



Australian Government

The Treasury

Australia's Low Pollution Future

**The economics of climate change
mitigation**

New Zealand, February 2009



Outline of Presentation

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- Policy context
- Analytical approach
- Modelling framework
- Results



Australian Policy context

- 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



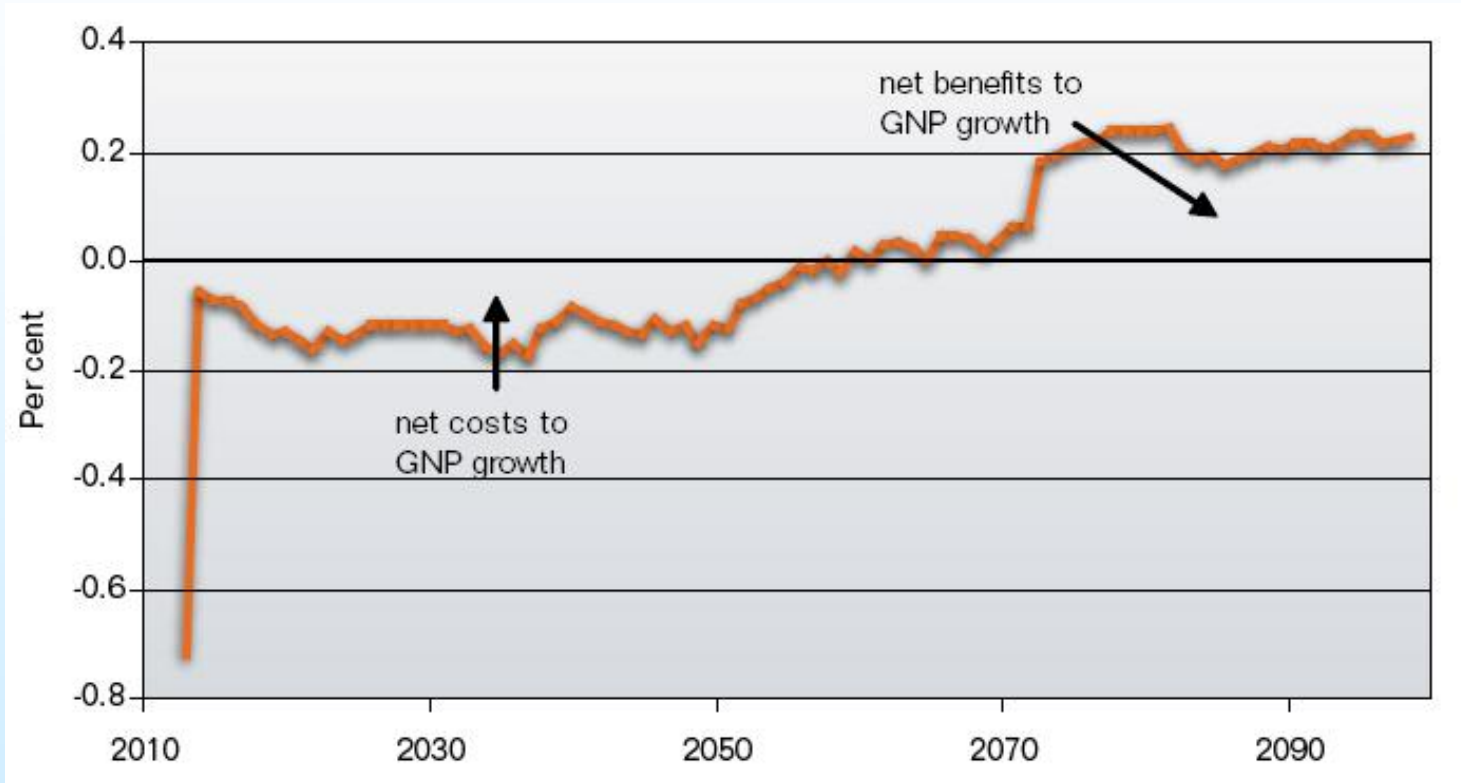
Garnaut Climate Change Review Framework

- 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
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 - 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

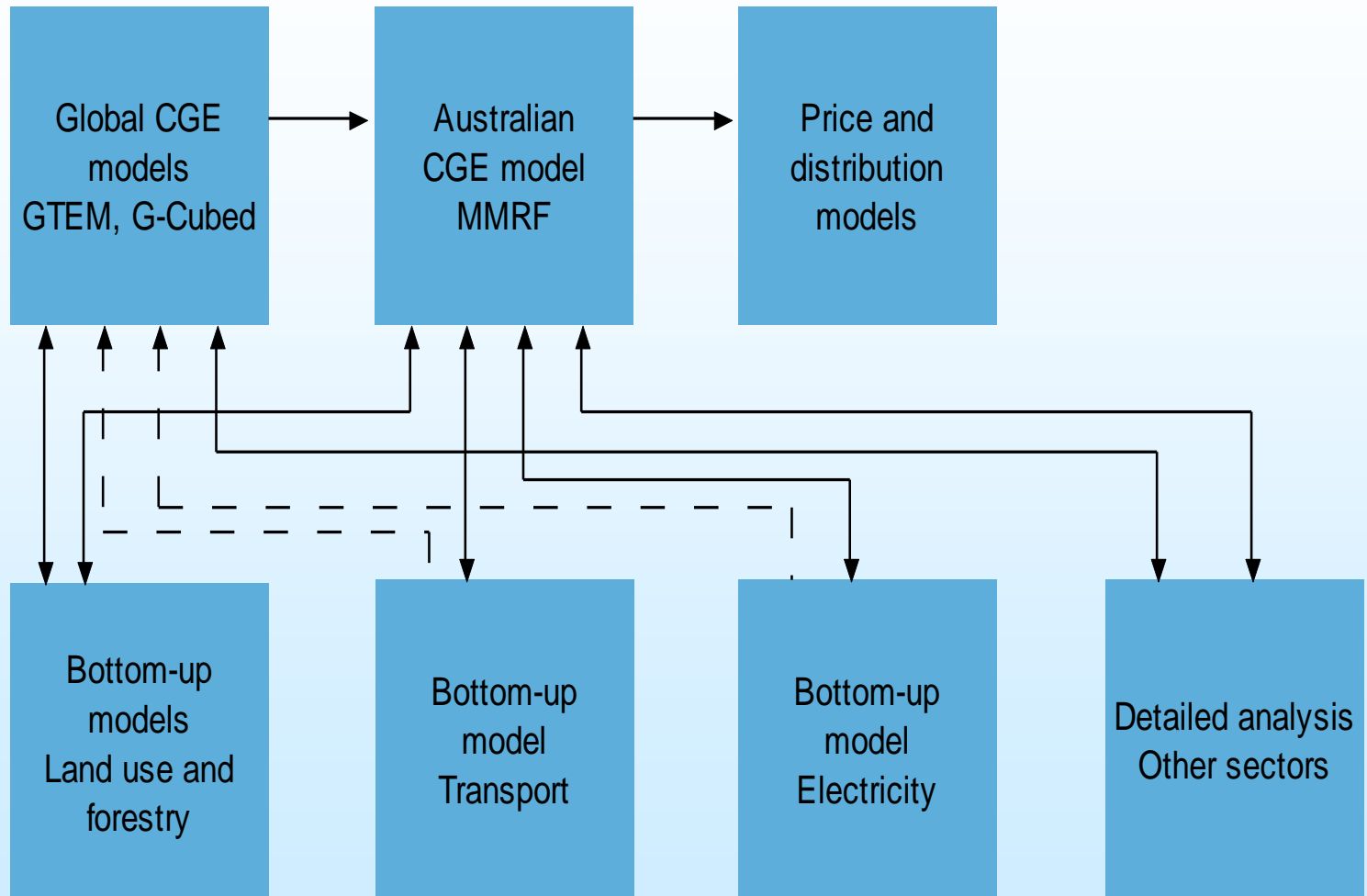
- CGE Models that include Australia
 - Two global (G-cubed and GTEM)
 - One more detailed on Australia (MMRF)
- Bottom-up models for key emissions intensive sectors
 - Electricity (MMA), transport (ESM) and land-use and forestry (ABARE, GCOMAP)
- Short-term price and household distributional impacts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



Linking of Models

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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



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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

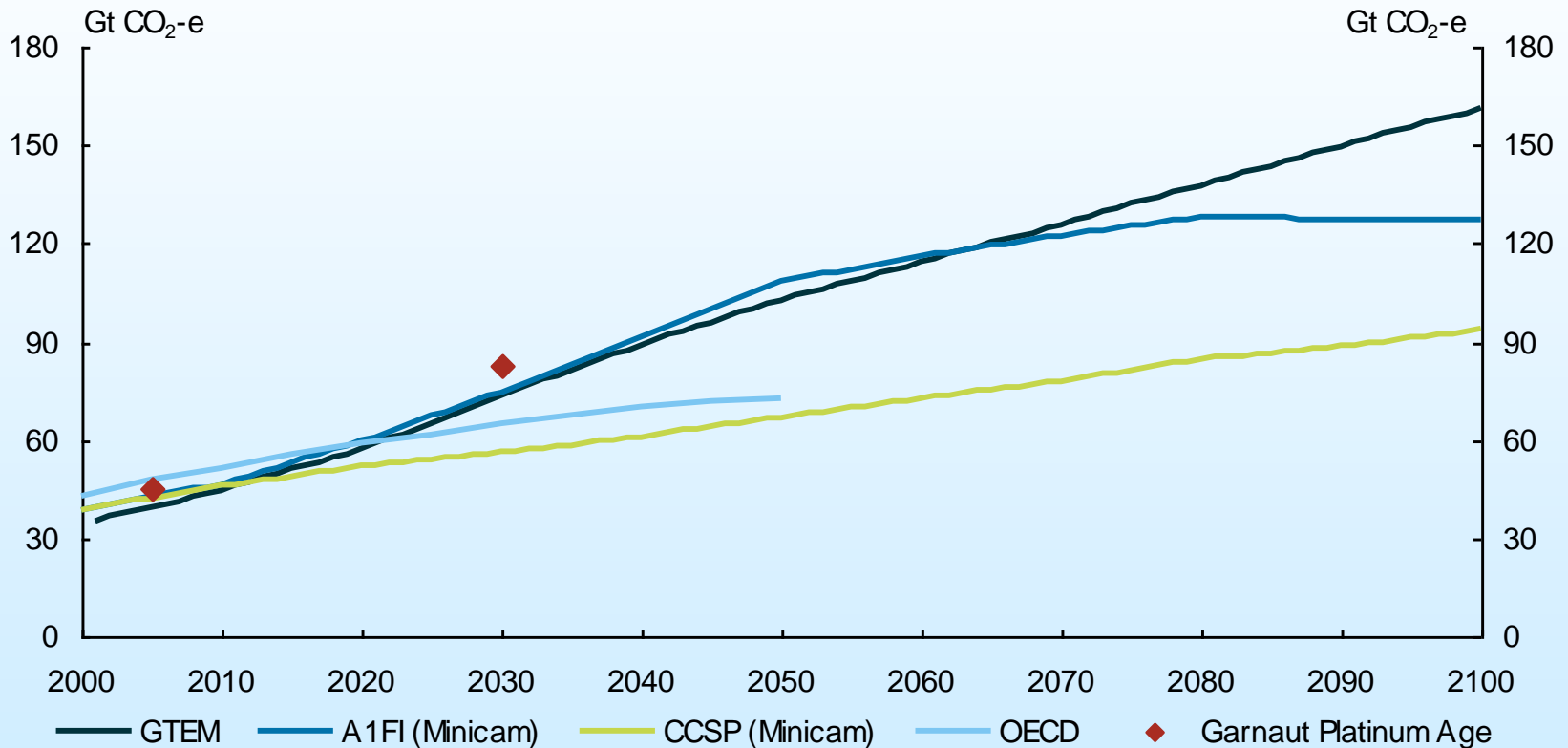


Summary of Reference Scenario

- 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

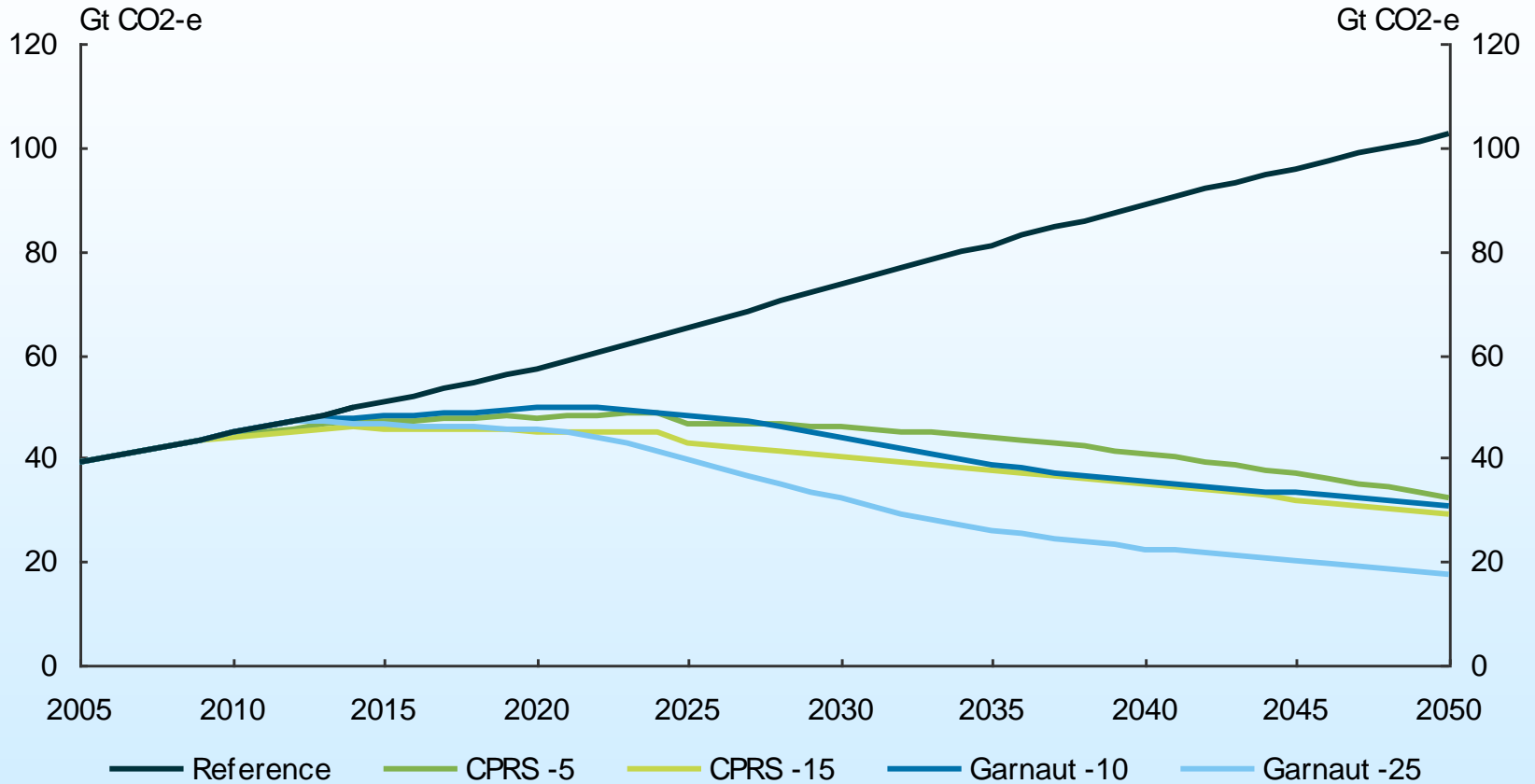
- Reference scenario
- Four main policy scenarios
 - Two scenarios focus on CPRS
 - Design based on Green Paper
 - Staged global action over period 2010-2025
 - CPRS -5 consistent with 550 ppm concentration levels
 - CPRS -15 consistent with 510 ppm concentration levels
 - Two scenarios developed with 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

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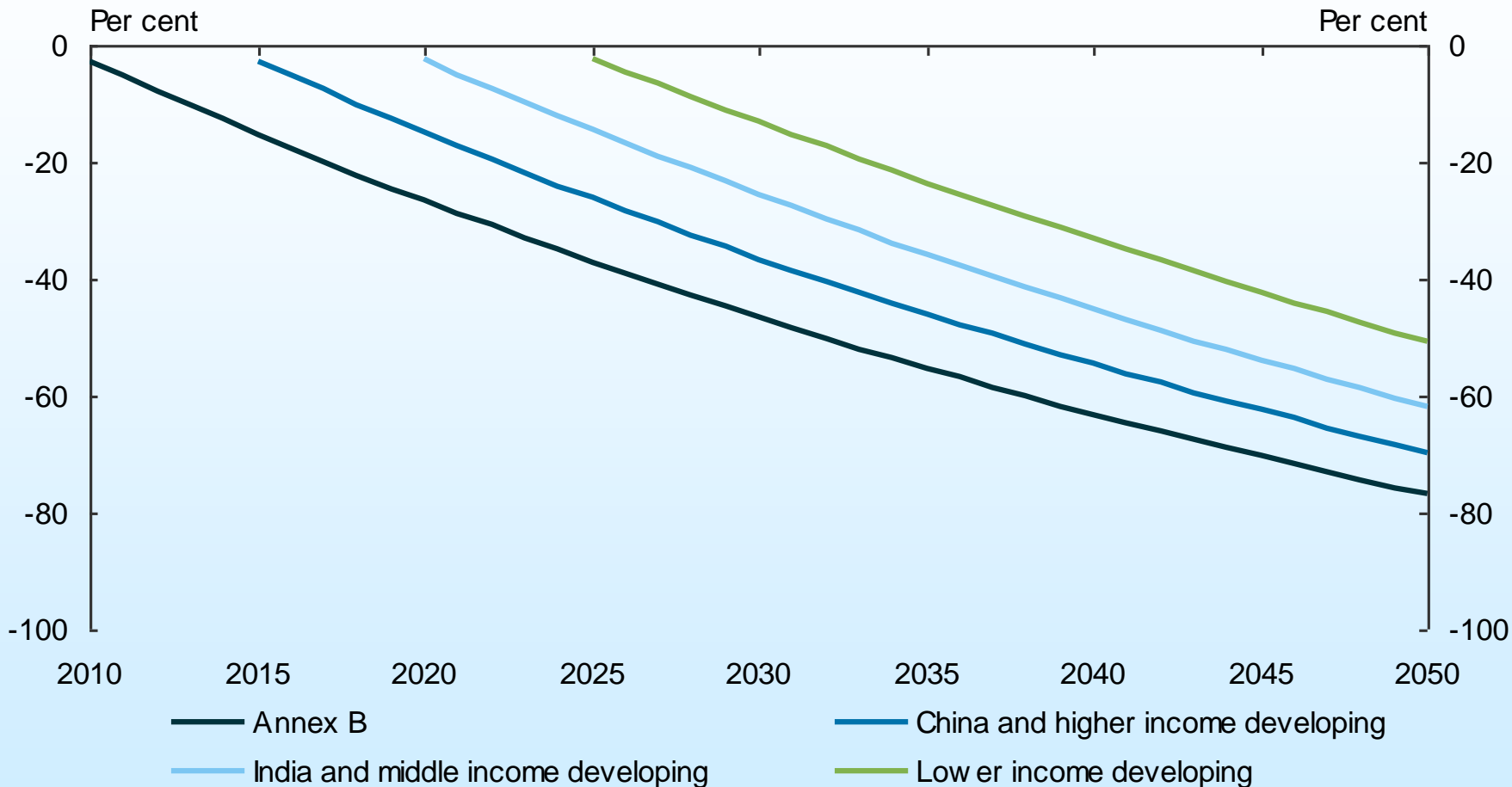
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CPRS Emission Allocations

Change from reference scenario emissions



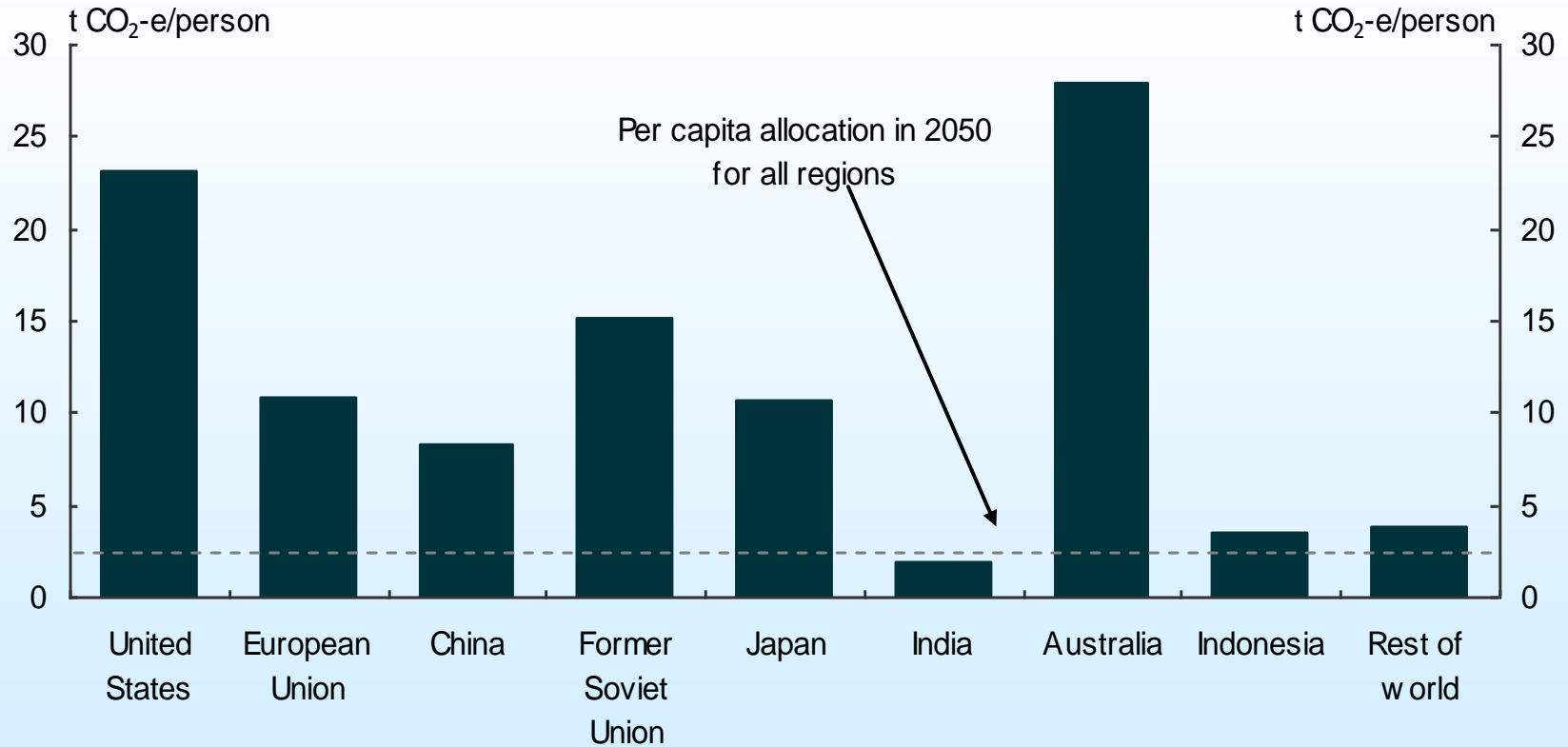


Garnaut Emission Allocations

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Per capita emissions in 2012





Global Emission Allocations

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| | 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

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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 |

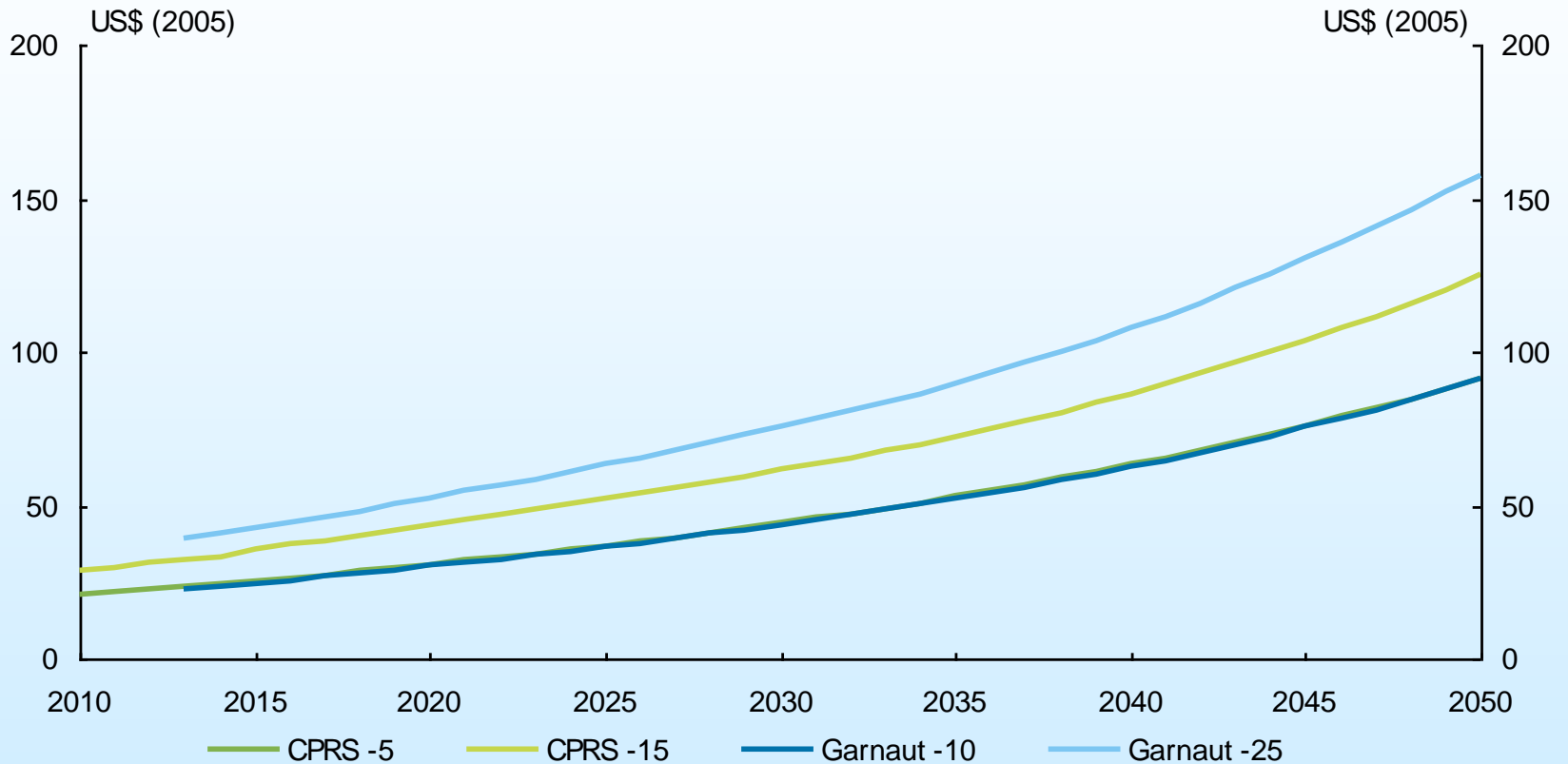
Based on UNFCCC emissions data including land use change and forestry; Australia's Low Pollution Future for Australian population projections; UN population projections for other countries.



Global Emission Prices

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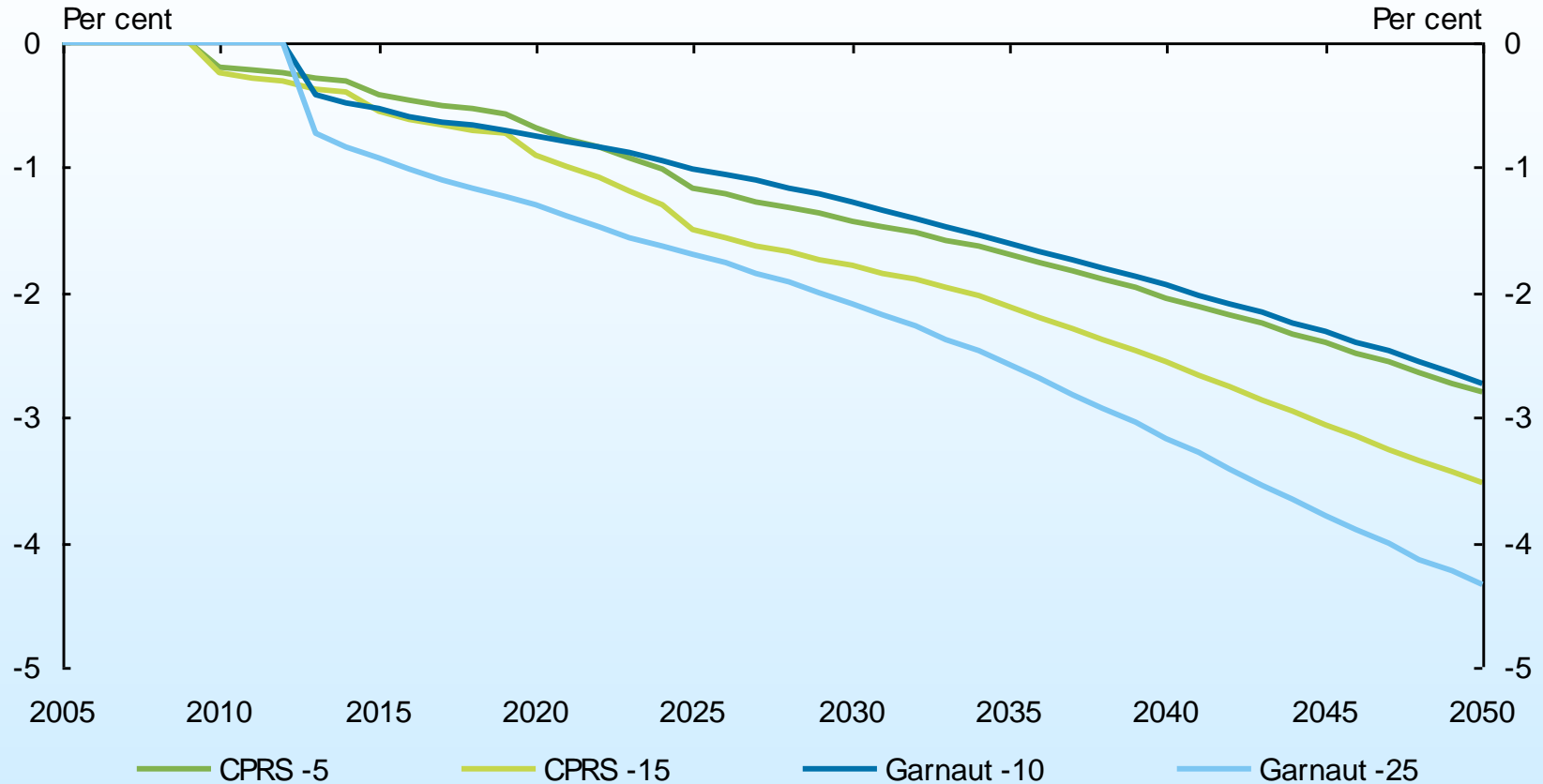
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GTEM: Gross World Product

Change from reference scenario

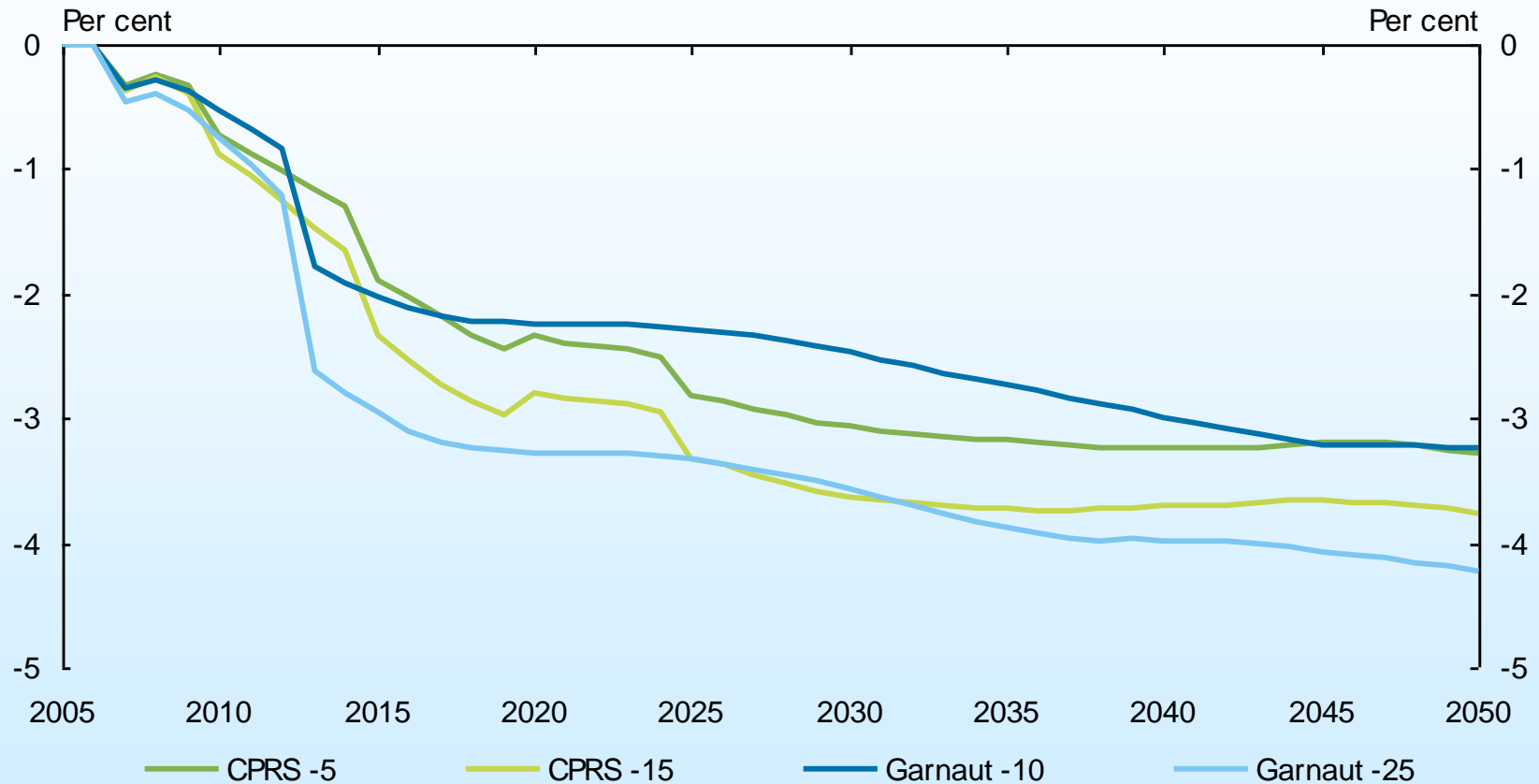


•GWP per capita grows 2.6 per cent per year in the policy scenarios versus 2.7 per cent in the reference scenario



G-cubed: Gross World Product

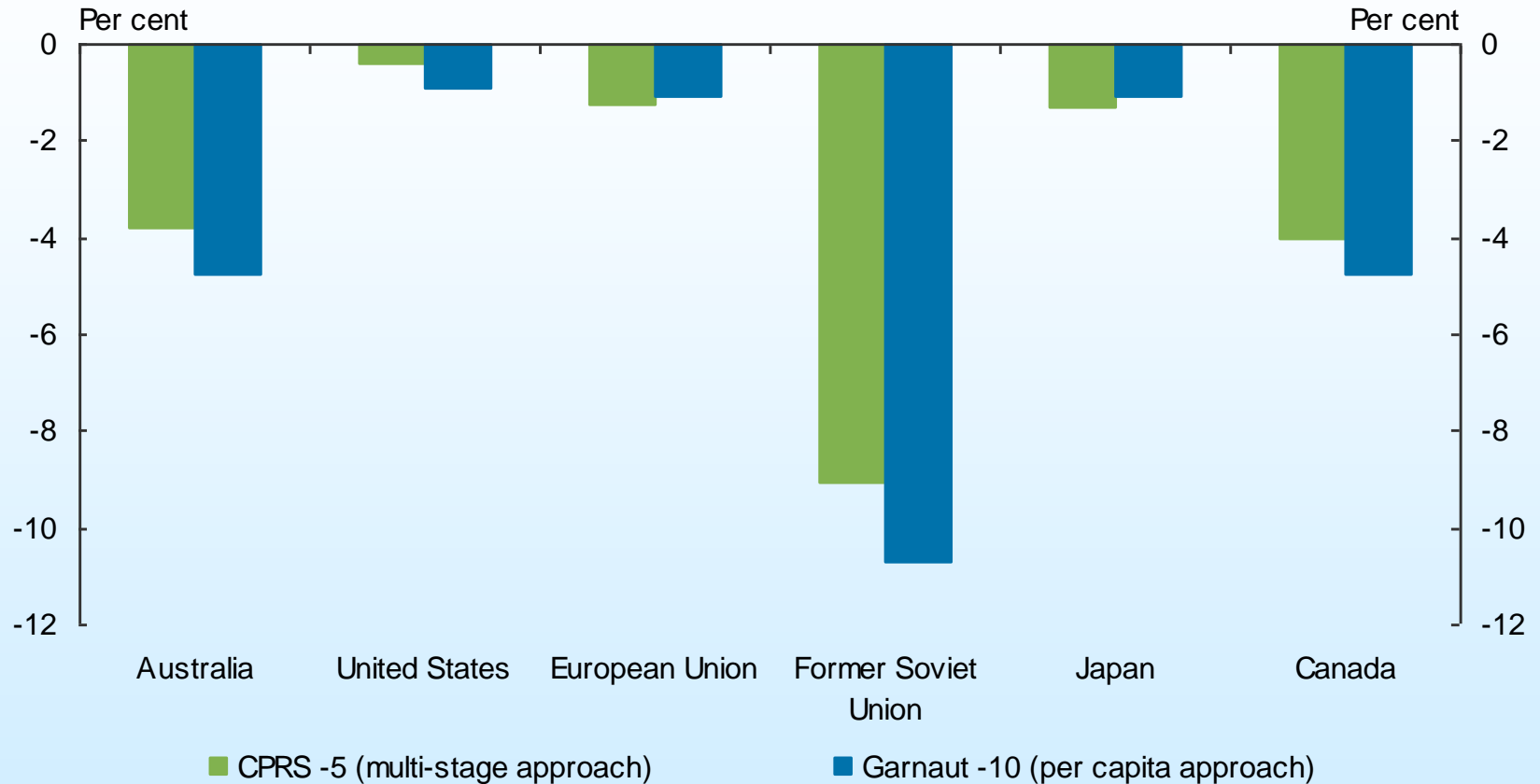
Change from reference scenario



•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





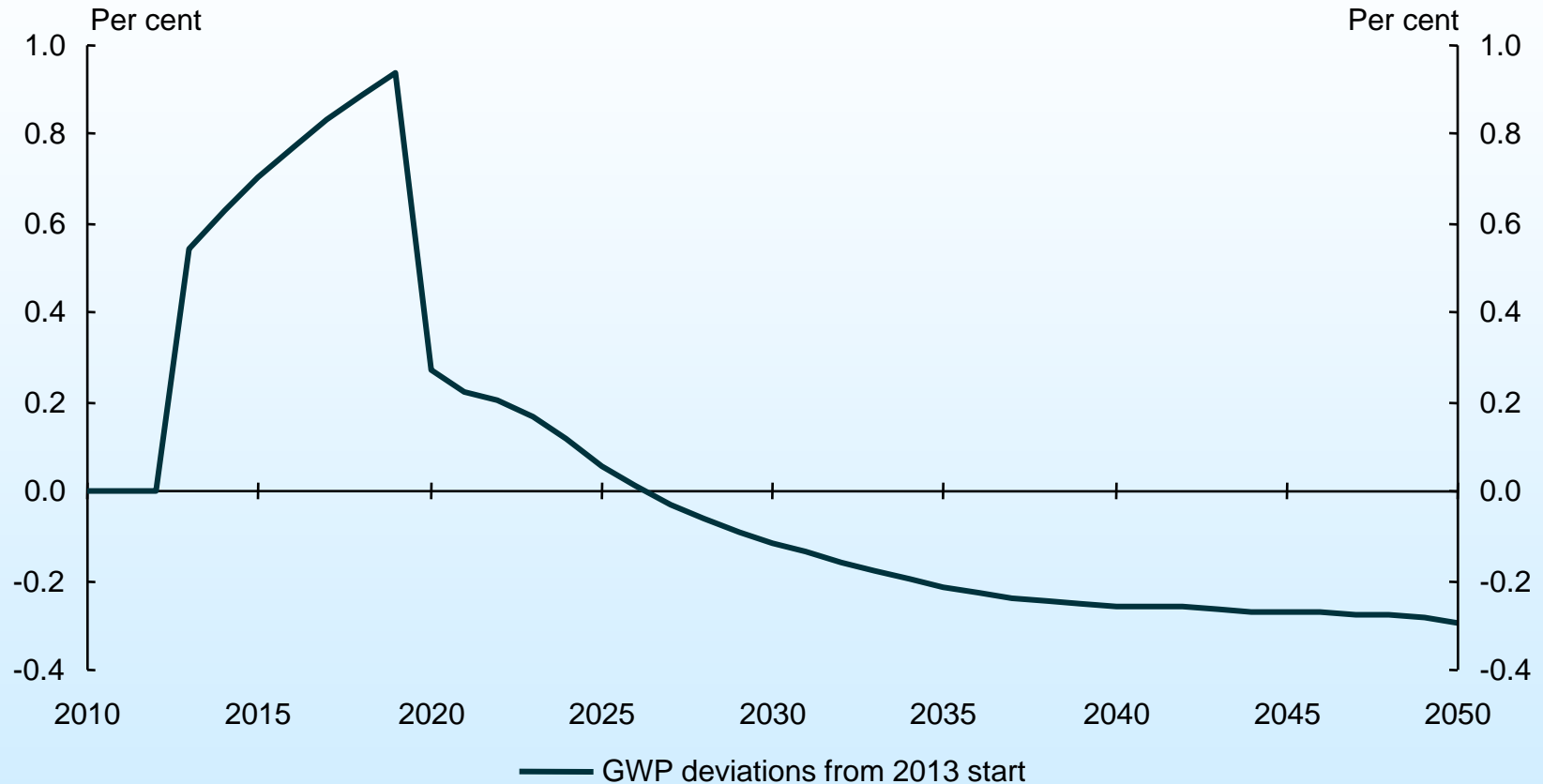
Timing sensitivities

- 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



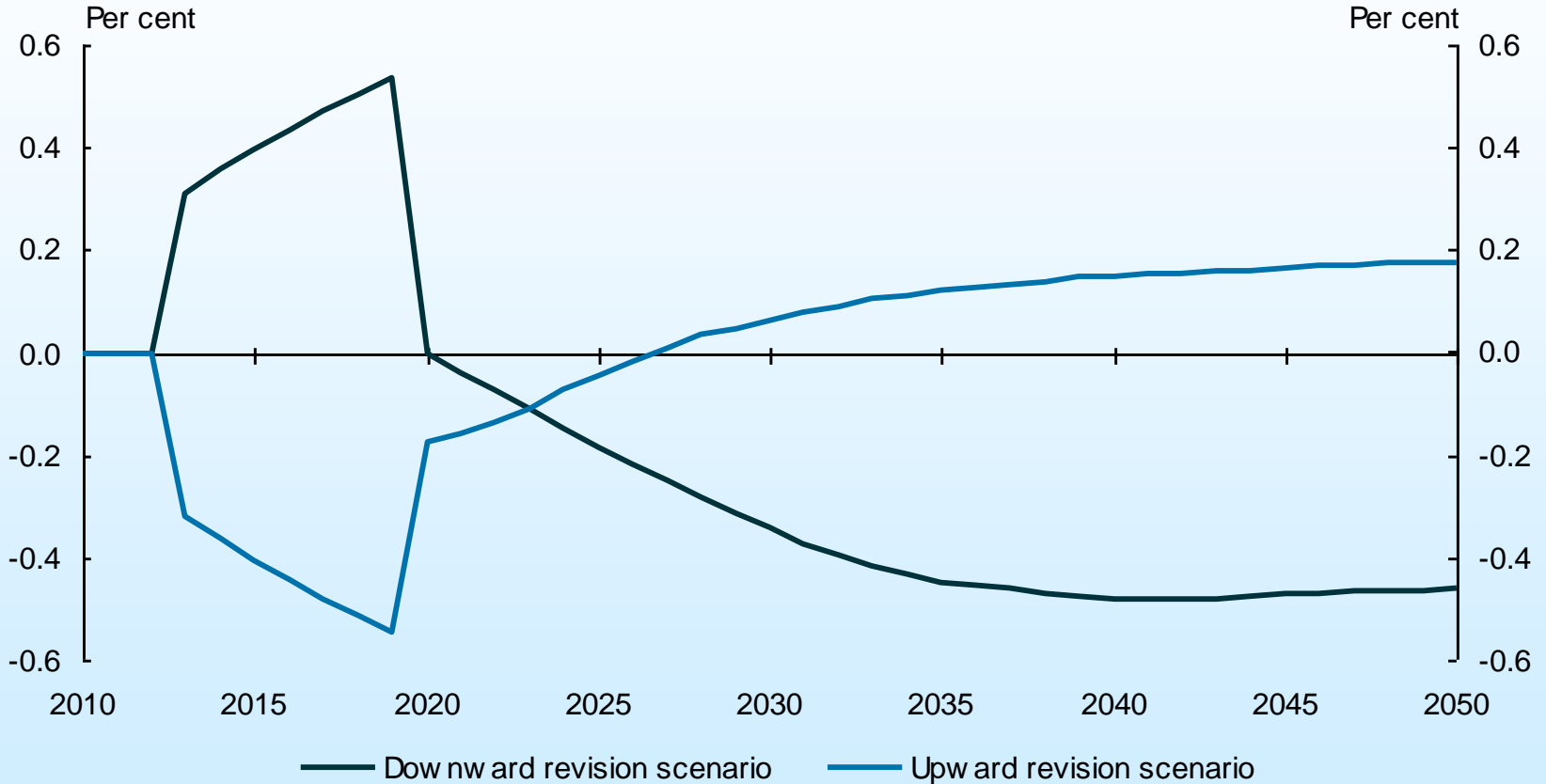
Note: GWP level change from the Garnaut -10 scenario and a sensitivity where global action is delayed from 2013 to 2020, but achieves the same 550 ppm CO₂-e concentration level by 2100.

Source: Treasury estimates from GTEM.



Revising Global Action

Compared with corresponding stabilisation scenario





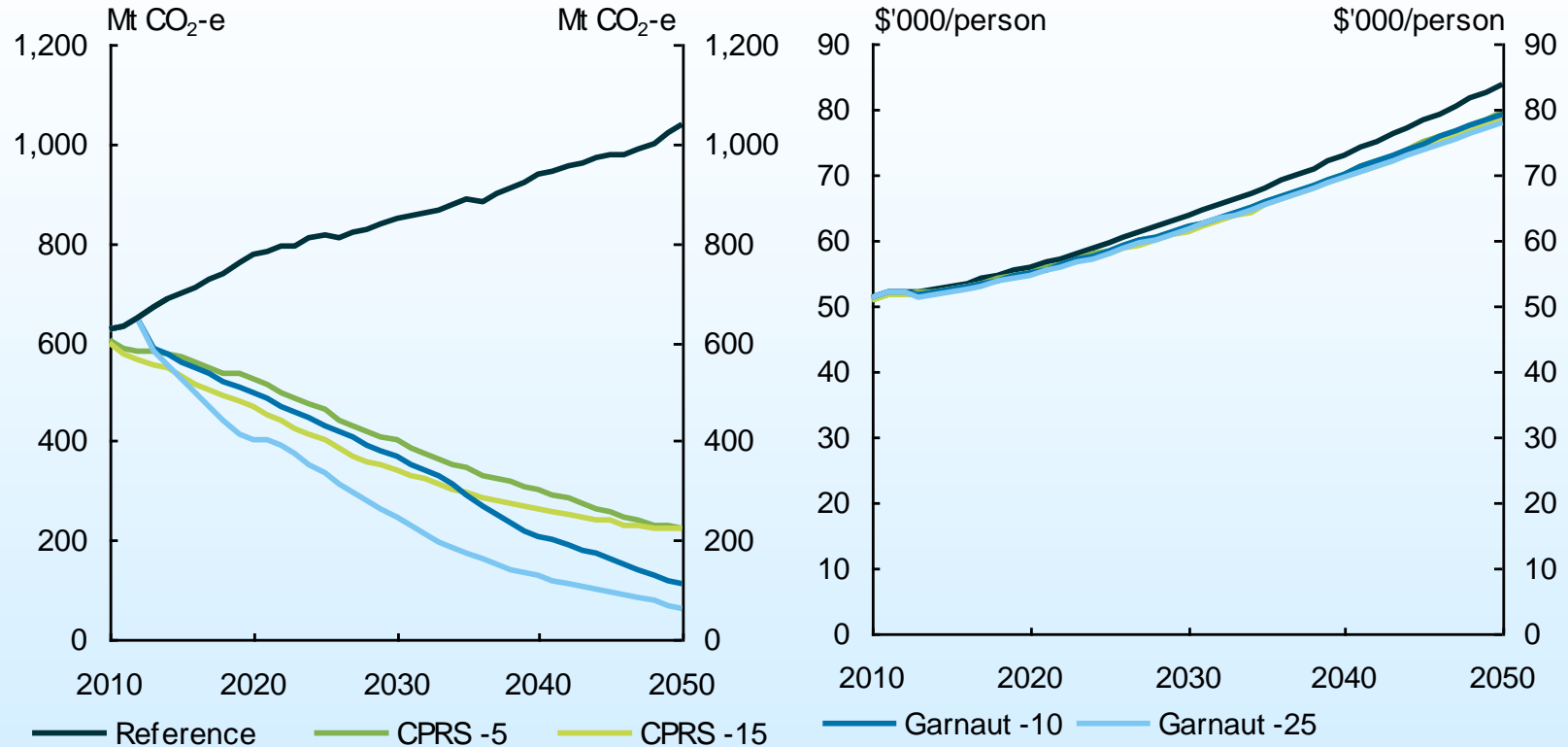
Headline Australian Results

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Emissions

Real GNP per capita



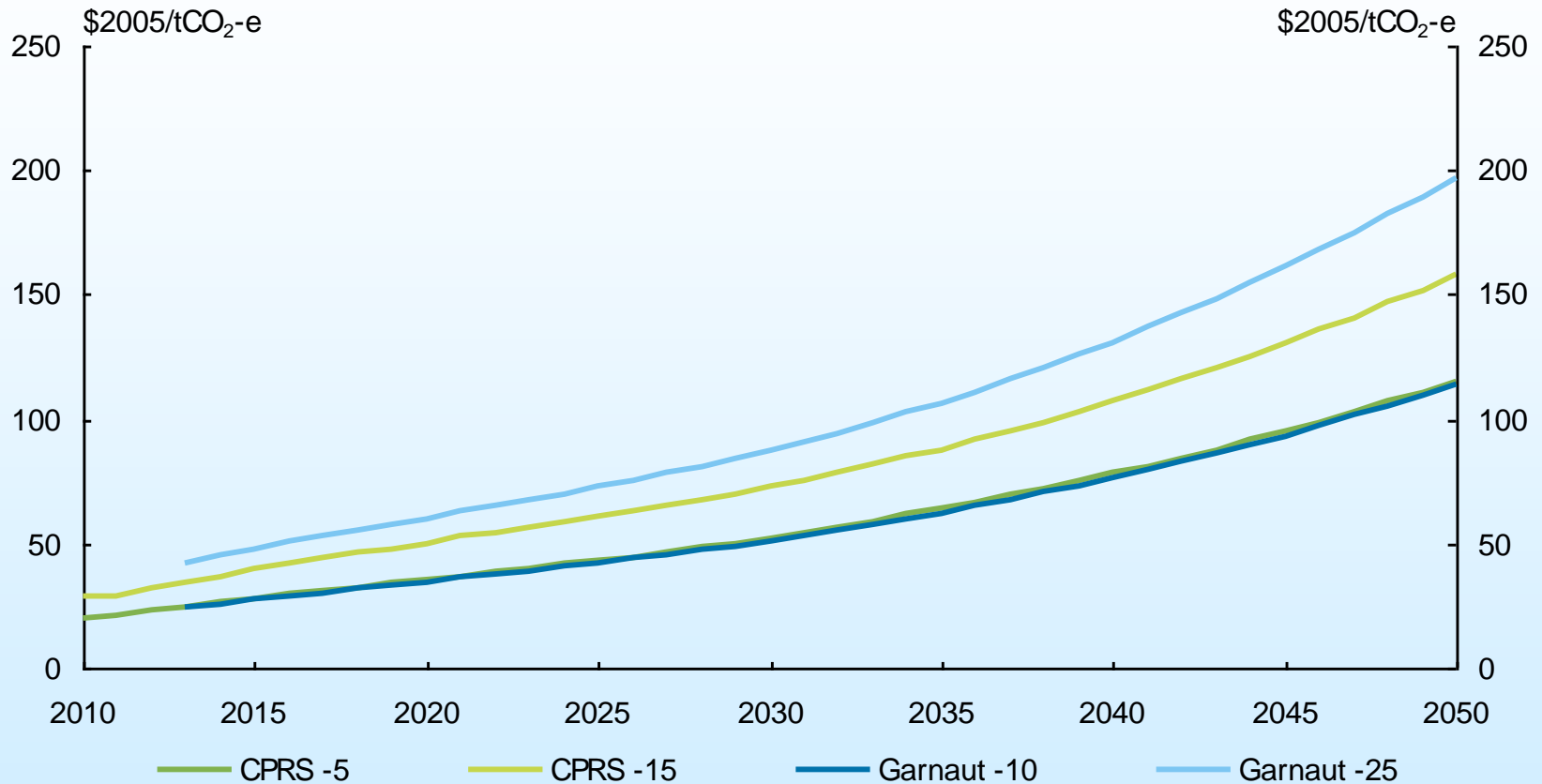
- GNP per capita grows 1.1 per cent per year in the policy scenarios versus 1.2 per cent in the reference scenario



Australia's Carbon Price

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Note: Price in 2005 Australian dollars.

Source: Treasury estimates from MMRF

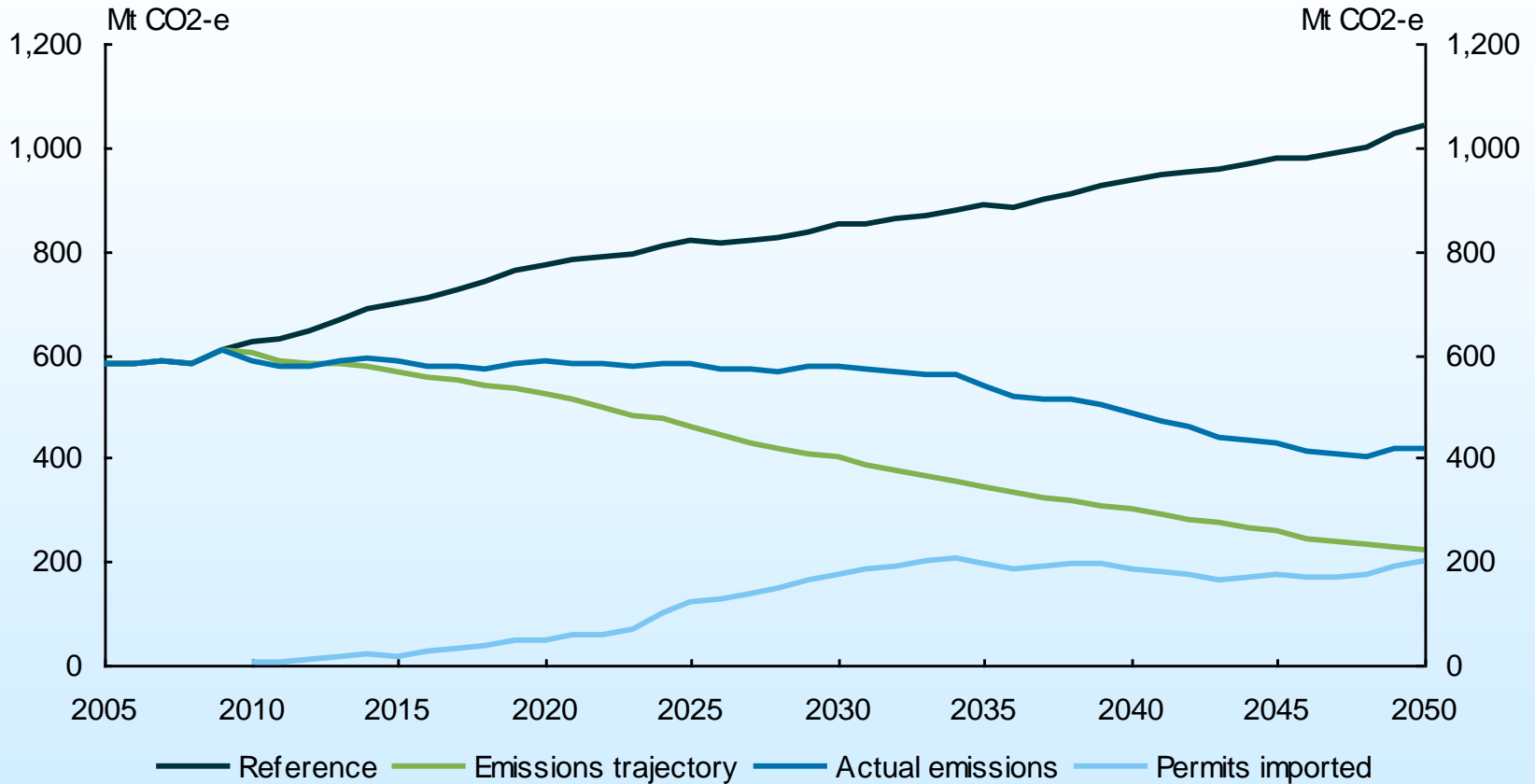


Australian Emissions and Trade

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CPRS -5 scenario



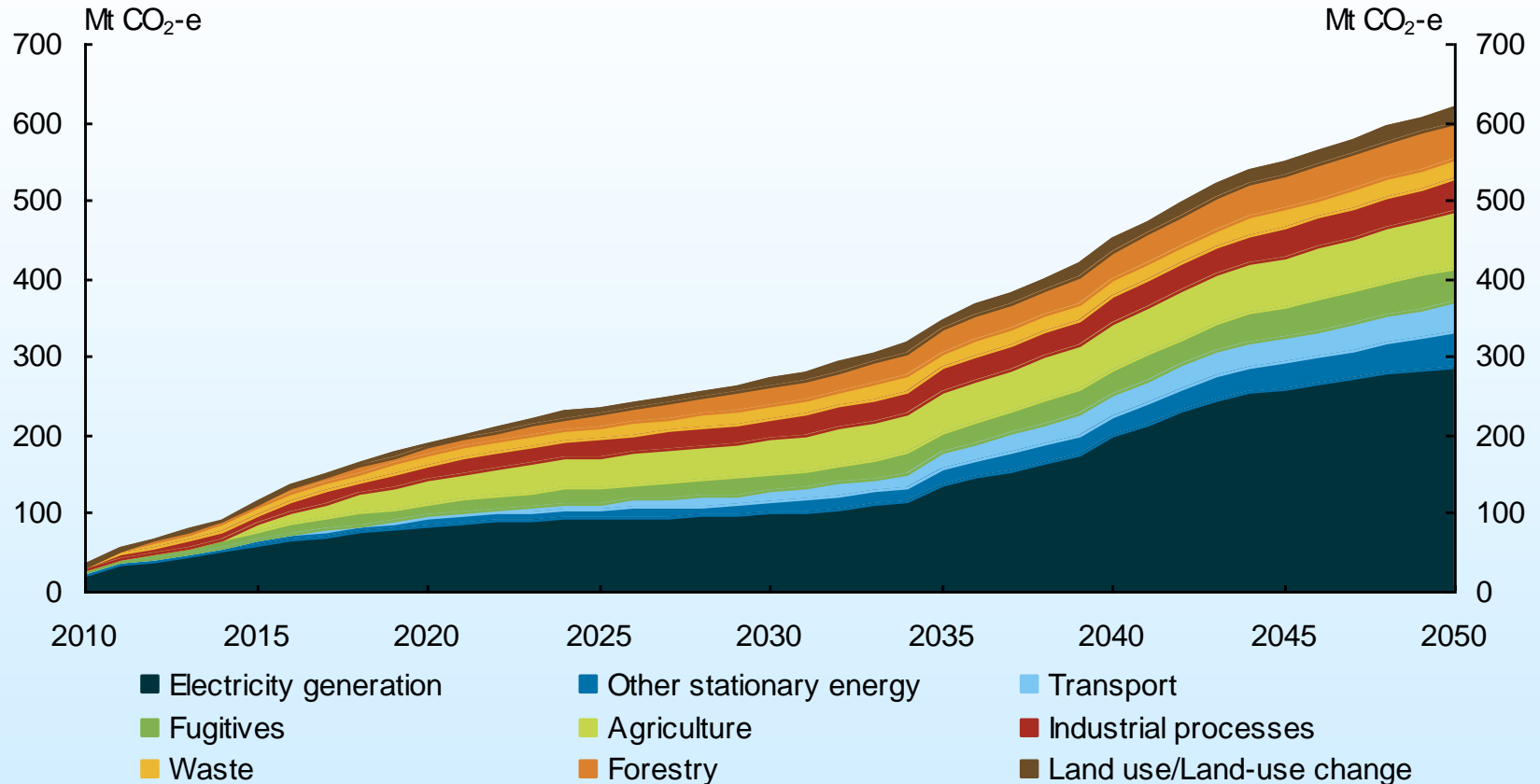


Sectoral Mitigation Efforts

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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

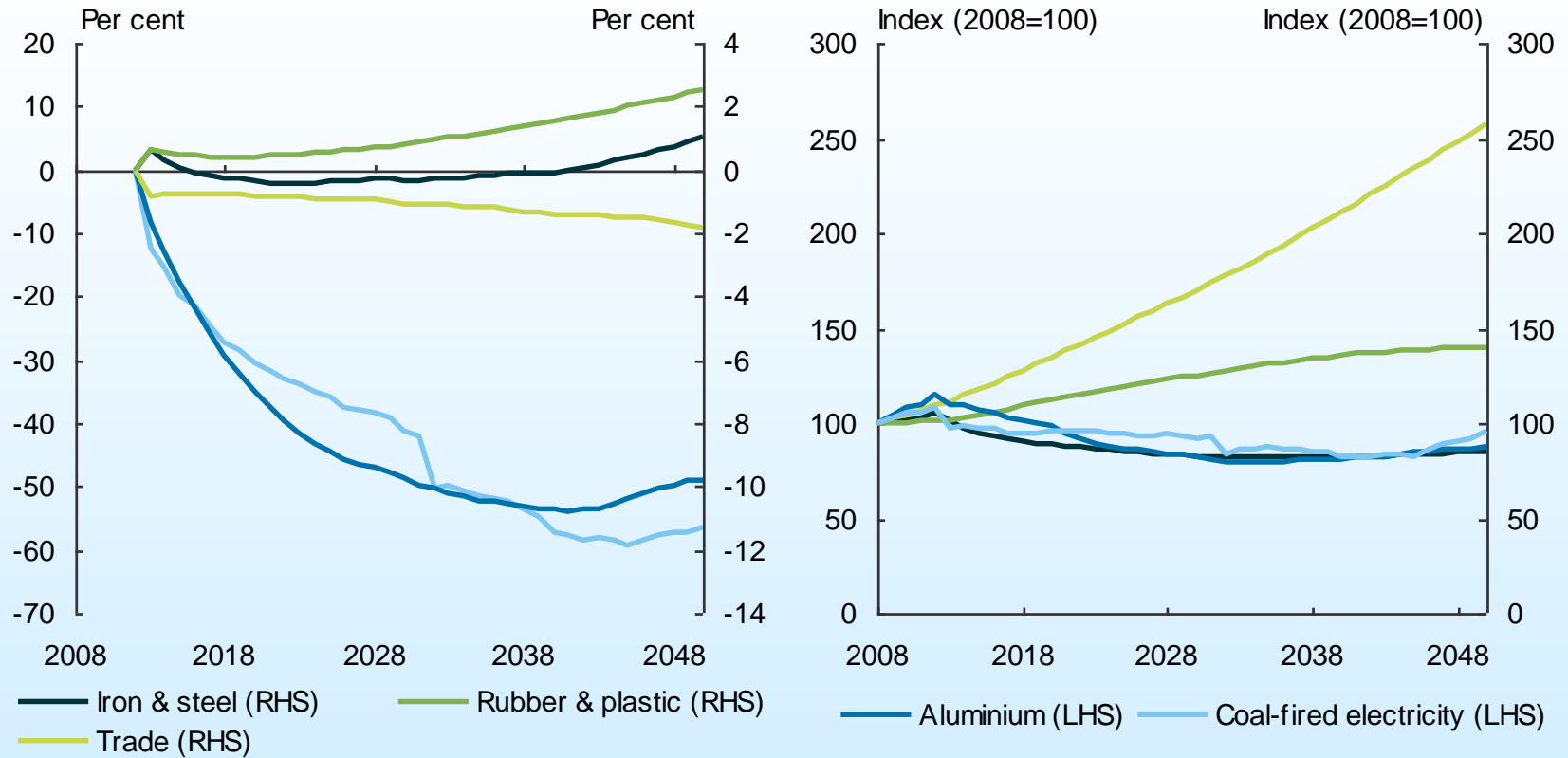


Sectoral Impacts

Relative to reference scenario

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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

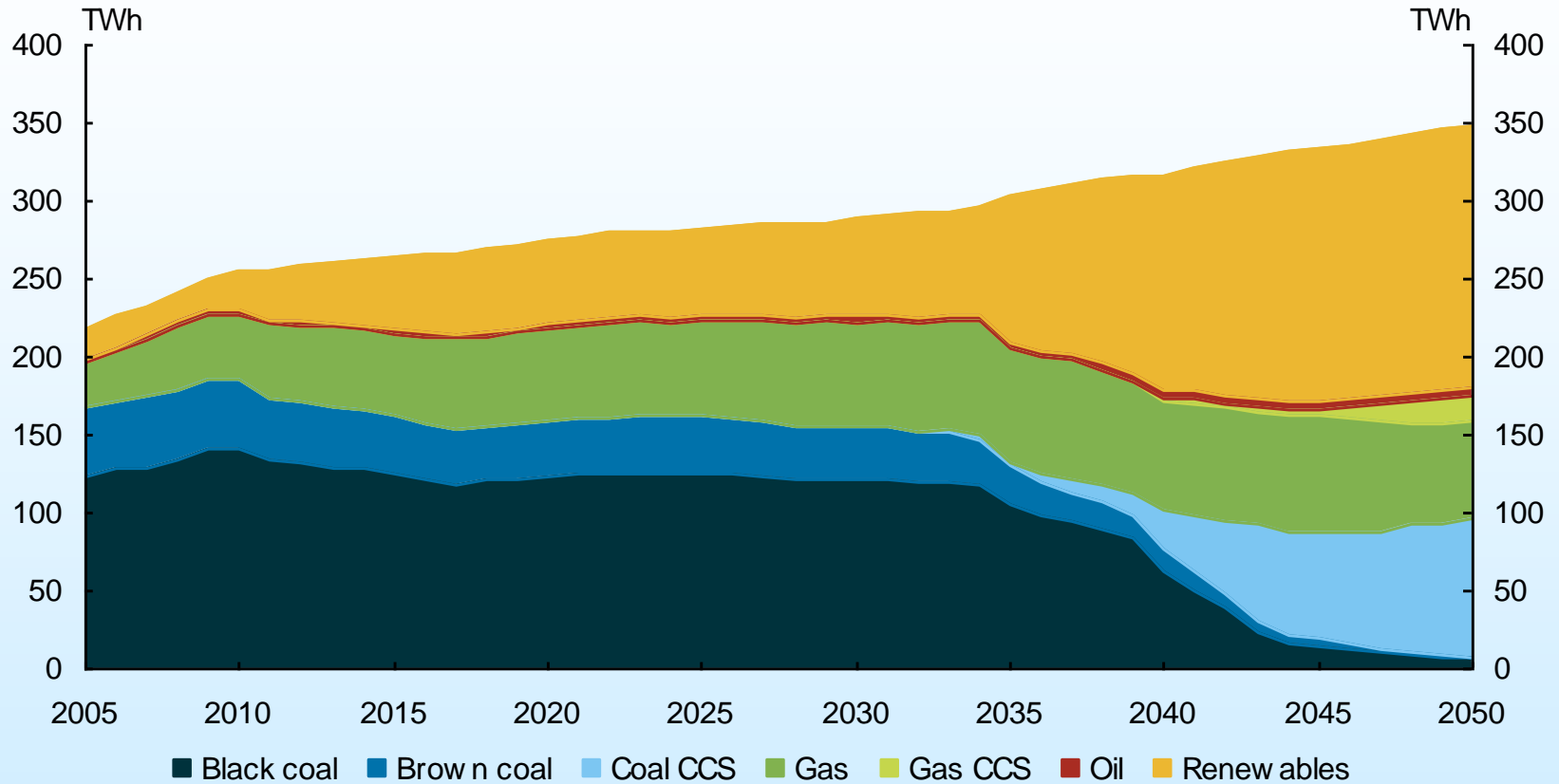


Australian Electricity Generation

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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

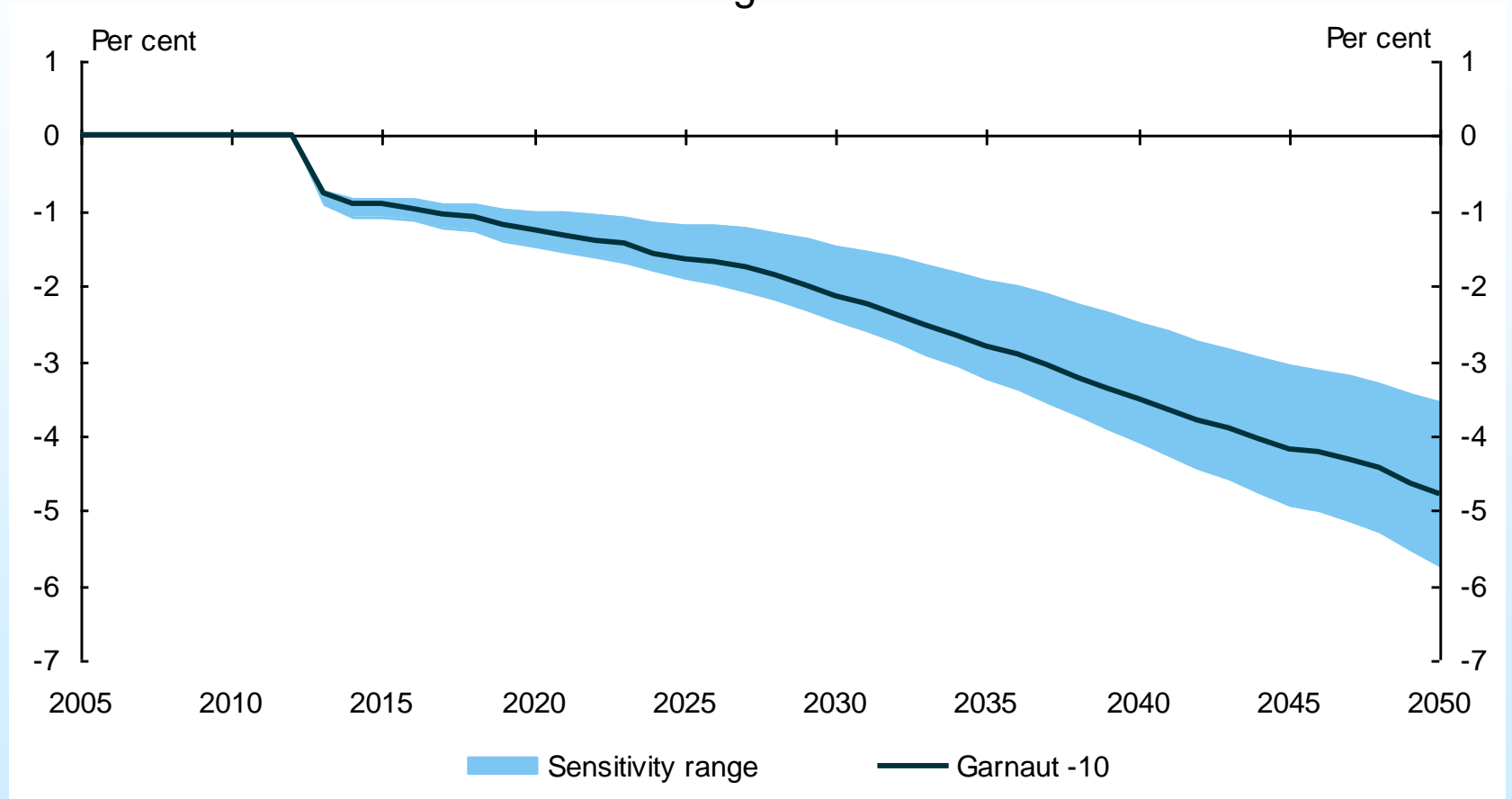


Technology Sensitivities Range

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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



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