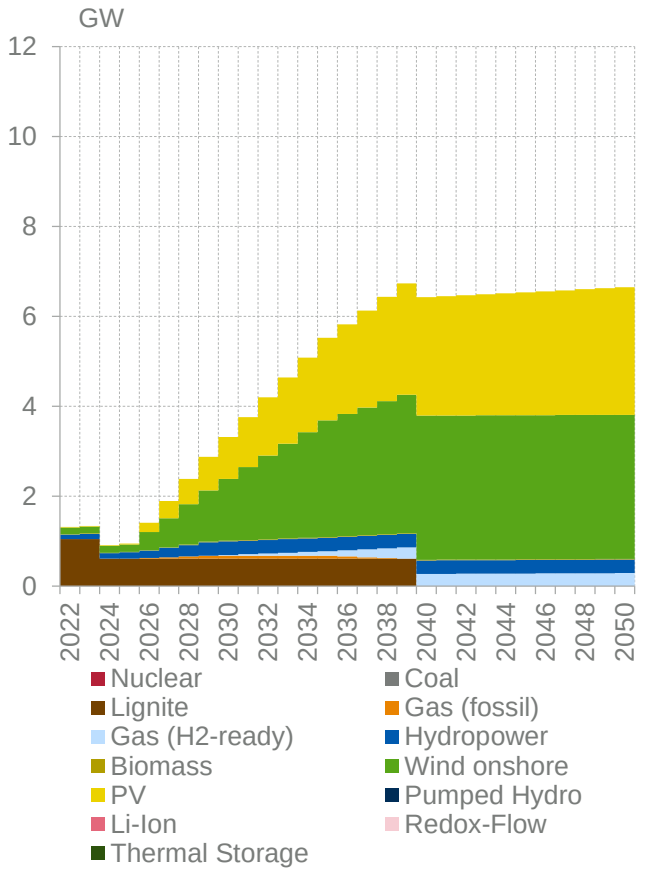
Capacity (XK)

In both decarbonisation scenarios, lignite capacities are replaced by increasing RES capacities. In the ST more than double of the GL PV capacities, complementary to storage expansion, are built in the long-term. Pumped hydro potential is fully utilised, while additional 1 GW of Li-Ion batteries are deployed. Gas / H2 only play minor role.

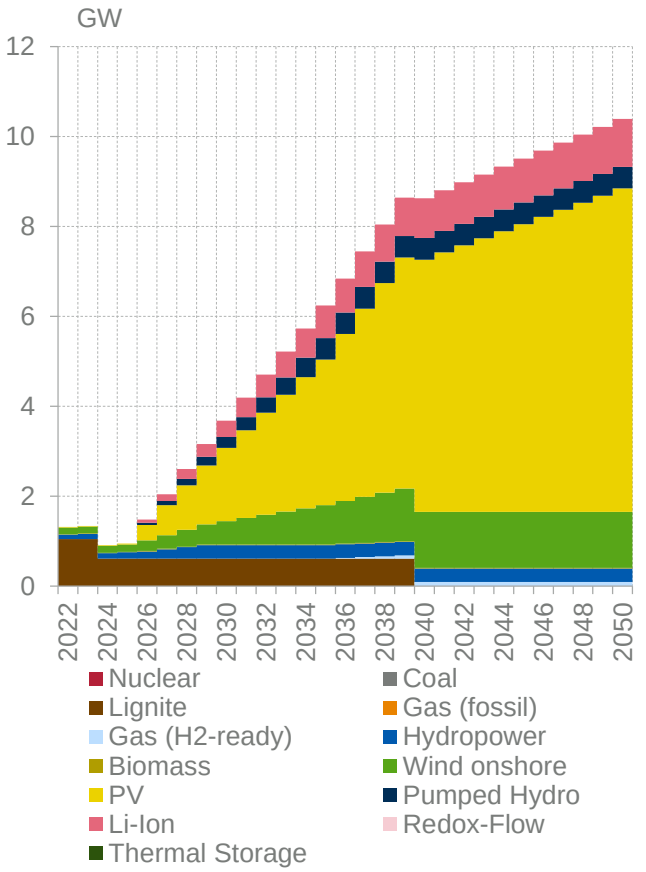
Fossil baseline



Gas lock-in



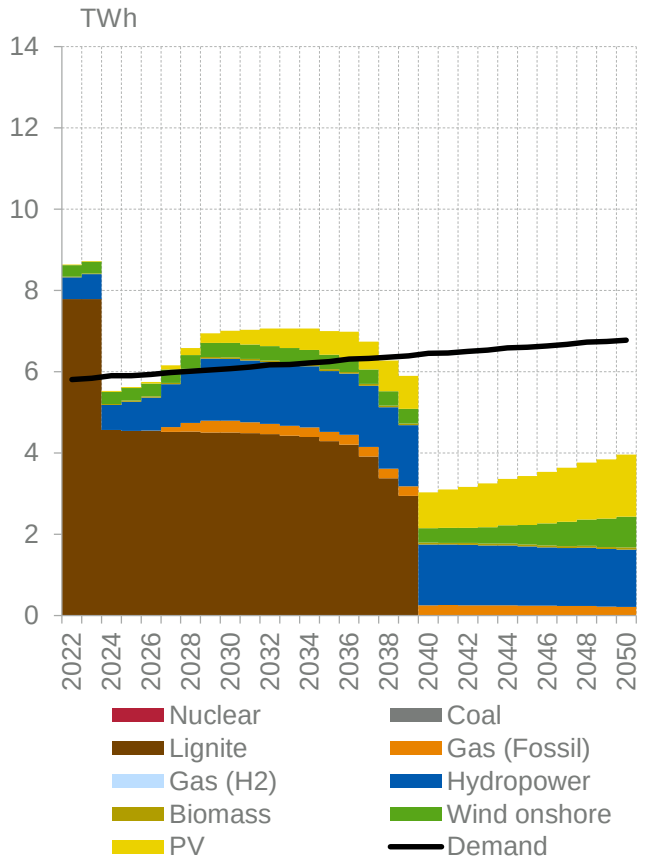
Smart transition



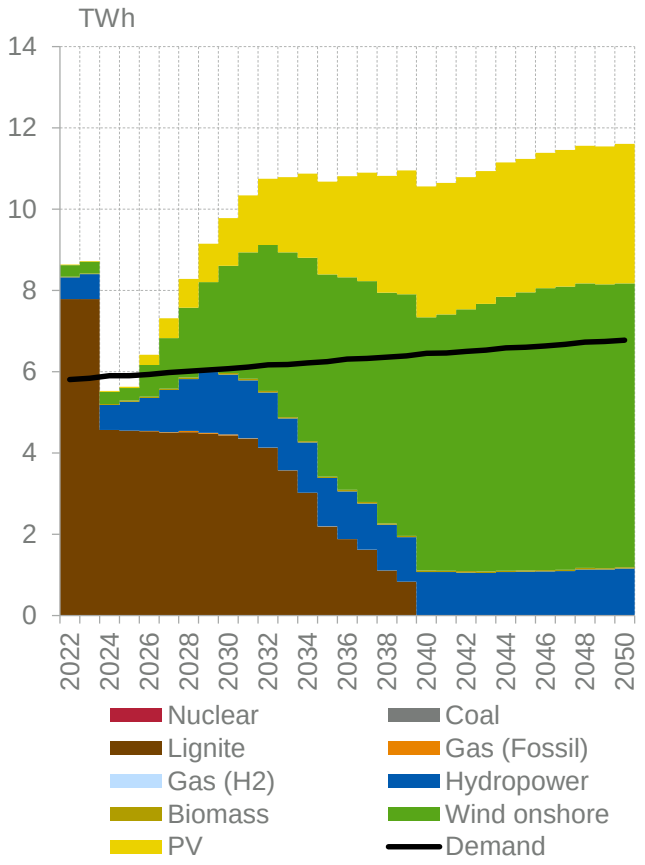
Generation (XK)

Earlier decomissioning and lower utilisation of lignite plants is compensated by renewables in the medium- and lont-term.

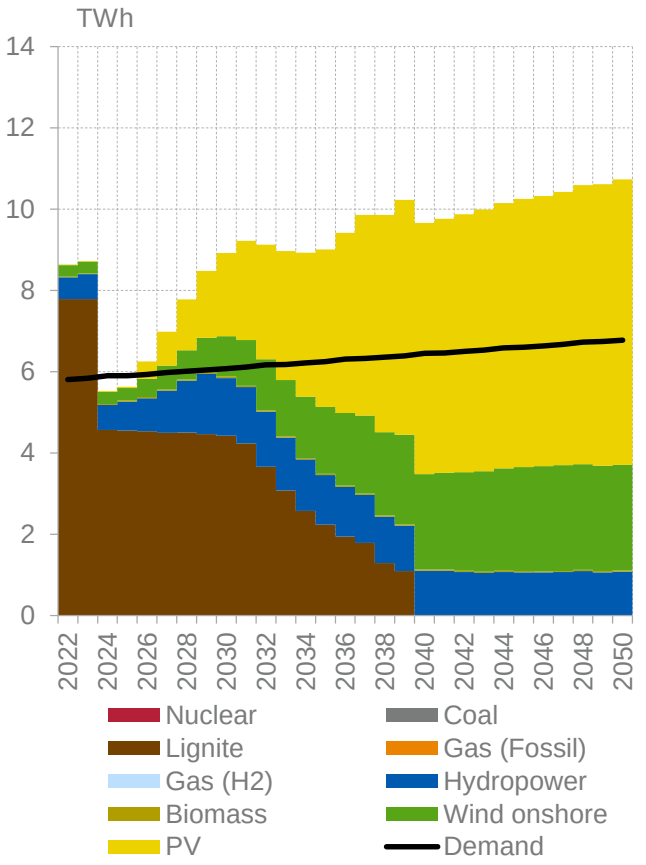
Fossil baseline



Gas lock-in



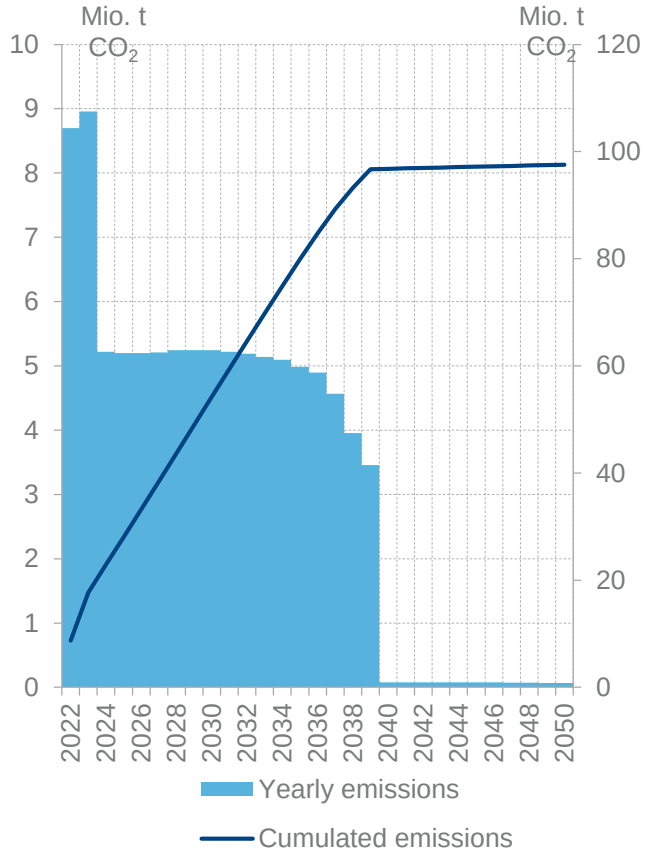
Smart transition



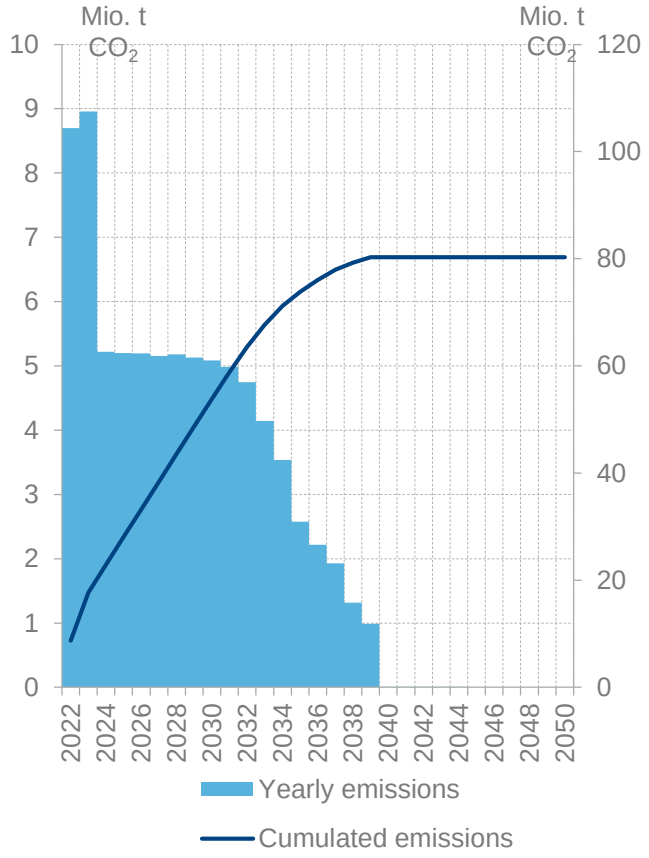
Emissions (XK)

Long-term cumulated emissions until 2050 are reduced by 18% in the GL and an additional 1% in the ST. A complete decarbonisation of the power sector can be achieved even before 2045.

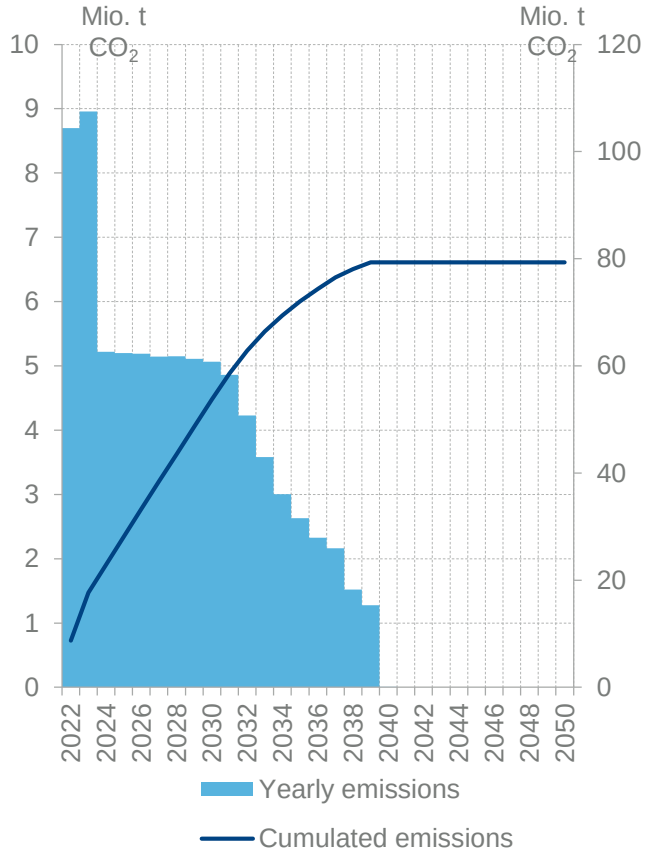
Fossil baseline



Gas lock-in



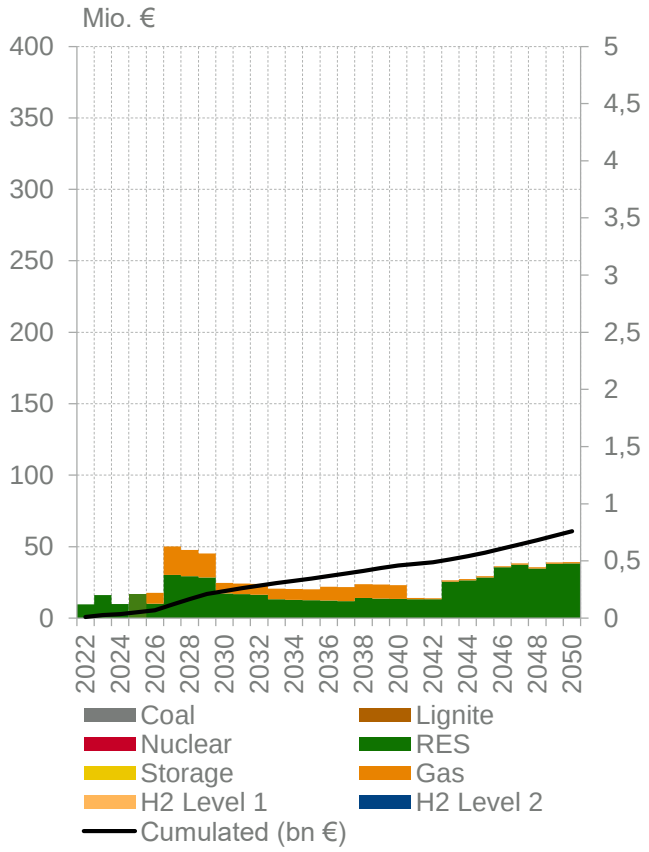
Smart transition



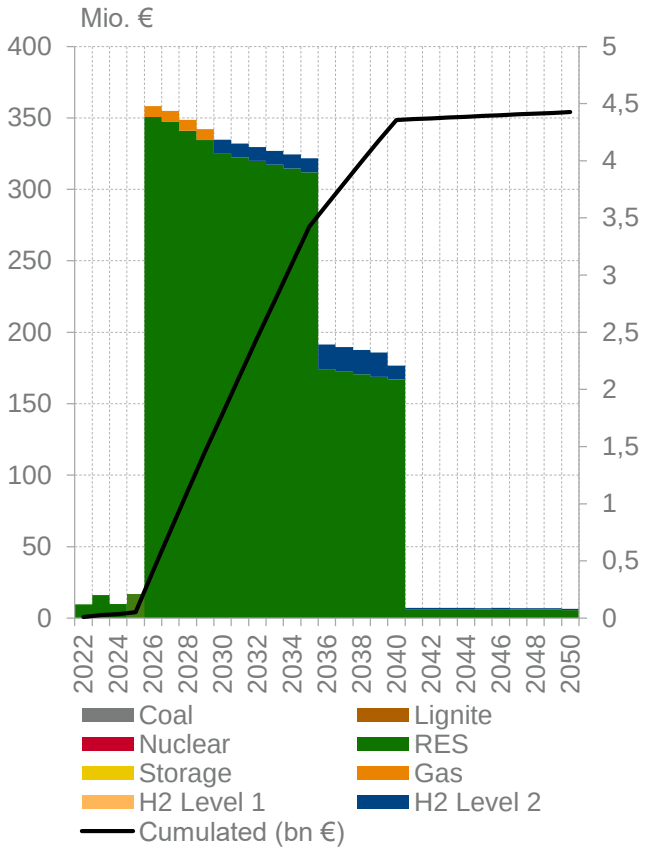
Investment costs (XK)

Required additional investments in the WB-6 accumulate to ~3.7 bn € or 483% (GT) and 3.2 bn € or 427% (ST) until 2050 compared to baseline. Additional investments are mainly channelled towards onshore wind and PV assets, as well as storages in the smart transition.

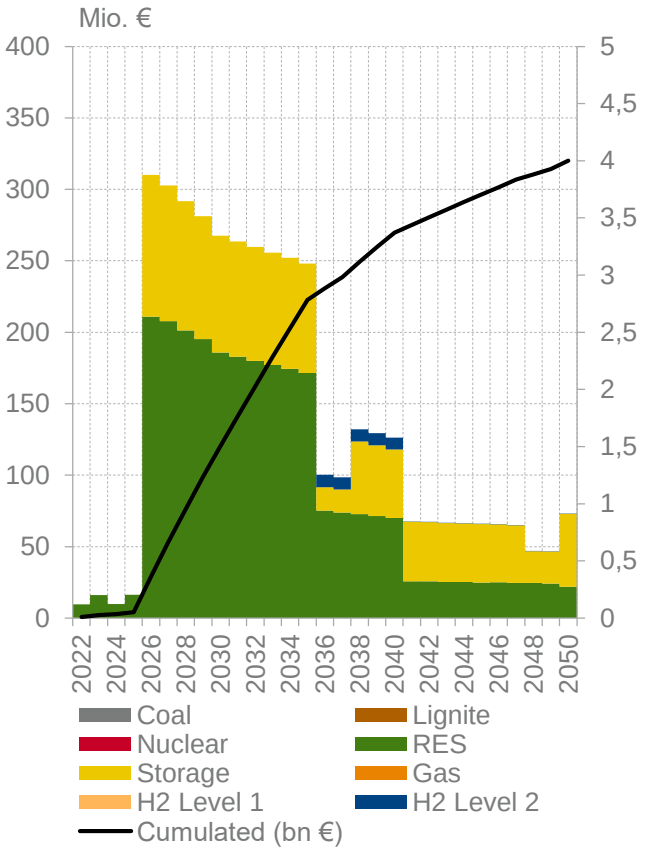
Fossil baseline



Gas lock-in



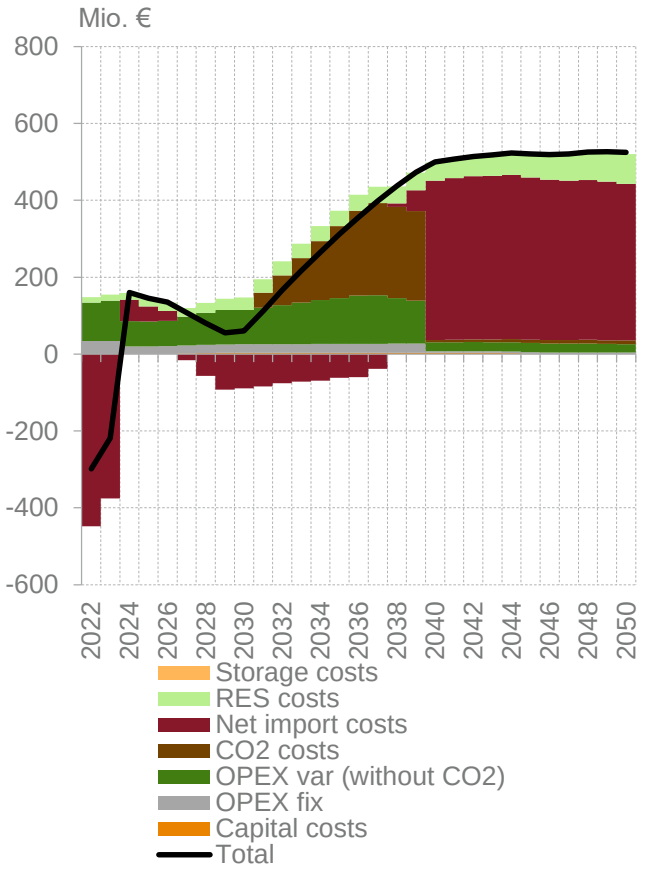
Smart transition



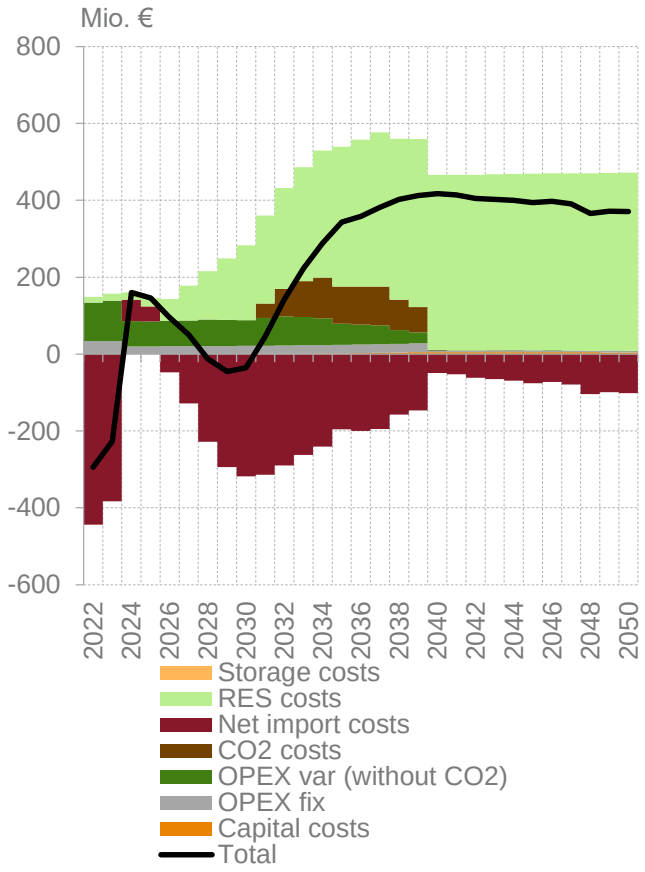
Incremental generation costs (XK)

In total, cumulated incremental generation costs until 2050 decrease in the decarbonisation scenarios (22% for GL and 40%. Significant savings in OPEX and CO_2 cost (due to lower lignite and gas-based production) are realised.

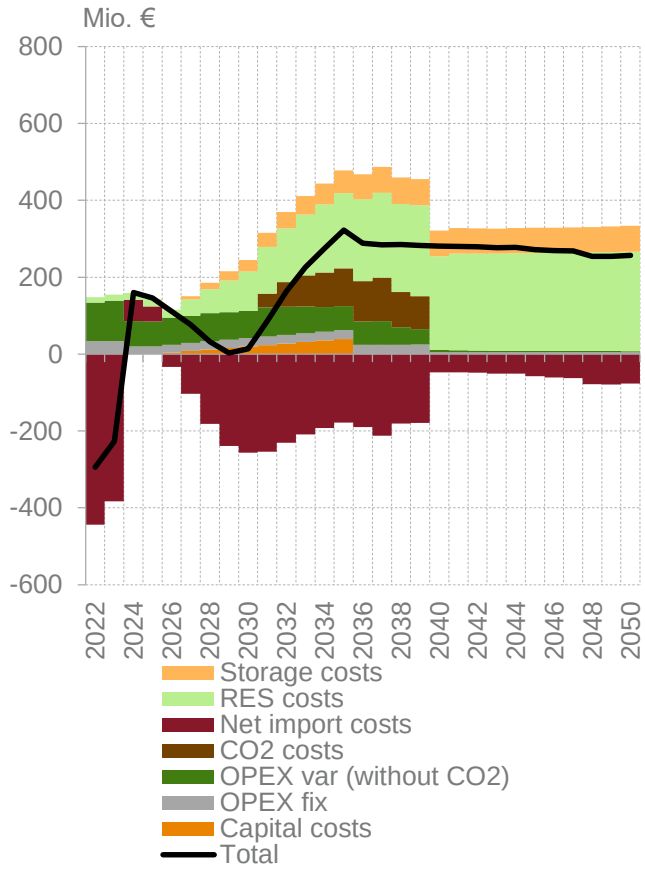
Fossil baseline



Gas lock-in



Smart transition



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