



Australian Government

The Treasury

Australia's Low Pollution Future

The economics of climate change
mitigation

New Zealand, February 2009



Outline of Presentation

Australian Government

The Treasury

- Policy context
- Analytical approach
- Modelling framework
- Results



Australian Policy context

Australian Government

The Treasury

- The Australian Government's climate change policy is built on three pillars:
 - Reducing Australia's emissions
 - Adapting to climate change we can't avoid
 - Helping to shape a global solution
- Garnaut Climate Change Review
- Carbon Pollution Reduction Scheme (CPRS) from 2010
 - White Paper released in December 2008



Treasury Analysis during 2008

- Garnaut Climate Change Review
 - Independent review
 - Treasury undertook mitigation cost analysis
 - Review undertook climate impacts analysis
 - First set of analysis for Australia



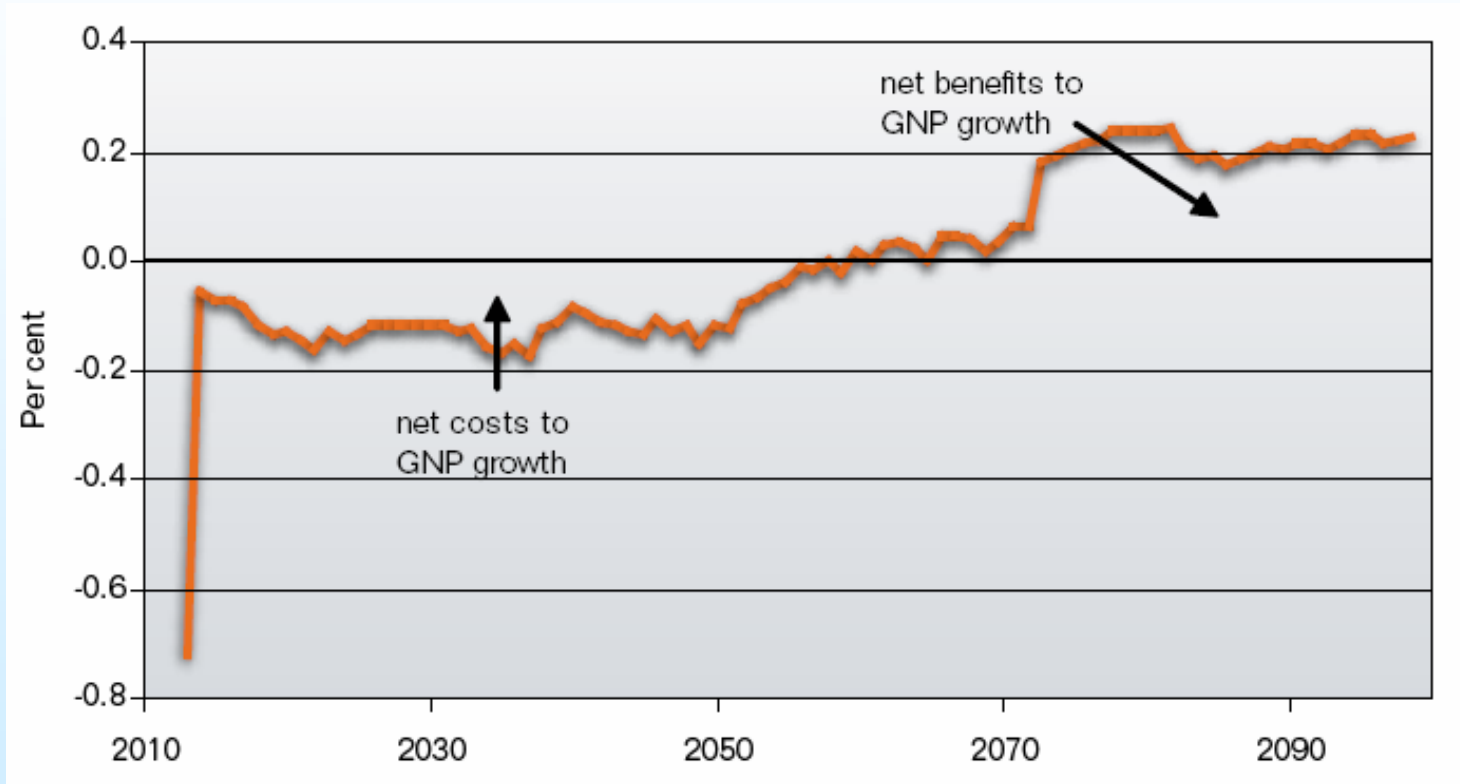
Garnaut Climate Change Review Framework

- The Review's analysis compared:
 - the costs of climate change (no mitigation); and
 - the benefits of mitigation
- Types of costs and benefits:
 - Type 1: Currently measurable market impacts
 - Type 2: Market impacts not readily measurable
 - Type 3: Insurance value against high damages
 - Type 4: Non market impacts
- CGE modelling explored Type 1 and Type 2 impact costs



Garnaut Review: Net impact of climate change on Australia GNP

Australia's Gross National Product



Note: Includes Type 1 and 2 costs, but not type 3 and 4.

Source: 550ppm scenario, The Garnaut Climate Change Review, pg 265



Garnaut Review: Aim for 450ppm or 550ppm?

Discount rate equals 1.4%	550	450	450 premium
Gross mitigation cost to 2050 (per cent)			
GTEM standard	2.6	3.3	0.7
GTEM enhanced	1.9	2.6	0.7
Net mitigation cost to 2100 (per cent)			
MMRF	3.2	4.0	0.8
Discount rate equals 2.7%	550	450	450 premium
Gross mitigation cost to 2050 (per cent)			
GTEM standard	2.4	3.2	0.7
GTEM enhanced	1.8	2.5	0.7
Net mitigation cost to 2100 (per cent)			
MMRF	3.3	4.2	0.9

Note: The figures give the discounted costs as a percentage of discounted GNP. The '450 premium' is the Excess of the 450 ppm cost over the 550 ppm cost. Costs in GTEM are gross of mitigation; costs in MMRF Net costs (gross costs net of Type 1 and Type 2 benefits). MMRF modelled results are adjusted to include Type 2 costs.

Source: The Garnaut Climate Change Review, pg 270



Treasury Analysis during 2008

- Garnaut Climate Change Review
 - Independent review
 - Treasury undertook mitigation cost analysis
 - Review undertook climate impacts analysis
 - First set of analysis for Australia
- Australian Government Report
 - Treasury undertook mitigation cost analysis
 - Support for Government's medium-term target range announced in White Paper
 - Reduction of between 5-15 per cent below 2000 levels by 2020 and 60 per cent below 2000 levels by 2050



Modelling Framework

- Suite of economic models approach:
 - Global
 - National
 - Sectoral
 - Household
- Generate an integrated set of projections
- Australia in a global context
- Global emission budget derived from stabilisation goals (450-550ppm CO₂-e)
- Emission trading a proxy for all mitigation policies



Modelling Framework

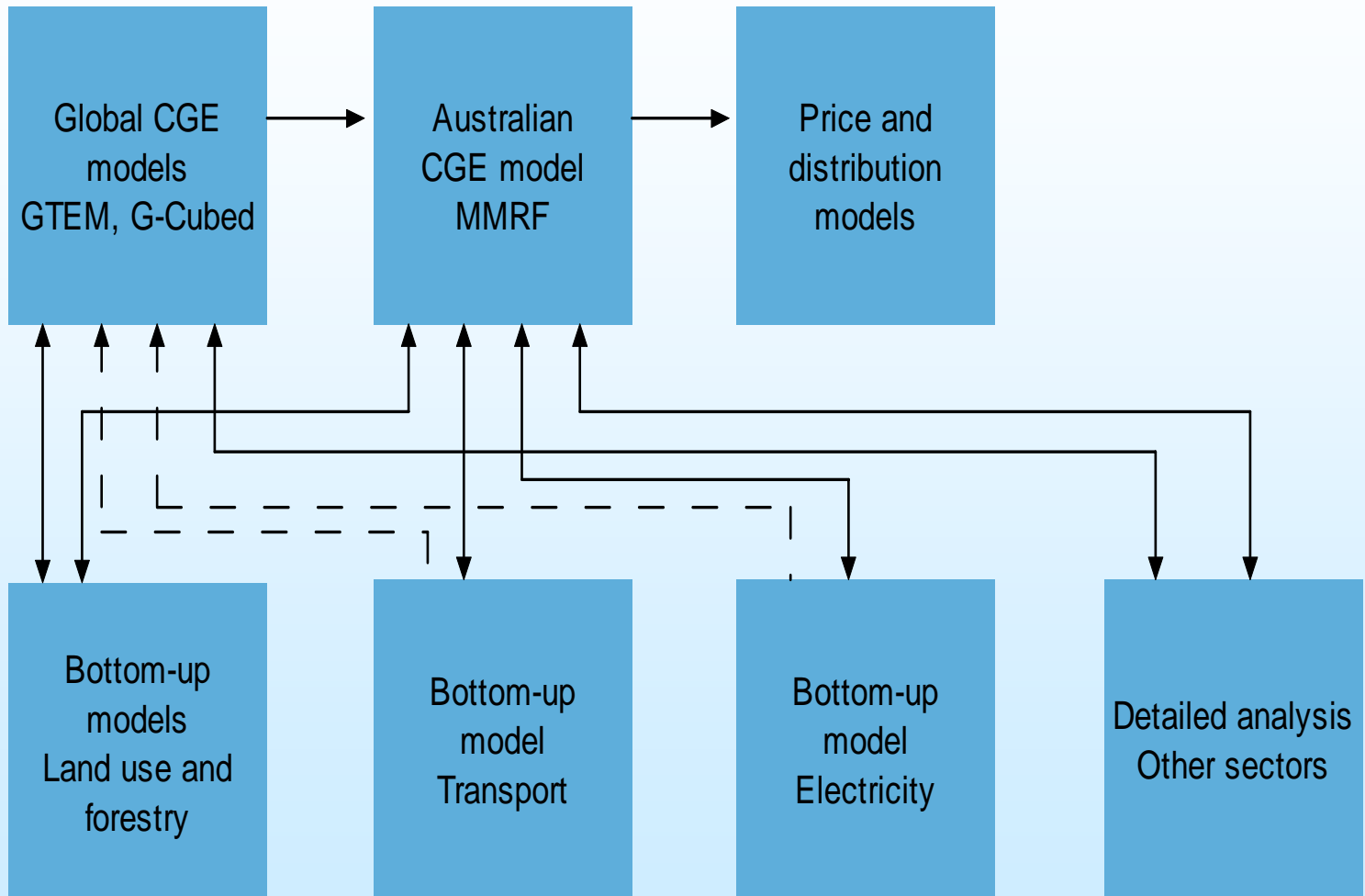
- CGE Models that include Australia
 - Two global (G-cubed and GTEM)
 - One more detailed on Australia (MMRF)
- Bottom-up models for key emissions intensive sectors
 - Electricity (MMA), transport (ESM) and land-use and forestry (ABARE, GCOMAP)
- Short-term price and household distributional impacts using input-output and household level data (PRISMOD, PRISMOD-Dist)
- Input assumptions represent central estimate within range of possible values



Linking of Models

Australian Government

The Treasury





Issues in Linking Models

- Different levels of aggregation
 - Mapping analysis
- Different databases
 - Conversions required
- Different economic theory
 - Potential adjustments to model structure/shocks
- Role of international drivers
 - Carbon prices, export prices, world demand, technology



Australian Government

The Treasury

Economic Analysis - Scenarios

- Reference scenario



Reference Scenario Assumptions

- World and Australia
 - GDP
 - Population
 - UN projections
 - Productivity
 - Convergence?
 - Issues around MER vs PPP
- Energy efficiency and role of technology
- Household tastes and development patterns
- Global energy prices
- Australia's terms of trade

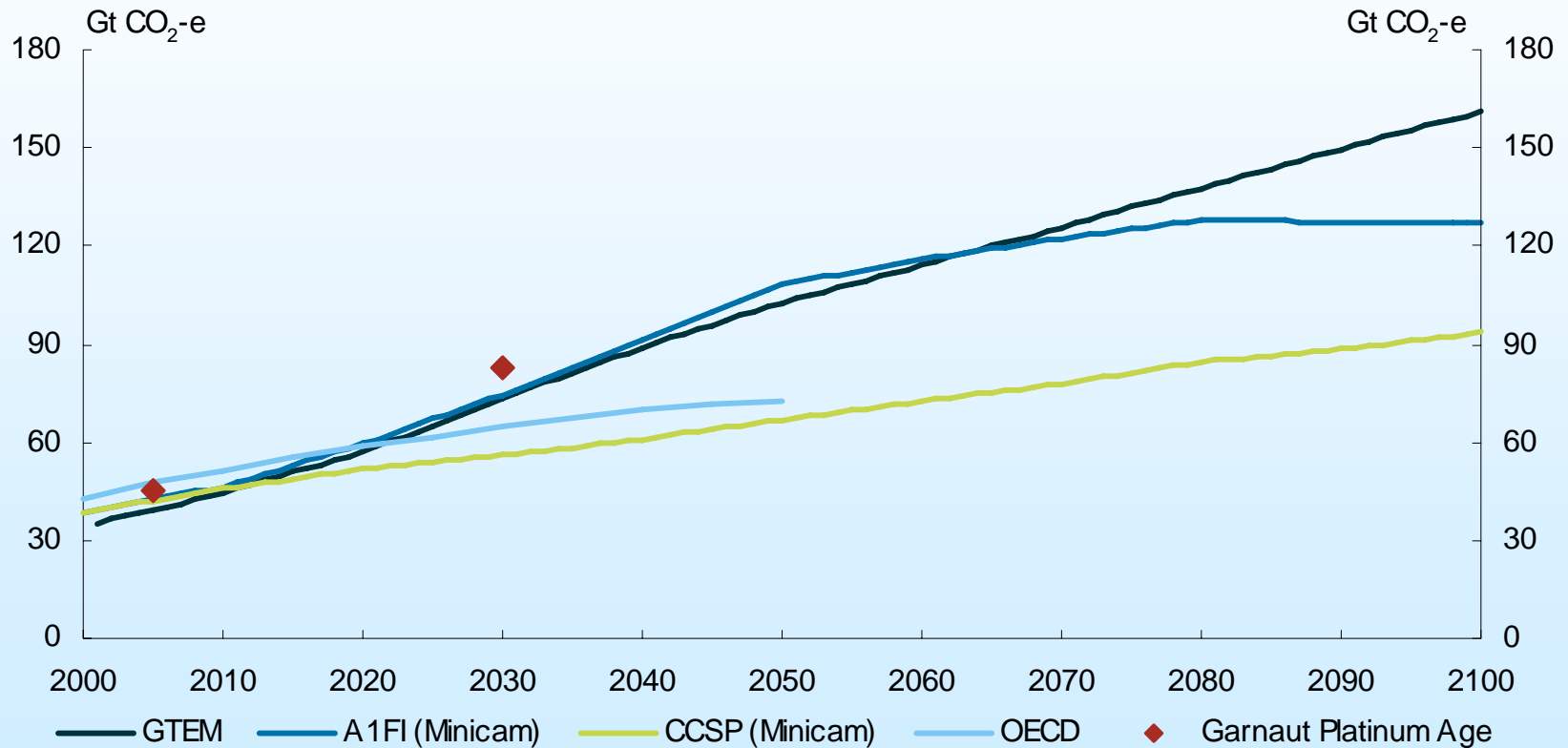


Summary of Reference Scenario

- Continued strong trend economic growth
 - Rising per capita incomes
 - Slowing population growth
- Continued reliance on fossil fuels for energy
- Strong emissions growth
 - Global emissions more than double current levels by 2050
- Does not include climate change impacts



Global Greenhouse Gas Emissions (reference scenario)





Economic Analysis - Scenarios

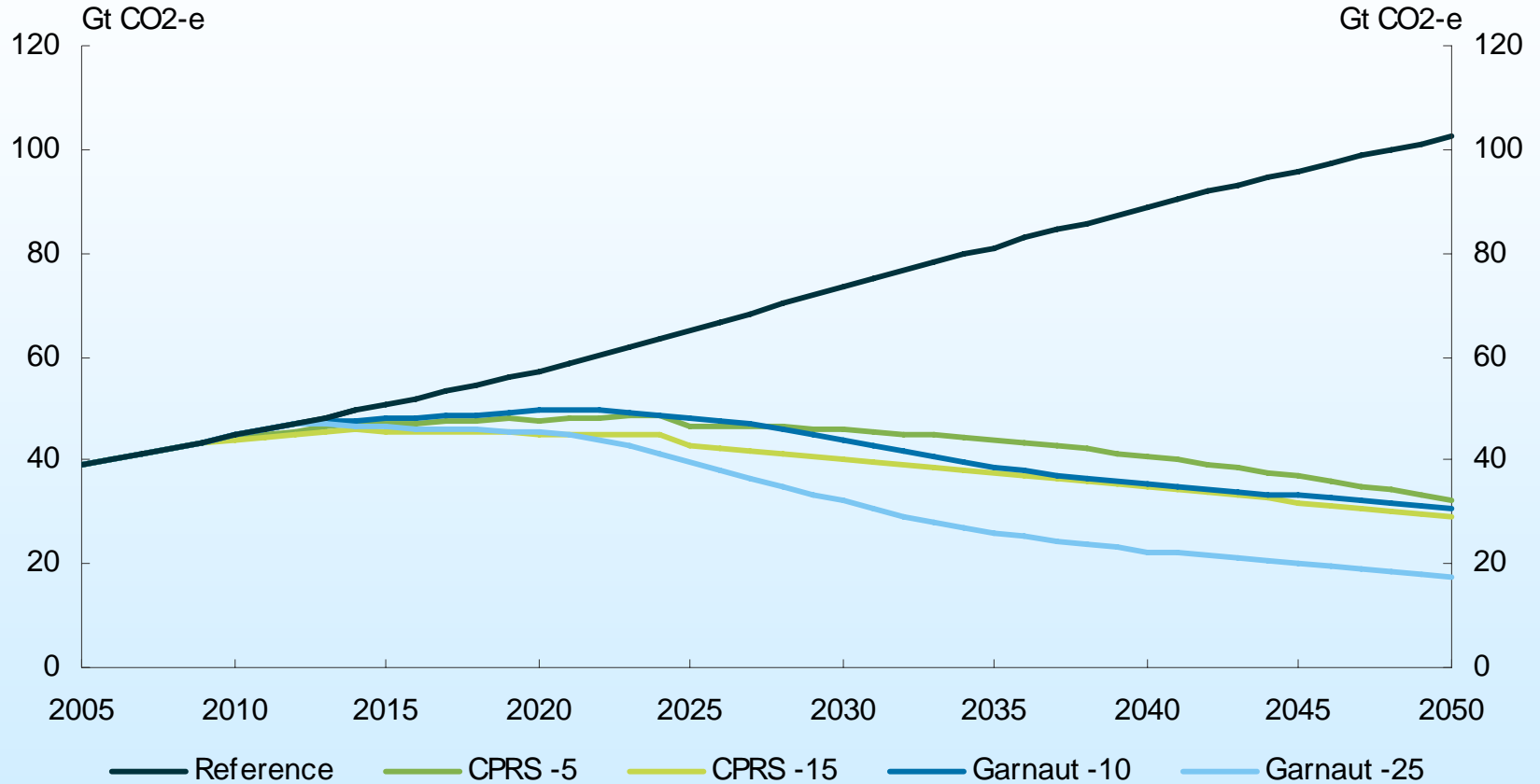
- Reference scenario
- Four main policy scenarios
 - Two scenarios focus on CPRS
 - Design based on Green Paper
 - Staged global action over period 2010-2025
 - CPRS -5 consistent with 550 ppm concentration levels
 - CPRS -15 consistent with 510 ppm concentration levels
 - Two scenarios developed with Garnaut Climate Change Review
 - More stylised unified global action from 2013
 - National targets based on per capita approach
 - Garnaut -10 consistent with 550 ppm concentration levels
 - Garnaut -25 consistent with 450 ppm concentration levels
- Sensitivity analysis on key assumptions



Global Emission Pathways

Australian Government

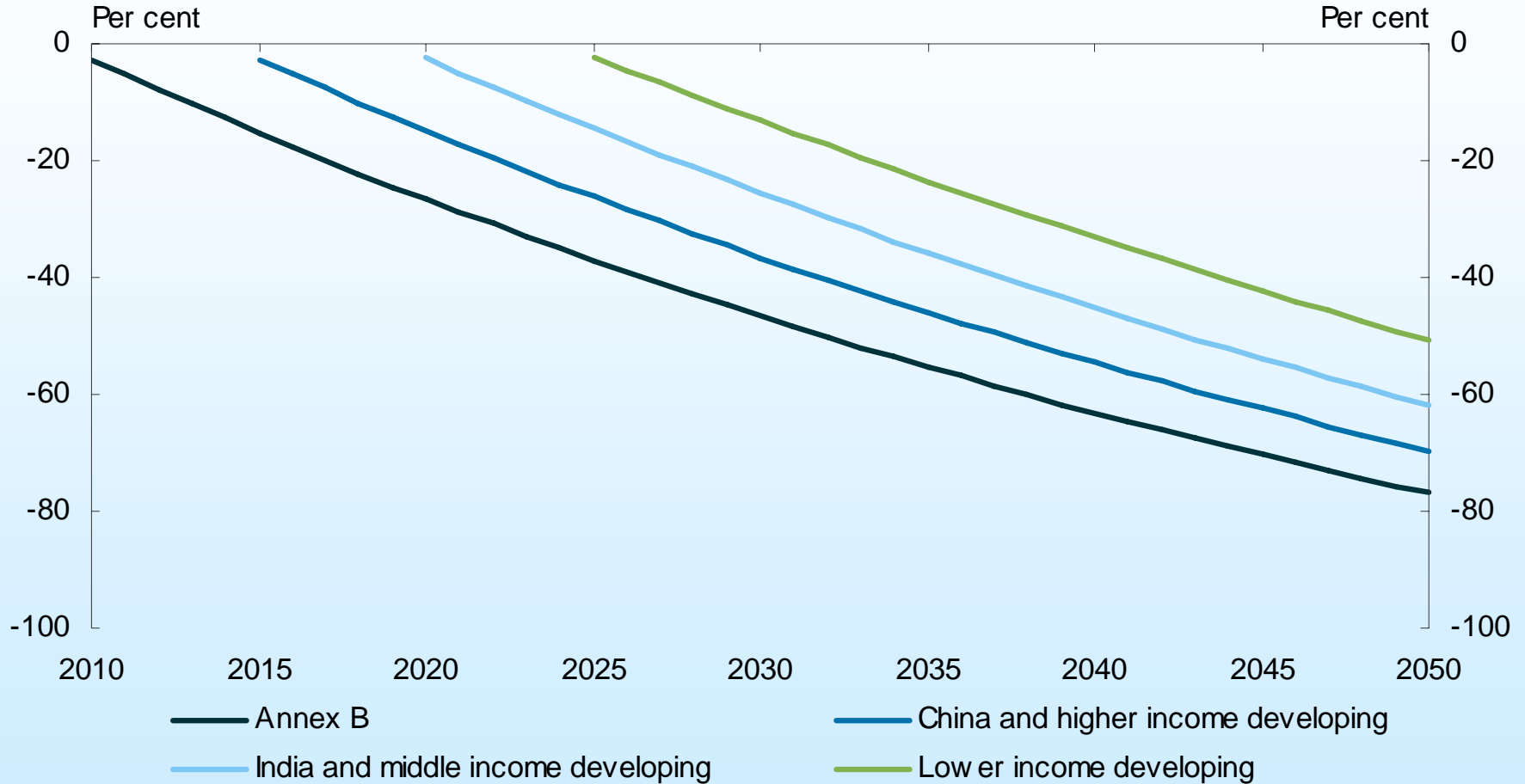
The Treasury





CPRS Emission Allocations

Change from reference scenario emissions



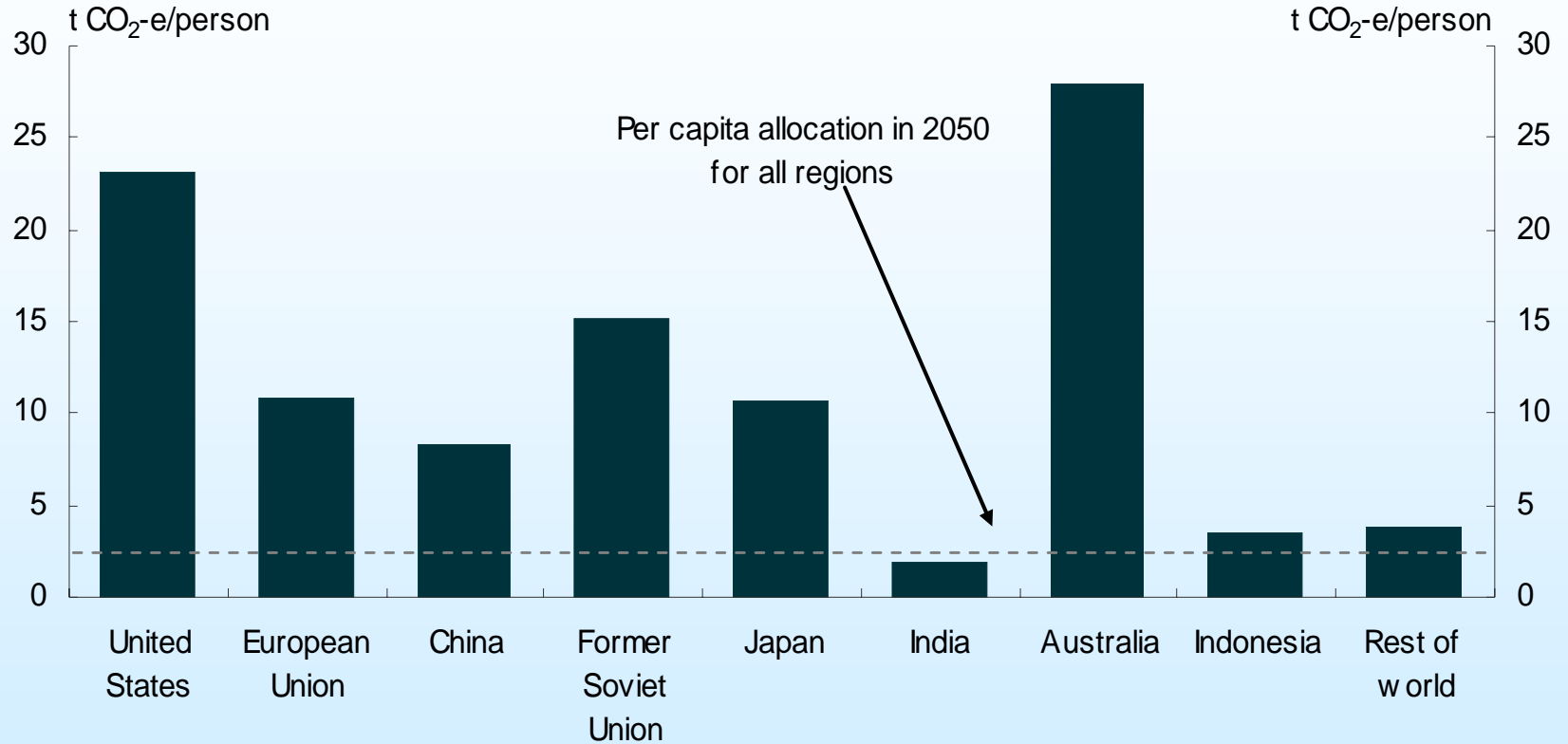


Garnaut Emission Allocations

Australian Government

The Treasury

Per capita emissions in 2012





Global Emission Allocations

Australian Government

The Treasury

	CPRS -5	CPRS -15	Garnaut -10	Garnaut -25
Greenhouse gas stabilisation goal ppm CO₂-e	550	510	550	450
Global, per cent change from 2001				
2020	32	24	40	29
2050	-9	-18	-13	-50
Per capita, per cent change from 2001				
2020	7	0	14	4
2050	-38	-44	-41	-66
Global, per cent change from reference scenario				
2020	-19	-23	-13	-20
2050	-68	-72	-70	-83
Year in which global emission allocations peak	2024	2014	2021	2012

Note: Allocations in G Cubed are calculated using the same policy rules, but some differences arise owing to differences in the database used in the model. GTEM's emissions database is from 2001.

Source: Treasury estimates from GTEM.



Per Capita Emission Allocation

Table 3.1: Comparing carbon pollution reduction targets of different countries

Country	2020 targets	2020 per capita reduction	2050 targets
Australia	5-15 per cent below 2000 levels (4-14 per cent below 1990 levels)	27-34 per cent below 2000 levels (34-41 per cent below 1990 levels)	60 per cent below 2000 levels (60 per cent below 1990 levels)
European Union	20-30 per cent below 1990 levels	24-34 per cent below 1990 levels	60-80 per cent below 1990 levels
United Kingdom	26-32 per cent below 1990 levels	33-39 per cent below 1990 levels	80 per cent below 1990 levels
Proposal			
United States (proposal of President-elect Obama)	Return to 1990 levels	25 per cent below 1990 levels	80 per cent below 1990 levels

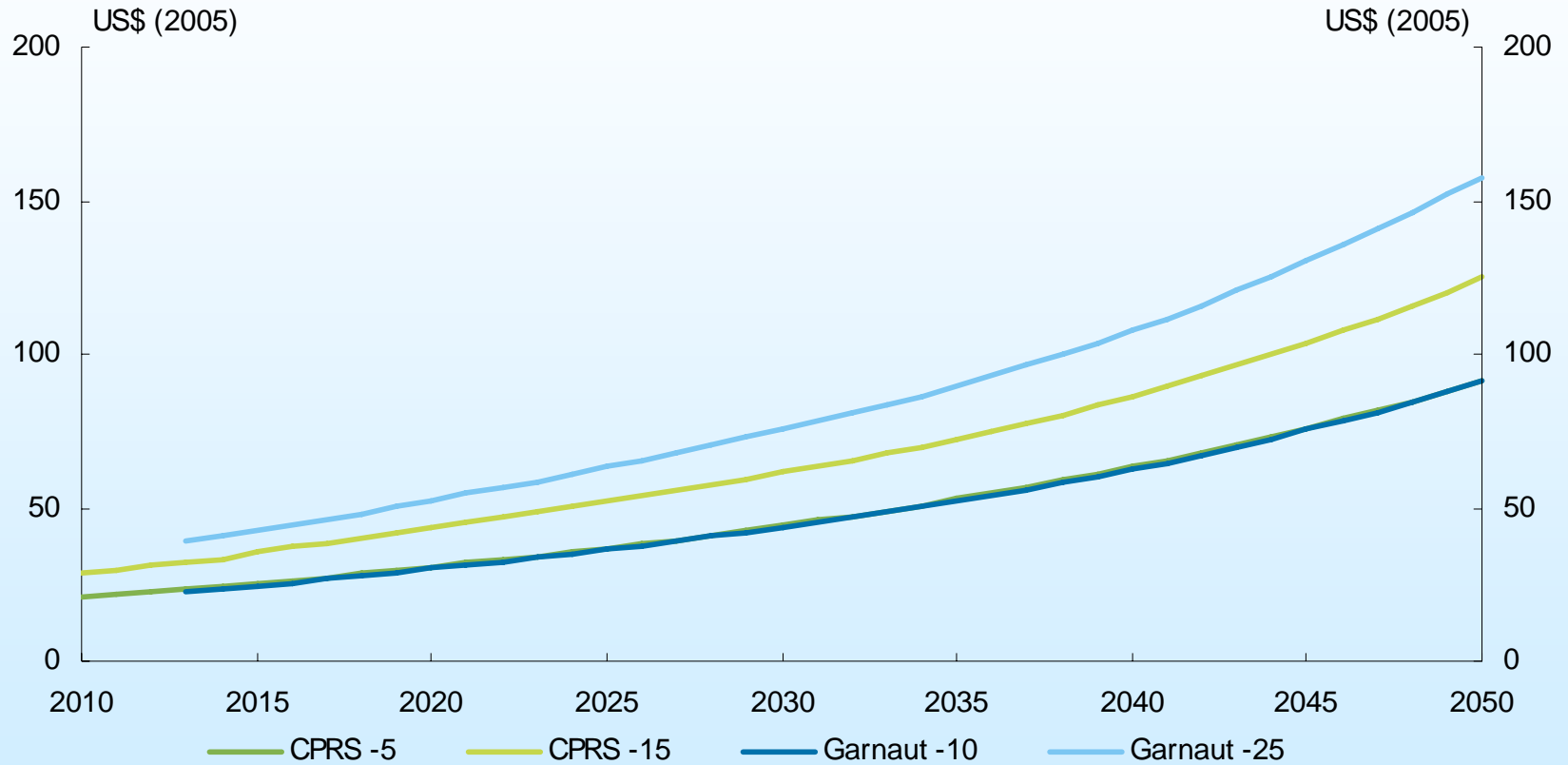
Based on UNFCCC emissions data including land use change and forestry; Australia's Low Pollution Future for Australian population projections; UN population projections for other countries.



Global Emission Prices

Australian Government

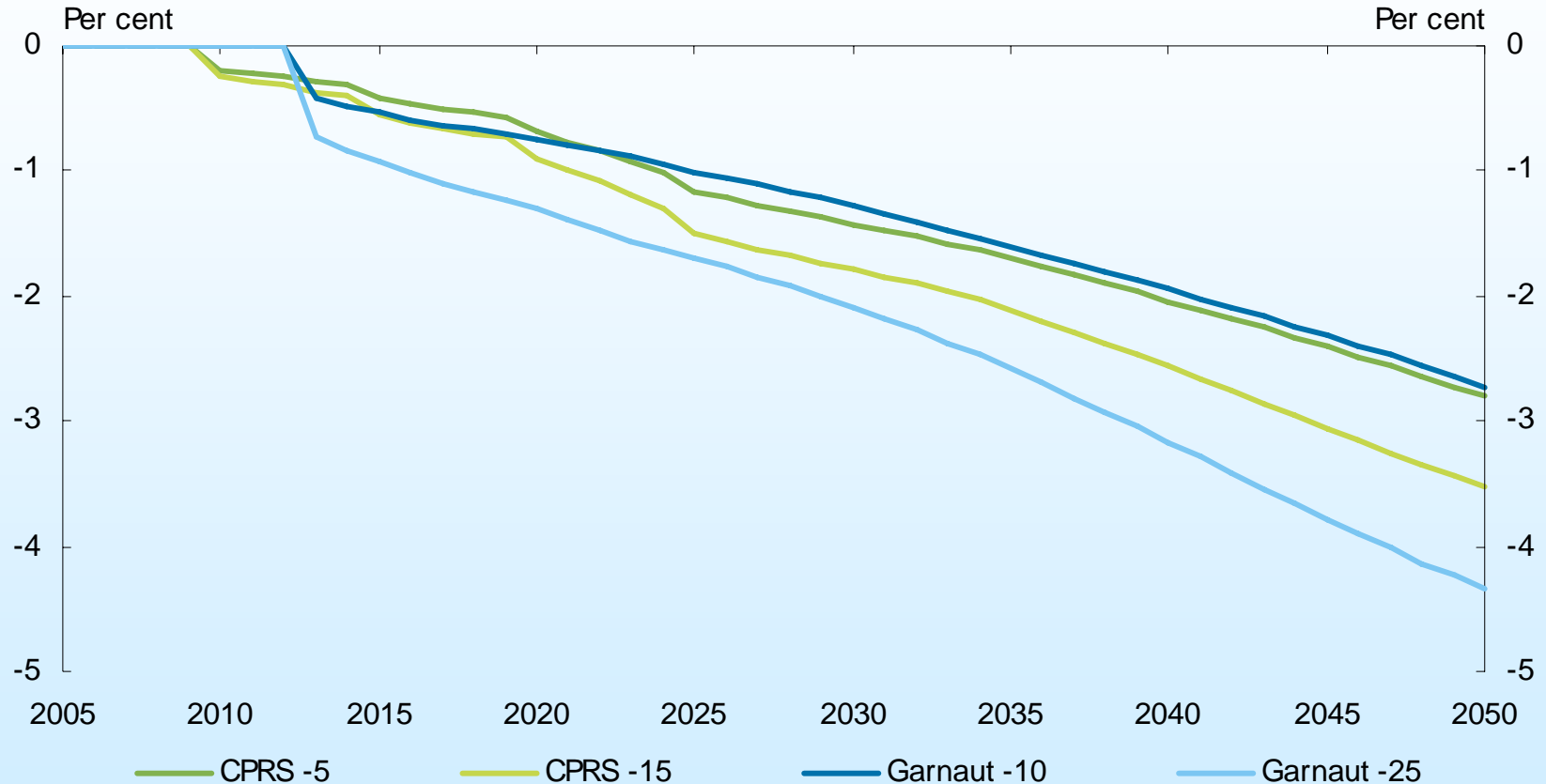
The Treasury





GTEM: Gross World Product

Change from reference scenario

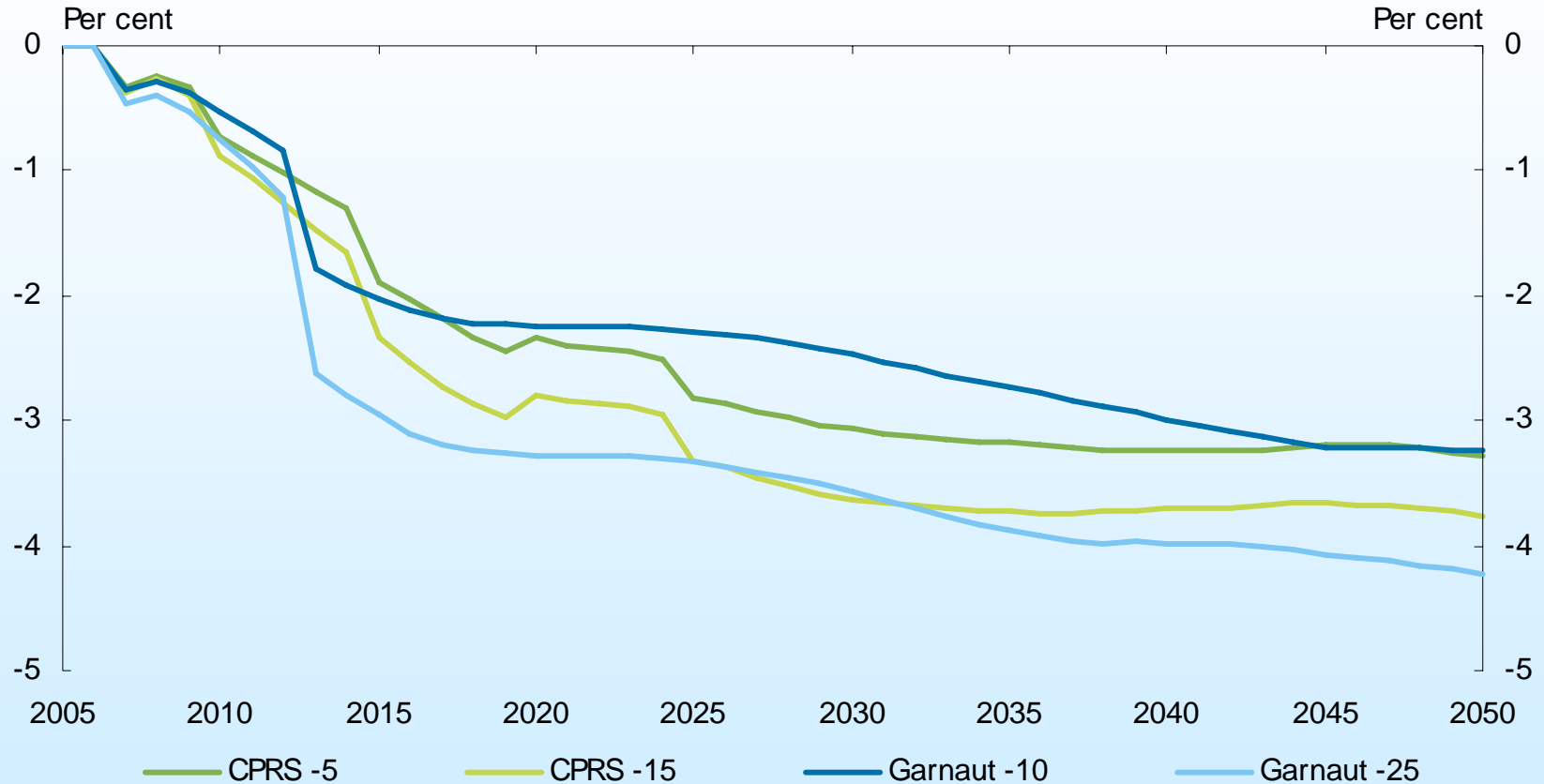


•GWP per capita grows 2.6 per cent per year in the policy scenarios versus 2.7 per cent in the reference scenario



G-cubed: Gross World Product

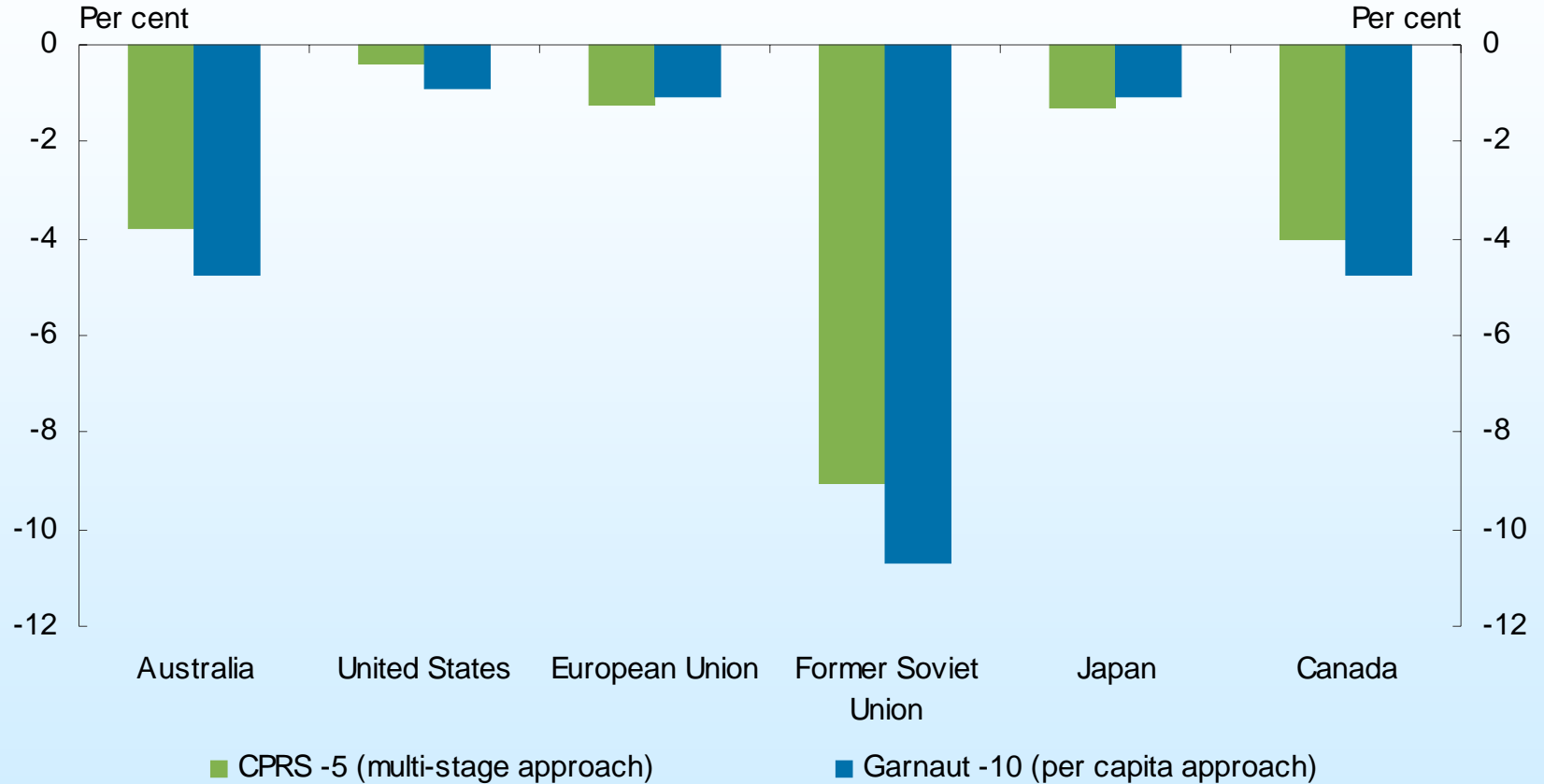
Change from reference scenario



•GWP per capita grows 2.6 per cent per year in the policy scenarios versus 2.7 per cent in the reference scenario



GNP costs – Annex B countries





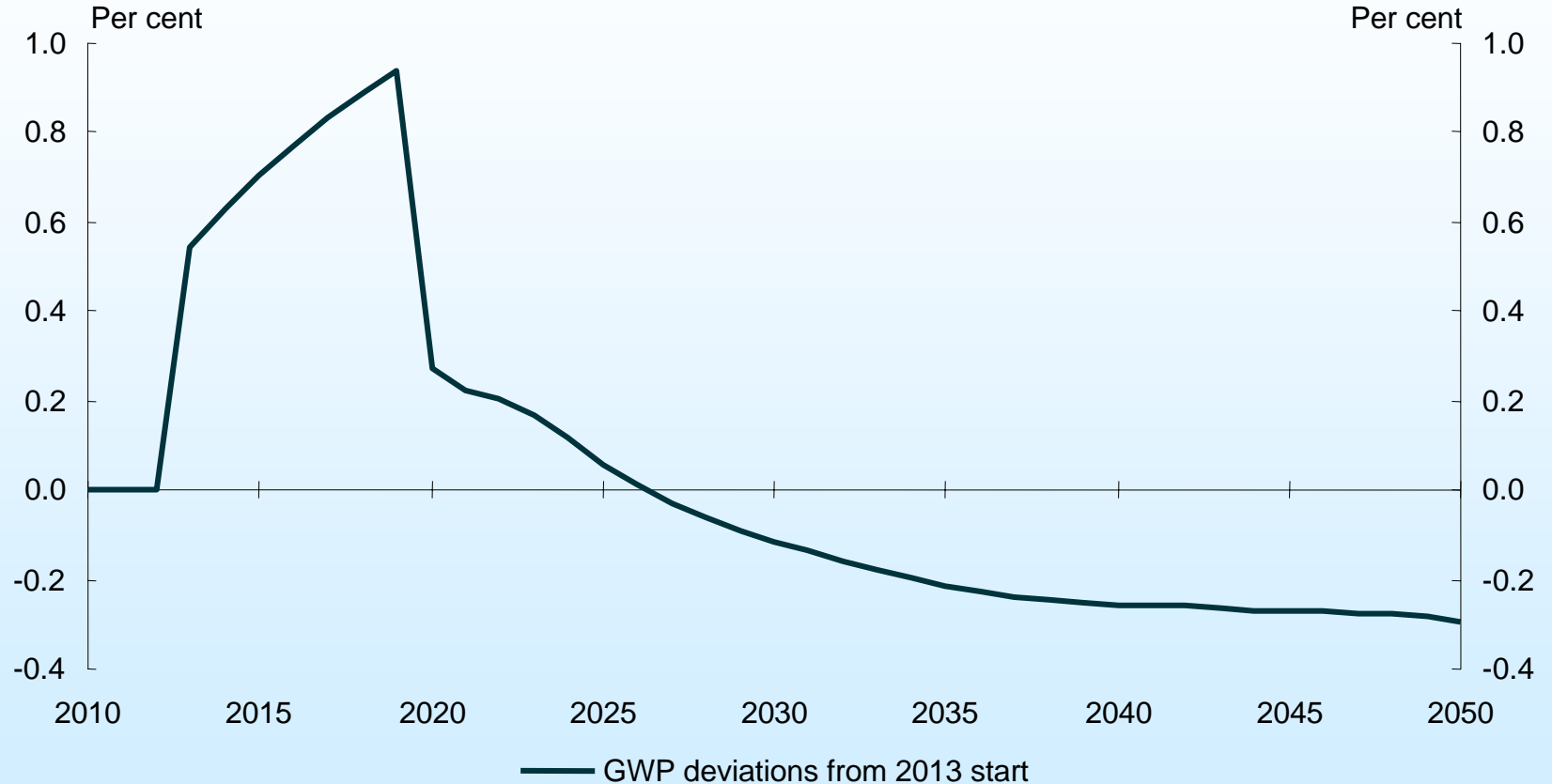
Timing sensitivities

- In a world where all countries delay action the short-term benefits are quickly outweighed by additional long-term costs
- In a world where emissions pricing is introduced gradually the costs are lower for early actors. By 2050
 - GDP costs for early movers are 15 per cent lower than when everyone acts together
 - GDP costs for late movers are 20 per cent higher than when everyone acts together
- In a world where revisions to action occur it seems better to err on going harder earlier



Cost of Delay in Global Mitigation

Change from Garnaut -10 scenario

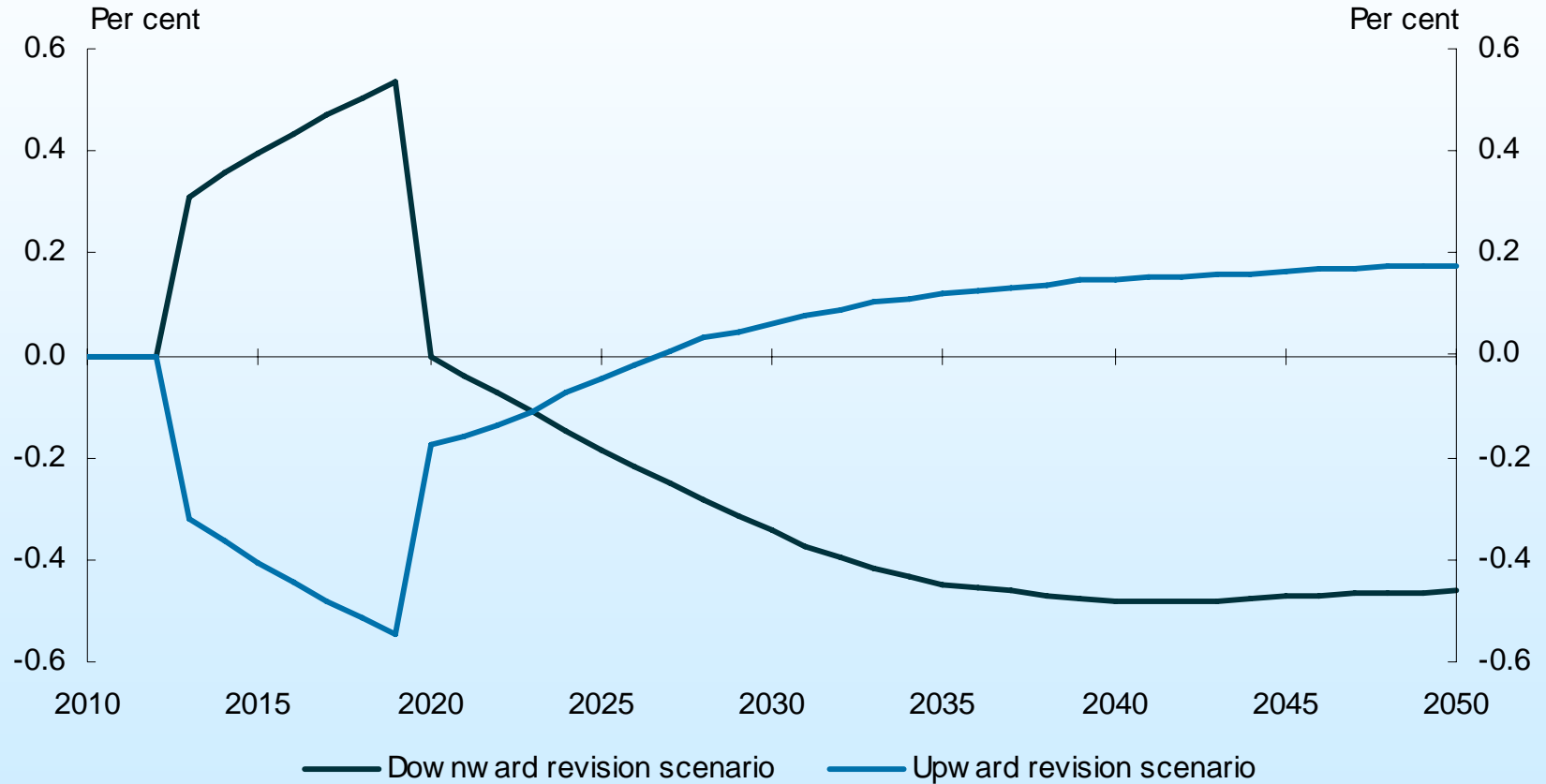


Note: GWP level change from the Garnaut -10 scenario and a sensitivity where global action is delayed from 2013 to 2020, but achieves the same 550 ppm CO₂-e concentration level by 2100.



Revising Global Action

Compared with corresponding stabilisation scenario



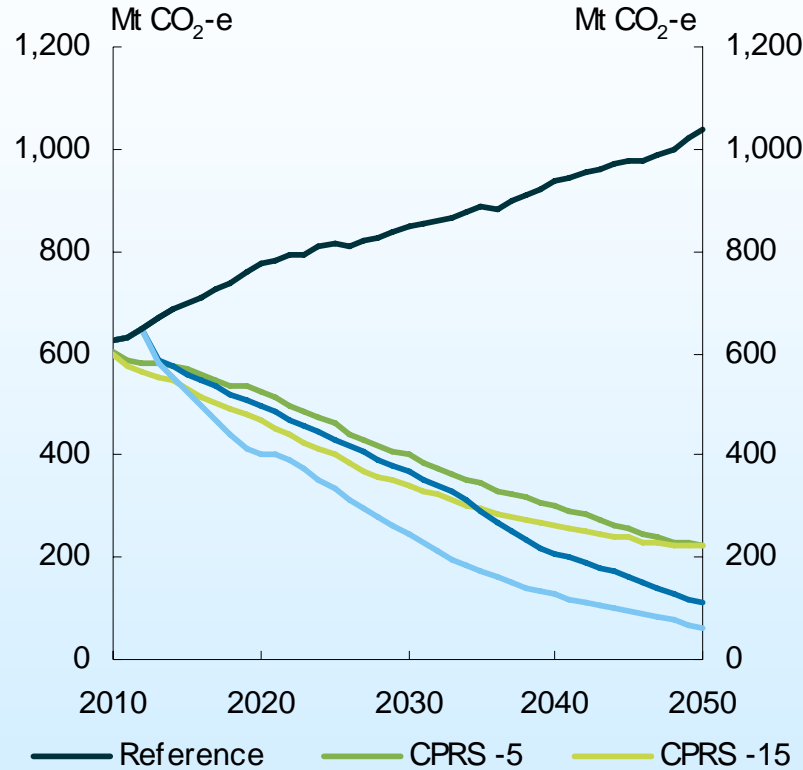


Headline Australian Results

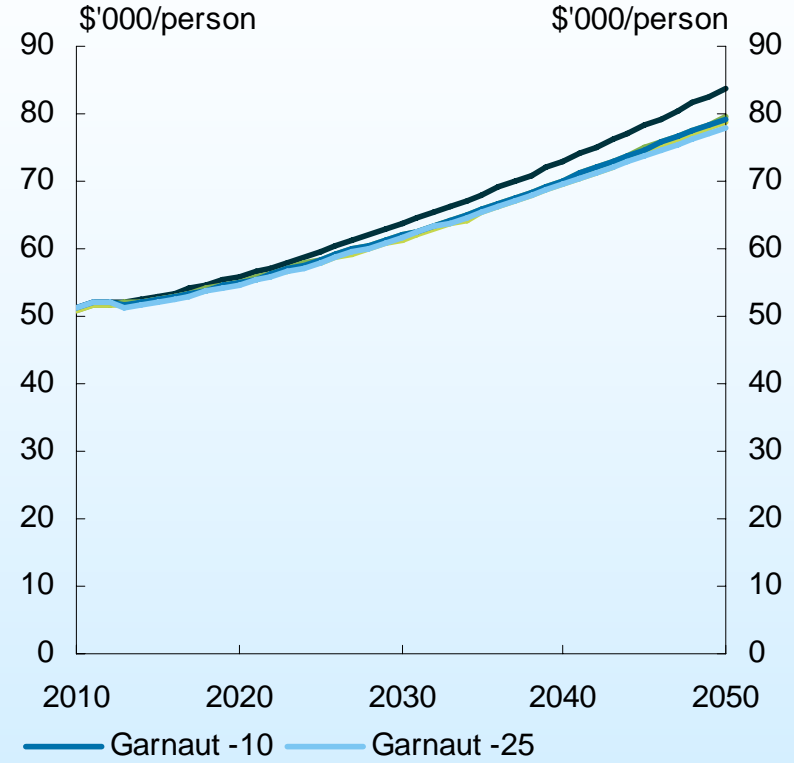
Australian Government

The Treasury

Emissions



Real GNP per capita



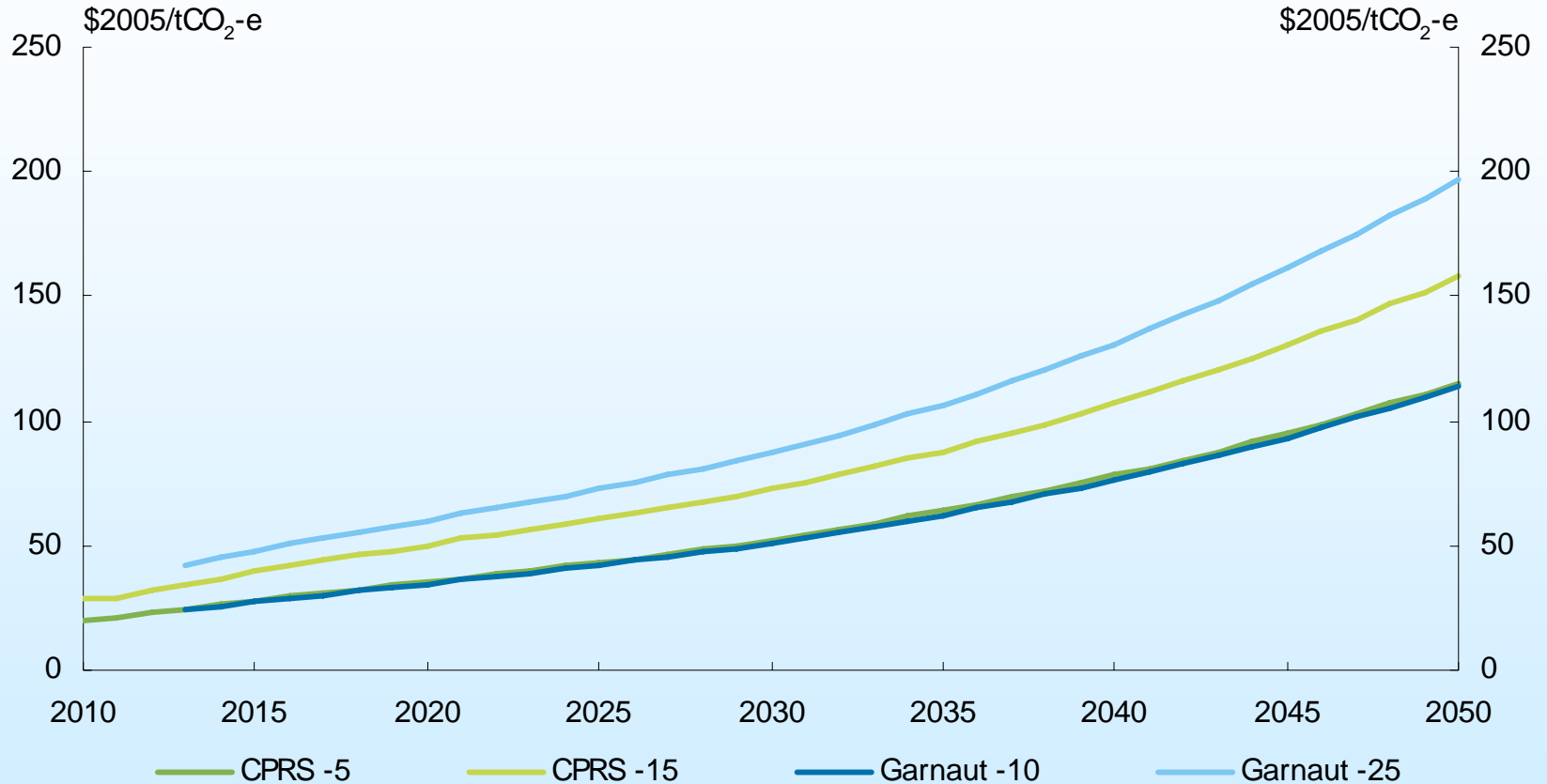
- GNP per capita grows 1.1 per cent per year in the policy scenarios versus 1.2 per cent in the reference scenario



Australia's Carbon Price

Australian Government

The Treasury



Note: Price in 2005 Australian dollars.

Source: Treasury estimates from MMRF

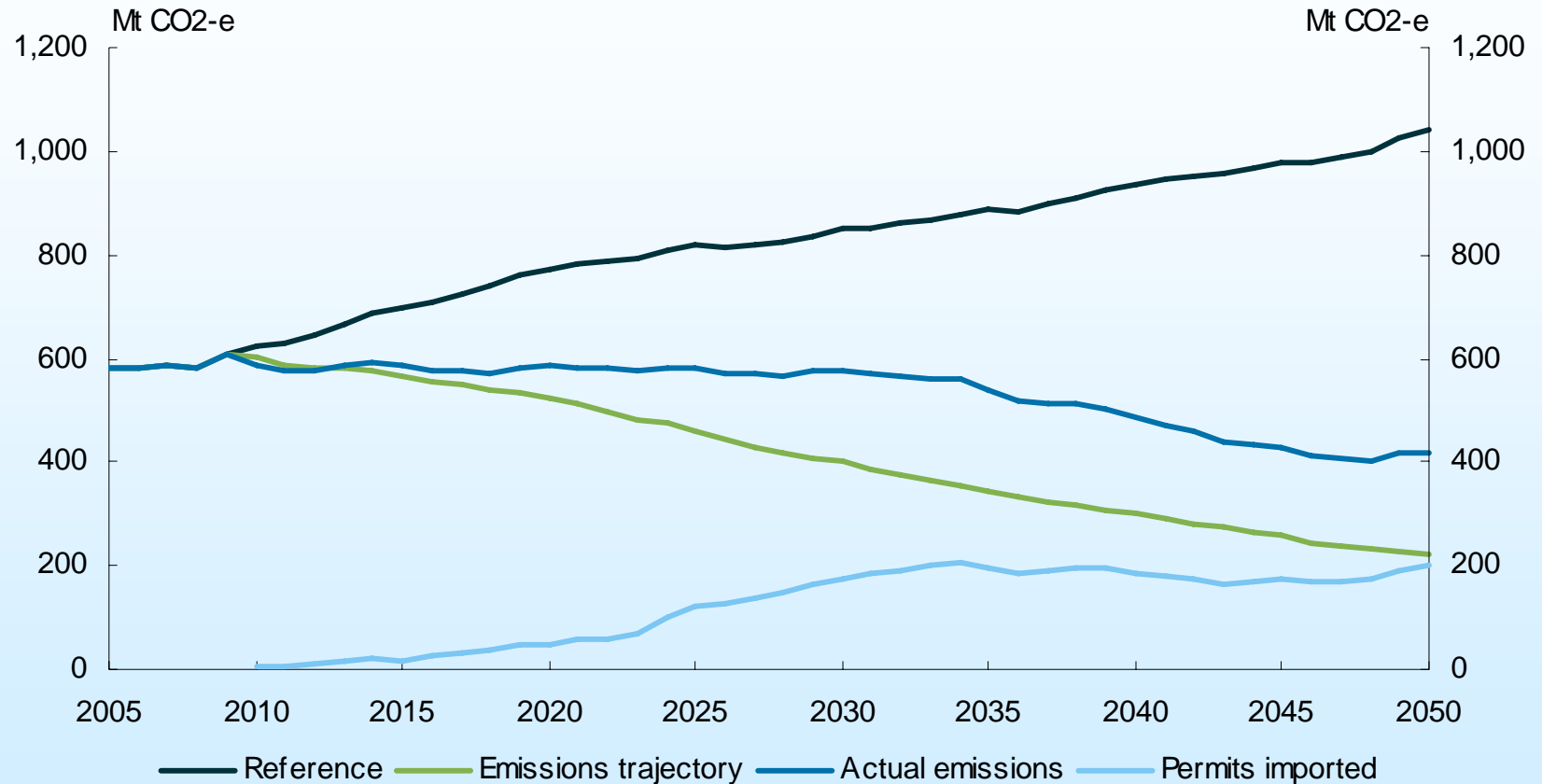


Australian Emissions and Trade

Australian Government

The Treasury

CPRS -5 scenario



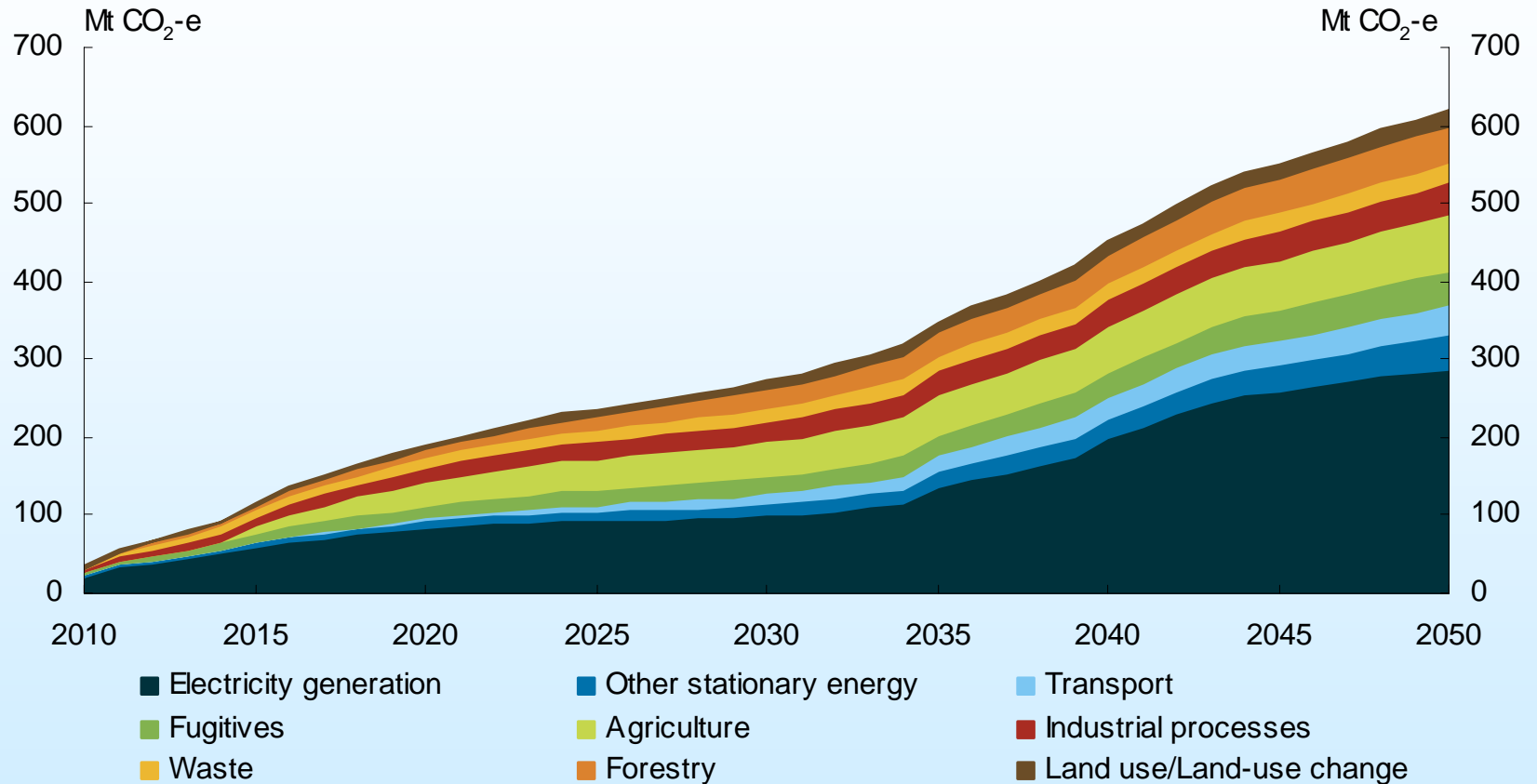


Sectoral Mitigation Efforts

Australian Government

The Treasury

CPRS -5 scenario





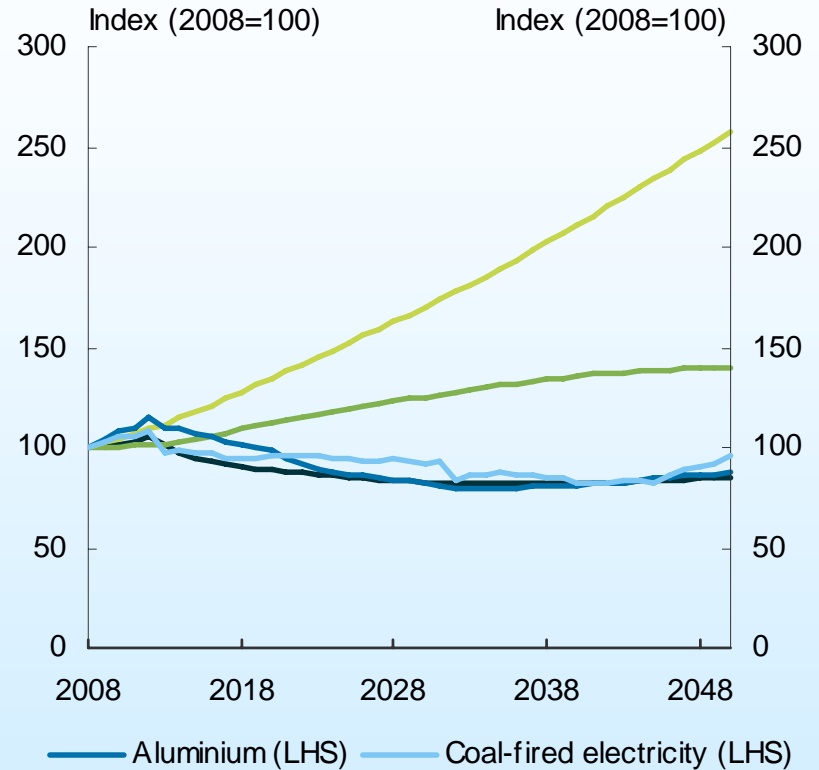
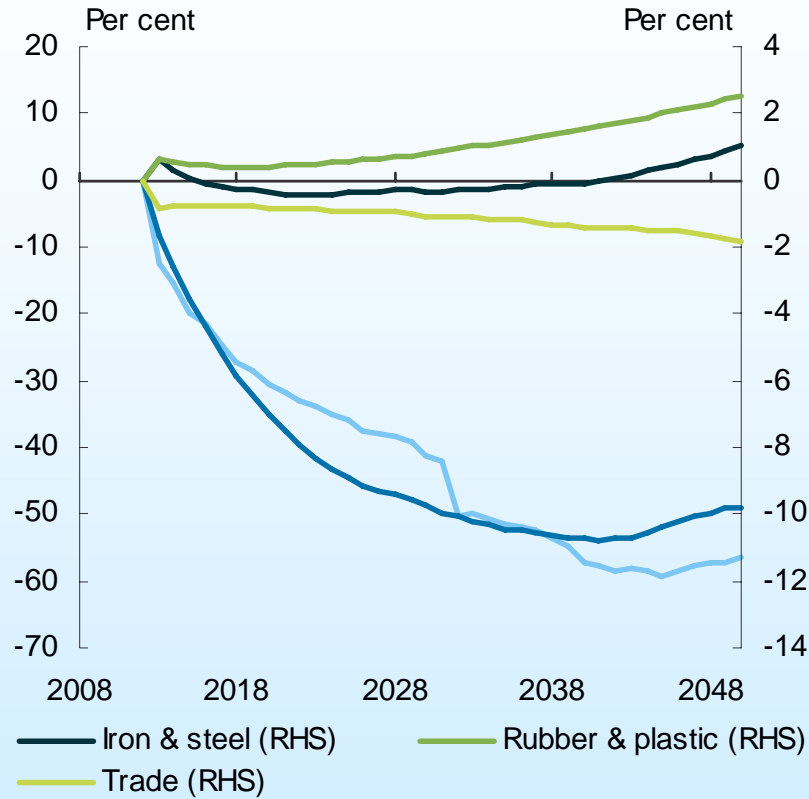
Sectoral Impacts

- Deviations are relative to the reference scenario
- Few industries face large falls
 - Aluminium and refineries face significant falls
- Key drivers:
 - Global demand
 - Exchange rates and competitiveness
 - Shifts to low-emission technologies
 - Relative emission intensity
 - Domestic demand



Sectoral Impacts

Relative to reference scenario





Carbon Leakage

- Little evidence of carbon leakage
 - Carbon prices are not high enough to induce significant industry relocation
 - Shielding helps ease the transition to a low-emission economy for shielded sectors
- Carbon leakage is likely to be *overestimated* in the models used
 - GTEM and MMRF are not forward-looking
 - Relocation costs are not taken into account

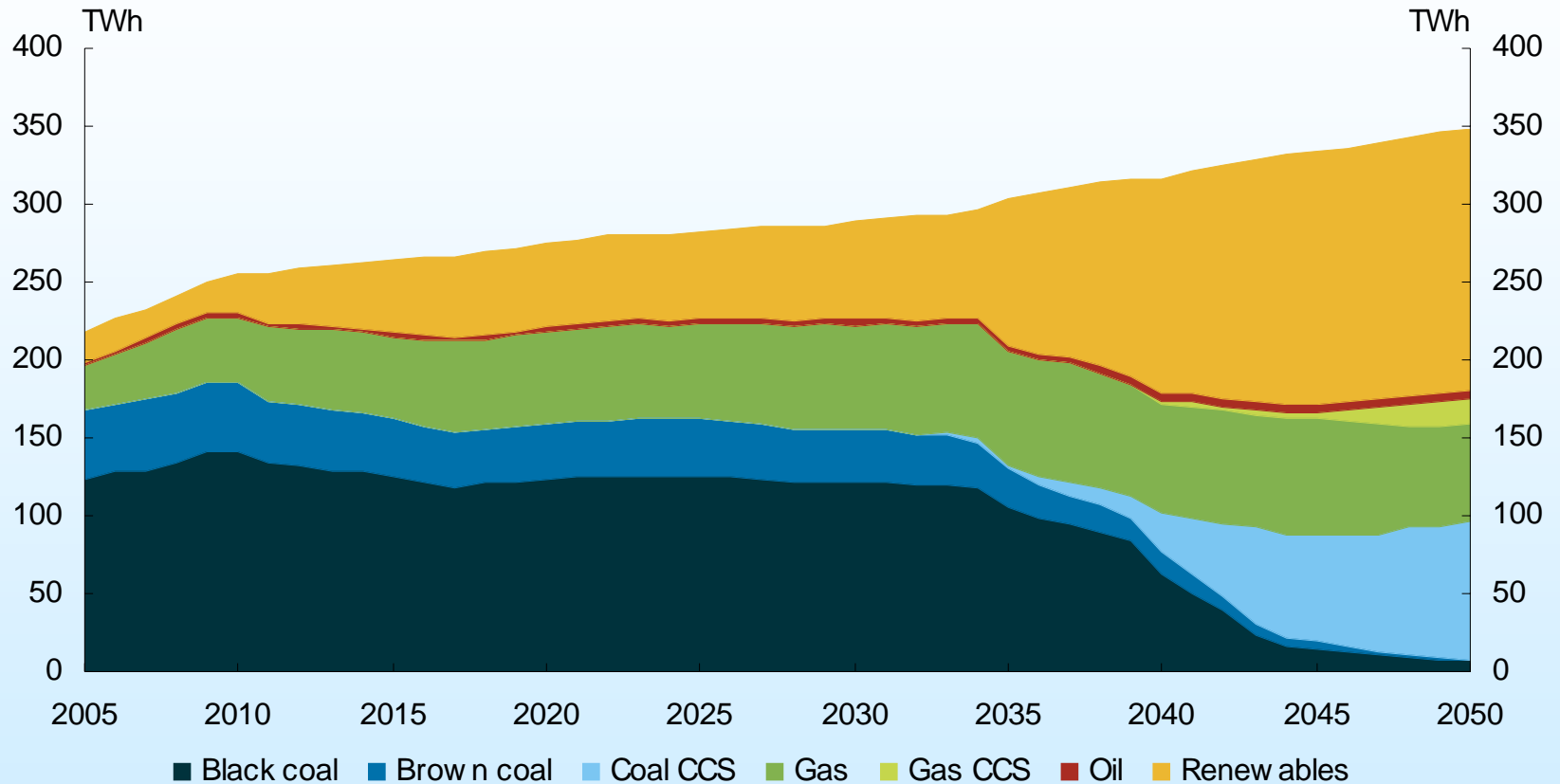


Australian Electricity Generation

Australian Government

The Treasury

CPRS -5 scenario





Carbon Capture and Storage

- Carbon capture and storage (CCS) is assumed to be technically possible from 2020
- But CCS is only deployed when it is commercial to do so
 - Ranges from 2026 to 2033 in the policy scenarios
- Sensitivities surrounding CCS
 - No CCS available
 - Australian costs 25% and world costs 10% higher in 2050
 - More effective CCS technology
 - Australian costs 10% lower in 2050

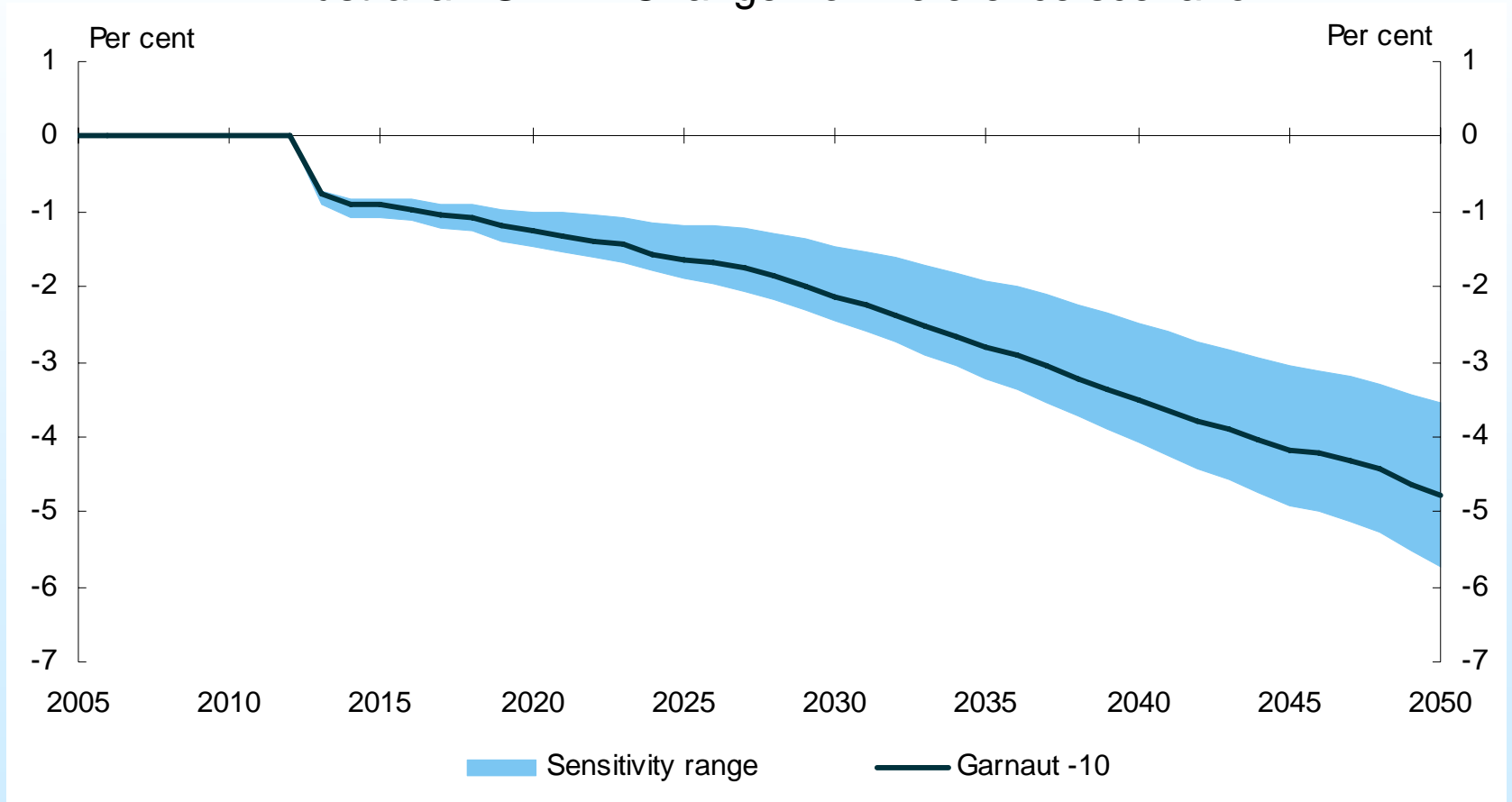


Technology Sensitivities Range

Australian Government

The Treasury

Australian GNP – Change from reference scenario





Household Impacts

- Household incomes continue to grow strongly in all scenarios modelled
- Average ‘morning-after’ impact in 2010 of 1-1.5 per cent in CPRS scenarios
 - The range across different household types is around 1 per cent
- The Australian Government has committed to assisting households, including increasing benefit payments and other forms of assistance as part of White Paper



Key Findings

- The Treasury's modelling demonstrates that:
 - early global action is less expensive than later action;
 - a market-based approach allows robust economic growth into the future even as emissions fall; and
 - many of Australia's industries will maintain or improve their competitiveness under an international agreement to combat climate change.
- Report is available from:
www.treasury.gov.au/lowpollutionfuture



Australian Government

The Treasury