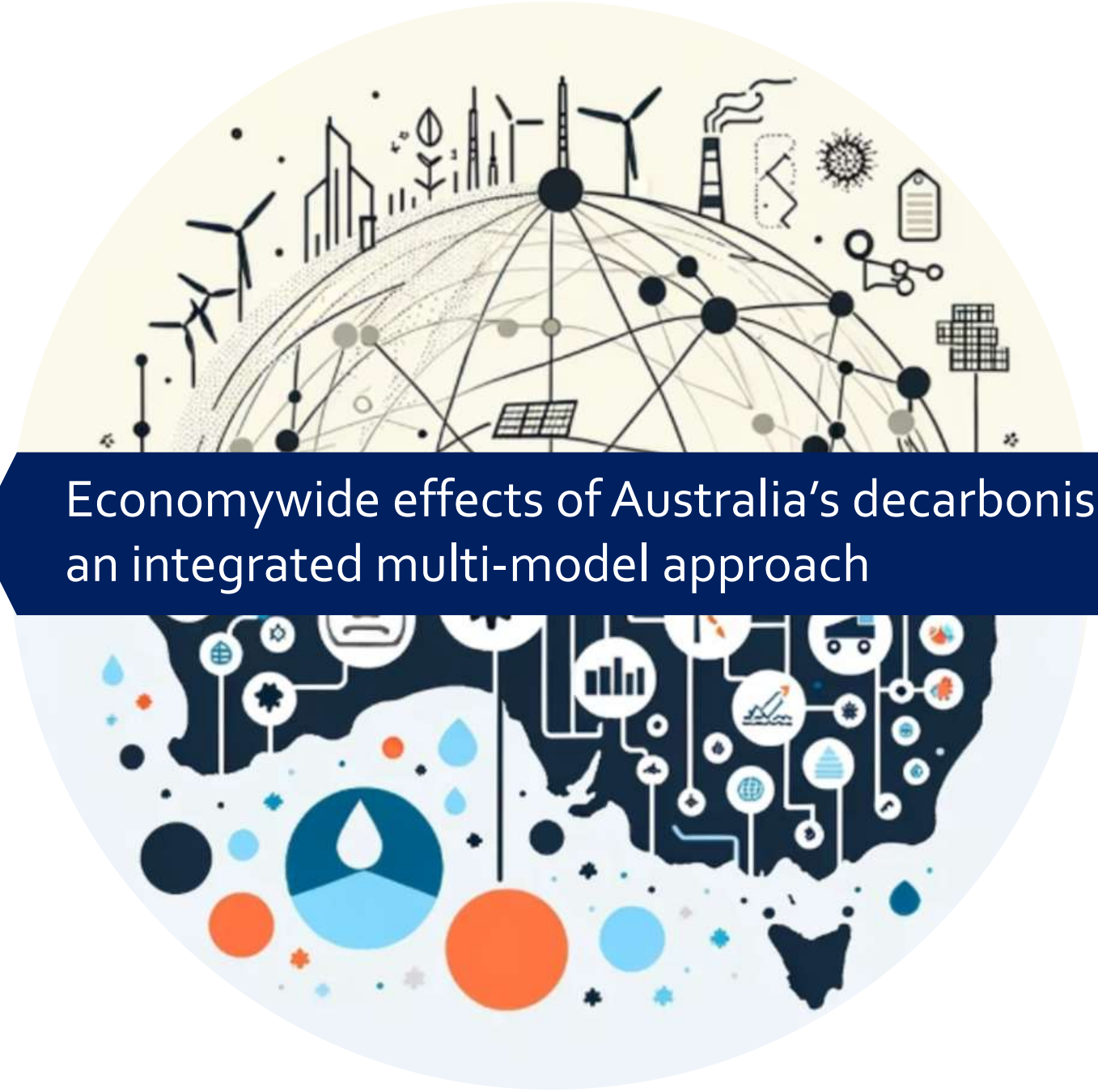

Economywide effects of Australia's decarbonisation pathway: an integrated multi-model approach

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RATIONALE

Climate change presents significant risks to the global and domestic economies

PHYSICAL RISK

Chronic risk
Changing climate conditions
(e.g., temperature)

Acute risk
Extreme weather events

Direct damage to assets or property

TRANSITION RISK

Policy and regulatory changes

Technological innovation

Social adaptation and consumer preferences

Disruption from adjustment to low-carbon economy

The focus of this paper is on transition risk!

OBJECTIVE

Model the economic effects of Australia's net-zero emissions (NZE) transition under a 1.5°C scenario

- Economic cost of decarbonisation
- Structural change in the economy
- Sectors most affected by the transition

METHODOLOGY

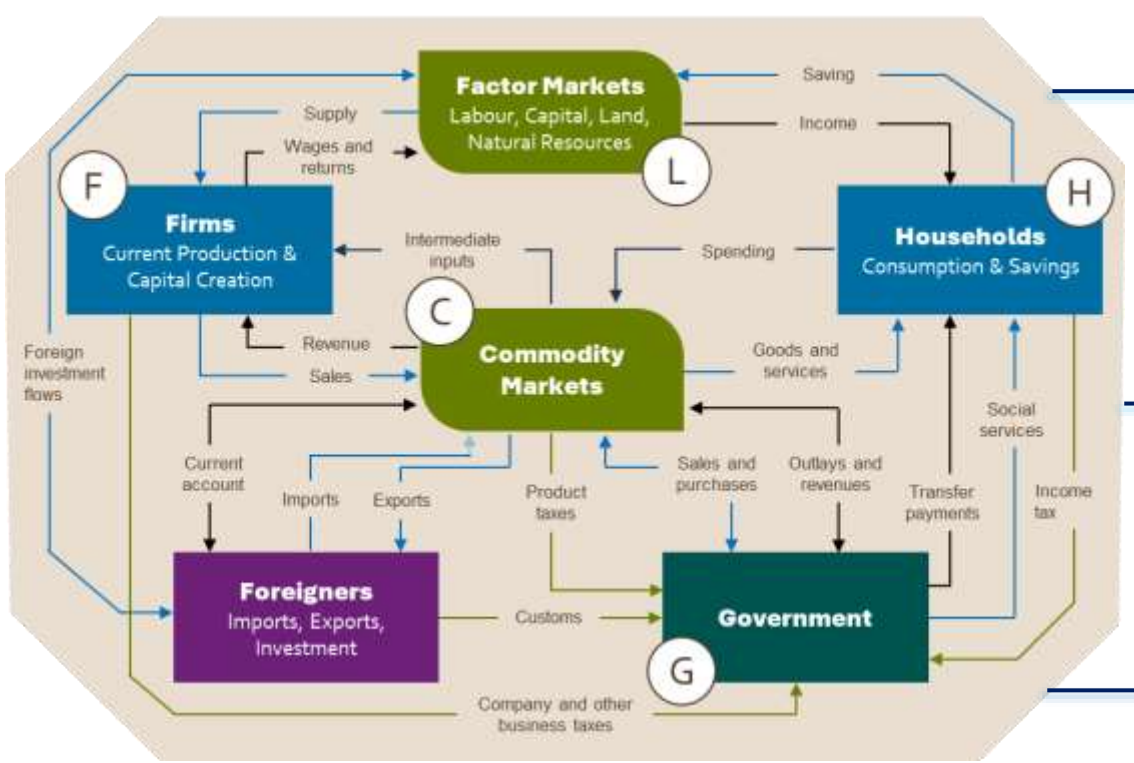
NZE scenario is modelled using an integrated multi-model framework

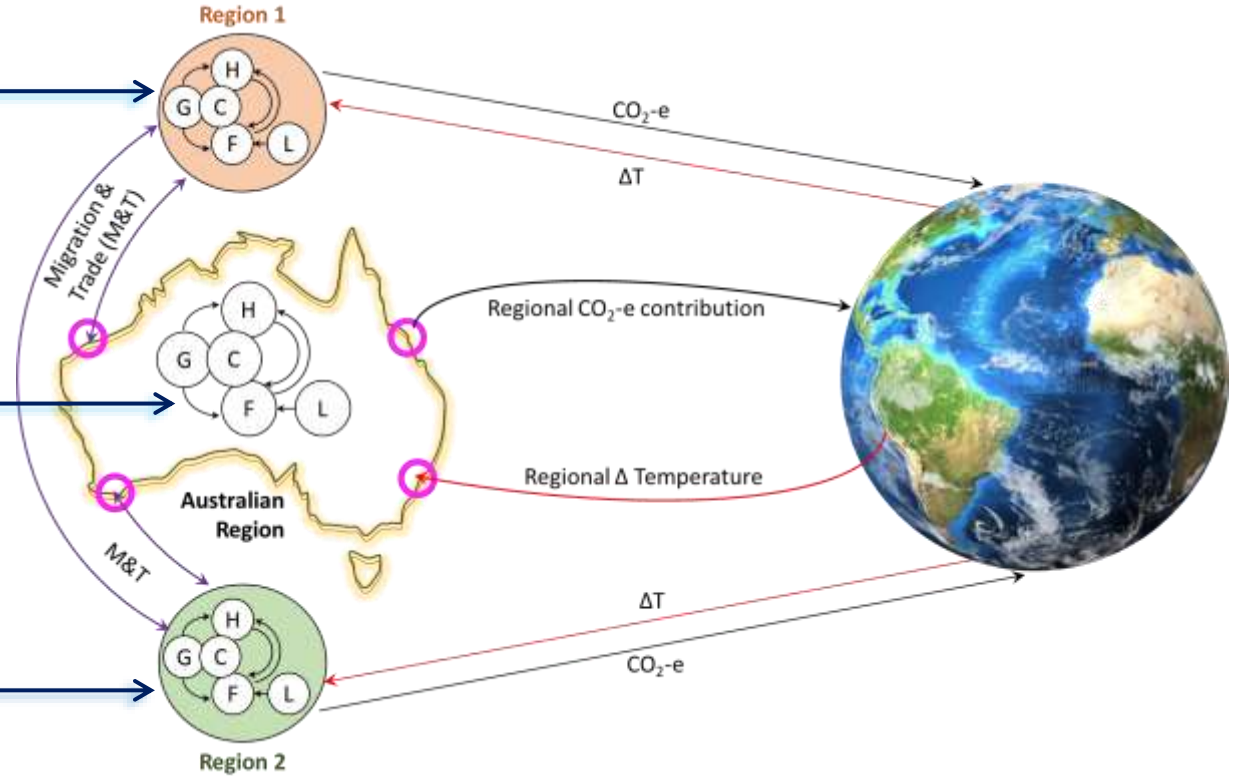
- Two CGE models (global and national)
- Two-stage model coupling approach

CGE framework

Computable – calibrated by real-world data
General – represents the whole economy
Equilibrium – based on general equilibrium theory

The interaction between the economic and biophysical systems is captured within the CGE framework





CGE models capture the economic flows, interlinkages, and behaviour of various agents

The model represents the resources drawn from the environment and the impact of climate on economic activity

CGE models

The strengths of the two models complement each other

	Global Trade and Environment Model	Australian Trade and Environment Model
		
Spatial dimension	Multi-country	Single-country
Sectoral aggregation	Less detailed (36 sectors)	More detailed (65 sectors)
International linkages	Inter-regional trade	Rest of the world is exogenous
Economic structure	Simplified representation of economic structure	Detailed representation of factor mobility, sectoral dynamics, taxation and institutional framework
Climate change features	Climate damage function, energy & emissions accounting, carbon price mechanism	

Model coupling approach

NZE policy scenario

Global target of 1.5°C
The world coordinates action to limit warming to 1.5°C.

Global modelling inputs

Two-stage simulation

STAGE 1

Global model

Global economic impacts

Transmit Australian and global settings to ATEM:

Exports and imports
Foreign prices of traded goods
International investment
Global fuel demands

Australia net-zero in 2040
Australia reaches net zero in 2040 and progresses into a negative emission path.

Domestic modelling inputs

STAGE 2

Domestic model

Australian economic impacts

Why link the two models?

- Improves the policy relevance of the NZE pathways
- Captures multi-scale dynamics and balances the breadth and depth of modelling results
- Supports robust sensitivity and scenario analysis under uncertainty

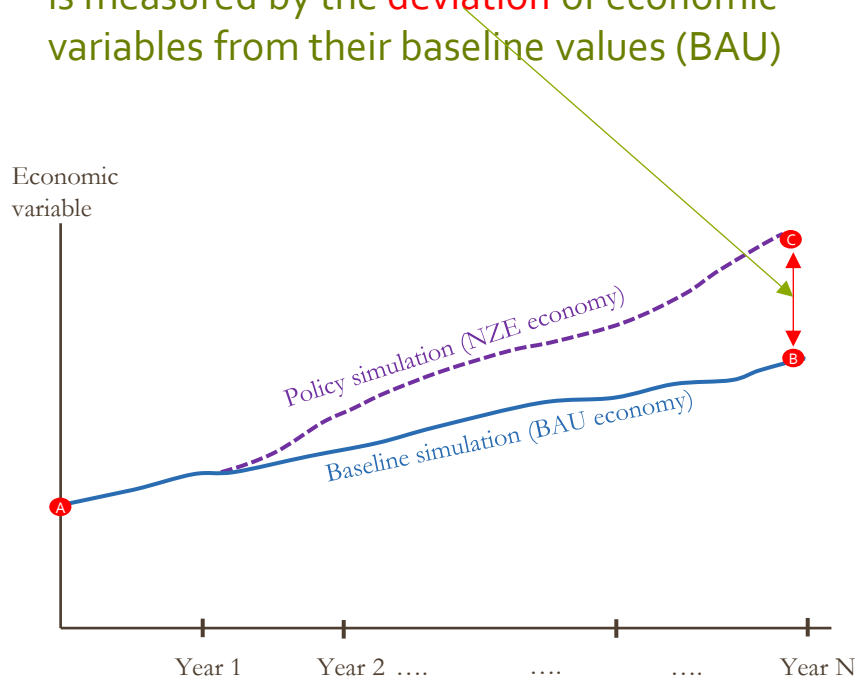
Simulation design: scenario analysis

The CGE models are run twice to simulate a (1) BAU economy and (2) NZE economy

	MODEL INPUTS	
	BAU scenario (baseline)	**NZE scenario (policy)**
GLOBAL	▪ Macroeconomic forecast (GDP, employment, CPI) ▪ Demographics (population, labour supply) ▪ CO_2 emissions (total and sectoral) ▪ Electricity output and tech mix ▪ Energy output and efficiencies ▪ Surface temperature	**Global target of 1.5°C** ▪ Global net emissions ▪ Global LULUCF emissions ▪ Global temperature ▪ Global electricity output and technology mix ▪ Global energy output
AUSTRALIA	▪ Macroeconomic forecast ▪ CO_2 emissions (total and sectoral) ▪ Electricity output and tech mix ▪ Energy output and efficiencies +++ GTEM output on Australian settings (import and export prices, export demand shift, exchange rate, foreign investment, global fuel demands)	**Australia net-zero in 2040** ▪ Aus total net emissions ▪ Aus LULUCF emissions ▪ Aus temperature ▪ Aus electricity output ▪ Aus energy output +++ GTEM's global settings for Australia

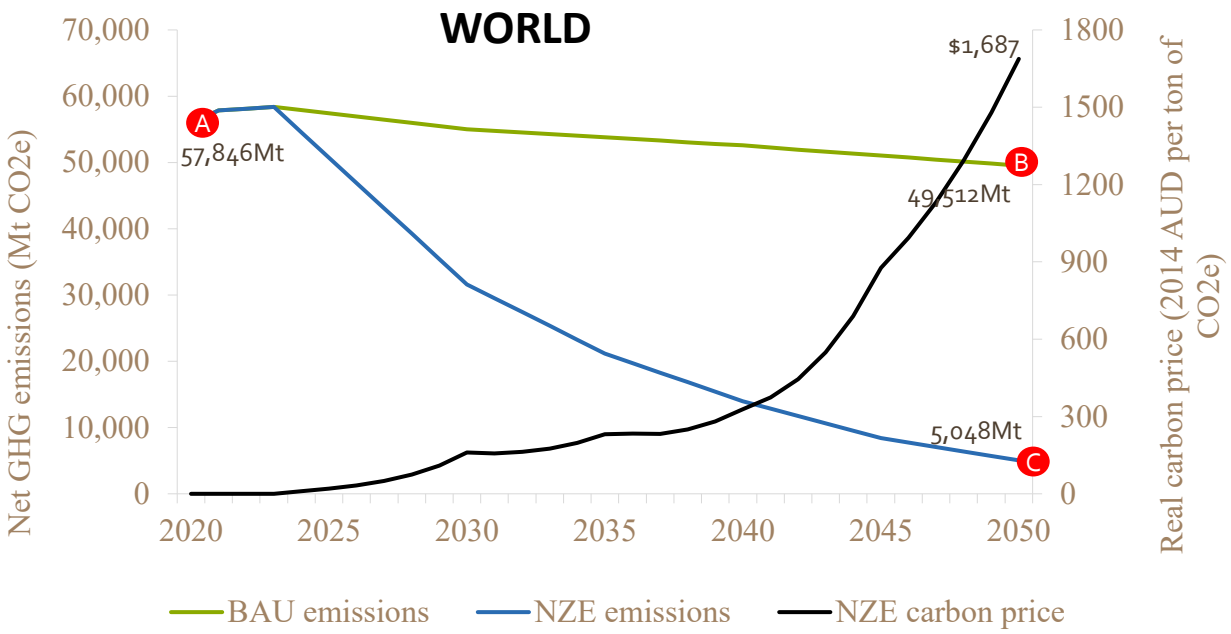
Sources of inputs: IEA's Net Zero by 2050 report, IEA's *World Economic Outlook* 2021 report, GLOBIOM, MAGICC, AusTIMES, DCCEEW

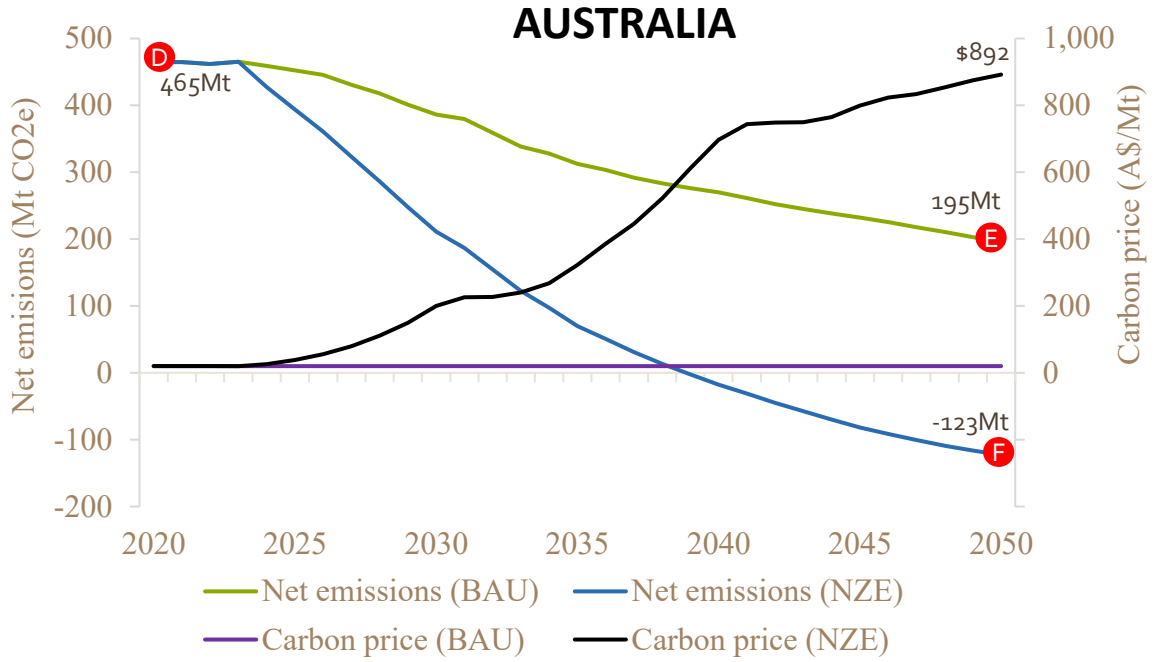
The economic impact of the policy (NZE) is measured by the deviation of economic variables from their baseline values (BAU)



Net emissions pathway

The emissions pathway is exogenously imposed, and the carbon price is endogenously determined





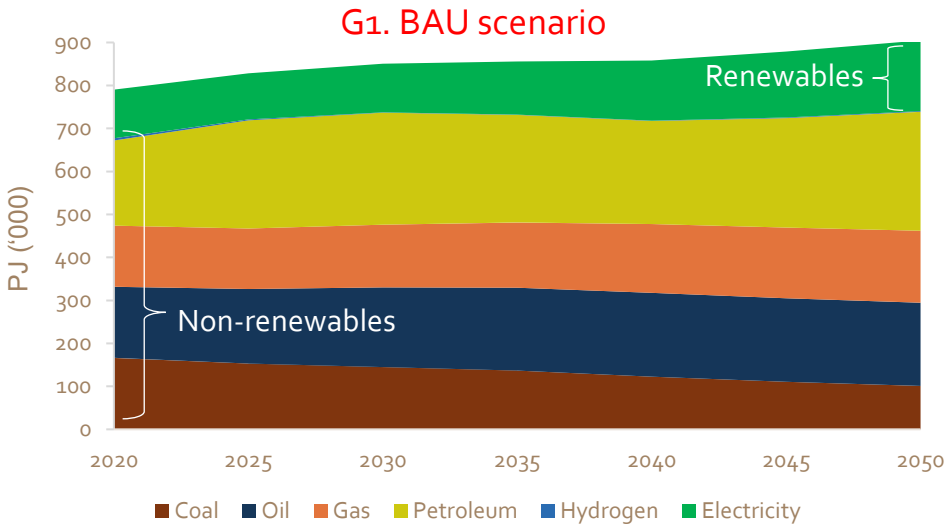
Global net emissions	BAU 2050	NZE 2050
Δ relative to 2020	-4%	-91%
Δ relative to BAU		-90%

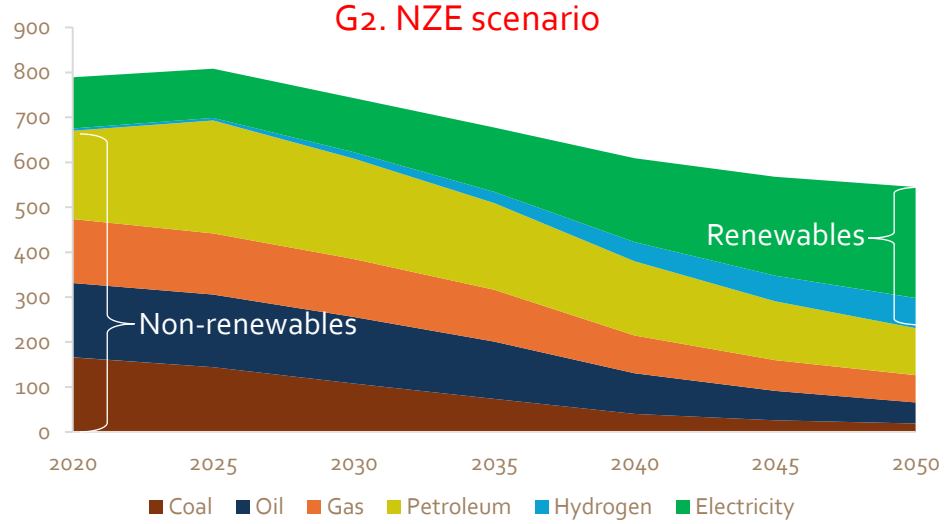
Aus net emissions	BAU 2050	NZE 2050
Δ relative to 2020	-58%	-125%
Δ relative to BAU		-159%

Energy mix

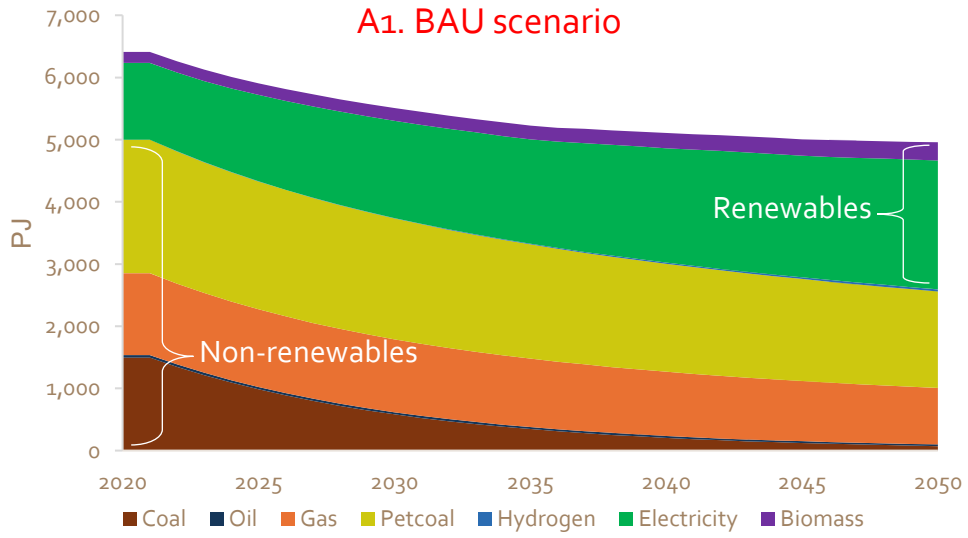
There is a shift from fossil fuels to renewables under the NZE scenario

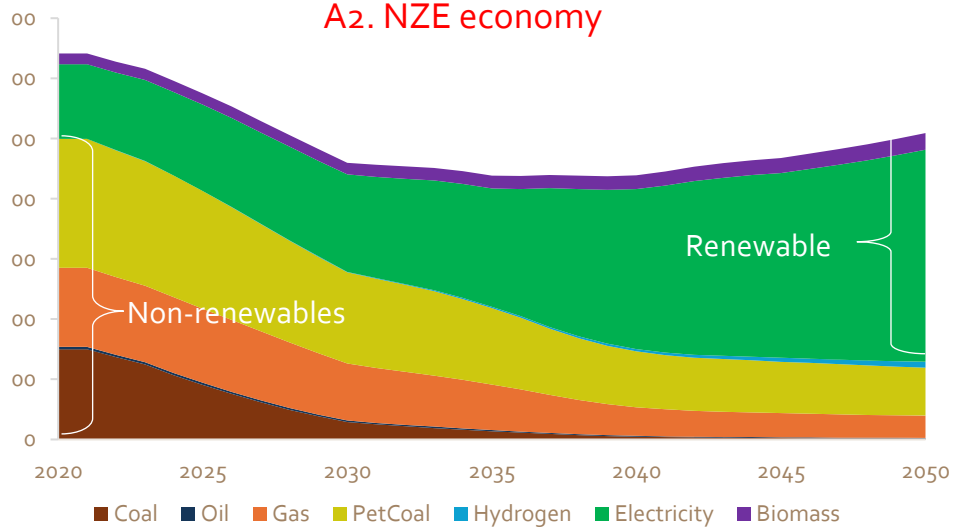
WORLD





AUSTRALIA





Global economic effects

WORLD	CPI Consumer Price Index	GDP Gross Domestic Product	FTE Full Time Employment
BAU	2.36% p.a.	2.35% p.a.	0.67% p.a.
NZE	2.54% p.a.	2.18% p.a.	0.57% p.a.
% change relative to baseline	0.18% p.a.	–0.17% p.a.	–0.10% p.a.

Avg. annual percentage change relative to baseline (2020-2050)

Region	GDP	Employment
ASIA	-0.20	-0.11
LAM	-0.24	-0.06
MAF	-0.43	-0.16
OECD	-0.07	-0.05
REF	-0.11	-0.10

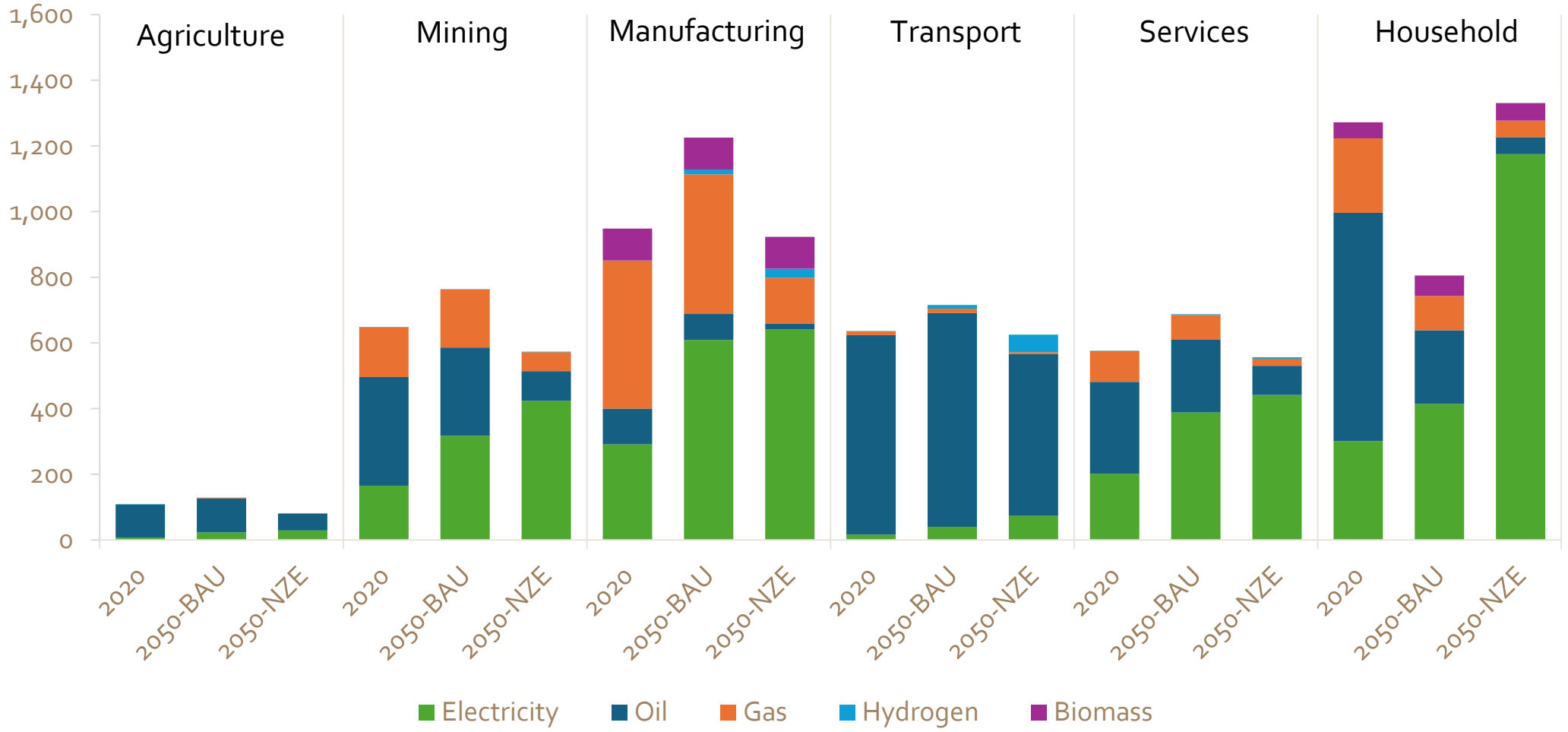
Legend:
ASIA - Most Asian countries excluding Middle East, Japan and Former Soviet Union states.
LAM - Countries of Latin America and the Caribbean.
MAF - Countries of the Middle East and Africa.
OECD - Includes the OECD 90 and EU member states and candidates.
REF - Countries from the Reforming Economies of Eastern Europe and the Former Soviet Union.

Domestic economic effects (2020-2050)

AUSTRALIA	CPI Consumer Price Index	GDP Gross Domestic Product	FTE Full Time Employment
BAU	1.89% p.a.	2.24% p.a.	0.63% p.a.
NZE	2.08% p.a.	2.11% p.a.	0.57% p.a.
% change relative to baseline	0.19% p.a.	–0.13% p.a.	–0.06% p.a.
Cumulative % change, 2050	5.67%	–3.95%	–1.97%

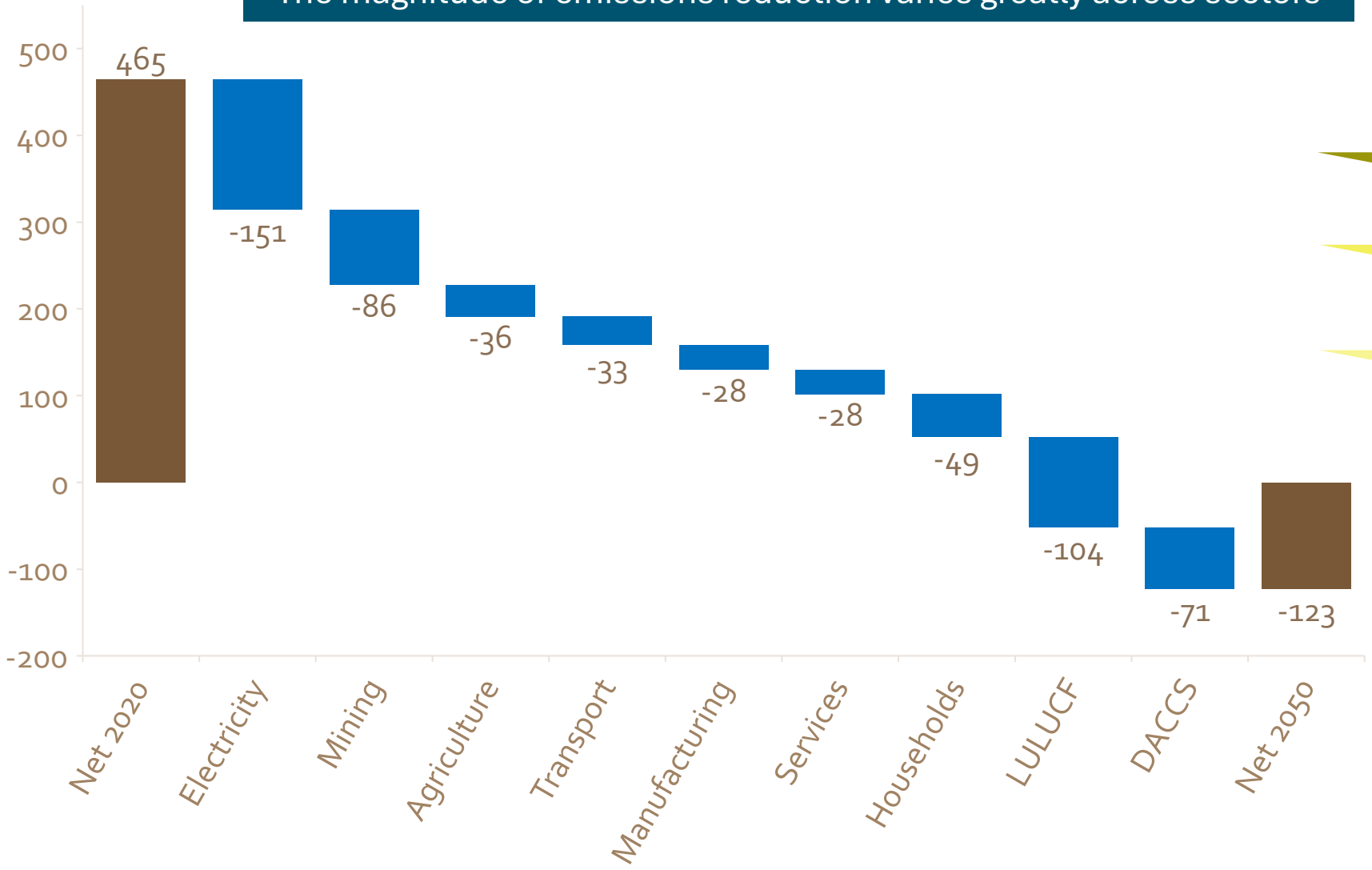
Australian Energy Mix by Sector (PJ)

Pricing emissions provides an incentive for businesses and households to switch to cheaper energy sources



Australian Sectoral Abatement (CO2e Mt)

The magnitude of emissions reduction varies greatly across sectors



Carbon price

fuel substitution effects

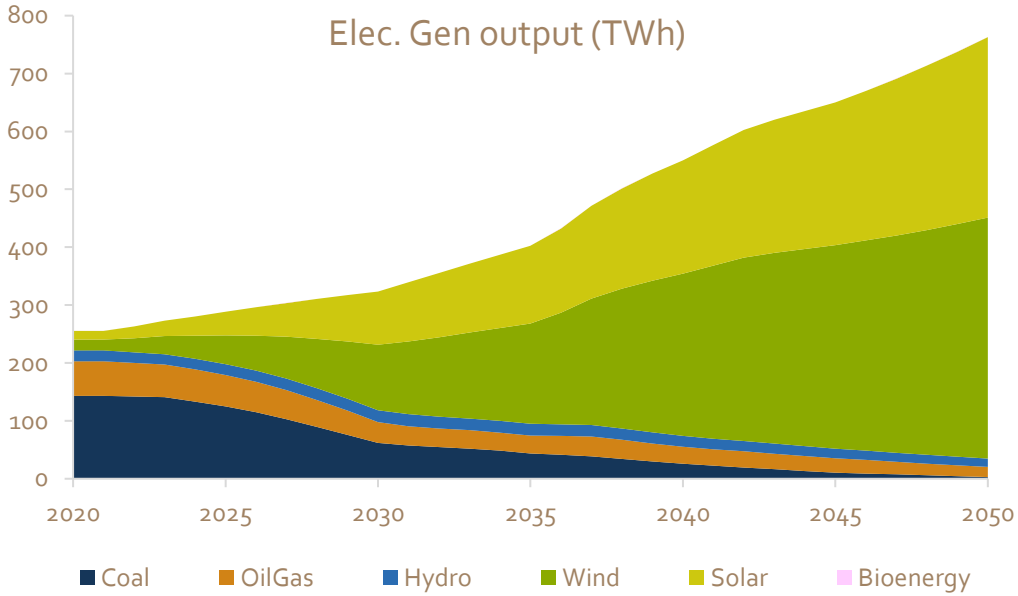
changes in energy use

emission reductions

Australian sectoral results: Output

Average annual percentage changes relative to baseline

	Output	Price
Electricity	1.45%	1.23%
Manufacturing	– 0.57%	0.15%
Mining	– 0.54%	0.02%
Agriculture	– 0.45%	0.20%
Transport	– 0.11%	0.07%
Services	– 0.05%	0.06%



The electricity generation sector undergoes significant transformation

Other industries face disruption due to rising production costs linked to emissions abatement

Conclusion

- An integrated multi-model CGE approach is used to evaluate the economic effects of the Australian NZE pathway under realistic global conditions.
- Results show GDP contraction globally (5%) and in Australia (4%) over the 30-year period.
- Sectoral impacts vary, highlighting transition risks.
  - ➢ significant transformation in the energy sector but disruption in others.

elec. generation shifts to renewables

cost of abatement raises production cost

E N D

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