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Viet Nam Energy Outlook Report
Pathways to Net-Zero

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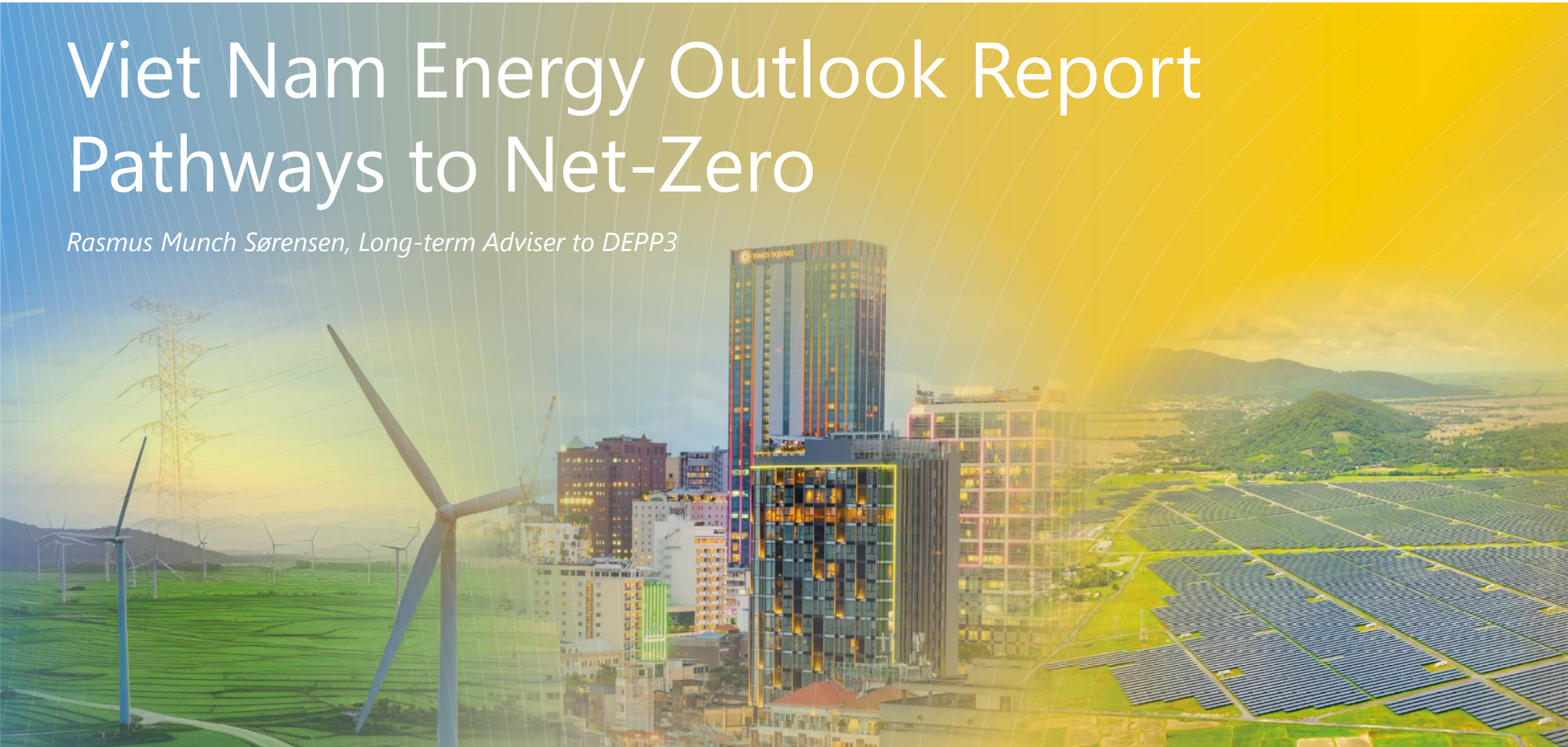
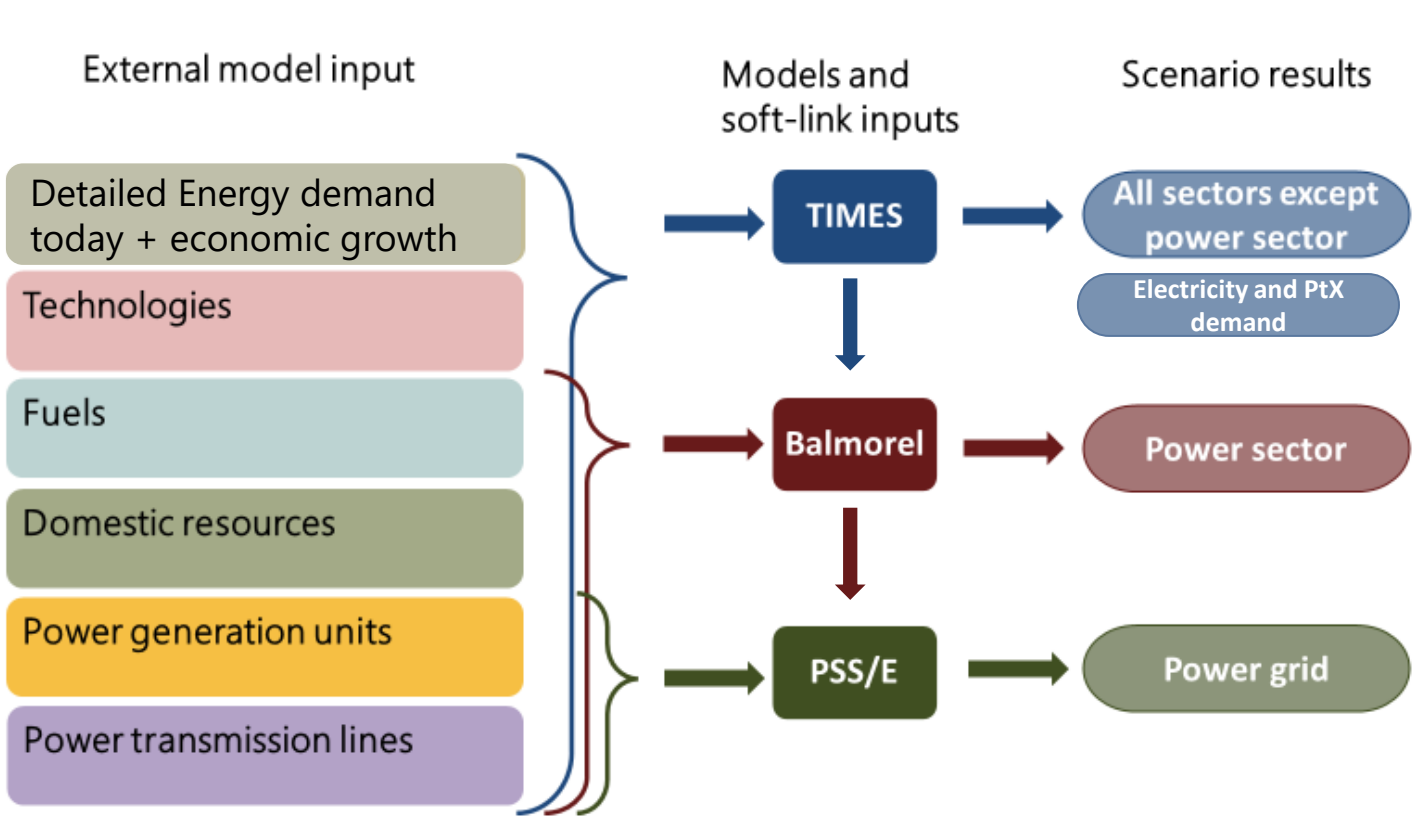
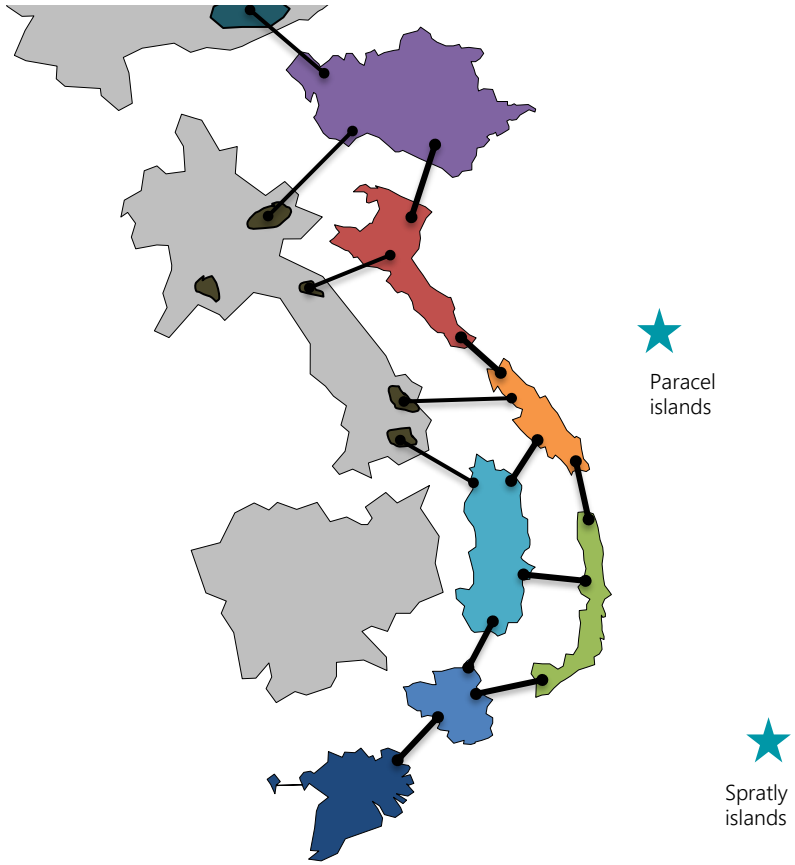


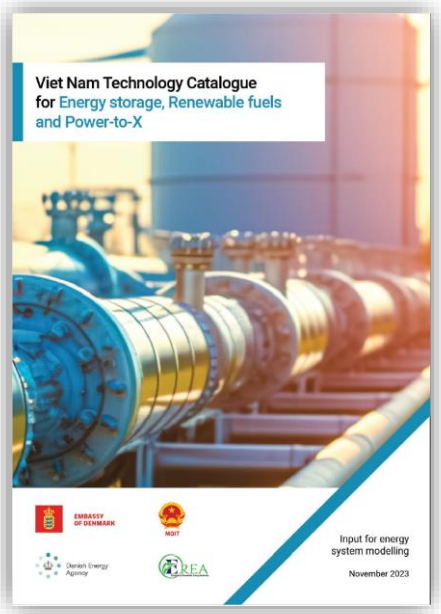
EOR is based on 3 energy system models

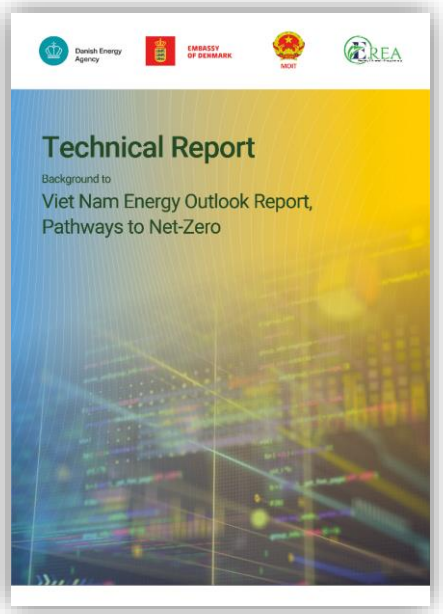
Based on input assumptions for GDP growth and other factors, final energy and electricity demand is a model result – not an input.

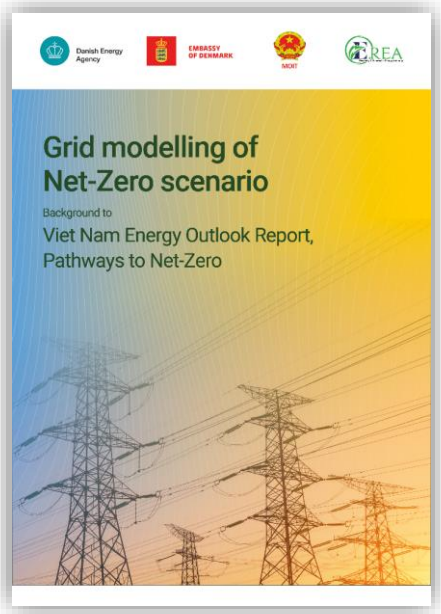




Based on comprehensive data and modeling







All reports available on https://depp3.vn

Purpose of the EOR

- Danish experience shows that good long-term government planning is critical to driving down costs for investors
- Aim to support work of VN plans such as PDP and EMP's by improving modelling and analytical skills in VN government and IE
- EOR scenarios can be used to analyse alternative technologies and goals, before committing to them politically

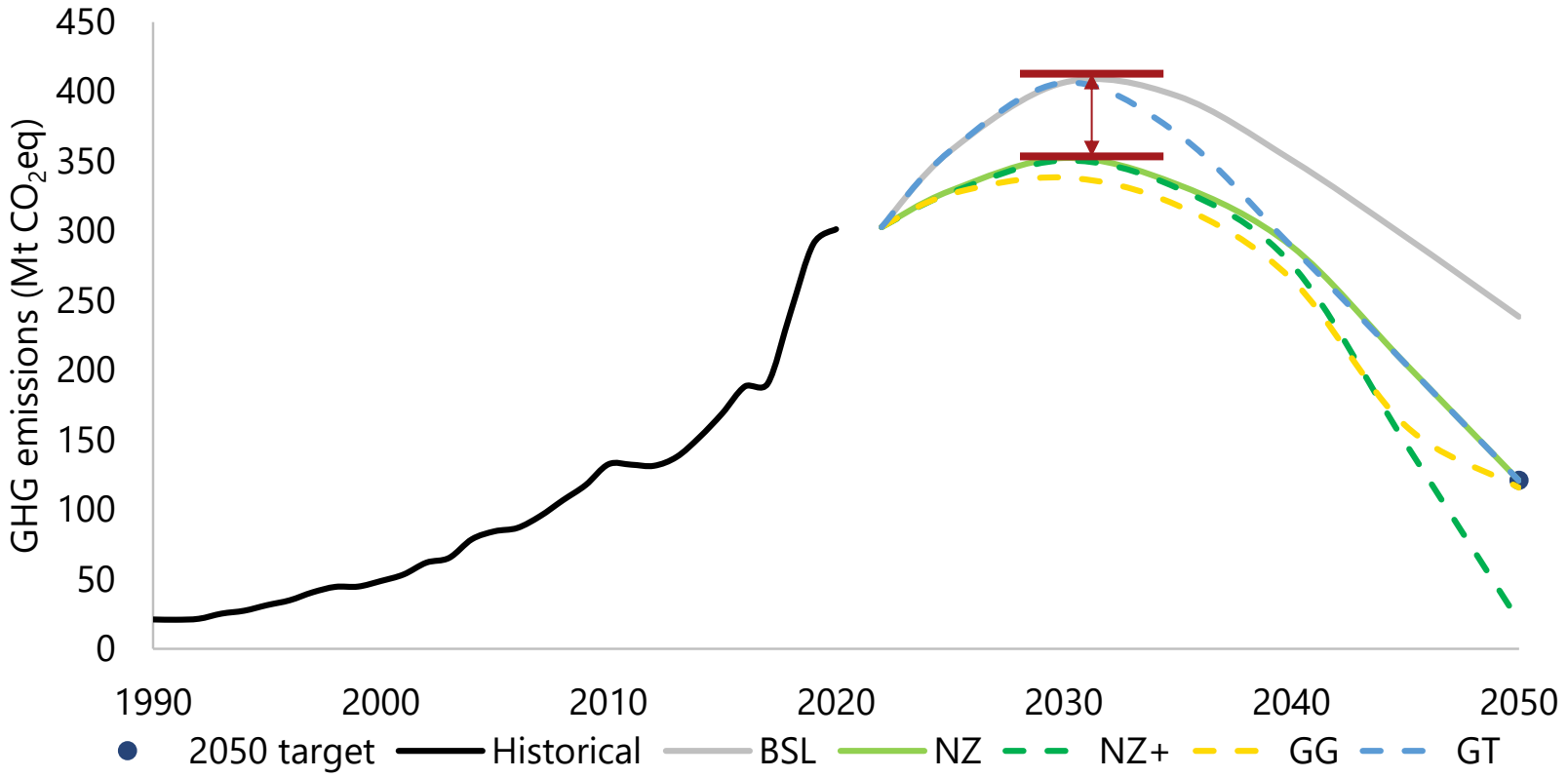
Scenarios

Overview of scenario input differences

	Emission target 2050	Power sector	Transport sector	Economic development
BSL - Baseline	None	PDP8 installed capacities in 2030	No specific policy	6.5% GDP growth
NZ - Net-Zero	121 MT (101 MT energy; 20 MT industry processes)	Only parts of PDP8 is enforced; Increased land solar potential	High-speed railway and metros enforced	6.5% GDP growth

Pathways to Net-Zero

CO_2 peak by 2030 is economically efficient



Emissions peak in 2030, regardless of Net-Zero targets

Net-Zero scenario peaking at 55 MT less than BSL scenario

Higher peak emissions in 2030 requires very steep reductions to 2050

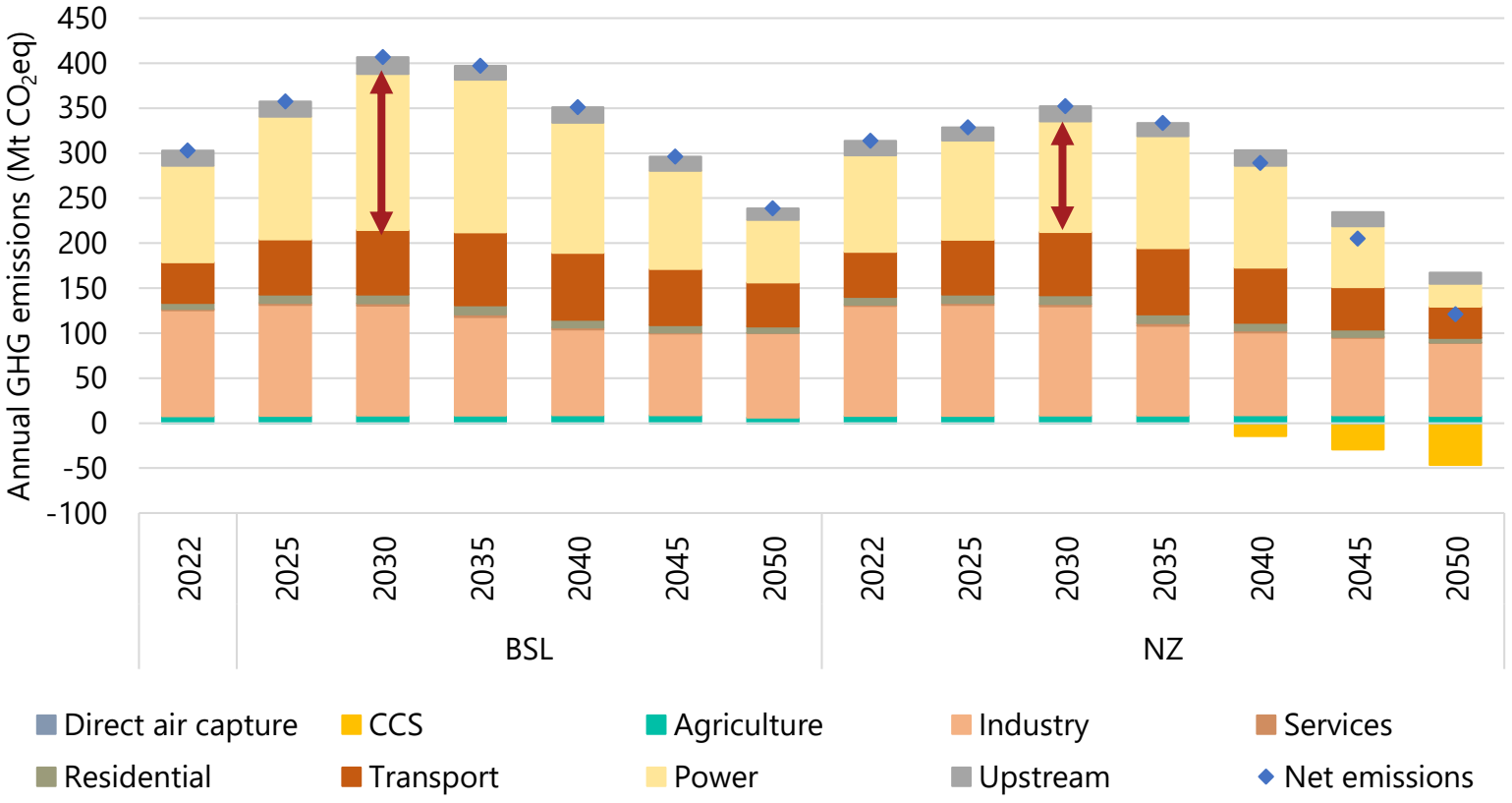
Green economic growth enables much easier development path

Recommendations

Early power sector decarbonisation is a pre-requisite for efficient transition of transport and industry.

BSL=Baseline. NZ=Net-Zero. GT=Green Transport. NZ+=Net Zero increased ambitions. GG=Green Growth.

Power sector first, then transport and industry



Reducing emissions in power sector necessary; already from today

-> BSL power sector up 61% by 2030
-> NZ scenario up by only 14%

Power and transport sectors most cost-effective reductions

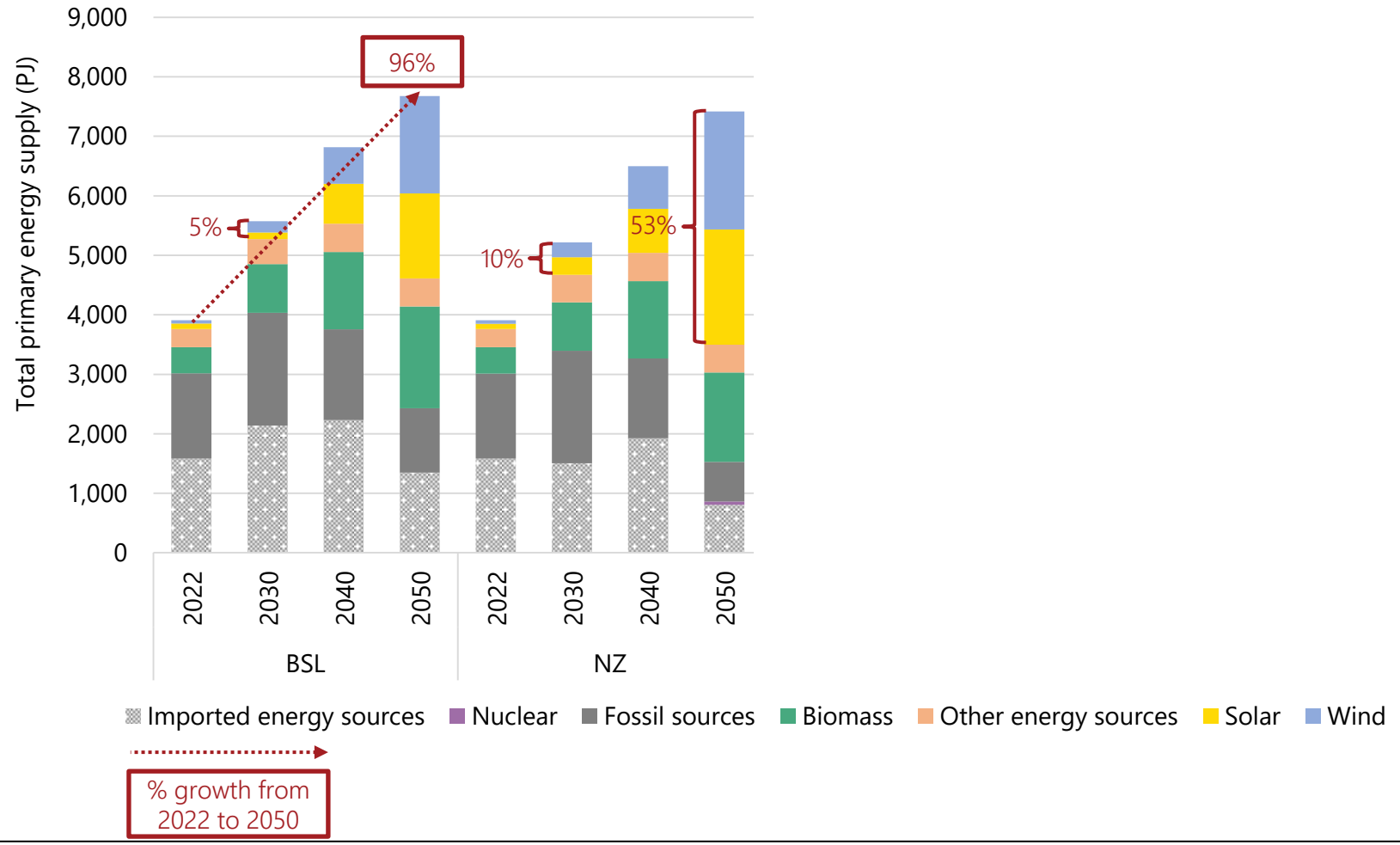
Carbon Capture and Storage (CCS) critical in long-term: Almost only in industry sector

Recommendations

Urgent power sector and green growth action before 2030 makes 2050 target much easier and cheaper to reach

BSL=Baseline. NZ=Net-Zero. GT=Green Transport. NZ+=Net Zero increased ambitions. GG=Green Growth.

Energy supply increases a lot, except in Green Growth



Energy Efficiency in all scenarios: GDP increases by more than 500% from 2022 to 2050, but energy supply much less

Imported energy sources is reduced

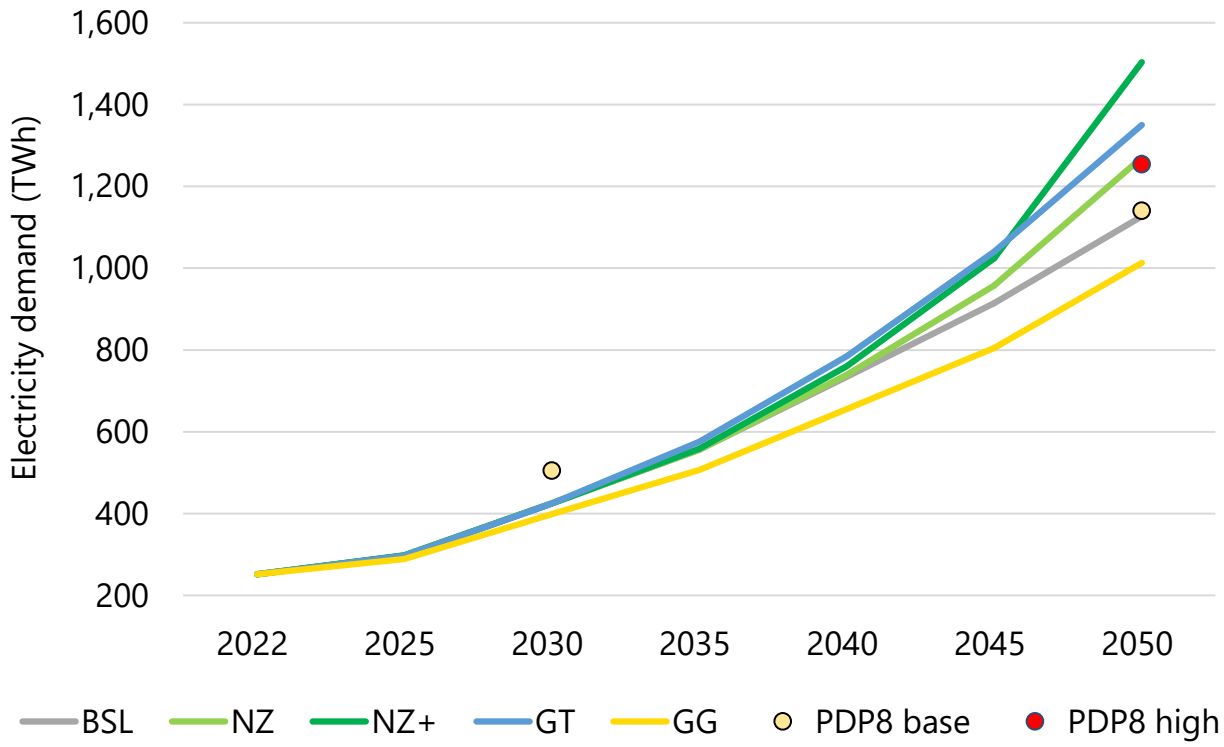
Net Zero+ requires more RE supply, but also large generation from nuclear.

Biomass is used in industries where possible – Not in power sector.

BSL=Baseline. NZ=Net-Zero. GT=Green Transport. NZ+=Net Zero increased ambitions. GG=Green Growth.


Power System

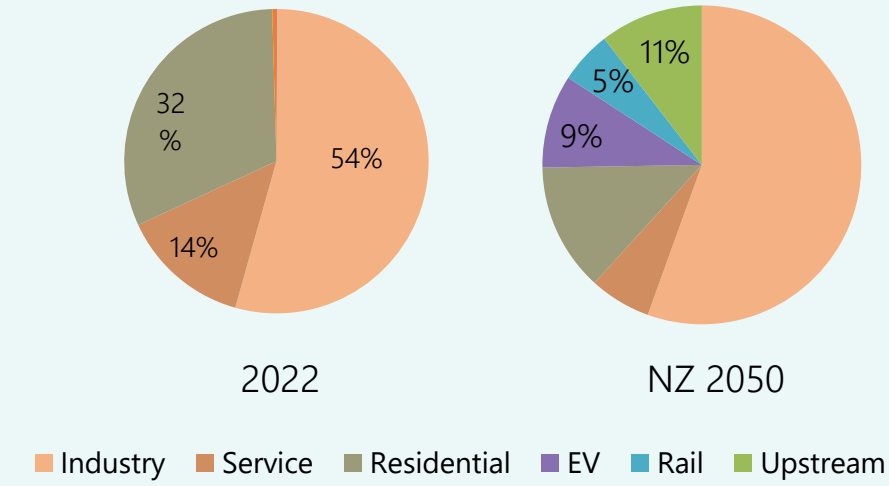
Power demand increases



Electricity demand is a model result. GDP growth same across all scenarios (6,5% per year)

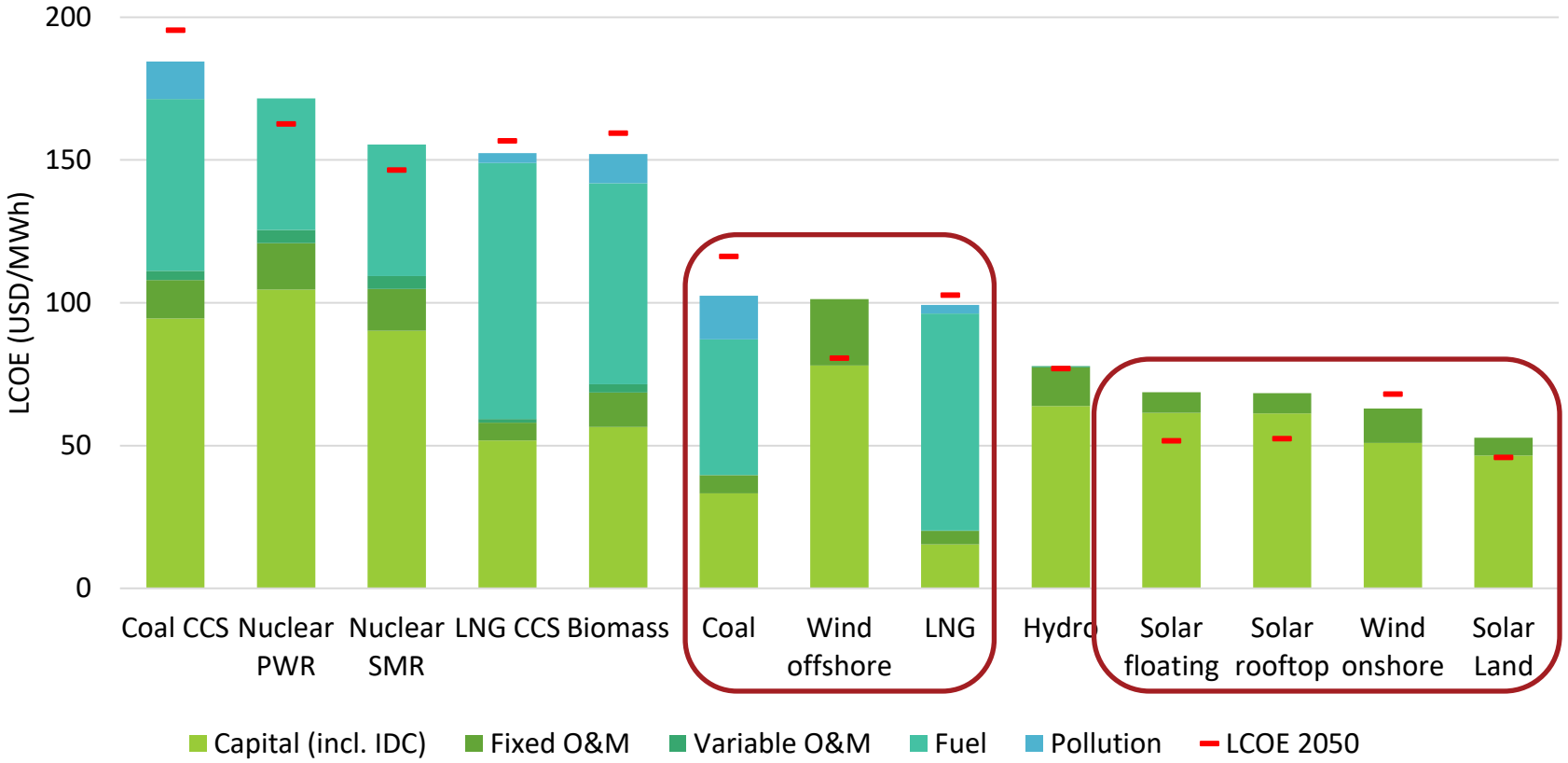
- 6-fold increase by 2050 in NZ+ scenario, and GG "only" 4-fold increase
- In 2050, Power-to-X (Upstream) uses significant electricity

Electricity consumption per sector



BSL=Baseline. NZ=Net-Zero. GT=Green Transport. NZ+=Net Zero increased ambitions. GG=Green Growth.

Renewables will soon be cheaper than fossil fuels

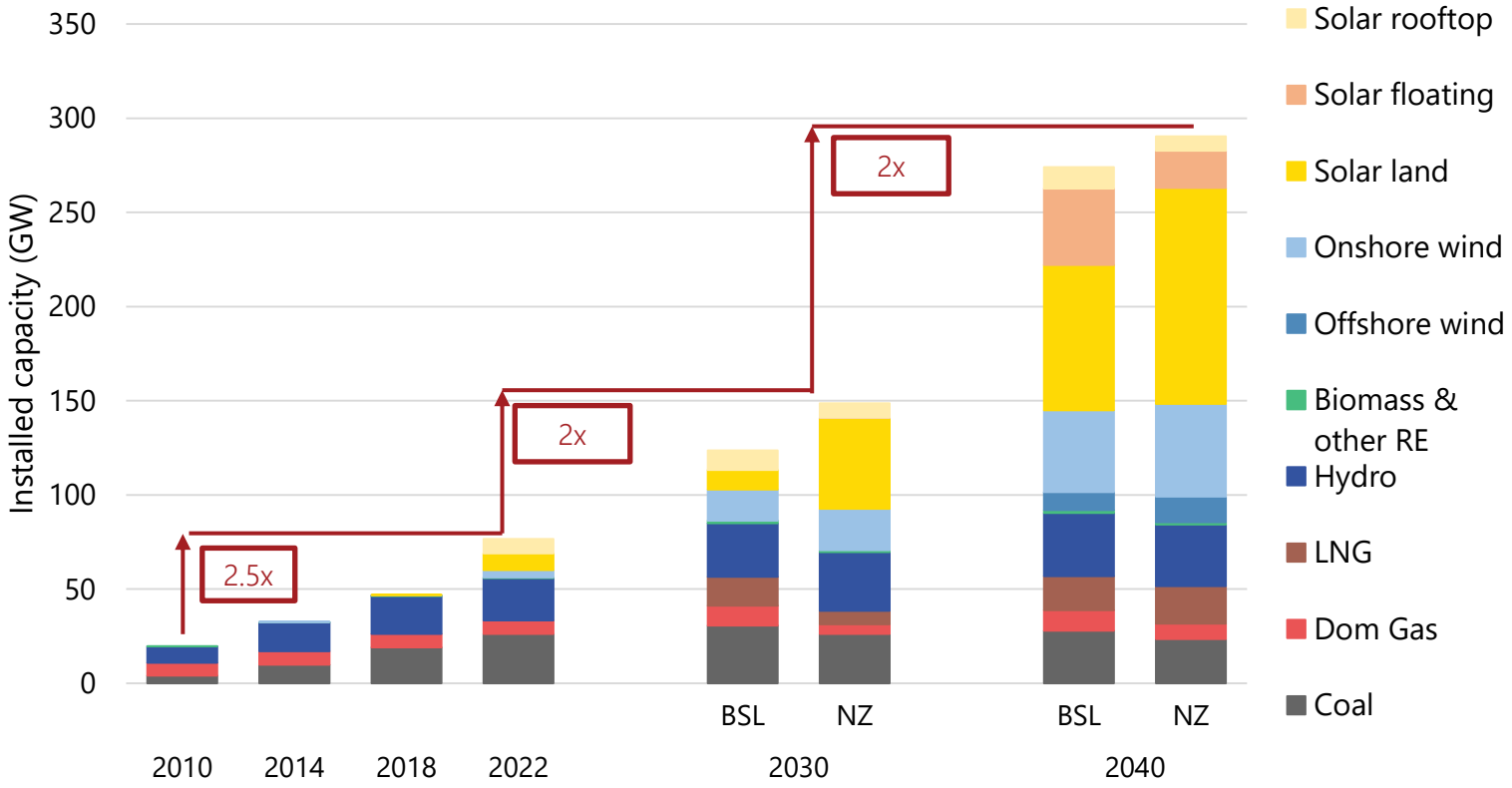


Renewables are the cheapest form of electricity generation across the globe, and also possible soon in Vietnam.

Primary cost drivers for RE is uncertainty about the investment: Stable, long-term regulation is critical

Generalized LCOE calculations using input data to models for EOR-NZ. Assumed 10% discount interest rate across all projects. Thermal power plants are assumed operating at 6000 full-load hours, nuclear at 7500 full-load hours. Average full-load hour values for Viet Nam used for RE. Offshore wind costs expected to be higher for first parks.

Stable investment climate needed before 2030



56 GW of new wind and solar power before 2030

Coal peak before 2030

LNG can play a critical role with large capacity additions towards 2050

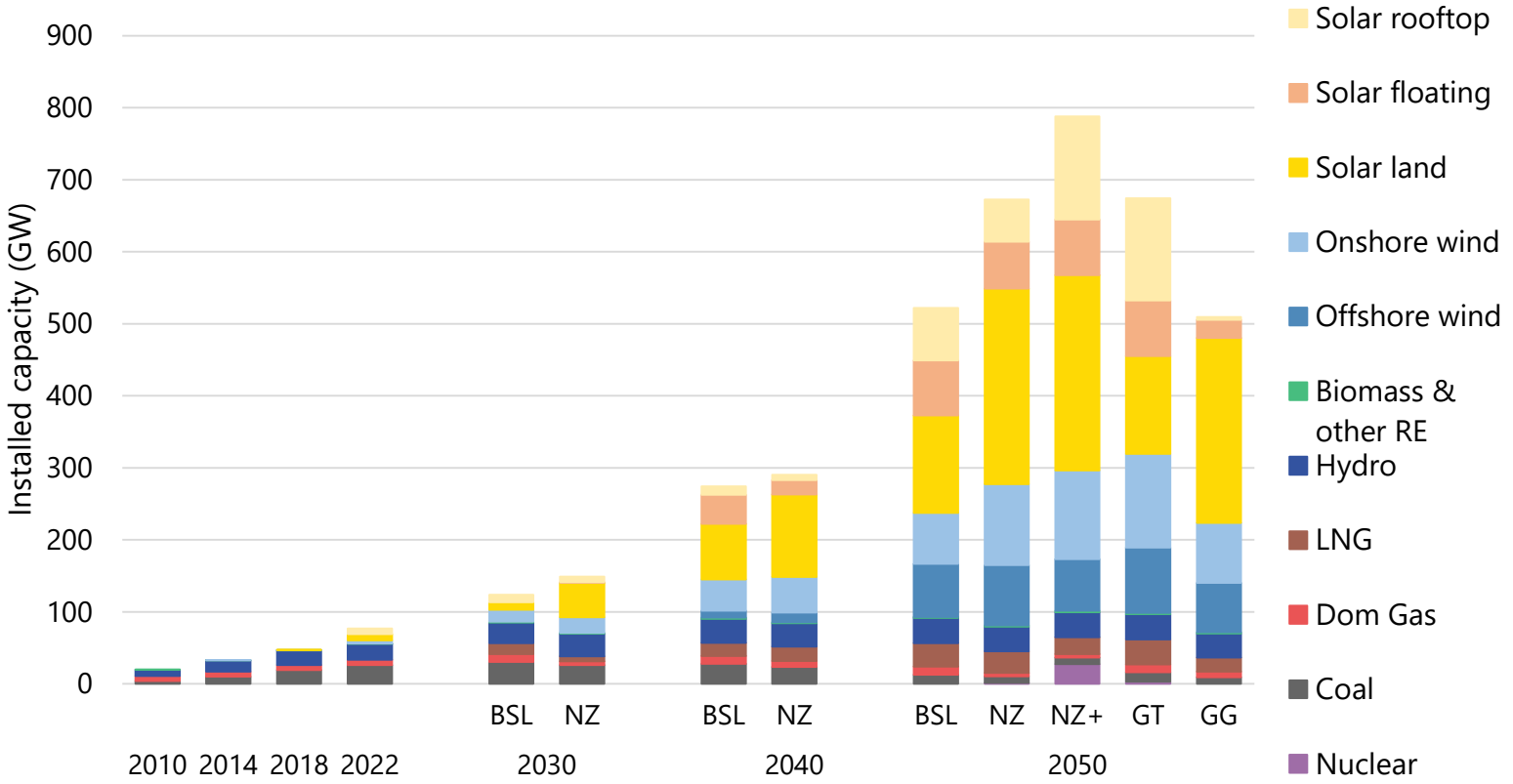
Offshore wind from 2035 with a rapid development towards 2050

Recommendations

Support early investments in renewable energy with focus on improved regulatory framework

BSL=Baseline. NZ=Net-Zero. GT=Green Transport. NZ+=Net Zero increased ambitions. GG=Green Growth.

Over 600 GW RE in 2050



Full deployment of land solar (271 GW) in NZ and NZ+, and Offshore wind reaches 84 GW in NZ by 2050

Nuclear power (small modular reactors) in NZ+ reach 28 GW

Not cost-efficient:
- Co-firing of hydrogen, ammonia or biomass
- Carbon Capture and Storage (CCS) on power plants

Recommendations

Investigate role of nuclear in a system with high RE share

Further explore potential for use of land for onshore wind and solar power (multi-purpose use)

Develop standards and regulations to promote rooftop solar power connecting to the grid

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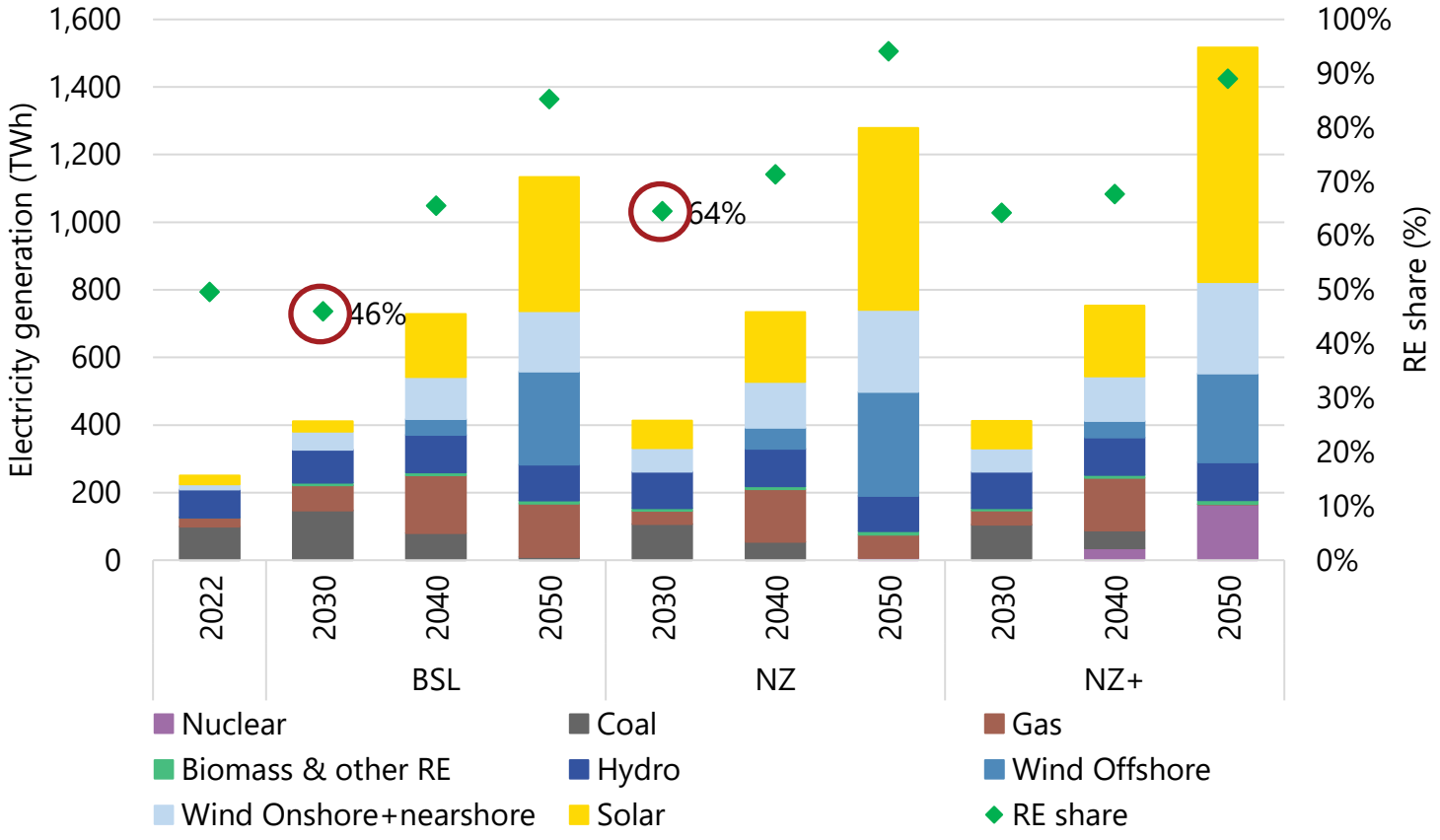
Power production: RE shares above 60% in 2030



It is cost-efficient to reach the JETP target on RE share in power mix even in BSL (47% 2030)

For a cost-efficient transition towards Net-zero, even higher RE shares should be targeted

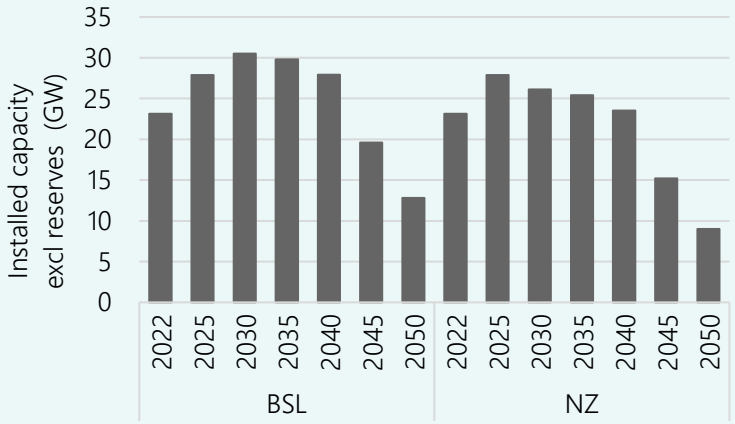
Recommendations

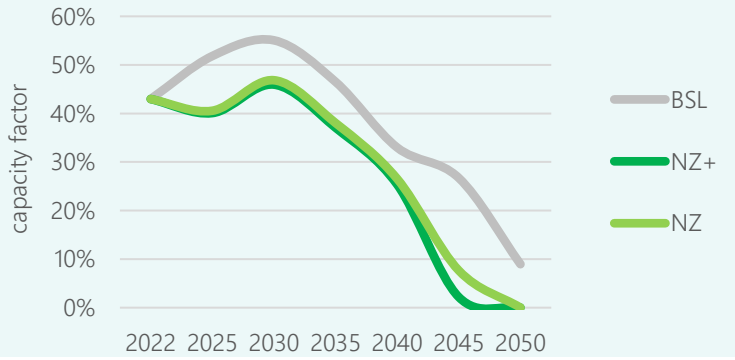
Set ambitious short-term targets for RE deployment, and reduce risks and delays in approving renewable energy projects.

Support the ambitious transport sector targets with similar ambitious targets for RE integration in the power sector.

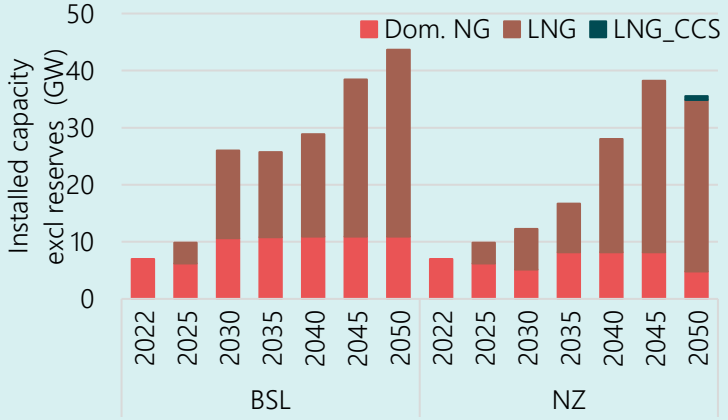
Thermal power: From baseload to backup

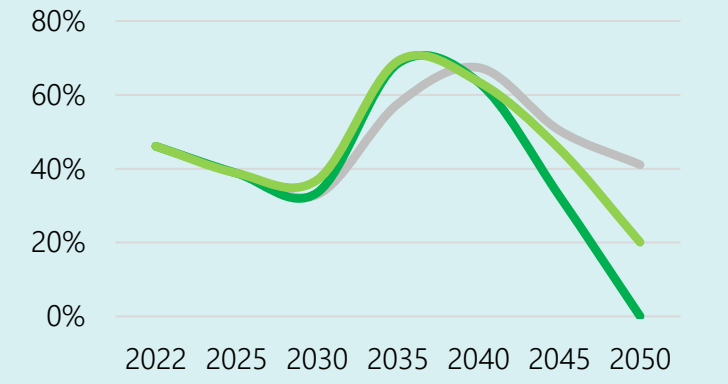
Coal power





Gas power





No new coal after 2025 in Net-Zero scenario

LNG plays important role, but result is sensitive to higher prices

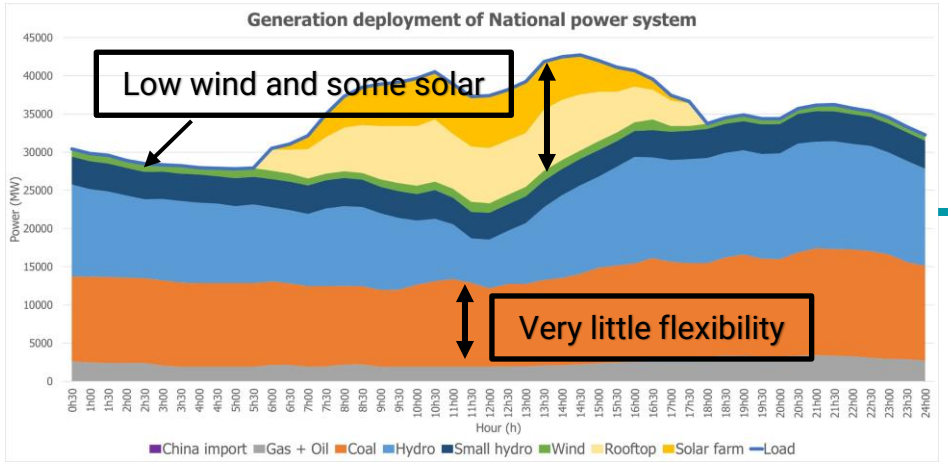
Recommendations

Improve power system efficiency by enhancing and timely prioritizing flexibility

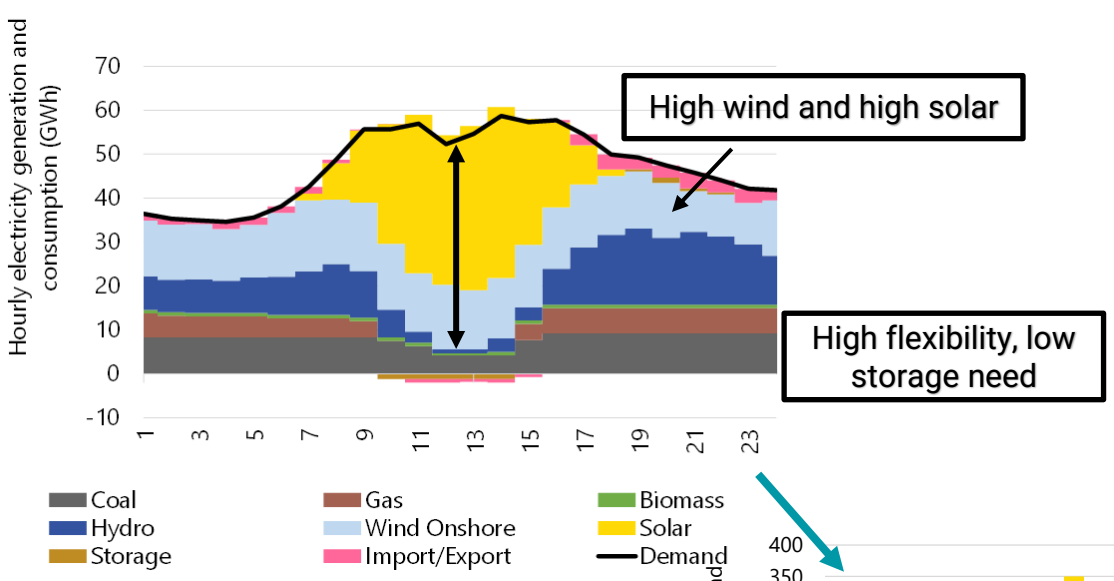
Consider to introduce support measures for supplying ancillary services to incentivize flexibility

Power System Balancing

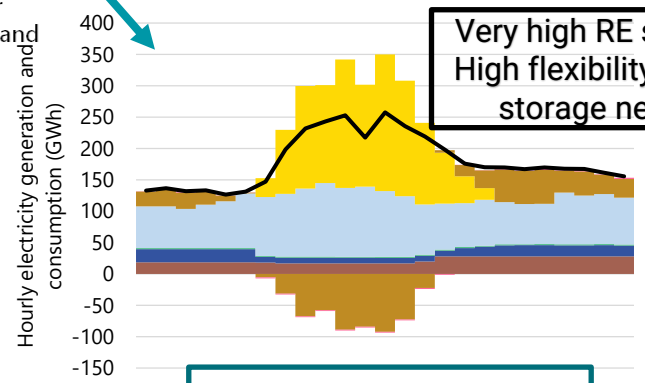
Integration of renewables: Use cheapest and simplest measures first



Actual data, today (2023)

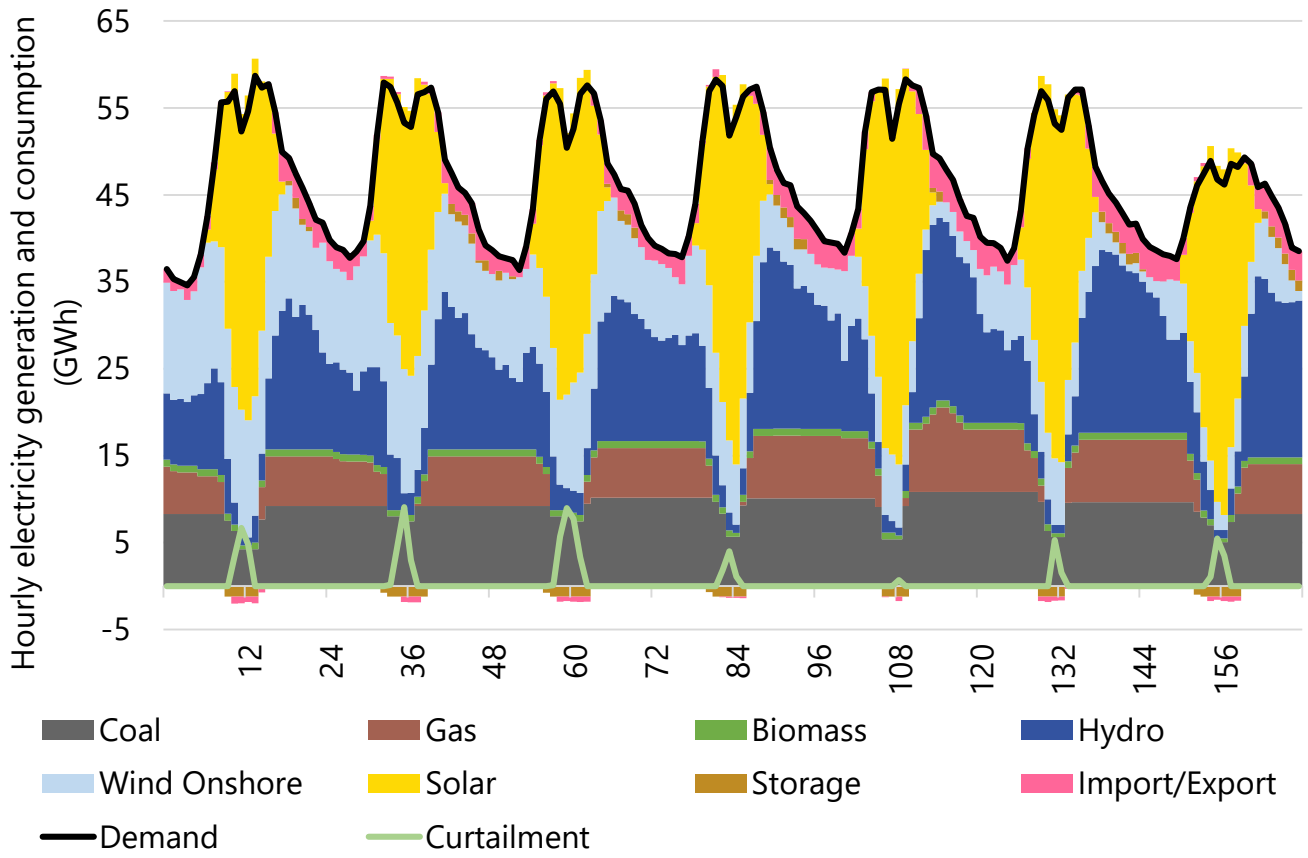


EOR simulation, 2030



EOR simulation, 2050

Already in 2030, power plants should be more flexible



Example of modelled hourly dispatch of full power system, assuming low flexibility of coal power plants. (NZ scenario, a week in March, 2030)

Power system almost fully renewable during daytime in 2030

Focus more on hourly value of power produced, than highest possible output of power plants

Flexible gas and hydro is not enough to ensure efficient integration – coal must also adapt

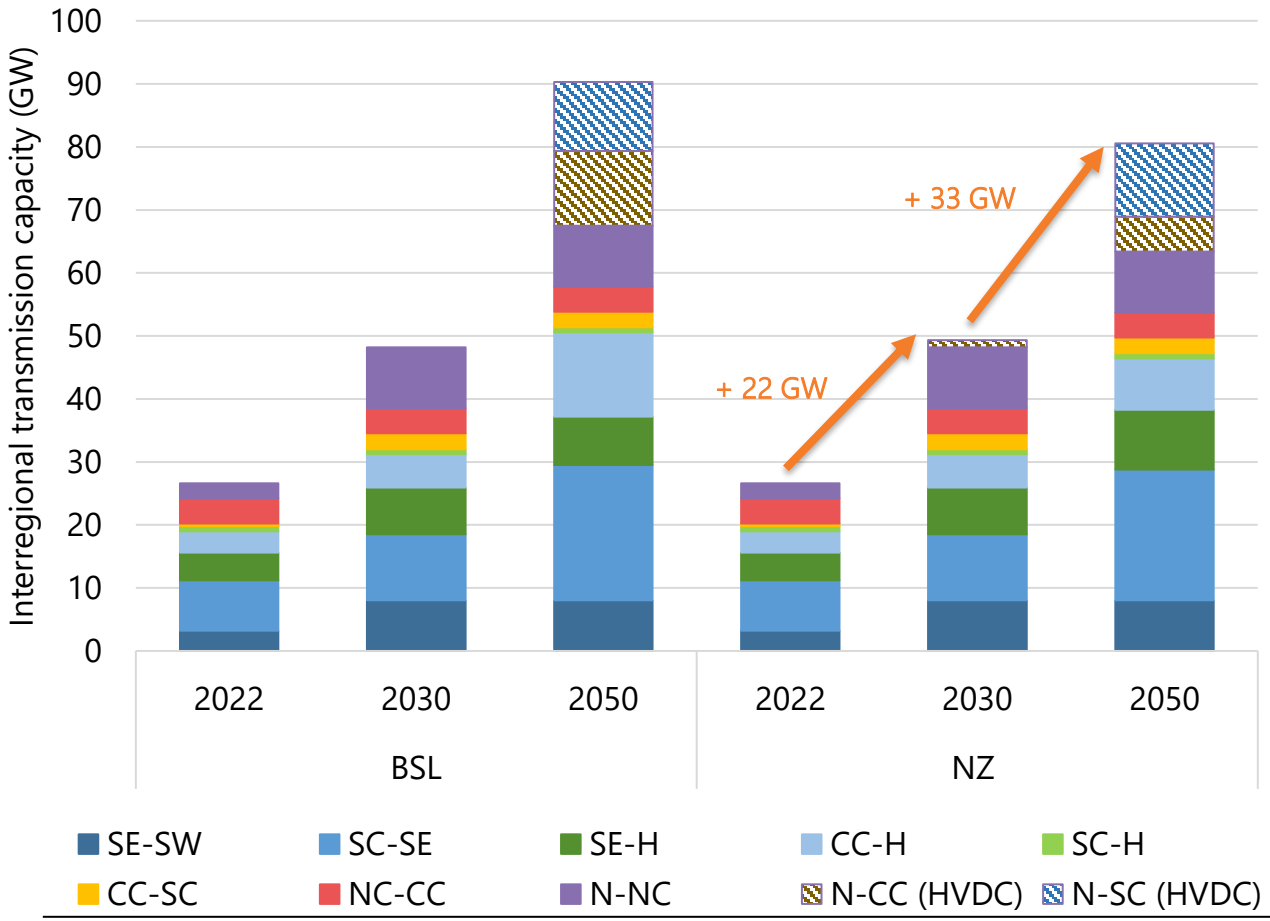
Recommendations

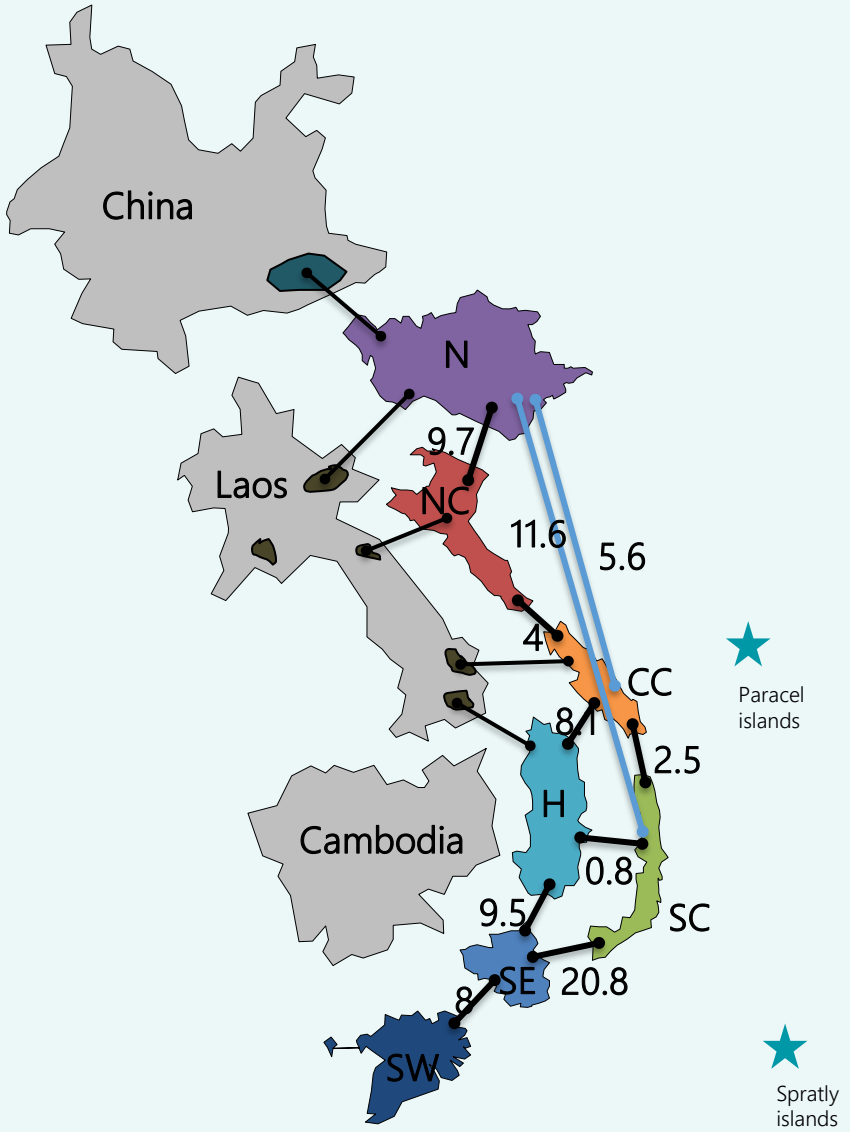
Support measures enabling flexible plant operation will help ensure power system stability and efficiency.

Analyse and propose support mechanisms when curtailing renewable-based generation.

Set standardized requirements for minimum load and ramp rates for existing and planned power plants.

Grid investments: Early and consistent expansion of transmission system in BSL and NZ

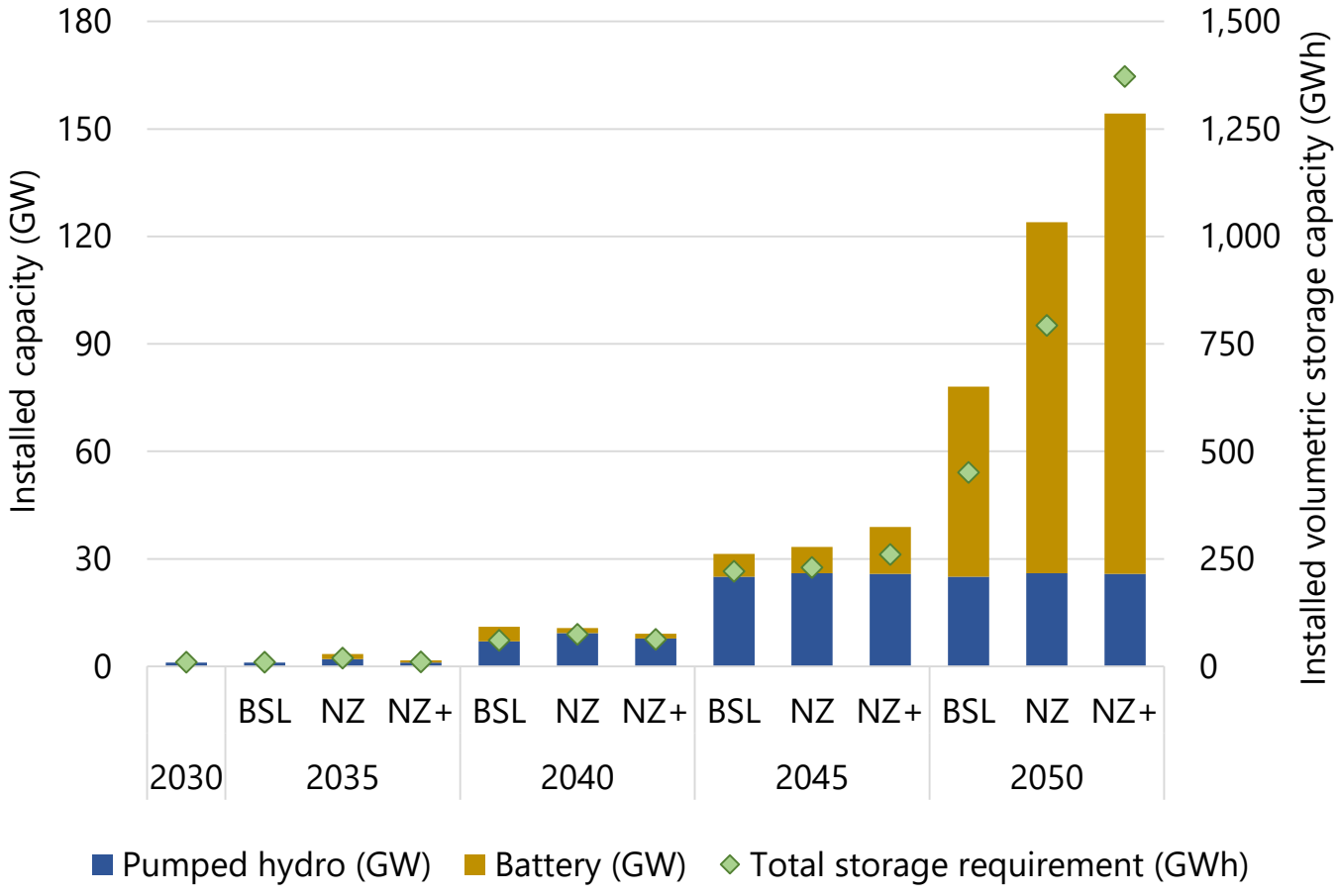


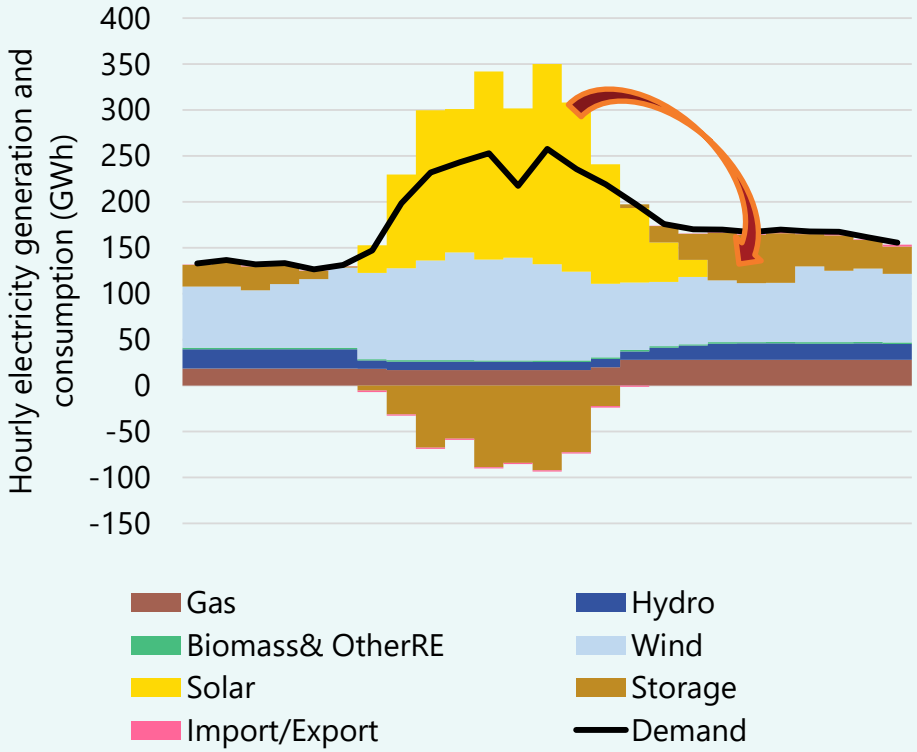


NZ 2050

Installed transmission capacity (GW). Blue is HVDC.

Electricity storage needs to be deployed after 2030, also in Baseline





Example operation in 2050

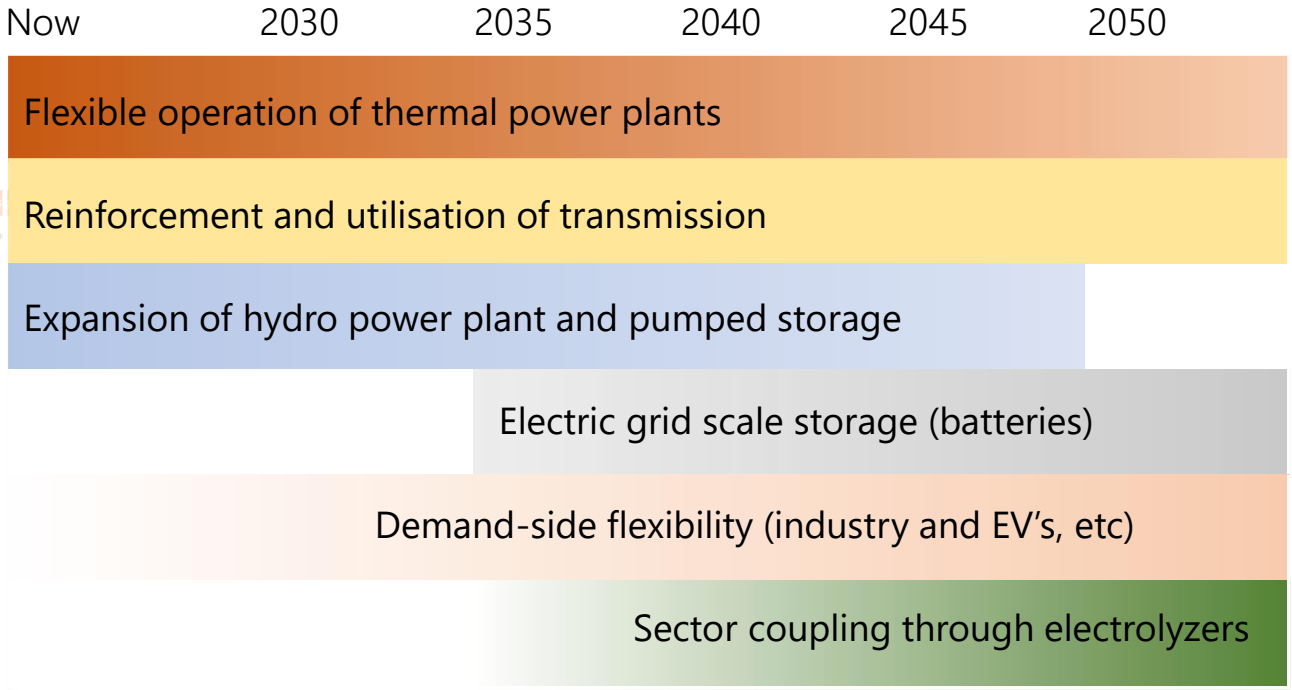
Recommendations

Develop the regulatory framework to support large scale deployment of electric storage after 2030

Use the cheapest measures first and save BESS (and hydrogen) for last

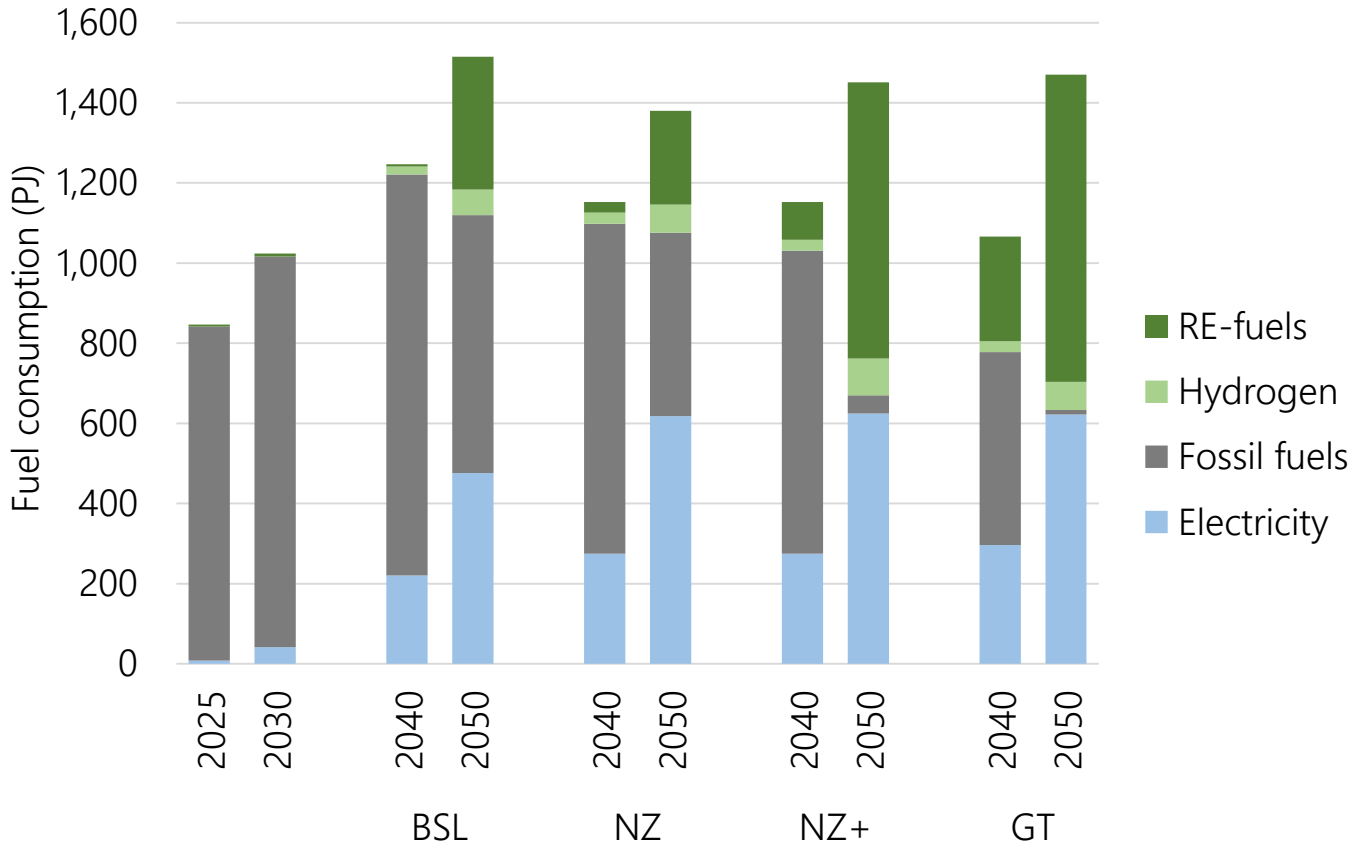
BESS data from DEPP3 2023 Technology Catalogue

Technical lifetime (years)	20	25	30
Construction time (years)	0.20	0.20	0.20
Energy density (Wh/kg)	150	200	300
Ramping configurations			
Response time from idle to full-rated discharge (ms)	50	50	50
Financial data			
Nominal investment (MUSD/MWh)	0.578	0.264	0.157




Transport

Electrification is key for transport sector



Rapid electrification of light transport is cost-efficient and reduces health/environmental impacts.

Almost full electrification of car and motorbike fleet by 2050

Renewable fuels for heavy transport

Recommendations

Consider targets for 50% BEV in 2030, and 90% in 2040

Plan for the needed infrastructure for electrification of the transport sector

Timely develop investment roadmaps for electric railroad (both passenger and freight) and promote public transport

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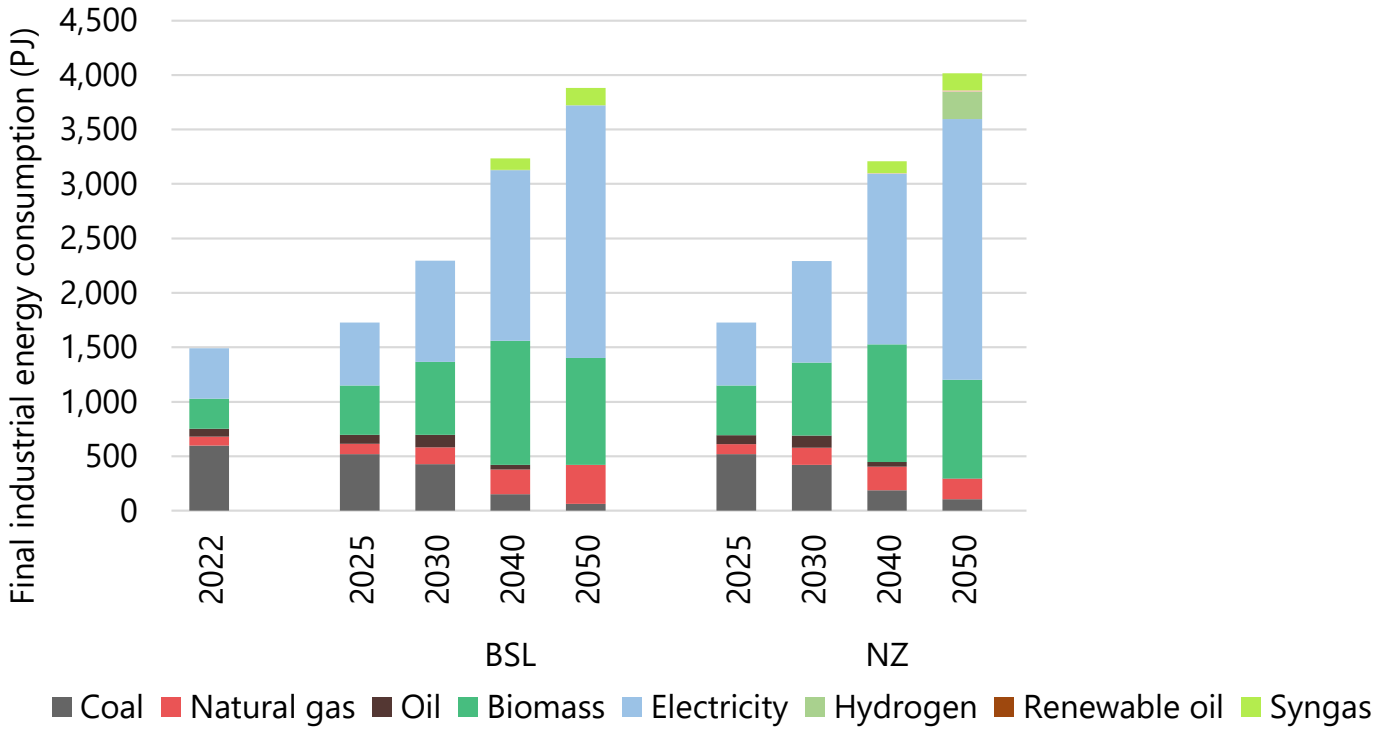
Industry

Industrial growth:
Fuelled by electricity and biomass



Energy demand set to increase significantly, even with all energy efficiency options used

Electricity is the primary energy form for industry growth – biomass second: Ensure sustainability

Reduction in fossil fuel use from today, across all scenarios

Coal use in industry almost phased out towards 2045

Recommendations

Ensure electrification of all sectors, and use biomass where thermal energy is required

Phase out coal in new industry segments no later than 2030

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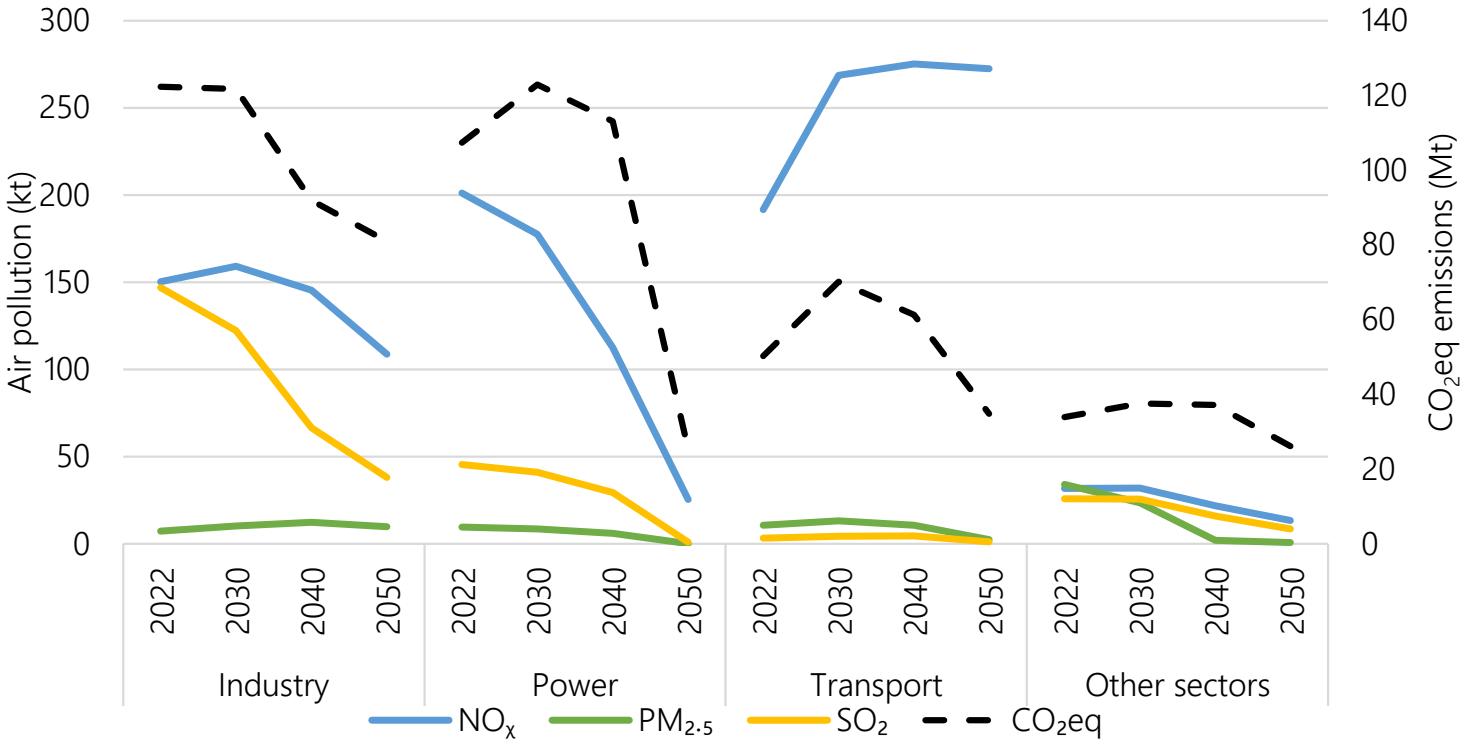
System costs and air pollution

Green transition also reduces local air pollution



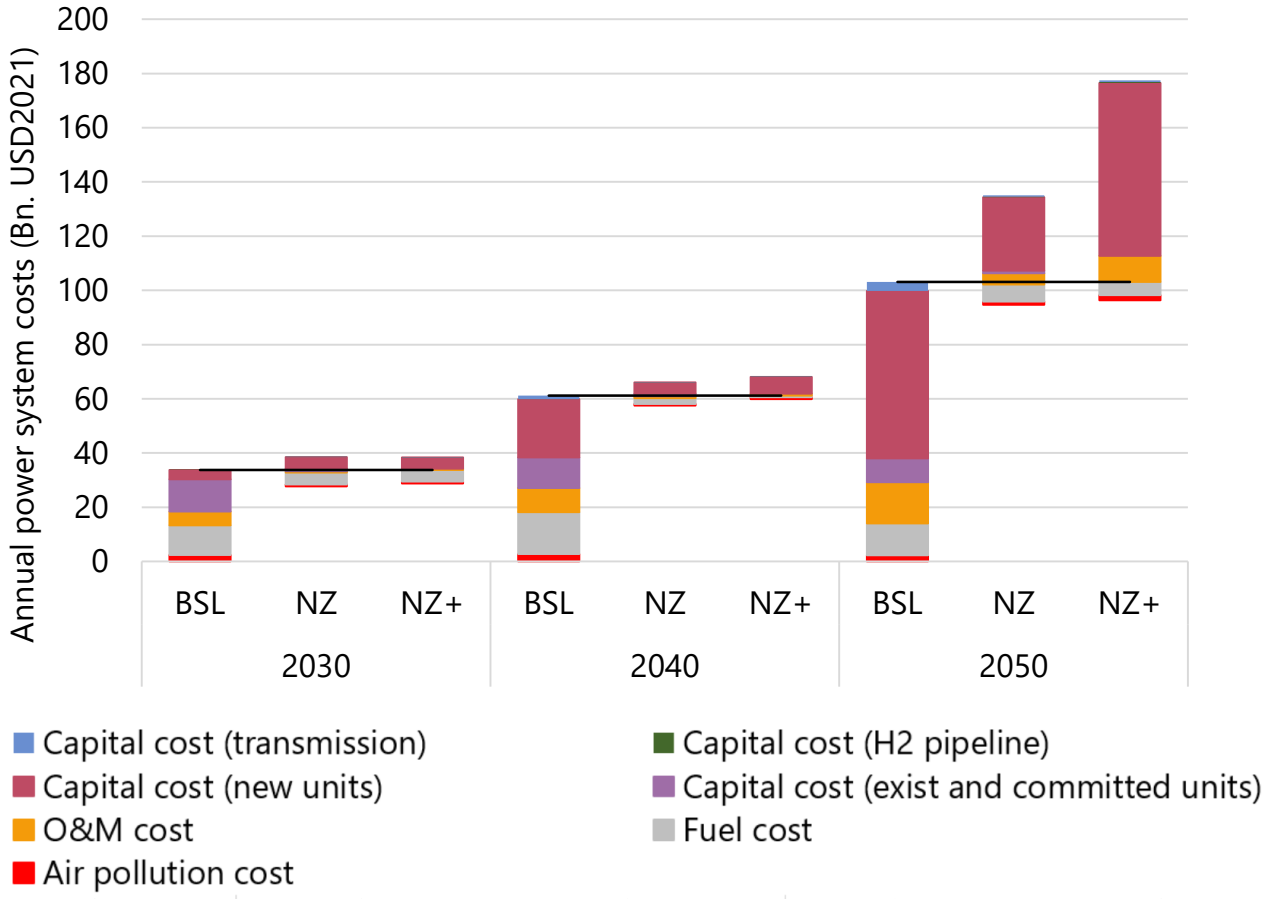
NZ - scenario

Reducing fossil fuels reduce air pollution drastically. Especially energy efficiency and electrification.

Power sector and industry can reduce emissions significantly, while transport sector is more difficult

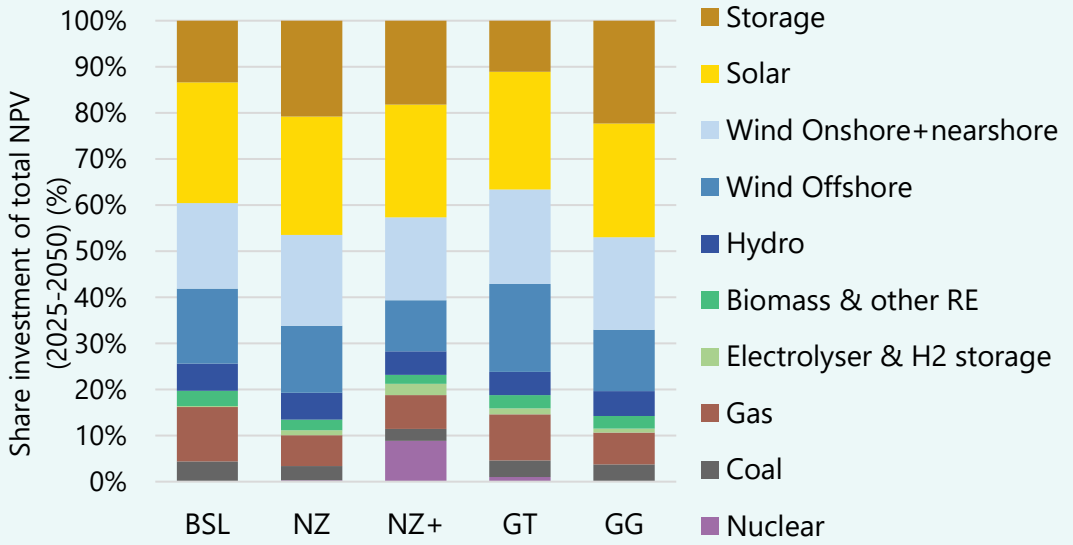
Cost and emission of NO_x keep increasing, as RE fuels also pollutes NO_x

Electricity system costs driven by RE investments



Shifting from high payment for fuels, to high investments in RE

Generation investments: 80% to 90% in RE technologies.



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Thank you!

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