The economic impact of the CPRS and modifications to the CPRS

REPORT FOR THE COALITION AND SENATOR XENOPHON

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About Frontier Economics

Frontier Economics (Frontier) is an economics consultancy specialising in applied microeconomic analysis, including industry regulation, institutional restructuring, private sector participation, competition policy, litigation support and environmental issues.

Frontier was founded in 1999 by a team of highly experienced consulting economists, and has offices in Melbourne, Sydney, Brisbane, London, Cologne, Madrid and Brussels. Frontier provides the highest standards in independent and well-founded economic advice for businesses and for public policy makers.

Frontier consultants have developed a strong analytical and modelling capability in the area of climate change policies, particularly in relation to the energy sector, other large emitters, abatement suppliers and the renewables sector. Frontier's work in the climate change area can be broadly categorised in the following areas:

- **Policy design and implementation:** the most notable example of this is Frontier's contribution to developing, modelling and implementing the NSW Greenhouse Gas Abatement Scheme in 2001-2 – the world's first mandatory broad based emissions trading scheme (ETS). Frontier has been significantly involved in climate change policy developments since then;

- **Policy impact assessment:** Frontier regularly works for governments, industry bodies and private sector clients to assess the impacts of a range of climate change policies. This complements advice on policy design/ implementation and the development of strategic response/transaction advice.

    - Emissions trading – including permit auction design and/or permit allocation options, including assessment of the Renewable Energy Targets (RET).

    - Macro-economic analysis - Frontier works with the Monash Centre of Policy Studies (CoPS) to assess the economy-wide effects on climate change policy using computable general equilibrium (CGE) modelling;

- **Strategic response and transaction advice:** Frontier regularly assists private sector clients and potential investors to understand risks and opportunities created by the introduction of new climate change policies, how markets will evolve and how best to respond to these new challenges. This includes advice to energy sector participants (current or potential), offset providers (such as forestry) and energy regulators who must adapt to changing markets.

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Importance of an appropriate carbon pricing scheme

The Australian Government wants to implement a greenhouse gas emissions trading scheme (ETS) they have called the Carbon Pollution Reduction Scheme (CPRS). The effect of the CPRS is to add a cost to as many goods and services as possible to reflect the damage that greenhouse gases are doing to the environment. The Government hopes that adding this greenhouse gas cost will induce people to produce and use goods and services that involve lower production of greenhouse gases.

In terms of the breadth and magnitude of economic effects the CPRS is arguably the most significant policy change in Australia's history. As such there is a substantial onus on the Government to demonstrate that whatever policy is introduced it is the best that can be developed. Moreover, unlike any other reform, the benefits to Australia from pricing and reducing emissions are contingent on global action, and on how Australia manages the interaction between its efforts and the efforts of its international partners. In fact, because Australia is such a small country, in terms of our contribution to global emissions, the environmental benefits from unilateral action by Australia are extremely small, and are unlikely to be measureable. One the other side of the coin, the costs will be both measurable and immediate.

As is widely recognised, concluding a binding agreement to stabilise global concentrations of greenhouse gases is, to use the words of Professor Garnaut, a "diabolical policy problem". This is because access to the benefits of lowering carbon emissions is not restricted to those participating in abatement activities, such as implementation of an ETS. Under these circumstances there is an incentive to free ride. Free riders avoid the adverse impacts on their own economy, but cannot be excluded from the benefits created by the actions of others.

One approach to overcoming free riding has been to negotiate binding international agreements whereby signatories all agree to simultaneously establish their own policies or programs to reduce greenhouse gases. In short, commitments are made to share the pain of meeting global greenhouse targets. Nevertheless, there continues to be reluctance among many countries to introduce domestic measures unless others do. The Government wishes to break this deadlock by introducing the CPRS ahead of securing a wider global agreement to co-ordinate policies to reduce greenhouse gases. While early action can pay off in the long run, it is not without short term risks in the form of adjustment costs, particularly in light of Australia's position as a small, open, energy-intensive economy.

To reinforce the opening remarks, given the potentially significant and immediate costs that will be associated with the implementation of an ETS, policy leadership, no matter how important it may be in encouraging international action, is not costless. It therefore remains the case that the Government should be in the position to reassure the Australian community that the CPRS is the best that we can do.

This report

This report examines the opportunities to improve the CPRS in terms of lowering the economic costs and, consequently, potentially tightening the emissions target.

Lowering the economic costs of the CPRS will not only aid Australia's economy, but will assist in securing greater political support for a scheme. If some of the cost savings from improving the CPRS can be used to tighten the emissions target, this will increase the chances of securing greater global support for reduction commitments, which is ultimately in Australia's economic interest.

The work presented in this report has been jointly commissioned by the Federal Coalition and Senator Xenophon. This analysis has been requested to assist these parties in their consideration of possible amendments to the CPRS legislation currently before the Parliament.

The following three key CPRS policy alternatives were modelled and compared in this report:

1. **CPRS:** as proposed by the Government
2. **CPRS Adjusted**: This adjusts the standard CPRS by increasing and extending the Energy Intensive Trade Exposed Industry (EITEI) shielding proposed by the Government and removing the arbitrary EITEI compensation thresholds. This is modelled with the same unconditional CPRS target (ie 5% reduction on 2000 levels by 2020)
3. **CPRS–Intensity**: This scenario combines the extended EITEI assistance described in Scenario 2 above with the introduction of an intensity target for permit allocations to the electricity sector. This would operate in the same manner as the EITEI shielding (ie contingent on output), but since this would dampen the harsh rises of electricity prices it would reduce or remove the need for (a) revenue churning to households and (b) EITEI assistance for indirect electricity price effects. This would mean that fewer permit funds are required to compensate for the losses incurred due to created by the CPRS. This is broadly consistent with the Waxman-Markey Bill in the United States, which proposes to distribute permits to electricity companies to offset increases in electricity prices.

The modelling presented in this report takes into account the effects of the global financial crisis and the most recent, of many, changes to the CPRS.

Summary

The analysis presented and discussed in this report has found that the CPRS can be greatly improved with relatively simple changes. Amendments to the Government's proposed CPRS would lead to the scheme becoming cheaper, greener, fairer and more secure.

Using the CPRS-Intensity combination (described above) it was found that the Real GDP costs can be cut by around $49b, or a third *even with a doubling of the Government's unconditional emission reduction target* of 5% below the level in 2000. Cutting emissions by 10% of the 2000 level will mean that by 2020 greenhouse gases will have been cut by nearly 28% compared to doing nothing, and by 2030 emissions will have been cut by 46%.

In other words, is it possible and relatively simple to amend the Government's CPRS so it is twice as 'green' and one third cheaper. To understand this how this can be achieved, it is necessary to understand that the direct cost of abatement represents only a proportion of the overall economy-wide costs. Emissions trading ensures that the direct abatement costs are low. However, other costs stem from a number of sources, primarily distortions to investment and savings decisions that can arise from introducing a new tax; the interaction between higher prices and existing tax-induced distortions (known as the "tax interaction effect") and inefficiencies and distortions that arise from recycling revenue to finance lump sum transfers.

The improvement in the economics of the CPRS reported below is mostly due to a reduction in the economic distortions arising from Government's revenue churning, as described above. This churning occurs, for example, when the Government charges electricity consumers for the full cost of greenhouse gas emissions from electricity production and then returns the money it collects to various groups it believes are deserving of Government support to compensate for the financial hardship arising from the CPRS. If this reallocation of funds is made an in-built feature of the trading scheme, rather than a distinct exercise that relies on the Government to intercept and reallocate permit funds, this ensures lower electricity price increases, which is better for the economy.

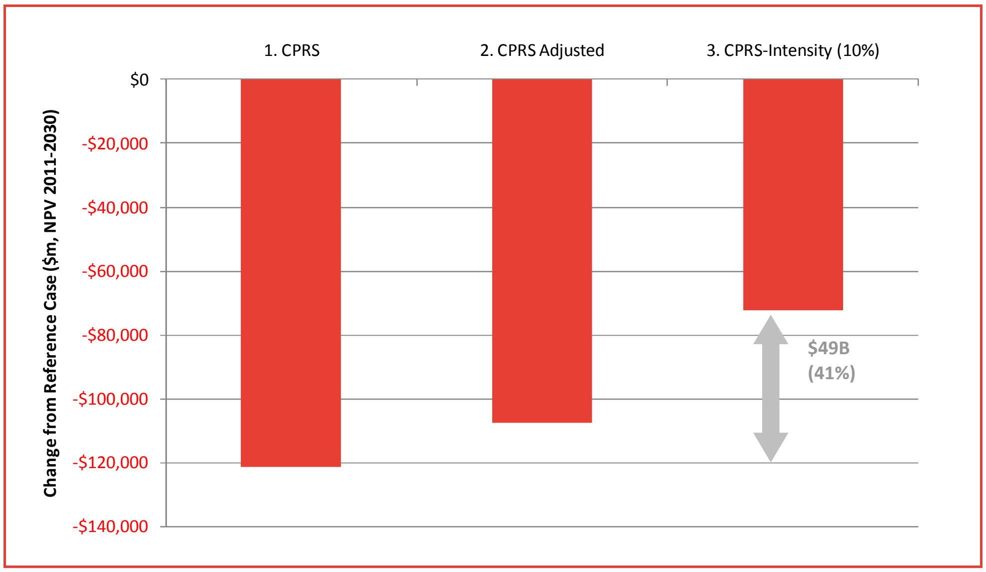
Furthermore, if the reallocation of funds is an in-built design feature of the trading scheme it further removes the Government from the carbon market and this will give investors greater certainty since the hand out of permits will not be at the discretion of the Government, as it is in the CPRS. This will increase the probability that investors will commit the funds to build the infrastructure necessary to efficiently achieve the emissions target.

Cheaper

The analysis found that the CPRS would result in a net economic cost, measured in terms of a reduction in the cumulative discounted dollar value in real GDP[1] over 20 years compared to a Reference Case where no action is taken, of $121b[2]. With relatively minor changes to the shielding arrangements to the CPRS (Scenario 2 described above) the GDP costs can be reduced to $108b.

By contrast, the CPRS-Intensity approach can reduce the GDP costs, *even with a doubling of the Government's emissions reduction target*, to $72b. While this still is a large cost, it represents a 41% cost saving compared to the Government's CPRS scheme, including the cost of achieving a more ambitious target.

Figure 1: Cumulative GDP comparison



Greener

The reduction in scheme costs obtained by moving to the CPRS-Intensity approach allows the Government to adopt a more ambitious target or to make the introduction of the CPRS more economically palatable, or both. The 41% reduction in economic costs from adopting the CPRS-Intensity approach includes the costs of doubling the Government's unconditional 5% abatement target to 10% of 2000 levels by 2020. The

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1 The Commonwealth Treasury uses GNP (rather than GDP) as an indicator of welfare changes. GNP accounts for that part of domestically generated income that accrues to non-residents, including that part required for the purchase of emissions permits from the international market. It also accounts for foreign generated income that accrues to domestic residents. Qualitatively, the effects on GNP are similar to the effects on GDP but GNP declines more than GDP because under all of the CPRS scenarios a substantial number of permits are imported.

2 Discounted at 4%

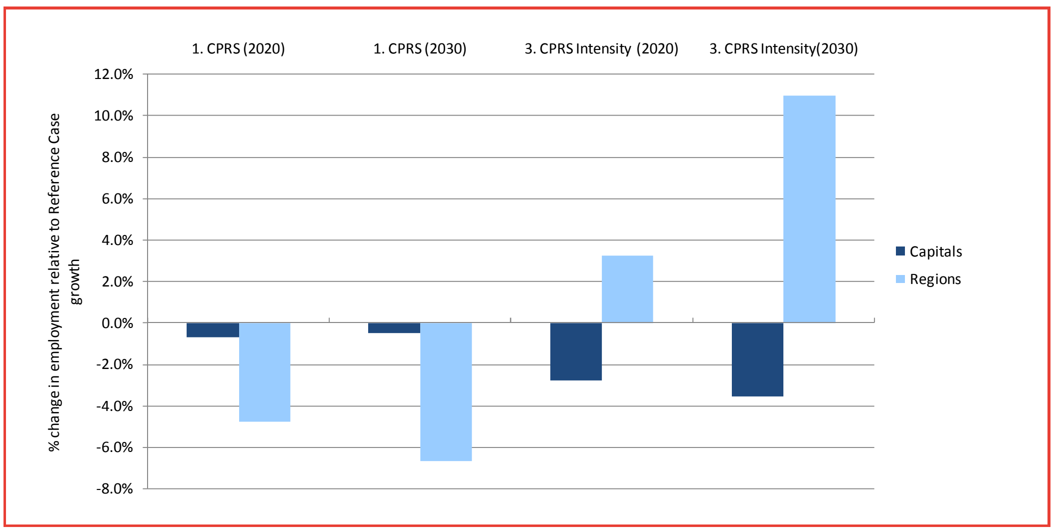
CPRS Intensity scheme includes a firm target; any increase in allocation to the electricity sector (as a result of higher levels of generation) or EITEI requires a reduction in permits auctioned by Government or an increase in imports of international permits to meet the target. This does not increase costs to, or require further emissions cuts from, other sectors because, under all variants of proposed design, international permit trade means that domestic emissions are not limited to the permits issued by the Australian Government. Liable parties are indifferent as to the source of permits. This is fully accounted for in the modelling.

Fairer

This study found that even taking into account Government measures to mitigate the effects of the CPRS the costs of introducing the scheme will be unevenly distributed across the Australian community. In particular, sectors and regions that rely on the use of large amounts of energy and produce large amounts of greenhouses gases, from which the entire economy benefits, will bear the majority of the burden of reducing Australia's greenhouse gas emissions.

The effect on these sectors and regions is more dramatic than the overall negative effect on the economy. This report shows there is also significant scope to better address the needs of rural Australia. Relieving farmers from the burden of having to acquire emissions permits but allowing them to sell credits from abatement under the CPRS-Intensity approach goes a considerable way to alleviating the harshness of the CPRS on rural and regional communities. However, even with these changes, more work may need to be done to help relieve the burden of the emissions reduction scheme on regional communities.

Figure 2: Employment effects by policy: capitals versus regions



Aside from the relief to the regions, the CPRS-Intensity approach delivers a less severe, more orderly transition of electricity prices. This better reflects the ability of households and businesses to adapt to the energy price signal and significantly reduces revenue churn passing through Government. This is a decisive factor in maintaining improved investment (and hence 'green' growth), compared with the CPRS. This treatment also alleviates the regressive nature of increased electricity prices on the community (and food prices, if agriculture is included), while the inclusion of the ability to incorporate credits for consumer abatement into the CPRS-Intensity scheme ensures a more positive, encouraging approach for securing customer demand response for the benefit of the environment.

In the short-term, the CPRS is expected to increase average household electricity costs by approximately $260-280 per year (as a direct result of the CPRS). Most of this increase would be avoided in the short-term under the CPRS-Intensity approach, where annual household electricity costs are likely to rise by $8 (2012) to $44 (2016).

More secure

The CPRS will not achieve its aim unless investors commit to undertake the necessary investments in new technology and infrastructure. Investors have indicated that they will be wary about making such large and long lived investments if the profitability of these investments is subject to a world in which rules and regulations are uncertain. This is particularly the case when many of these potential investors regard the proposed compensation arrangements as inadequate. Although some dispute these claims, they have not yet been tested under any comparable scheme in the world (since the European Emissions Trading Scheme provided more substantial compensation). Given the critical importance of a reliable electricity supply at a time when Australia needs to commit to significant new investment in supply for the first time in many years, it will be important to have practical policies in place to ensure investors will commit to the development of new capacity.

Some of the economy-wide cost savings identified in this report could be used to safeguard against this risk. This could encourage and enable generators to source and spend the necessary capital to produce 'greener' energy, and ensure that Australians will have continued access to reliable and competitively priced energy.

The proposed changes to the CPRS

The key proposed changes to the CPRS are summarised in the following table. The centrepiece of these changes is the adoption of an intensity based approach for electricity; removing the arbitrary thresholds for EITEIs; relieving farmers from the burden of having to acquire permits, but allowing them to compete with farmers in the US and Europe by providing them the same ability to create and sell abatement credits to the market; and allowing consumers to sell credits to positively reward them for undertaking abatement activities.

Combined, the above measures allow the Government to **double** the unconditional emission abatement target, appropriately compensate generators and encourage investment in 'greener' technologies, while still delivering very significant cost savings compared to the Government proposed CPRS.

Feature	CPRS	Proposed change
Targets	Unconditional target of 5% reduction on 2000 levels by 2020	Unconditional target of 10% reduction on 2000 levels by 2020
Agriculture	Subject to coverage from 2015	Included only as a potential offset provider
Emissions Intensity Trade Exposed Industry (EITEI) thresholds	Emissions intensity thresholds: "High" indicatively includes Sheep and cattle, Dairy, Rice, Cement, Steel and Aluminium "Low" indicatively includes Pigs, LNG, Paper products, Chemicals, Ceramics, Alumina and Other non-ferrous metals Coal mining technically eligible but excluded	Remove the distinction between high and low "thresholds" Standard EITEI treatment applied to fugitive emissions from coal (as per other sectors)
EITEI baseline allocations	Baseline allocation rate of 94.5% (high)/66% (low) of current emissions levels Baseline rate declines by 1.3%/year 4.5%/6% reduction after year 5 (recession buffer expires) Removed between 2020 and 2024.	Increase baseline to 100% (of best practice) for all above low threshold No decline in baseline rate until comparative global action Replace indirect shielding measures with electricity baseline (below)
Electricity sector	N/a (compensation is required to offset rising energy costs) Electricity Sector Adjustment Scheme (ESAS) to provide estimated $3.5B in compensation to electricity generators ESAS distribution mechanism directs most compensation to brown coal generators	Introduce electricity baseline (to replace indirect shielding, reduce revenue churn): reduces price effects for consumers Removes the need for compensation to households/businesses Increase ESAS pool to ensure energy security and new investment Revise ESAS distribution baseline to better reflect damages to black and brown coal
Energy efficiency	Voluntary action and energy efficiency not recognised	Allow creation of credits

1 Background and approach

The aim of the analysis presented in this report is to examine the economic effects of the Commonwealth Government's proposed carbon pollution reduction scheme (CPRS) compared with alternative policies. The results of this analysis are intended to provide an input into the development of amendments to the CPRS legislation.

The analysis was conducted using essentially the same modelling system employed by the Garnaut Review and the Commonwealth Government in support of its CPRS proposals. This modelling system comprises a detailed bottom-up model of the Australian electricity supply system and a dynamic multi-sector multi-region computable general equilibrium (CGE) model of the Australian economy. The CGE model is MMRF-GREEN, which was developed and is maintained at the Centre of Policy Studies (CoPS) at Monash University and was used for the Garnaut and Commonwealth analysis conducted by Treasury. For the electricity-sector model we have used Frontier Economics' proprietary model (WHIRLYGIG) rather than the McLennan Magasanik Associates (MMA) model that was used by Garnaut and the Commonwealth. This is the main difference between the modelling systems and assumptions; this difference is not a material factor in the economy-wide results, though the impacts on the electricity sector are discussed separately in Section 4.

1.1 Policies and scenarios

To assess and compare the economic costs of the CPRS with the alternatives, all policies are compared to a world in which no policy action is taken. This is known as the Reference Case. Compared to the Reference Case the following CPRS policy alternatives are analysed:

1. **CPRS** (as proposed);
2. **CPRS Adjusted**: This adjusts the standard CPRS by increasing and extending the Energy Intensive Trade Exposed Industry (EITEI) shielding proposed by the Government and removing the arbitrary EITEI compensation thresholds. This is modelled with the same CPRS target (ie 5% reduction on 2000 levels by 2020).
3. **CPRS – Intensity**: This scenario combines the extended EITE assistance described in Scenario 2 above with the introduction of an intensity target (explained in Appendix 3) for permit allocations to the electricity sector. This would operate in the same manner as the EITEI shielding, but since it would offer more muted electricity price effects, it would reduce or remove the need for (a) transfers to households through, for instance, recycled permit auction revenue and (b) EITEI assistance for indirect electricity price effects. This means that fewer permit funds are required to compensate for the losses incurred due to the CPRS.

- This requires only one additional baseline and minimal legislative change. This is broadly consistent with the Waxman-Markey Bill in the United States which proposes to distribute permits to electricity companies to offset increases in electricity prices.
- This scenario is modelled with a 10% emissions reduction of 2000 levels by 2020.

Details of each scenario are provided in Table 2, including a comparison of the proposed EITEI shielding rates in each scenario.

Table 1: Scenario and target overview

	1. CPRS (Standard)	2. CPRS Adjusted	3. CPRS -Intensity
CPRS 5	✓	✓	✗
10%	✗	✗	✓

The 10% emissions reduction scenario (Scenario 3) adopts the same carbon prices projected in the Commonwealth modelling for the CPRS5 scenario on the basis that the Australian carbon price is determined by global carbon prices, which are contingent on the same global policy conditions that are assumed for CPRS5. It is assumed that an increase in Australia's domestic emissions reduction targets will not affect global prices (since Australia contributes only 1.5% of global emissions). This is consistent with the Commonwealth Treasury modelling of the Garnaut 10% target, which also adopts the same carbon price as the CPRS5 scenario.

As explained in Appendix 1, if the global policy environment is the same for different domestic policy scenarios, global carbon prices will remain unchanged regardless of the domestic target. This means that, all other things being equal in global policies, domestic abatement achieved will be the same regardless of the domestic target. The result of an increase in the abatement target adopted by Government will be a reduction in Government auction revenue and an increase in permit imports. This will not increase business or transitional costs.

By contrast, the CPRS15 scenario modelled by the Commonwealth Treasury is contingent on more stringent global policies which result in higher carbon prices. A partial objective of this modelling is to assess the relative costs of more stringent targets, holding the global policy environment constant.

Table 2: Scenario overview

	1. CPRS	2 CPRS Adjusted	3. CPRS Intensity
Time frames	Scheme commences 2011 with price of $10/tCO2e	Varying CO2 price from 2012-onwards	Modelling period 2010-2030
Coverage	Stationary energy, Transport, Fugitive emissions, Industrial processes and Waste from 2011. Agriculture from 2015*	Stationary energy, Transport, Fugitive emissions, Industrial processes and Waste from 2011. Agriculture allowed as offsets but not included in coverage	
2020 Target	5% reduction on 2000 levels by 2020		10% reduction on 2000 levels by 2020
2050 Target	60% reduction on 2000 level by 2050 (allowing for permit imports to meet any shortfall)		
International linkage	No trade in 2011 (price cap of A$10/tCO2). Full international trade of permits from 2012 As per Commonwealth Treasury, assume a global price in 2012 of A$ 24.3 (CPRS5) or A$ 33.6 (CPRS15) Rising by 4% per year to reflect the real cost of holding permits.[3] This implies unlimited banking and borrowing over time. Import/export prices (products) differ from the Reference Case to reflect similar Global action: Eg global aluminium prices rise		
EITE emissions intensity threshold	**"High"** Emissions intensity > 2000 tCO2e per $m of revenue; OR Emissions intensity > 6000 tCO2e per $m of value added Sheep and cattle, Dairy, Rice, Cement, Steel and Aluminium **"Low"** Emissions intensity > 1000 tCO2e per $m of revenue Emissions intensity > 3000 tCO2e per $m of value added Pigs, LNG, Paper products, Chemicals, Ceramics, Alumina and Other non-ferrous metals	**One threshold** Emissions intensity > 1000 tCO2e per $m of revenue Emissions intensity > 3000 tCO2e per $m of value added Does not includes fugitive emissions from coal mining	**One threshold** Emissions intensity > 1000 tCO2e per $m of revenue Emissions intensity > 3000 tCO2e per $m of value added Includes fugitive emissions from coal mining

3 Converted to A$2008 – Commonwealth Treasury cites costs in A$2005

Final

Table 2: Scenario overview

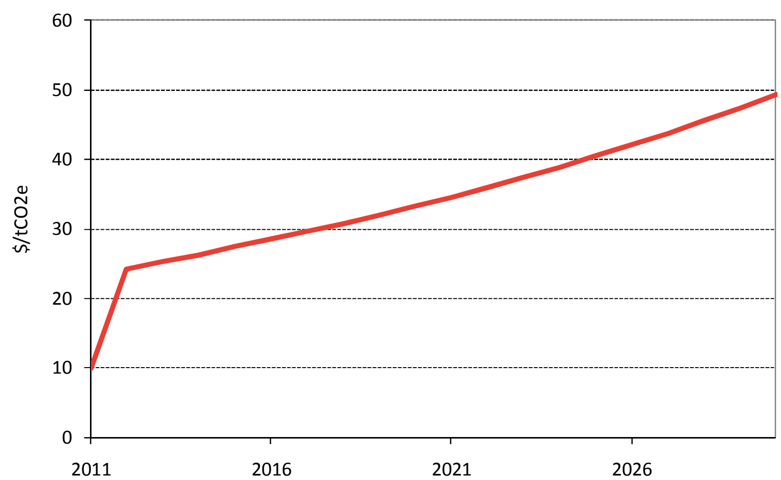
	1. CPRS	2 CPRS Adjusted	3. CPRS Intensity
Baseline rate for allocation (EITE)	94.5% / 66% of direct and indirect emissions	100% of direct and indirect emissions	100% of direct emissions
Rate of decay in EITE rate	1.3%/year 4.5%/6% reduction after year 5 (recession buffer expires) Removed between 2020 and 2024.	No decay (until global action)	No decay (until global action)
Electricity baseline	N/A		Baseline for permit allocation to electricity, starting at 0.86tCO_2/MWh ramping down to 0.25tCO_2/MWh by 2030

Background and approach

Carbon price

The carbon price adopted for all scenarios is the same as that used by the Commonwealth Treasury for the CPRS5/Garnaut 10 scenarios, except that the price is fixed at $10/tCO2 in 2011: Figure 3.

Figure 3: Carbon price

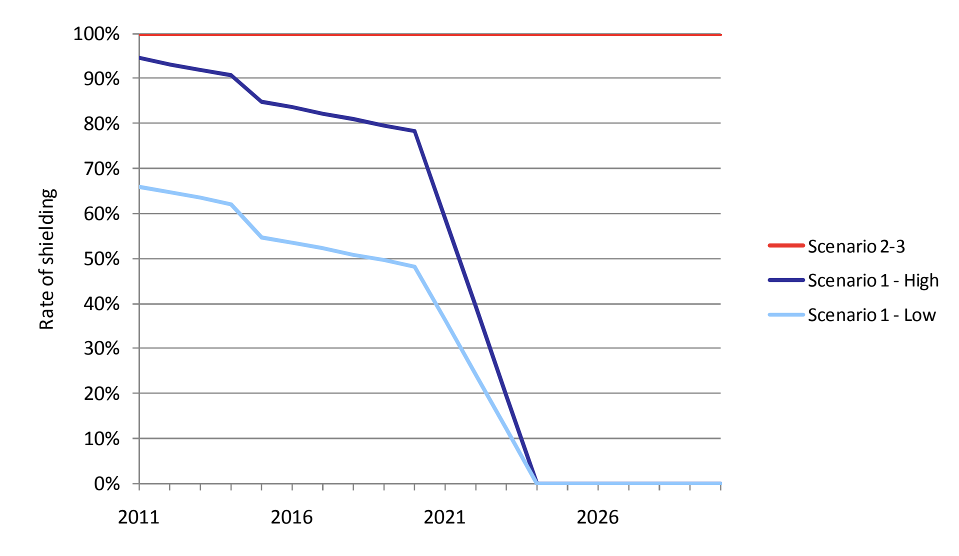


EITEI shielding

The CPRS proposes to allocate "shielding" to EITEIs using a baseline emissions intensity multiplied by the output of a given activity. This is effectively an output based rebate, whereby the allocation of permits is conditional on output. This preserves incentives to improve emissions intensity (efficient producers are rewarded, explained in Appendix 2) but it allows for price-taking EITEI to maintain margins, and hence competitiveness. This will stem the movement of production and producers from Australia to countries that do not have an emission trading scheme, or other method of applying a comparable price on greenhouse gas emissions.

A comparison of EITEI shielding rates assumed for each scenario is provided in Figure 4. Scenario 1 and 2 include shielding for both direct and indirect emissions. Scenario 3 includes shielding only for direct emissions: shielding for indirect emissions is provided for through the electricity baseline allocation, which results in lower energy costs for households and businesses.

Figure 4: EITEI assistance rates comparison



Electricity baseline

The electricity sector baseline is a transitional measure that operates in exactly the same manner as the shielding for EITEI: generators receive an allocation of permits equal to the baseline rate multiplied by their output. Generators with emissions intensity above the baseline will be liable only for their emissions in excess of the baseline; generators with emissions intensity below the baseline will be able to sell the excess credits. Because the allocation is conditional on production, generators will pass-through the cost saving onto consumers through lower energy prices.[4] In effect, the proposed CPRS implicitly sets a baseline rate of allocation to electricity that is equal to zero. Under the proposed alternative, the baseline commences at a higher rate and declines toward zero – the scheme becomes equivalent when the baseline declines to zero. The result of setting a baseline above zero is that energy consumers pay lower prices, the Government receives lower permit revenue, and there is no need to recycle (or 'churn') this revenue back to consumers.

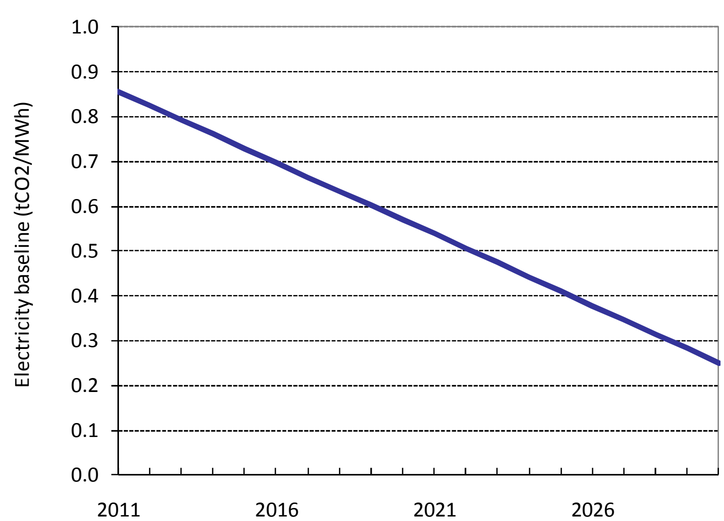
The baseline rate for the electricity sector (applicable in Scenario 3) is provided in Figure 5. This represents a rate of 100% of average emissions intensity, declining to 30% by 2030, which translates to an allocation of 0.86tCO2e permits per MWh of electricity produced in 2011, declining to 0.25tCO2e permits per MWh of electricity produced in 2030. This allocation would be provided to all generators, including hydro and renewables.

4 This is entirely distinct from a grandfathered allocation which is not tied to output. This is the method of allocation used in Europe, and generators passed on the opportunity costs of permits through higher prices because they had the alternative of selling unused permits.

The implication of this electricity baseline is explained in Appendix 2. In summary, it will preserve the incentives for generators to improve emissions intensity, since cleaner generators are rewarded. However, because the baseline rebate is offered to all generators (including low emissions plant, who are able to sell credits), the reduction in average costs will result in lower energy prices than under the proposed CPRS, and it is consumers (households and businesses) who will benefit from these relatively lower prices. This 'shielding' for electricity will result in a smoother increase in electricity prices compared with the CPRS. The modelling results are presented in Section 3.

The value of this shielding (permits allocated and the value of these permits) and the 'affordability' of adopting this measure are discussed in the modelling results (Section 3). The implications for aggregate emissions and the real consequence of dampening the energy price signal (which is argued is essential for delivering consumption abatement) is also discussed in Section 3.

Figure 5: Electricity intensity baseline rate



2 Outline of the modelling system

This section provides details about the electricity-sector model and the computable general equilibrium model that are used in this project and how they interact to produce a reference case and projections of the effects of the various CPRS scenarios described in Section 1.1.

2.1 Electricity market modelling: *WHIRLYGIG*

A model of an efficient and competitive electricity market is used to examine the effects of various CPRS schemes, where costs, prices and generator returns are determined on an optimal least-cost basis. This approach involves determining the future pattern of generation and hence the long run marginal cost (LRMC) of the generation system by computing the least-cost mix of future generation plant, having regard to the current stock of plant. LRMC is a proxy for a price in an efficient market. The process for determining the LRMC is well developed and understood and therefore provides a systematic and easily verifiable basis for comparing the economic effects of the various CPRS scenarios.

Frontier's proprietary long-term investment model, *WHIRLYGIG*, computes the least-cost mix of generation, interconnection, demand-side management and greenhouse abatement investments, subject to *simultaneously* meeting a system reliability target (as determined by Australian Energy Market Operator – AEMO) and any greenhouse emission target (including, for instance, MRET, GGAS, the Queensland Gas Scheme or an emission trading scheme).

2.1.1 Key model inputs

The model requires the following data for generation plant and potential greenhouse abatement options, including:

- new entrants' costs, including "technology curves"
- fuel cost projections
- fixed costs for existing plant
- electricity demand and demand-side impacts
- carbon intensity coefficients
- capacities and annual energy output potential
- plant commissioning timeframes

- emissions target for the electricity sector in the case of CPRS policy simulations

2.1.2 Key model outputs

The outputs of this electricity modelling include new plant build and carbon prices for each scenario and an indication of long-term dispatch and least-cost pricing. Although plant is dispatched on the basis of short-run marginal costs (SRMC), as is customary, *WHIRLYGIG* can also provide long-term forecasts of LRMC as a proxy for long-term average market prices.

2.2 The CGE model: MMRF-Green

MMRF-GREEN is a multi-sector, multi-region dynamic model of the Australian economy. The key features of the model are summarised in the dot points below.

- It models the six Australian States and two Territories as separate economies, interacting with one another via inter-regional flows of commodities and primary factors

- In each of the eight regions, it models the production and investment behaviour of a representative producer/capital creator in each of 58 sectors. These representative agents are price takers who choose inputs to minimise the costs of production and capital creation subject to functions that specify technological relationships between the relevant inputs and outputs

- Each region contains a representative household that chooses a consumption bundle subject to its disposable income and the relative prices of consumption goods

- The income and outlay sides of the budgets of the Commonwealth government and each of the State and Territory governments are modelled separately

- International trade is included, with exports disaggregated by (domestic) region and sector of origin but not by (foreign) country of destination. Similarly, imports are disaggregated by (domestic) region and sector of destination but not by (foreign) country of origin. Australia is assumed to be a price taker in its import markets but to exercise some market power with respect to its main exports

- Domestically produced commodities are used as inputs to current production and capital formation, in household and government consumption, and for export. Markets for these commodities are assumed to clear

- In its treatment of energy, the model recognises:
  - production, domestic usage and trade for three primary fuels (coal, oil and natural gas);
  - six electricity-generating technologies (coal-fired[5], gas-fired, oil-fired, hydro, other renewable);
  - an electricity-supply sector covering transmission, distribution and retail activities; (In buying electricity from the generators the sector can substitute between the different generating technologies in response to changes in their relative costs.)
  - a petroleum-products sector, producing automotive petroleum, aviation fuel, diesel, LPG and other petroleum products; and
  - a transport sector comprising five sub-sectors -- road transport, rail transport, water transport, air transport and private transport services. ("Private transport services" is a dummy sector. Its capital stock consists of the domestic vehicle fleet. It purchases automotive fuels and supplies private motor vehicle services to the households.)[6]
- It accounts for greenhouse-gas emissions (measured in CO2 equivalents) from each of its regionally disaggregated sectors and households. The emitting activities that are recognised are the burning of fossil fuels and non-combustion emissions such as fugitives and agricultural emissions
- The dynamic mechanisms in the model concern capital accumulation, labour-market adjustment and debt accumulation
  - For capital accumulation, it is assumed that investment in year t augments the capital available for use in year t+1. Hence, year t+1's capital stock is year t's stock *minus* year t's depreciation *plus* investment undertaken in year t. Investment in year t is a function of the expected rate of return on capital[7]. Investors in each sector seek to expand the sector's capital stock so long as the expected rate of return exceeds the

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5 The model's regional dimension implicitly splits coal-fired generation into black-coal (NSW and Queensland) and brown-coal (Victoria and South Australia) components.

6 This treatment is analogous to the treatment of owner-occupied houses in the ABS input-output tables.

7 Although it is possible in the MONASH models to specify forward-looking (model-consistent) expectations for rates of return, static expectations are assumed in most applications.

required rate of return for the sector. The higher the rate of growth of a sector's capital stock (relative to its trend growth rate), the higher is the rate of return required by investors assumed to be (relative to the normal rate of return on investment in the sector). Similarly, if the rate of growth of a sector's capital stock declines relative to its trend growth rate, investors are assumed to receive a rate of return that is below the normal rate. The percentage growth rate of a sector's capital stock is bounded by (the negative of) its depreciation rate and a maximum rate set at 6 *plus* its trend growth rate[8]

- The labour market is not assumed to clear instantaneously. Labour-market shocks affect the level of unemployment in the short run but over time real wage rates adjust to eliminate the short-run unemployment effects
- Dynamic mechanisms track the accumulation of the net foreign liabilities and the net liabilities of the nine governments distinguished in the model

2.3 Modelling approach: linking Frontier Economics' electricity models and MMRF-Green

The effects of emissions trading are modelled using *WHIRLYGIG* interactively with MMRF-GREEN. *WHIRLYGIG* provides more detail for the electricity sector than is available in MMRF-GREEN. The added electricity-sector detail is warranted because the sector generates a large share of aggregate greenhouse-gas emissions.

2.3.1 Reference case

The first step is to generate a Reference Case that is consistent between the two models. This comprises annual time paths for exogenous and endogenous variables over the period 2008 to 2030.

Table 3 illustrates the structure of the computation: key exogenous inputs are shown in black text in the middle column of the table. They include scenarios on macroeconomic variables and world prices; these are taken from specialist forecasting agencies. Also included are assumptions about technological and preference changes; for most sectors, these are extrapolations of trends observed in historical simulations[9] with the CoPS models but for electricity generation they

8 For details, see Dixon and Rimmer (2002), especially Section 21.1.

9 For details about how historical, forecast and policy simulations are run in the MONASH models, see Dixon and Rimmer (2002), especially Section 2.2.

are implied by detailed assumptions about the characteristics of existing and potential new generating technologies and by the program of capacity expansion that emerges from the electricity-sector modelling[10]. The outputs of the reference-case modelling (shown in the final column of Table 3) are projections of annual time paths for numerous structural variables (e.g. outputs and employment by sector, prices, domestic usage, exports and imports by commodity), all with regional dimensions.

Of particular interest are projections for the electricity sector. These include: electricity demand by region; electricity output and fuel usage by generation technology and region; and wholesale electricity prices by region. These are endogenous variables for the modelling system as a whole but for the individual models comprising the system they are sometimes exogenous and sometimes endogenous. To emphasise this, the relevant variables have been colour-coded in Table 3. Electricity demand by region (green-coded) is endogenous in MMRF-GREEN but exogenous in *WHIRLYGIG*. On the other hand, electricity output and fuel usage, wholesale electricity prices and the carbon price (red-coded in the table) are endogenous in *WHIRLYGIG* but exogenous in MMRF-GREEN.

As in most previous studies combining MMRF-GREEN with a detailed electricity-sector model, investment in electricity generation is determined by MMRF-GREEN rather than by the detailed electricity-sector model. There is no formal process for reconciling the MMRF-GREEN investment projections with the more detailed investment projections produced by *WHIRLYGIG*. The assumption in MMRF-GREEN is that the generators' capital stocks adjust annually to keep their rates of return fixed. Rates of return for the generating technologies (at given capacity) are tied down by projections for the wholesale price of electricity and technology-specific fuel costs supplied by the electricity-sector model, together with MMRF-GREEN's own projections of the costs of constructing plant for the generating technologies[11]. Technologies that would otherwise be experiencing increases (decreases) in their rates of return expand (contract) their capital stocks to keep their rates of return fixed. In MMRF-GREEN, projections of investment are reconciled with projections of fuel usage, fuel prices, electricity output and the wholesale electricity price by an endogenous shift in capital intensity.

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10 Formally, projections of output, fuel usage and emissions are all supplied to MMRF-GREEN by *WHIRLYGIG*, as are projections of the wholesale electricity price. In MMRF-GREEN, this information is sufficient to imply fuel intensity, emissions intensity and capital intensity for the generating technologies.

11 In MMRF-GREEN, construction costs are determined by the prices of the main capital-goods inputs.

Table 3: Assignment of variables in the base case

Model	Key exogenous variables	Key endogenous variables
MMRF-GREEN	Macroeconomic variables World prices (including fuels) Oil and gas supplies Technological and preference changes outside electricity generation Electricity output and fuel usage by technology and region Wholesale electricity prices by region Carbon price	Numerous structural variables (sector by region) Electricity demand by region
whirlygig electricity investment model	Electricity demand by region Fuel prices Oil and gas supplies Technological specifications for existing and potential new generators	Electricity output and fuel usage by technology and region Wholesale electricity prices by region Carbon price

2.3.2 CPRS policy simulations

Policy simulations (in this case, simulations of the effects of the CPRS) are conducted as deviations from the reference case. For whatever scheme is to be simulated, an assumption is made about the demand path for electricity[12] and the path of emissions reductions that will be required from the electricity sector[13]. Given that international permits will be accepted in the proposed CPRS, it is assumed, as discussed above, that the Australian electricity sector will be a price taker in the global carbon market and, therefore, the same carbon price assumptions used by the Commonwealth Treasury in their analysis of the CPRS is used in this study. Then, in *WHIRLYGIG*, revised projections for electricity output and investment, fuel usage, fuel prices, and wholesale electricity prices are computed after taking into account the assumed international carbon price.

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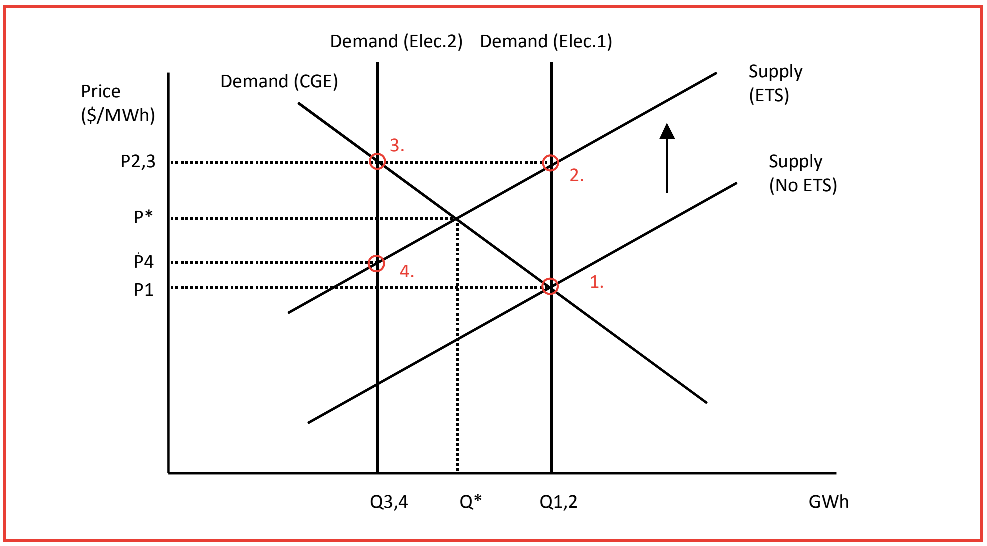
12 Noting that the elasticity of demand for electricity is likely to be low, a reasonable starting assumption would be that demand is the same as in the reference case.

13 A default assumption is that electricity provides the same share of the aggregate required reduction in emissions as it accounts for in the level of emissions in the reference case.

The carbon prices and revised electricity-sector projections are then fed into an MMRF-GREEN policy simulation. Among the variables projected by MMRF-GREEN in this simulation is the demand for electricity. It is necessary to check that the demand projection is consistent with the demand assumption that underlies the electricity-sector modelling. Another output of the MMRF-GREEN policy simulation is non-electricity emissions. It will be necessary to check that together with electricity-sector emissions, these are consistent with the overall emissions cap required under the emissions-trading policy. To eliminate any inconsistencies in electricity demand or the emissions cap, iteration between MMRF-GREEN and *WHIRLYGIG* may be required.

Figure 6 illustrates a case in which iteration leads to convergence with respect to electricity demand. "Demand (CGE)" is the electricity-demand schedule implicit in MMRF-GREEN. The supply schedules are the schedules implied by *WHIRLYGIG*, without and with emissions trading. "Demand (Elec. 1)" is the inelastic demand schedule initially assumed in the electricity-market modelling[14]. With this demand schedule, *WHIRLYGIG* projects a wholesale price for electricity of P2. At this price, MMRF projects a lower level of demand (Q3), which implies a lower price (P4) in the electricity-market model. Continuing this iterative process, the models would converge to the with-CPRS equilibrium (P*,Q*). Given that the elasticity of demand for electricity in the CGE model is low, the demand schedule in Figure 6 will be steep relative to the supply schedule and convergence is rapid.

Figure 6: Illustrative iteration



14 Note that this is the equilibrium quantity demanded without emissions trading.

As noted above, the MMRF simulations assume that the capital stock in electricity generation continues to earn a constant rate of return: if the introduction of the CPRS would otherwise reduce the return on capital, the model would respond by reducing the capital stock to maintain the required return on capital. A limitation of this approach is that it may underestimate the structural adjustment costs of the CPRS if there are significant amounts of sunk capital that cannot be adjusted to maintain the required rate of return. As an example, the CPRS may encourage the early retirement of emissions intensive plant in the electricity generation sector: this effectively reflects accelerated depreciation of those assets. These costs are not estimated or included in any of the reported figures.

3 Modelling results: CGE

In this section, the modelled economy-wide effects of imposing the CPRS scenarios are modelled. The results are from an MMRF-GREEN simulation of the CPRS, though it is the Frontier Economics model that supplies details of the effects of the CPRS on the electricity sector.

3.1 Summary results

The CPRS results in a reduction in real GDP and real wages relative to the Reference Case growth. Real wages fall to maintain the model 'closure rule' that shocks do not affect the unemployment rate in the long term – that is, employment effects of the CPRS are fairly moderate in the long term, by assumption. There is also significant structural adjustment from emissions intensive industry to manufacturing and services.

The cumulative dollar reduction in real GDP[15] over 20 years (2007 prices, discounted at 4%) is $121B in Scenario 1 (CPRS), $108B in Scenario 2 and $72B in Scenario 3 (CPRS-Intensity) – see Figure 7 and Figure 8. In all cases, this represents a reduction relative to the future Reference Case levels as opposed to a decline on current levels. In other words, the results point toward slower growth as distinct from an actual decline in production. Nevertheless, this difference in costs warrants careful consideration of scheme design, given that the overall cost to the economy can be reduced by 41% while delivering a more stringent emissions reduction target.

Neither the Reference Case nor the various CPRS cases take account of potential climate change damage and resulting effects on GDP. The underlying presumption is that an ETS is necessary to prevent more costly climate change damage: instead the analysis focuses on the relative costs of the different scheme designs to achieve the same (or greater) level of reduction in greenhouse gases.

The direct cost of abatement contributes to the reduction in real GDP in all scenarios; this cost is similar in each scenario[16]. However, this represents only a proportion of the overall economy-wide costs. Other costs stem from a number

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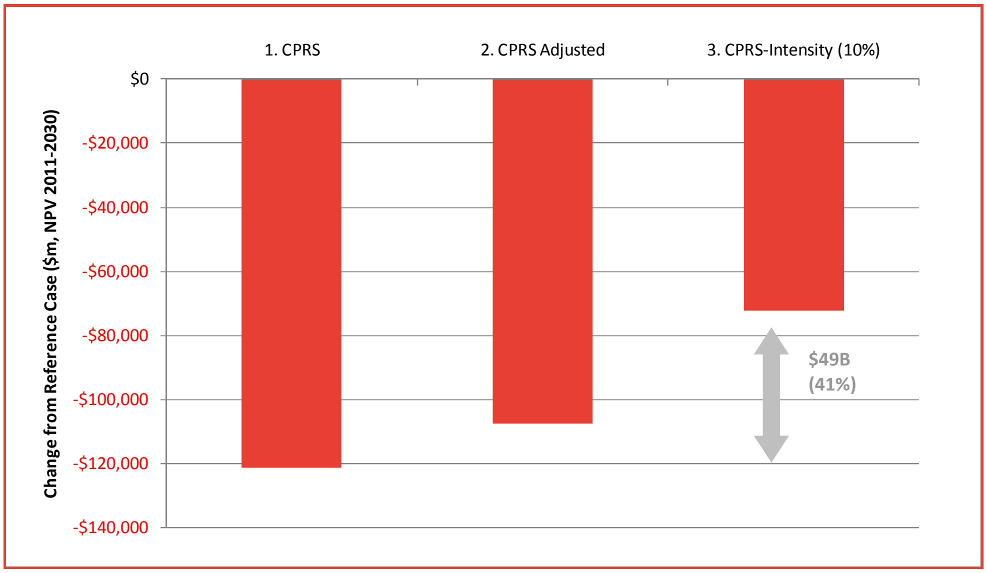
15 The Commonwealth Treasury uses GNP (rather than GDP) as an indicator of welfare changes. GNP accounts for that part of domestically generated income that accrues to non-residents, including that part required for the purchase of emissions permits from the international market. It also accounts for foreign generated income that accrues to domestic residents. Qualitatively, the effects on GNP are similar to the effects on GDP but GNP declines more than GDP because under all of the CPRS scenarios a substantial number of permits are imported.

16 This concept is explained in Figure 48 in Appendix 2.

of sources, primarily[17]: distortions to investment and savings decisions that can arise from introducing a new tax[18] and inefficiencies and distortions that arise from recycling revenue to finance lump sum transfers. Differences arise in the economy-wide costs for each scenario due to how costs are distributed across the economy and the resulting impacts on investment and employment incentives. The overall cost of the scheme to the economy is reduced when the shielding measures are increased (Scenario 2. CPRS Adjusted); this is applying the same emissions target, with negligible change to projected domestic emissions. Adopting further changes to the scheme design (by replacing indirect shielding measures with an intensity target for the electricity sector) produces even greater savings in terms of economy–wide GDP costs (Scenario 3. CPRS-Intensity). Cumulative GDP costs are reduced by 41%, even after accounting for the economic cost of doubling the Government's unconditional 5% abatement target to 10%, for the same global policy conditions. This is a material reduction in overall costs to the economy resulting from the proposed change to scheme design.

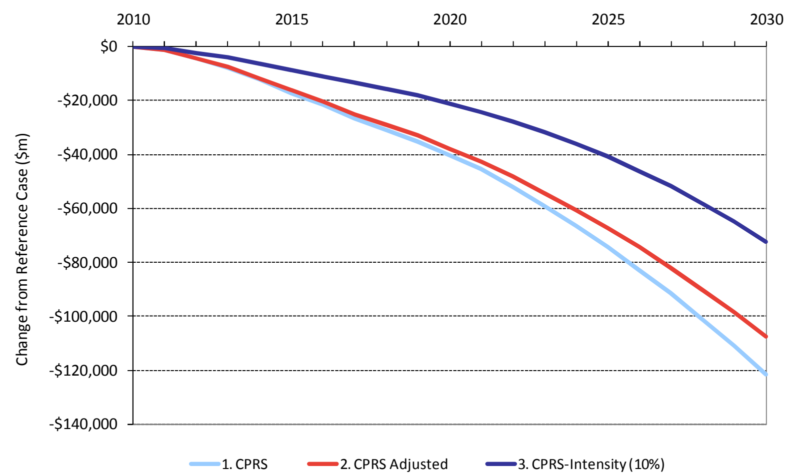
Figure 7: Cumulative GDP comparison



17 See for example Carolyn Fischer and Alan K. Fox (2009) "Combining rebates with carbon taxes: Optimal strategies for coping with emissions leakage and tax interactions", *Resources For the Future Discussion Paper 09-12,* May.

18 In principle, taxing an externality such as carbon emissions does not have the distorting effects on resource allocation that standard taxes on income and investment have. However, that desirable property of externality taxes is in this case attenuated by the risk of leakage and competitiveness loss that pricing emissions can have absent a comprehensive global agreement. In these circumstances, pricing carbon does cause a distortion in the sense that it can cause a reallocation of production away from the pattern governed by long term comparative advantage without any substantial reduction in global emissions.

Figure 8: Cumulative GDP comparison over time



The economic costs are lower in Scenarios 2 and 3 (compared with Scenario 1). Because the return to capital is fixed in the long run by the world capital market, these costs are borne by labour in the modelling. As noted above, the labour-market assumption is that wages adjust downwards (with a lag) to prevent these costs from increasing unemployment. Because the costs are lower in Scenarios 2 and 3 than in Scenario 1, the required reduction in wage rates is smaller. This means that producers' demand for capital, and hence investment and real GDP, are higher.

In scenario 3, the need for lump sum transfers to households and for payments to shield EITEIs from the indirect effects of the CPRS is largely obviated by the lower electricity prices. In essence, this approach reflects a more productive use of emissions permits relative to that proposed and modelled by the Government, which effectively relies on significant increases in overall tax churn and revenue recycling through lump-sum transfers. This unnecessarily increases the broader economic cost of the CPRS, in particular the distorting effects on investment.

Given that the MMRF model is set-up to prevent shocks affecting employment in the long run (as did the Commonwealth's modelling), the aggregate employment effects are, naturally, moderate. The more important modelling indicator when assessing employment effects is the change in real wage rate, which in the face of rising business costs (such as a carbon price) tends to decline relative to its reference-case level to preserve employment. This employment closure rule also causes domestic producers to reduce their capital/labour ratios; achieved by allowing capital stocks to fall.

The employment closure rule for the overall economy does not mask the structural effects of the CPRS - that is, the changes to the fortunes of particular sectors and regions. While the overall employment effects are moderate (by assumption) certain sectors and regions bear the brunt of the structural adjustment costs of the CPRS. These need to be well understood and managed if a CPRS is to enjoy broad community and ongoing political support – which are prerequisites to ensure investors respond efficiently to the incentives created by the scheme. It is not entirely clear how the CPRS costs (on households, small businesses and regions) relate to the proposed assistance measures (such as household assistance and the Climate Change Action Fund). The current arrangements rely heavily on Government discretion to determine appropriate levels and the distribution of assistance. By contrast, the proposed allocation of permits under Scenario 3 is a more direct and transparent method of managing the transition costs, since it ultimately distributes the assistance to those who will be most affected.

3.2 Macroeconomic overview

In developing the Reference Case, the likely effects of the current global financial and economic crisis are included. This crisis was not anticipated when the modelling work for the Commonwealth's CPRS White Paper and the Garnaut Review was completed. Table 4 shows results of the CPRS Scenarios for some key variables. The results are reported as deviations of the values of variables from their Reference-Case values.

Table 4: Summary of results

Change from Reference Case (% except where shown)	Long Run (2030)			Medium Run (2020)		
	1 CPRS	2. CPRS adjusted	3. CPRS Intensity (10%)	1 CPRS	2. CPRS adjusted	3. CPRS Intensity (10%)
Supply variables						
Real GDP	-1.25	-1.07	-0.87	-0.52	-0.50	-0.30
Real GNP	-1.96	-1.91	-1.77	-0.75	-0.76	-0.63
Capital stock	-2.01	-1.66	-1.26	-0.66	-0.57	-0.20
Domestic emissions	-26%	-23%	-23%	-15%	-15%	-13%
Total emissions	-44%	-44%	-46%	-25%	-25%	-28%
Employment (persons)	-37,000	-28,000	-29,000	-23,000	-22,000	-20,000
Real wage	-3.06	-2.60	-2.06	-1.63	-1.53	-0.88
Trade variables						
Foreign permit cost (% of GDP)	0.36	0.42	0.46	0.15	0.17	0.23
Terms of trade	-1.40	-1.53	-1.67	-0.35	-0.36	-0.51
Real depreciation	2.94	2.51	2.54	0.80	0.71	0.79
Export volume	0.32	1.18	1.60	-0.28	-0.09	0.47
Import volume	-2.33	-2.03	-1.87	-1.10	-1.04	-0.83
Demand variables						
Real investment	-3.9	-3.3	-2.9	-1.8	-1.7	-1.1
Real consumption	-1.4	-1.5	-1.5	-0.4	-0.4	-0.5
Export volumes						
Coal	-12.3	-13.2	-7.4	-2.9	-3.1	0.4
Aluminium	-5.1	6.8	6.3	-10.5	-6.4	-4.1
Meat products	3.2	1.6	0.3	-4.1	-2.1	-1.8
Other mfg	7.6	5.8	5.7	1.3	0.9	0.8
Business services	7.8	4.7	3.9	1.1	0.5	-0.1
Accom.& hotels	7.6	4.5	3.7	-3.3	-3.7	-3.8

Supply variables

The effects of the CPRS on the growth of real GDP and aggregate employment are adverse, though contained by the shielding arrangements included in the CPRS package and the significant degree of labour-market flexibility that is assumed in the model. The macroeconomic effects would be more serious if wage adjustment was resisted or if investors responded to uncertainty about the policy by requiring higher rates of return on investment.

The CPRS policy (Scenario 1) reduces total growth in real GDP by 0.52% (2020) and 1.25% (2030). Extending the shielding arrangements as in the CPRS Adjusted policy (Scenario 2) improves this somewhat, while the CPRS Intensity policy with output-based allocation of permits to the electricity sector (Scenario 3) restricts growth even less, by 0.30% (2020) and 0.87% (2030).

In terms of aggregate employment numbers, the CPRS reduces growth by 23,000 jobs (2020) and 37,000 (2030). This compares with the CPRS Intensity scenario, which reduces employment growth by 20,000 (2020) and 29,000 (2030). In aggregate, this reflects a slowing of growth relative to the Reference Case as opposed to an absolute decline (relative to current levels). However, this aggregate amount does not reflect the structural transition of employment from some sectors/regions to others – a larger number of jobs lost in some regions (and gained elsewhere) would generate greater upheaval than indicated by this figure. In some regions this leads to a absolute decline in employment relative to current levels as opposed to a slowing of growth in other regions. This is discussed in later sections.

Two factors limit the extent to which the CPRS policy generates adverse macroeconomic effects: the shielding arrangements included in the proposed policy package[19] and the assumptions about economic flexibility that are built into the model. In particular, the model assumes that real wage rates are sufficiently flexible to prevent the policy shock from generating an increase in unemployment in the long run. The CPRS policy reduces growth in real wages over the period 2007-20 by 1.63% (3.06% to 2030). Short-run reductions in employment are generated, however, because wages are assumed to adjust to shocks with a lag. Because the policy reduces real-wage growth, it increases the labour intensity of production and reduces investment. The CPRS Intensity policy reduces the real wage rate by less, and hence the reduction in investment is also less in that scenario.

The CPRS would have more dramatically adverse macroeconomic effects if it led to a sharper reduction in the usage of labour and/or capital. One possibility is that uncertainty about the policy could lead investors to demand sharply higher

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19 For this purpose, we measure the effects of the CPRS policy on output and employment as percentage deviations between the levels that would eventuate if the policy is imposed and the levels that eventuate in the no-CPRS-policy base case.

rates of return on capital than would have been the case in the absence of the policy. This is especially likely if investors regard the details of the policy package as likely to be changed in future as the political environment changes. The results in this report do not include this potential scenario. Another possibility is that the labour market is insufficiently flexible to prevent the negative shock from causing reductions in employment beyond the short run.

The fall in real GDP in Table 4 is greater than can be explained by the small fall in employment and the reduction in the capital stock that is implied by the fall in investment. The additional contribution to the fall in real GDP comes from the resource cost to producers of emissions-saving changes in production technology. The charge on emissions that is implied by the introduction of the CPRS policy induces producers to implement these changes. The model assumes that producers reduce emissions up to the point at which their marginal abatement cost is equal to the emissions charge. Abatement costs are modelled as increases in the amount of all inputs required per unit output.

The real trade balance

The assumption of global action results in a deterioration in the terms of trade and a need to generate foreign income to pay for the purchase of emissions permits from the international market. All else being equal, the purchase of foreign permits puts downward pressure on the currency ('real depreciation' is positive). This is partially offset by the resulting improvement in competitiveness of export goods (which increase) and the decline in competitiveness of imports (which decline). Even though foreign permit costs are higher in Scenario 3 relative to Scenario 1 (which enforces a lesser abatement task), the depreciation in the exchange rate is less in the long run because exports volumes are more sustained in Scenario 3 as a result of higher investment and production of goods in which Australia has a comparative advantage. This effect more than offsets the higher cost of foreign permit purchases in Scenario 3.

Domestic absorption

Because the terms of trade are weaker than the Reference Case levels under all CPRS scenarios, domestic absorption (consumption and investment) must fall relative to GDP. In the third block of variables (*Demand variables*) in Table 4, investment and consumption both decline further in Scenarios 1 and 2 (relative to the Reference Case) than they do in Scenario 3, with investment accounting for most of the difference.

Exports

In all CPRS scenarios there is a significant shift in the structure of the economy's export bundle away from emissions-intensive sectors toward services and manufacturing sectors. On the one hand, the decrease in competiveness in EITE products more than outweighs any benefits from the depreciation of the exchange rate, resulting in declining exports in those sectors. On the other hand, less emissions intensive exports benefit from the currency depreciation and expand as a result.

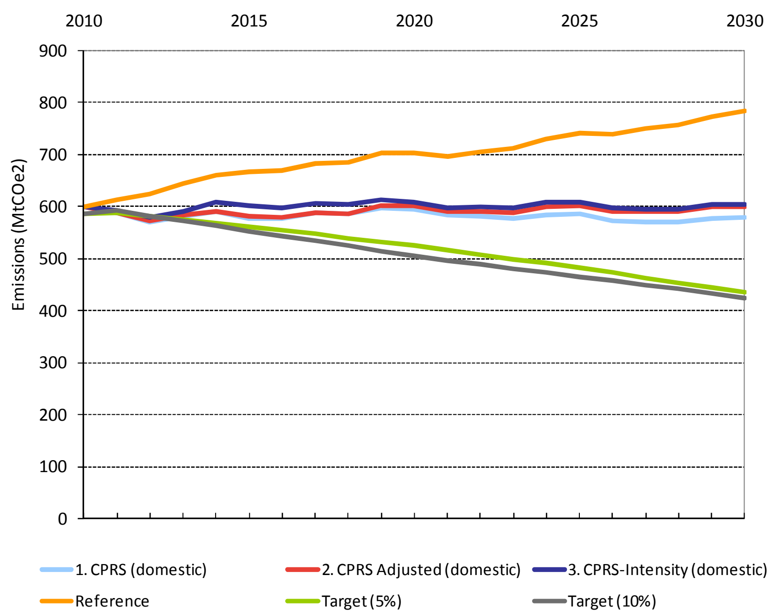
The difference between the scenarios is that Scenario 1 results in a greater structural shift, whereby the emissions intensive sectors contract further (and more rapidly) and non-emissions intensive sectors expand further, relative to Scenarios 2 and 3. It is worth noting, however, that while ***exports*** for some less emissions intensive sectors expand less in Scenario 3, this is mainly due to the lower depreciation of the currency. Total output from Non-EITE sectors such as Business Services and Construction contracts less in Scenario 3 than compared with Scenario 1 due to increased real investment (as reported in Section 3.5).

3.3 Emissions

The key objective of the CPRS is to reduce the level of greenhouse gas emissions both domestically and globally.

Figure 9 presents the projected domestic emissions for each scenario relative to the Reference Case emissions and the 5% and 10% reduction targets. The domestic emissions in each scenario are very similar as a result of global carbon prices (which are largely beyond Australia's control), though Scenario 3 involves lower global emissions due to the purchase of a greater volume of imports.

Figure 9: Emissions comparison



The Reference Case emissions in 2020 are lower than those projected by the Commonwealth Treasury modelling. This reflects more recent growth projections allowing for the effects of the global financial crisis.

The CPRS Intensity scheme includes a firm target; any increase in allocation to the electricity sector (as a result of higher levels of generation) or EITEI requires a reduction in permits auctioned by Government or an increase in imports of international permits to meet the target. This does not increase costs to, or require further emissions cuts from, other sectors because, under all variants of proposed design, international permit trade means that domestic emissions are not limited to the permits issued by the Australian Government. Liable parties are indifferent as to the source of permits. This is fully accounted for in the modelling.

Some may argue that dampening the electricity price signal (as per Scenario 3) will materially reduce potential abatement on the demand-side (ie due to a response to higher prices). However the results indicate that in practice this is non-material, since greater demand-side abatement can be achieved through alternate measures to directly encourage energy efficiency (as opposed to a blunt price signal).

Part of the confusion may stem from the consultant reports that contributed to the Commonwealth Treasury modelling, which incorrectly attributed far greater weight to demand-side abatement in electricity due to a simple calculation error.[20]

MMA attribute approximately 120Mt of abatement to the reduction in electricity demand in 2050.[21] This estimate is based on a reduction in electricity consumption (relative to the Reference Case) of approximately 120TWh[22]. This implies an emissions intensity of generation avoided in 2050 of 1 tCO2/MWh – in other words, a reduction in demand of 1MWh reduces emissions by 1tCO2. This is internally inconsistent, since the same modelling results report the emissions intensity of generation in 2050 at 0.1tCO2/MWh by 2050. This later result is intuitively correct, since production of electricity is cleaner as a result of the scheme. Hence, the estimate of emissions avoided through demand side abatement is incorrect and should be one-tenth of what is concluded (12Mt rather than 120Mt), and the difference (90%) should be attributed to the improvement in emissions intensity of production.

3.4 Regional effects

The emissions intensity of production processes varies greatly between sectors, as does the ability of sectors to pass on cost increases to their customers. Hence, there is a commensurate variation in the effects of the CPRS across sectors. Because individual geographic regions within the national economy can be much more heavily exposed to adversely affected sectors than is the national economy overall, the effects of the CPRS on output and employment in regional economies can be much more dramatic that its effect on GDP or aggregate employment.

The adoption of CPRS involves considerable structural change to the economy relative to its Reference Case profile. To assess whether the structural changes required under the CPRS policies is likely to result in structural adjustment problems, it is important to consider not only how the policies affect sectoral and regional output, employment, exports etc relative to the Reference Case but also what the prospects of the sectors and regions are in the Reference Case. For example, an adverse implication of the CPRS policy for some industry or region that is already growing strongly in the Reference Case is likely to pose much less of an adjustment problem than an adverse implication for a sector or region that already has poor prospects in the Reference Case.

In the first case, the policy may just mean that the sector or region would grow less strongly than it does in the Reference Case while in the second case the

20 MMA, Impacts of the Carbon Pollution Reduction Scheme on Australia's Electricity Markets (Dec 2008)

21 Exec Figure 2: Sources of Abatement;

22 Table 3.2: electricity demand falls from 512TWh (Reference) to 392TWh (CPRS5)

policy may mean that a sector or region that is already declining in the reference case would decline further or that a sector or region that is experiencing only slow growth in the reference case would experience even slower growth or may even decline.

State level effects

The effects of the CPRS on regional gross product (GRP) for the States and Territories, together with the GDP effect, are shown in Table 5. The effects of the CPRS on the largest, most diversified regions (NSW and Victoria) are similar to the effect on GDP (national). The most severely affected region is Queensland, reflecting its dependence on emissions-intensive mineral and agricultural sectors. A particular factor is the decline in the coal export price resulting from the adoption of emissions-reduction policies in the rest of the world. Tasmania, NT, and South Australia are the regions least affected by the ETS. Tasmania is especially favoured by its availability of hydroelectric power. In Scenario 3, the adverse effect on most regions is less severe, due mainly to the increase in real investment and consequential improvement in GDP.

Table 5: Regional results

Change from Reference Case (% except where shown)	Long Run (2030)			Short Run (2020)		
	1 CPRS	2. CPRS adjusted	3. CPRS Intensity	1 CPRS	2. CPRS adjusted	3. CPRS Intensity
NSW	-1.29	-1.22	-0.87	-0.65	-0.70	-0.39
VIC	-0.87	-0.92	-0.80	-0.54	-0.50	-0.44
QLD	-2.16	-1.82	-1.18	-0.71	-0.69	-0.12
SA	-0.72	-0.76	-0.88	-0.52	-0.62	-0.57
WA	-1.35	-0.81	-1.21	-0.15	0.03	-0.21
TAS	2.94	3.27	3.34	0.38	0.43	0.60
NT	0.14	1.47	0.91	0.30	0.54	0.18
ACT	-1.01	-1.23	-1.15	-0.55	-0.61	-0.54
Australia	-1.25	-1.07	-0.87	-0.52	-0.50	-0.30

Sub-state regional effects

In this section we report projections of the CPRS policies on sub-state statistical divisions. These projections depend on the sectoral composition of gross value added in the regions. They assume, for example, that poor prospects for particular sectors under an ETS will have implications for regional prospects that are proportional to the shares of the sector in the gross value added of the regions. The projection method does not use detailed information about the likely location of new forms of renewable energy generation (wind farms, for example) that might expand substantially under the CPRS.

In terms of gross regional production, most regions are negatively affected by all schemes due to the resource costs involved in achieving emissions abatement. Again, this is excluding the estimated benefit of avoided costs imposed by climate change damages if global climate change policies were not implemented.

The effects are most pronounced where EITEI are most important to regional economies. Figure 10 shows the regions that are most affected (positively or negatively) by the CPRS. Scenario 3 tends to have less severe impacts on the regions most heavily affected by the CPRS, including Fitzroy, Mackay, Gippsland, Hunter, Pilbara and Kimberley. Offsetting this, Scenario 3 dampens the expected improvement in growth in Perth that is projected to result from the CPRS.

Figure 10: Sub-state regional effect:% change in GRP relative to Reference (2020)

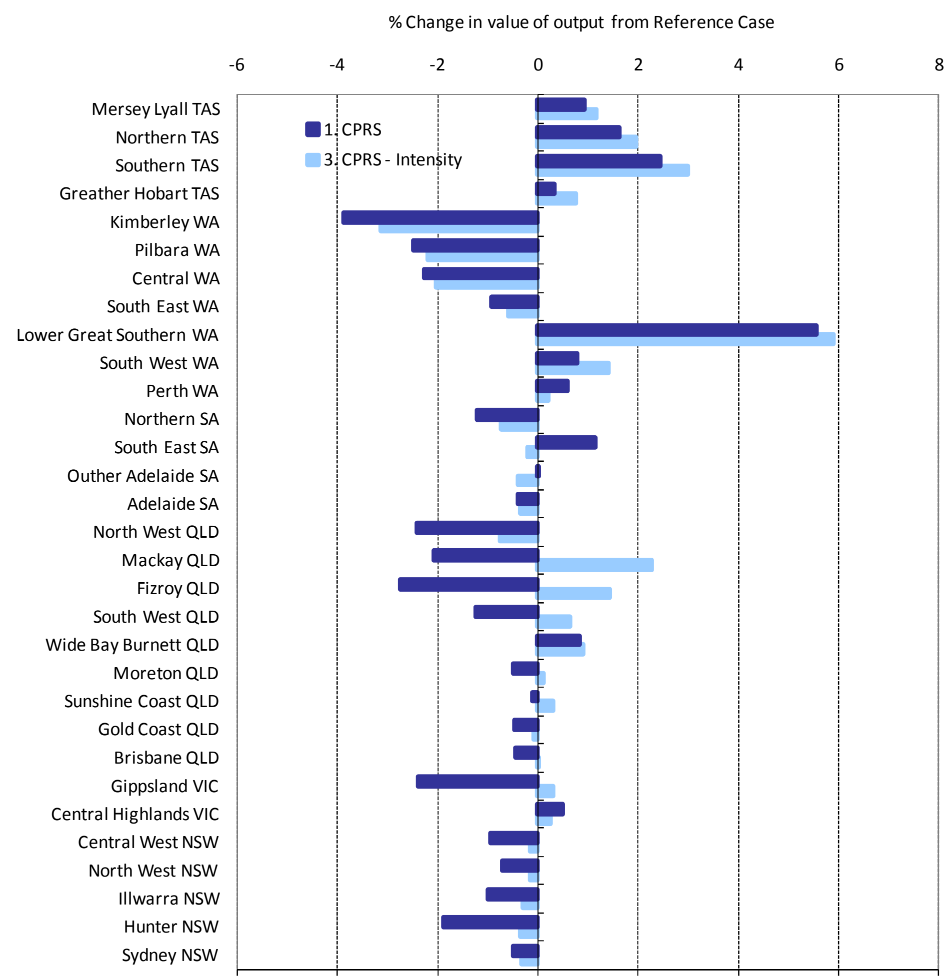
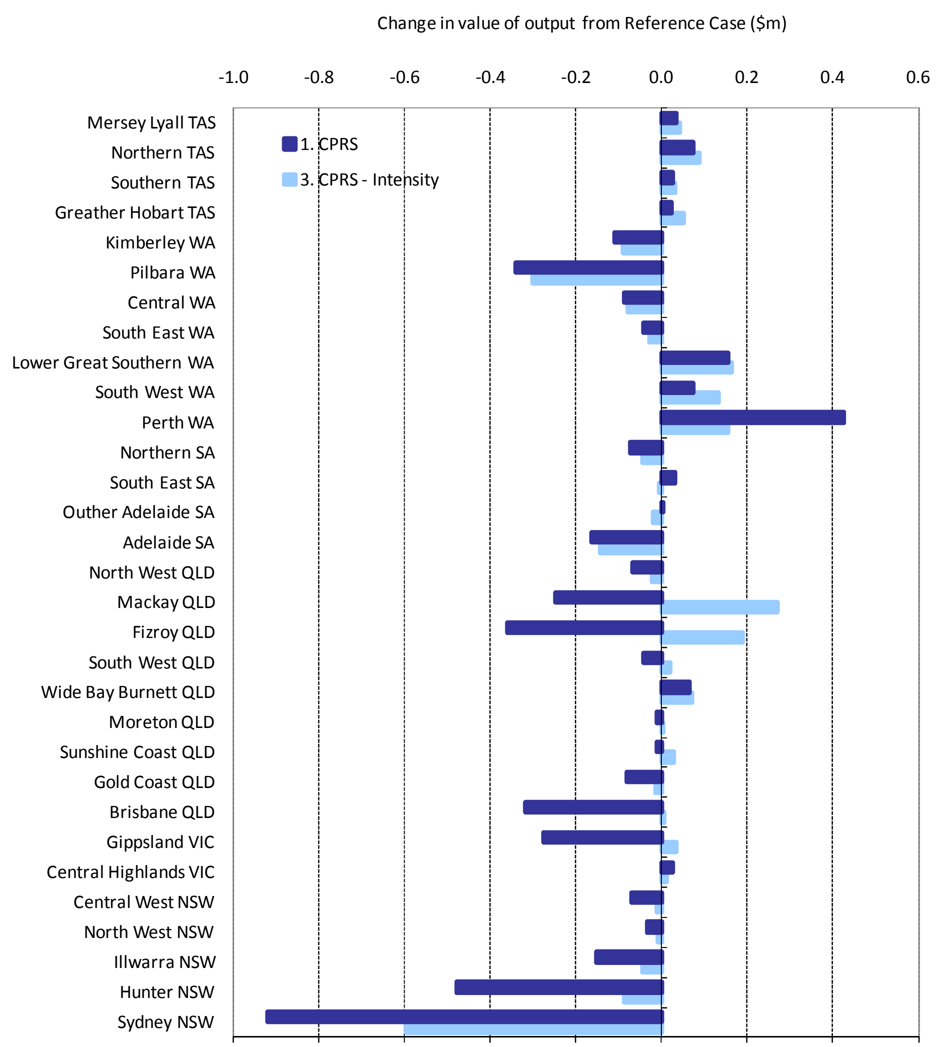


Figure 11 shows the same information in absolute terms: in this chart, the effects in the capital cities are more pronounced due to their larger local economies.

Figure 11: Sub-state regional effect:$ change in GRP relative to Reference (2020)



Regional employment

As discussed above, aggregate employment figures do not reflect the full extent of structural adjustment occurring in the economy. Aggregate numbers do not reflect the amount of transition from regions to cities, for example.

The charts below provide some indication of the relative extent of structural adjustment required to maintain the assumption of full employment in each policy scenario. In each chart, the Reference Case growth prospects are shown on the horizontal axis: regions further to the right are expected to grow more rapidly than regions to the left in the absence of the CPRS. Regions in the negative area are expected to contract:

- the relative (percentage) effects of the CPRS relative to the Reference Case are shown on the vertical axis: regions further to the bottom are expected to be more adversely affected by the CPRS

- the size of the dots represents the *absolute* difference between the Reference Case and the CPRS – larger regions will show a larger impact on total employment for a given percentage change

Combining these factors, markers to the bottom-left of the chart are of most concern since they are expected to be most adversely affected by the CPRS. Regions toward the top-right are least affected, since this indicates strong growth in the Reference Case and minimal CPRS effects.

Figure 12 presents the effects of the CPRS as proposed (based on regions of concern, excluding regions not adversely affected). All markers to the left of the Hunter, NSW, represent regions where the effects of the CPRS more than offset projected growth in the reference case, pointing to actual contraction as opposed to slowing of growth.

Figure 12: CPRS regional effect:% change in employment (2020)

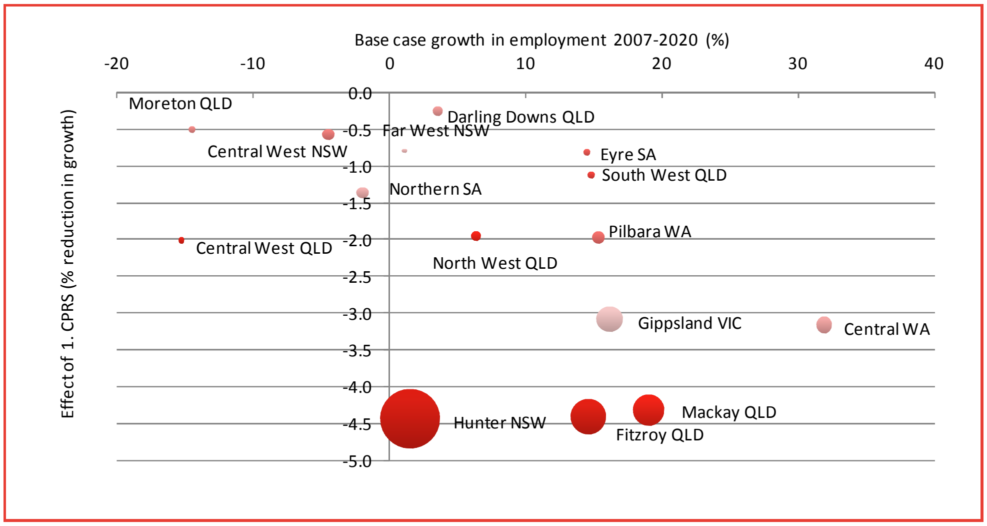


Figure 13 presents the results for the CPRS-Intensity scenario. The disappearance of some regions from the chart (which are present in the chart above) means that the intensity modification to the CPRS means that these regions are no worse off than the Reference Case. Regions that are still adversely affected are generally better off under the CPRS-Intensity scheme than under the standard CPRS scheme, as indicated by the relative shift upward and the shrinking of the red markers size.

Figure 13: CPRS-Intensity regional effect:% change in employment (2020)

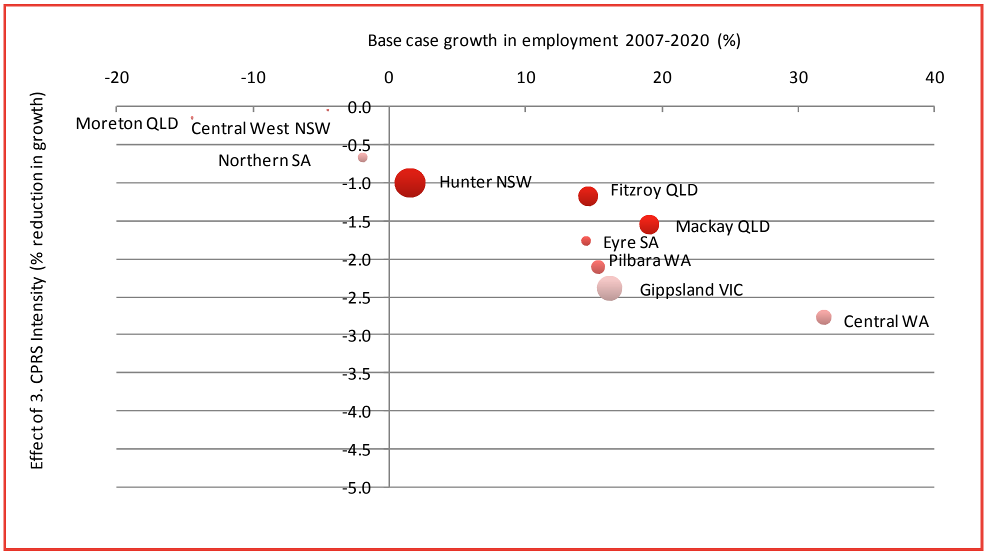
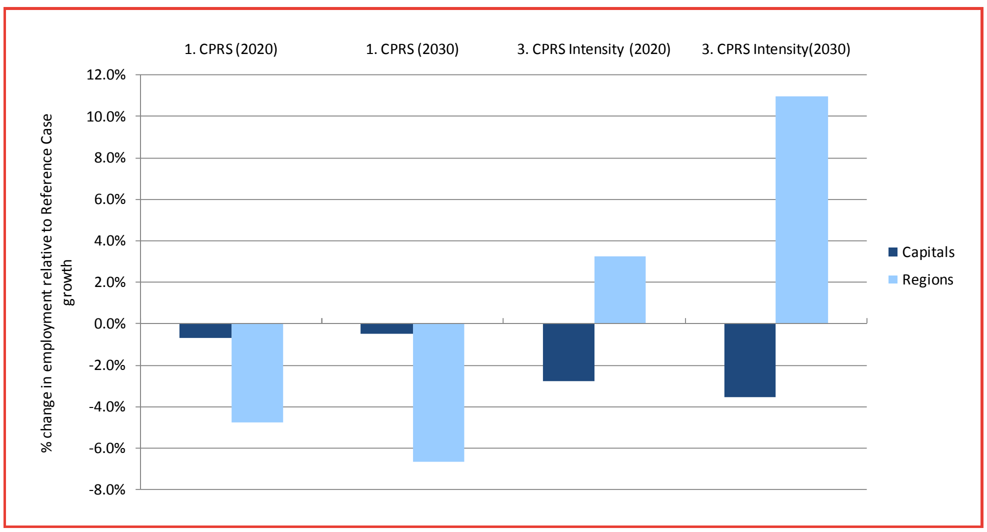


Figure 14 presents the relative effect of each policy alternative on employment growth. The vertical axis represents the impact of the respective CPRS policy on employment as a percentage of the Reference Case employment growth in each region. The CPRS, as proposed by the Government, has greater relative impact on regional employment growth than on the capitals; in contrast, the CPRS-Intensity has a larger impact on the capitals but a lesser impact on regional growth. To place this in context, reference case employment growth in the capitals is projected to be 16% (2020) to 30% (2030), while in the regional areas this is 9% (2020) to 11% (2030).

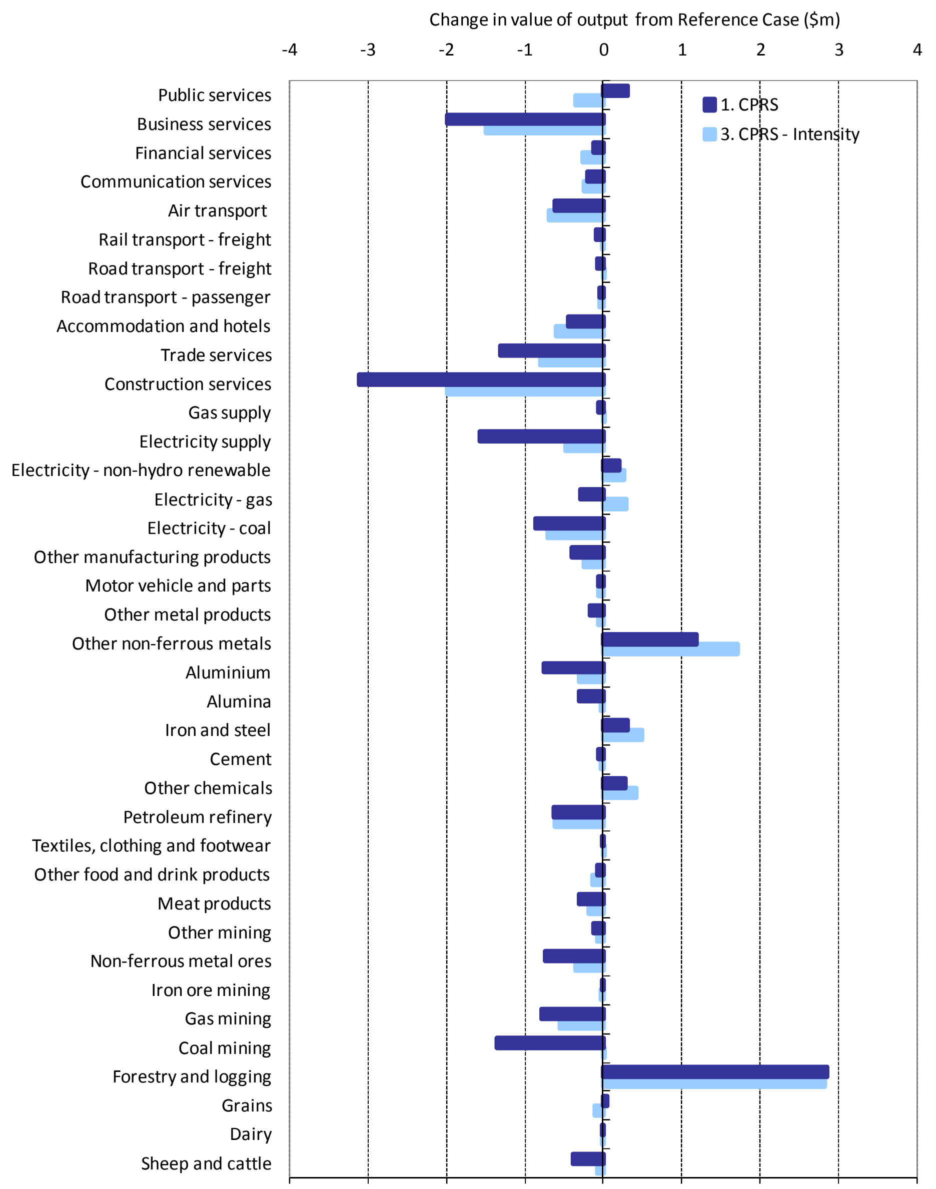
Figure 14: Employment effects by policy: capitals versus regions



3.5 Sectoral effects

Figure 15 compares the effects on industry output of both the CPRS and the CPRS-Intensity (each relative to the Reference Case, in year 2020). Scenario 3 tends to have less severe impacts on the sectors most heavily affected by the CPRS, including Construction, Business and Trade Services, Coal Mining, Electricity, Aluminium and Sheep and Cattle – i.e. sectors prominent in the regions identified above. Few sectors are substantially worse off relative to Scenario 1.

Figure 15: Sectoral effect:$ change in output relative to Reference (2020)



3.6 EITEI assistance and permit use

The "affordability" of EITEI assistance has been raised as an issue in the CPRS debate: it is argued that any increase in EITEI assistance rates represents an increase in costs to non-EITEI sectors or households.

This modelling analysis considers the implications of any increase in shielding to EITEI to put this in context. The most frequently cited benchmark of "affordability" is the proportion of permits allocated to shielding as a percent of total permits issued. However, any comparison with the US or European measures is fraught, since the structures of the respective economies are vastly different. Firstly, the Australian economy is generally more trade exposed and more energy intensive, due to its relatively smaller size and greater comparative advantage in resources. Secondly, the Australian CPRS is the only scheme that proposes to include agriculture; the majority of agriculture emissions are defined as EITEI, hence this increases the relative share of permits allocated to shielding.

Even then, just as a change in targets will not increase (or decrease) the carbon price, a change in permit allocation will not increase the ***direct*** costs to households or non-EITE businesses. The impact of any change in EITEI assistance rates will be equivalent in effect (in terms of the cost of reduced Government revenue) to a change in overall targets. The modelling suggests that these costs are negligible given the relatively small increase in permits allocated to shielding. The modelling also suggests that this is a more productive use of permits compared with the alternatives proposed/modelled by the Commonwealth Treasury. The result is highly intuitive, and reflects the fact that it is efficient to reduce the distorting effects of introducing a price on carbon (when there are leakage and competitiveness issues driven by incompleteness and asymmetries in global abatement efforts) and to meet abatement through lower cost options (i.e. importing permits).

The following charts provide transparent analysis of the source and use of emissions permits (including imports and emissions from non-covered sectors). Figure 16 presents Scenario 1 (CPRS as proposed). By way of explanation:

- The grey bars represent emissions from non-covered sectors (eg agriculture pre-2015 and some land-use change emissions)
- The orange bars represent imported permits
- The navy blue bars represent permits auctioned domestically
- The light blue bars represent permits issued by the government to EITEI

- The red bars represent permits issued by the government to electricity consumers via the intensity scheme proposed for Scenario 3 (which is not applicable in this scenario)

Permits allocated to EITEI (shielding) represents a small share of domestic emissions[23]:

- between 16-20% before agriculture is included in scheme coverage (2015)
- rising to 30% when agriculture is included, and
- falling to 0% once the shielding measures for EITEI are removed by 2024 (as proposed)

Over the 20 year modelling period, this represents 15% of all domestically issued permits. Both permits for shielding and auctioned permits increase after 2015 when agricultural emissions are assumed to be included within the scheme coverage (since most agricultural emissions are EITEI). As discussed previously, this overstates the share of emissions allocated to shielding relative to comparisons with the US and EU proposals, which exclude agriculture from coverage. Even so, permits auctioned represent some 80-100% of all permits issued domestically (85% on average over the modelling period). This significantly surpasses similar measures in the proposed US scheme (and compared with the EU).

23 Proportions are calculated as a share of permits issued domestically (excluding imports and non-covered sectors) since this is more comparable with US calculations. Even then, fundamental differences between the economies (such as size, openness and emissions intensity) must be considered in any comparison.

Figure 16: Source and allocation of permits: 1. CPRS

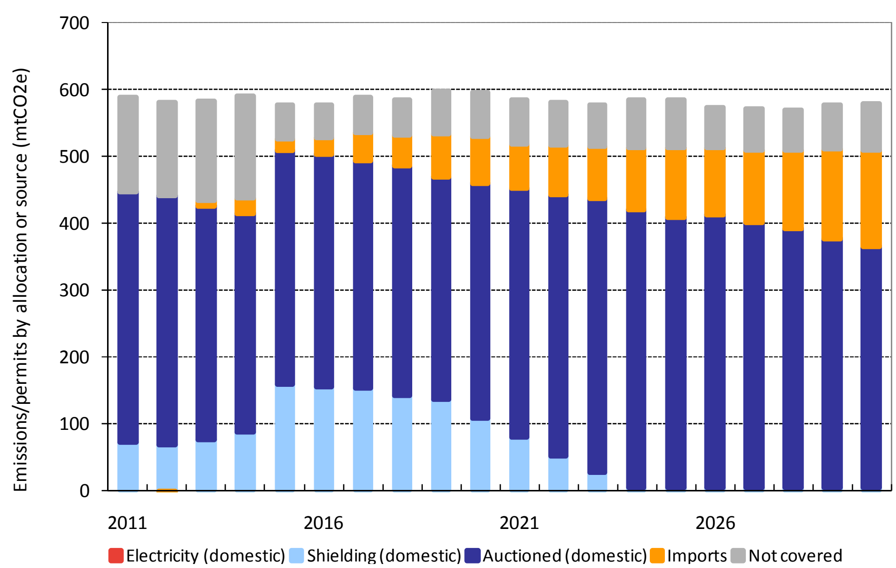


Figure 17 presents Scenario 2, CPRS Adjusted. In this Scenario, it is assumed that (a) agriculture is not included as a covered sector, and (b) the rates of shielding for EITEI are increased. These factors counteract each other such that permits allocated to shielding do not increase from 2015-2020, but do not fall to zero beyond 2024. The share of non-covered emissions increases, though the incentive to reduce the emissions intensity of production is just as strong as in Scenario 1 because agriculture is eligible to create offsets (improvements in emissions are rewarded). This means that the level of domestic abatement is not reduced, nor is the cost of achieving this abatement increased. The share of permits allocated to EITEI for shielding remains steady at 20-30% of all domestically issued permits (excluding imports), while the remaining 70-80% of permits are auctioned.

Figure 17: Source and allocation of permits: 2. CPRS Adjusted

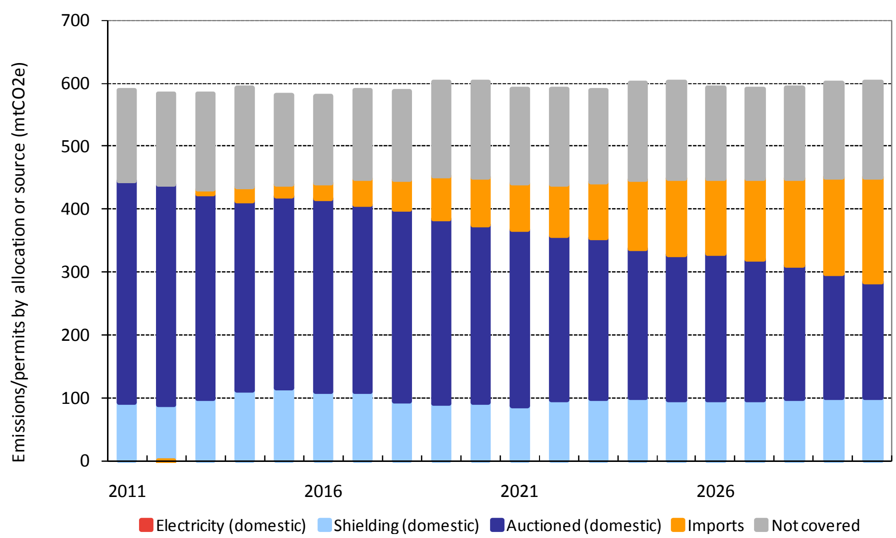
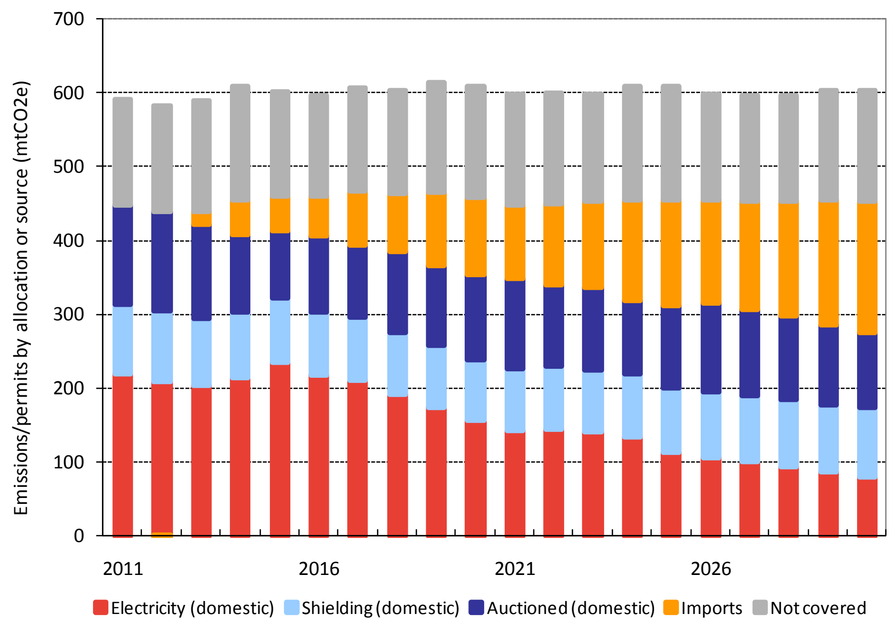


Figure 18 presents the results for Scenario 3, CPRS Intensity. This scenario replaces indirect shielding to EITEI and replaces it with a baseline allocation to the electricity sector. This will result in a more gradual increase in energy costs for all users, including households and small businesses (rather than just EITEI).

In this instance, permits auctioned still represent 31% of all permits allocated domestically, which exceeds US measures. Permits allocated to electricity emissions effectively reflect a transfer to electricity users, predominantly households and, to a lesser extent, businesses, due to the resulting reduction in electricity prices. This is a productive use of the permits, which contributes to the relative increase in real investment, GDP and real wages (compared with Scenario 1). Less than 25% of domestically issued permits are allocated to shielding for EITEI. This percentage share is relative to a smaller base, since in this Scenario a lower target is adopted.

The allocation to smooth the increase in electricity costs largely offsets the regressive nature of an increase in electricity prices. With regard to total emissions (and the incentive for demand-side abatement), the difference is negligible.

Figure 18: Source and allocation of permits: 3. CPRS Intensity



Budget impacts

The allocation of permits (or the use of permit revenue) is currently subject to change over time, since much of the assistance is discretionary spend with a short-term horizon as opposed to being inherent in the scheme design. Publicly available information on the expenditure plans is limited, though the Revised fiscal impact of the Carbon Pollution Reduction Scheme (CPRS), Fact Sheet, May 2009, (Table 6) is one indicator. The estimate calculates permit revenue on the basis of total permit sales (for covered sectors) of 447-448Mt. The Fiscal impact statement proposes to allocate 150-175Mt of permits (34-39%) to household assistance, mostly via increased payments.

A further 80Mt of permits (or 20%) are essentially allocated to fund the fuel tax offsets - a reduction in the fuel excise which is proposed to operate for three years. This budgeted amount effectively covers almost all transport emissions for 3 years. The mechanism used to distribute these funds is effectively an output based rebate (with a baseline set at 100%), since it offsets the CPRS price effects by reducing the excise. This is actually very similar to the proposed approach to electricity in Scenario 3, though the proposed electricity treatment would reach a broader target and would provide greater long term certainty.

Approximately 120Mt of permits (27%) are budgeted to EITEI, 26Mt (6%) to the ESAS and the equivalent of 21-70Mt of permits is earmarked for the Climate Change Action Fund (CCAF). The fund expenditure ($2.75bn over 5 years) includes:

- $1.4B to small, medium sized businesses and communities: to offset the higher costs (eg grants to install energy efficient lighting etc);
- $750m to coal mines/regions as an alternative to EITE assistance;
- $200m in structural adjustment to workers in other sectors who find their jobs at risk; and
- $130m for an information program for small business and community organisations

It is not entirely clear how the distribution of funds via these mechanisms reflects the costs imposed by the CPRS (ie whether the assistance is adequate or more than sufficient).

Table 6: Affordability and permit accountability: Fiscal impact as reported

	$m		Permits (m)		% of Total	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Revenue	**4,470**	**12,990**	**447**	**448**	**100%**	**100%**
Household assistance	-1,500	-5,080	-150	-175	-34%	-39%
Fuel tax offsets	-875	-2,205	-88	-76	-20%	-17%
EITEI allocation	-1,200	-3,570	-120	-123	-27%	-27%
ESAS	-260	-760	-26	-26	-6%	-6%
Climate change action fund (CCAF)	-700	-600	-70	-21	-16%	-5%
Total	**-4,535**	**-12,215**	**-454**	**-421**	**-101%**	**-94%**

Source: Revised fiscal impact of the Carbon Pollution Reduction Scheme (CPRS), Fact Sheet, May 2009, Frontier calculations for Permits and Percentages based on reported carbon price of $10/tCO2 in 2011-12, $29/tCO2 in 2012-13 used in the Budget calculations

Reconciliation

In this section, the modelling results and implications for permit allocation and available funds are reconciled against the proposed fiscal impacts reported above. This is generally indicative since public information limits the scope for complete reconciliation. The MMRF modelling projections of the CPRS as proposed (Scenario 1) is summarised in Table 7. Permit revenues are lower than the fiscal estimates in 2012-13 due to a lower assumed carbon price in 2012-13 (the Commonwealth revised its 2012-13 forecast upward for the fiscal impact estimate).

The key difference is a much lower projection for EITEI allocation: around 70Mt compared with 120Mt allowed for in the Fiscal Impact statement. Details regarding specific EITEI activities and allocation rates are very limited, so it is difficult to reconcile at this stage. On the face of it, the fiscal estimates have been conservative with the estimated requirements of EITEI allocations, since it is unlikely that the MMRF modelling results produced for this report would be significantly different to those produced for the Commonwealth. Alternatively, it is possible that the bottom-up estimates of EITEI assistance (which is still being developed by the Department of Climate Change) reveal a greater need for EITEI assistance than the initial top-down estimates allowed for in the MMRF modelling (based on information available).

It is also possible that the fiscal estimates are based on some calculation other than the modelling; a quote in the CPRS White Paper refers to an estimate of permits allocated to EITEI assuming that "*EITE industries grow at the same rate as the rest of the economy" (pXXXVi)*. This would lead to a higher estimate of EITEI permit allocations (at least in the later years), though the modelling suggests that these sectors do not grow as quickly as the rest of the economy, particularly with the CPRS in place. In addition, the emissions intensity of EITEI production declines, though it's not clear whether this is taken into account in the fiscal impact.

In Table 7 the "permits auctioned" represent permits that are auctioned and not allocated to EITEI. This represents funds (or permits) available for allocations along the lines of those committed to in the fiscal impact statement. In all CPRS scenarios, the MMRF modelling distributes these excess permits via lump-sum transfers, though not explicitly in the manner accounted for in the fiscal impact statement. Given the lower estimate for EITEI allocation, the modelling suggests that revenue or permits available for allocation is greater than the fiscal estimates suggest (though the actual EITEI allocation needs to be verified against better information when available).

Table 7: Affordability and permit accountability: Modelling (1. CPRS)

	$m		Permits (m)		% of Total	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Revenue	4,480	10,716	448	441	100%	100%
Permits auctioned*	-3,770	-9,072	-377	-373	-84%	-85%
EITEI allocation	-710	-1,644	-71	-68	-16%	-15%
Total	**4,480**	**10,716**	**448**	**441**	**100%**	**100%**

Assumes carbon price of $10/tCO2 in 2011-12, $24.3/tCO2 in 2012-13

Table 8 presents the same results for Scenario 3 (CPRS-Intensity). In this instance, permits allocated to EITEI are higher than in the previous scenario by around 5%. On the one hand, shielding *rates* are increased and coal mining is now included as an EITEI; this increases the EITEI allocation. On the other hand, indirect shielding for electricity costs is removed and replaced with the electricity allocation; this partly offsets the increase.

The electricity allocation and the remainder of permits that are auctioned effectively represent a combined allocation of permits (or the permit revenue) to offset the need to compensate households (household assistance), small businesses and communities (via the CCAF), and the indirect energy costs for EITEI. This allows for EITEI assistance to the coal mining industry in a manner consistent with other sectors, which further reduces required expenditure via the CCAF. This method of allocation is more likely to direct assistance in proportion to costs incurred.

This still leaves approximately 130-140Mt of permits for distribution, which is sufficient to allow for the proposed ESAS allocation (26Mt[24]), and the fuel tax offset (80Mt[25], though this is only an interim measure), and allow for a contingency for higher EITEI allocation requirements.

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24 This could potentially be extended from 5 years of allocations to 10 years. The modelling does not explicitly include the ESAS allocation, or the CCAF, though all residual permits other than those allocated to EITEI are allocated as a lump-sum transfer which is equivalent in effect.

25 The fuel tax offset is included in the modelling, though it is an interim measure and the cost of reducing the fuel excise is not subtracted from the permit revenue.

Table 8: Affordability and permit accountability: Modelling (3. CPRS Intensity)

	$m		Permits (m)		% of Total	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Revenue*	4,480	10,716	448	441	100%	100%
Permits auctioned*	-1,340	-3,327	-134	-137	-30%	-31%
Electricity allocation	-2,198	-5,078	-220	-209	-49%	-47%
EITEI allocation	-942	-2,311	-94	-95	-21%	-22%
Total	**4,480**	**10,716**	**448**	**441**	**100%**	**100%**

Assumes carbon price of $10/tCO2 in 2011-12, $24.3/tCO2 in 2012-13

This simple reconciliation does not take account of the indirect effects of the scheme, though these should be marginally favourable under this scenario given the higher GDP growth and stronger employment/wage growth. For example, the improvement in Real GDP in 2011 (comparing Scenario 3 against Scenario 1) is equivalent in value to 86m permits in that year; in 2020 the relative improvement is worth 98m permits; and in 2030 this annual improvement is worth 148m permits.

Another indirect effect not explicitly accounted for here is the impact on coal mining royalties. This impact were not estimated as part of this study, though a report for the Council of Australian Federation estimates that the loss in coal mining royalties to State Government revenue (due to the CPRS) rises from $500m (2013/14) to $1.5B (2020/2021).[26] This fall in royalties would be far less (if at all) in the CPRS-Intensity scenario. This is worth approximately 5-10% of the annual CPRS revenue.

3.7 Electricity prices

A key benefit of the scheme design in Scenario 3 is the more orderly transition of electricity prices: since electricity demand is relatively inelastic (particularly in the short-run) there is little to be gained from a sudden shock to prices created by the Commonwealth's CPRS. For example, it is unreasonable (and very costly) for households and businesses to replace all appliances immediately with more

26 Access Economics report for Council of Australian Federation Secretariat, Report 1: Impact of CPRS – Fiscal report (May , 2009)

energy efficient models. Similarly, the built environment will not change overnight to become more energy efficient – the transition will take time as stock is replaced. As such, an immediate increase in energy costs is a blunt instrument that will simply increase costs for households and businesses and raise government revenues.

The aggregate emissions projections in each scenario support this point. As such, the increase in electricity prices in Scenario 1 act as an additional tax, with minimum benefit. This unnecessarily increases the cost of the scheme. In addition, it is widely acknowledged that this increase in energy costs is regressive, since it is disproportionately borne by lower income households. Scenario 3 results in a more orderly transition path for more or less the same emissions path (in fact, if the lower costs of an intensity based scheme encourages the Government to adopt a more ambitious target it will deliver a reduction in global emissions).

Figure 19 presents the average percentage increase in wholesale electricity price across all regions. In Scenario 1 (CPRS), wholesale prices increase by 50-65% initially, once the initial permit price cap is removed after 2011. Even though carbon prices are increasing, the rate of increase declines marginally due to (a) a declining rate of cost pass-through over time, as the emissions intensity of generation falls and (b) projected rising prices in the Reference Case.

In Scenario 3 (CPRS Intensity), the increase in wholesale electricity prices starts at 0% and rises to 30% by 2030. This is because the baseline allocation to the electricity sector reduces average costs for all generation, and this is passed-through to energy consumers to offset the effects of the carbon cost. The electricity baseline declines over time, reflecting the increased ability of energy users to respond to increases in costs. As the electricity baseline rate eventually falls to zero, the price effects of the two schemes converge.

Again, the incentive to reduce emissions intensity is preserved, though this incentive is based on a mixture of carrots and sticks rather than simply the sticks that characterise the CPRS.

In the short-term, the CPRS is expected to increase average household electricity costs by approximately $260-280 per year (as a direct result of the CPRS[27]). Most of this increase would be avoided in the short-term under the CPRS-Intensity approach, where annual household electricity costs may rise by $8 (2012) to $44 (2016) (as a result of the CPRS, ignoring other factors). It would provide substantial benefits (in terms of reduced risk) in the process of electricity retail price determinations,

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27 Wholesale energy costs reflect around 40-50% of total retail electricity costs, hence the increase in retail costs is lower.

Figure 19: Average change in wholesale electricity price relative to Reference Case

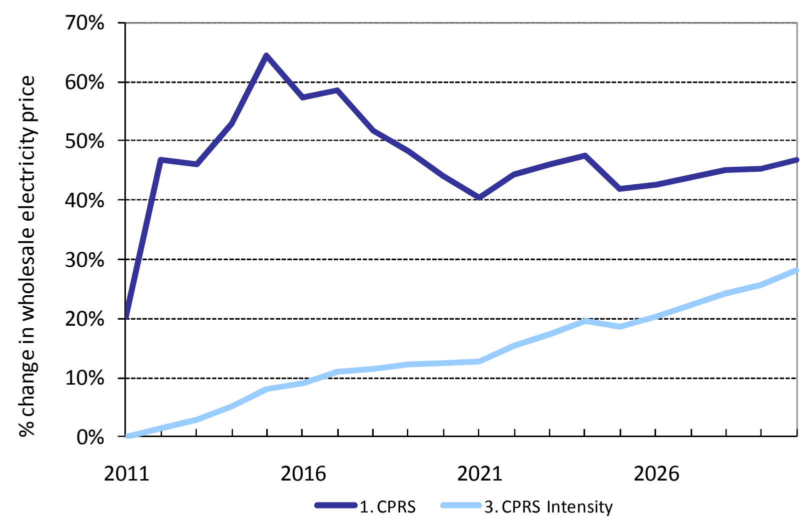


Figure 20 to Figure 25 provide estimated wholesale electricity costs for each scenario in each State.

Figure 20: Electricity prices - NSW

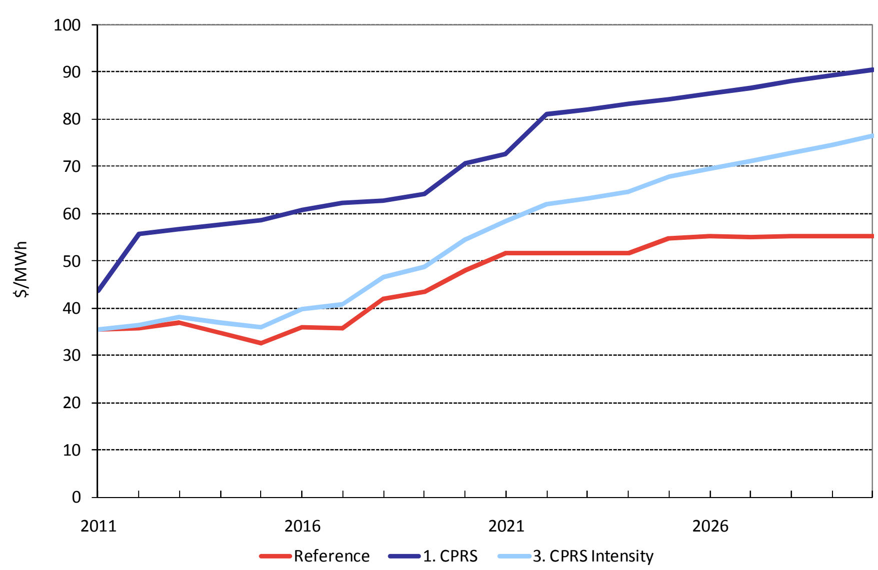


Figure 21: Electricity prices – Victoria

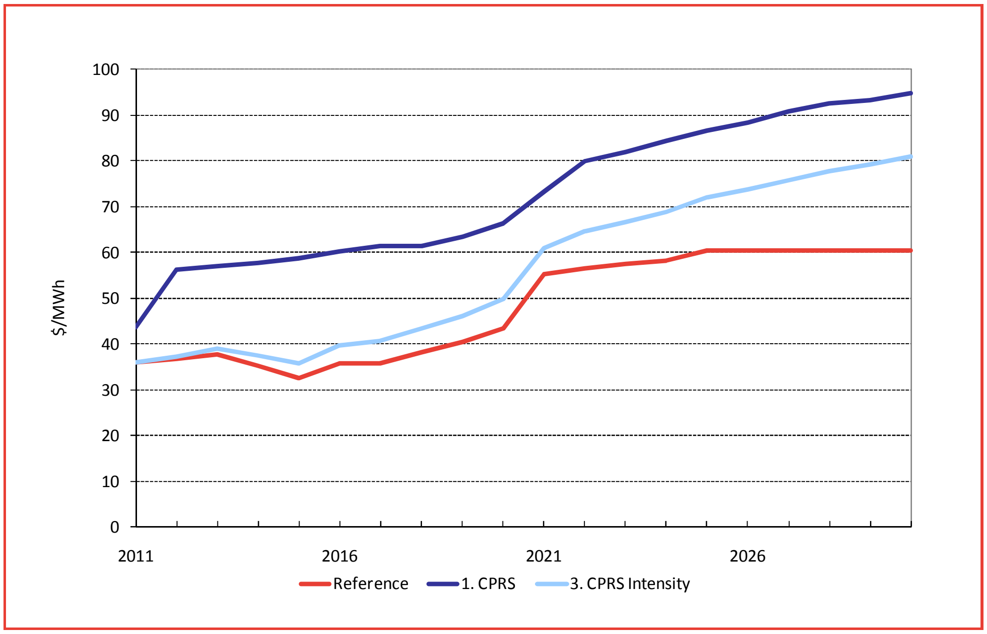


Figure 22: Electricity prices – Queensland

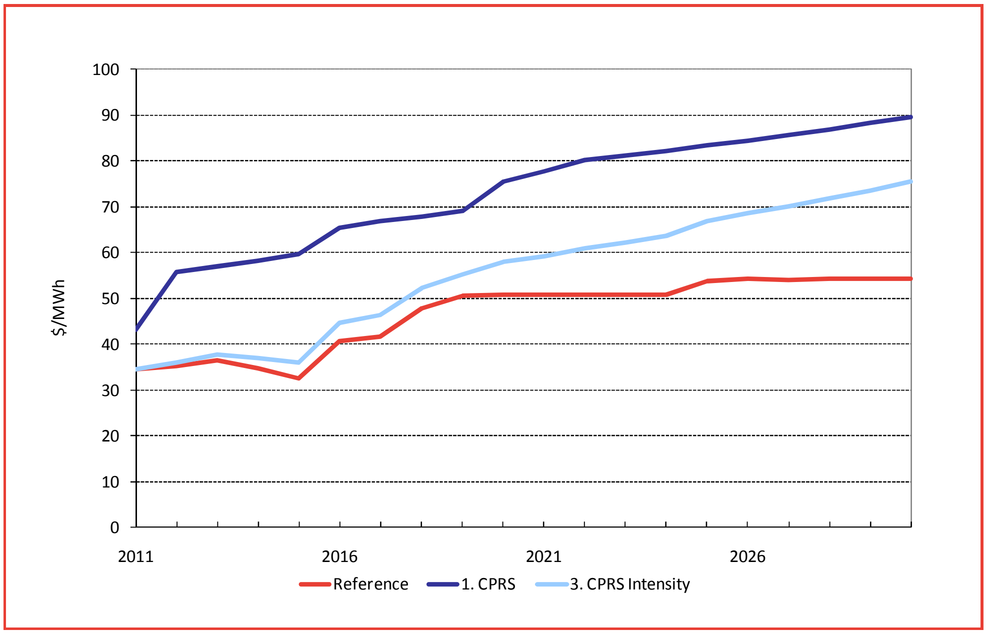


Figure 23: Electricity prices – South Australia

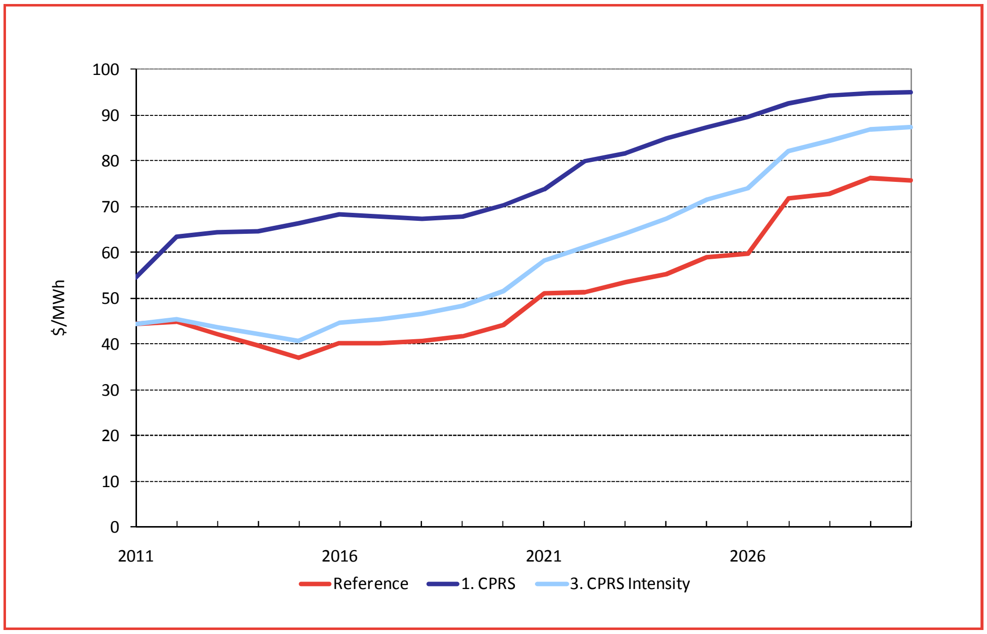


Figure 24: Electricity prices – Tasmania

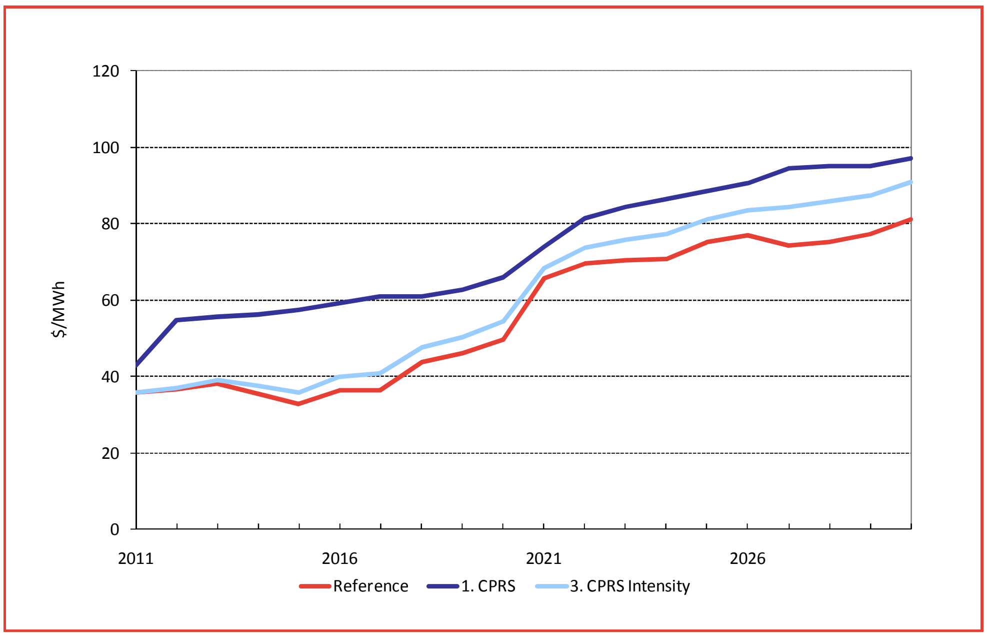
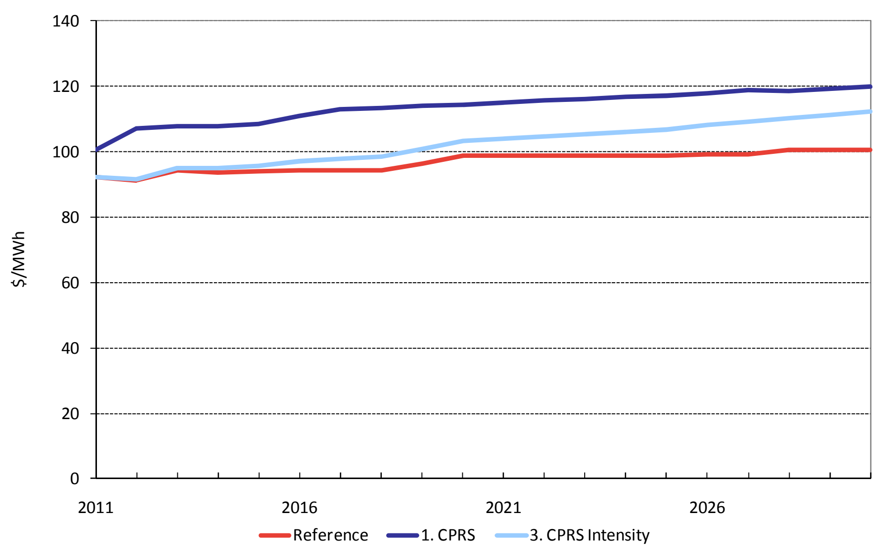


Figure 25: Electricity prices – Western Australia



3.8 Scenario 1: CPRS as proposed

This section presents detailed results of Scenario 1 (CPRS as proposed) relative to the Reference Case scenario.

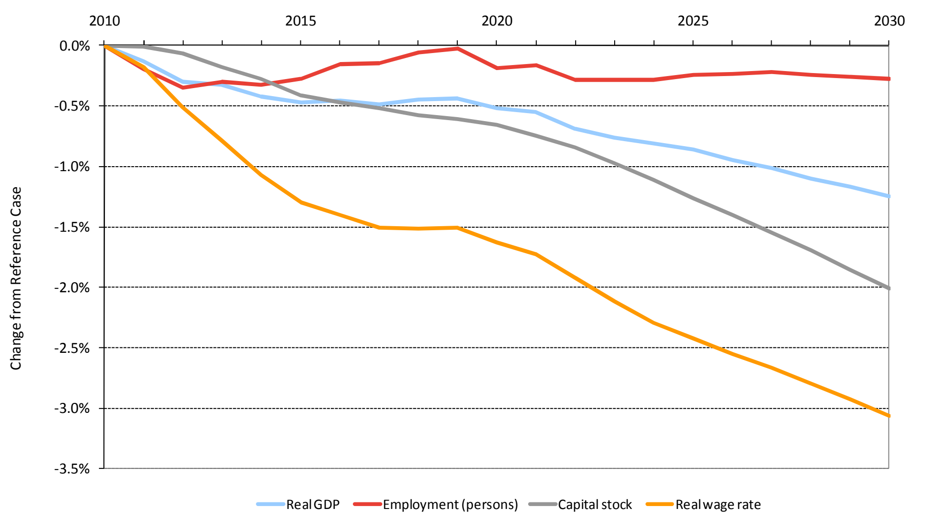
Figure 26 focuses on the effects of the CPRS on the supply side of the national accounts. The CPRS increases domestic producers' costs. To the extent that these cost increases cannot be passed on in higher prices, this reduces returns to primary factors. Hence, producers' reduce their demands for labour and capital and reduce their outputs, leading to a decline in real GDP relative to its Reference Case path.

In MMRF-GREEN, the unemployment rate is assumed to be unaffected by the CPRS shock in the long run. As the shock reduces the demand for labour, the real wage falls (with a lag) to prevent the unemployment rate from rising. Hence, the cost of labour falls relative to the cost of capital and producers' capital/labour ratios fall. In Figure 26, this shows up as a fall in the aggregate capital stock, while aggregate employment does not deviate significantly from its Reference Case level (by assumption). Even under this employment assumption, there is considerable structural change as employment falls in some sectors/regions and rises in others (as discussed previously).

The fall in real GDP in Figure 26 is greater than can be explained by the changes in factor inputs. This reflects emissions-saving changes in production technology that are implemented by producers in response to the introduction of the CPRS.

The empirical basis for this in the MMRF-GREEN simulations is information on sectors' marginal abatement cost schedules. It is assumed that all sectors undertake abatement up to the point at which marginal abatement cost is equal to the emissions permit price. The consequent abatement costs are implemented as all-input-using shifts in sectors' production functions[28].

Figure 26: Supply: Scenario 1 relative to Reference Case



In Figure 26, the long-run (2030) reduction in real GDP is about 1.25% relative to the Reference Case level. This long-run effect of the CPRS on GDP is predicated on the economy being sufficiently flexible to absorb the amount of structural change that underlies the macro results. For example, if real wages are not sufficiently flexible to ensure that the policy has only a short-run employment effect, the macro-economic effects of introducing the CPRS are likely to be more severe.

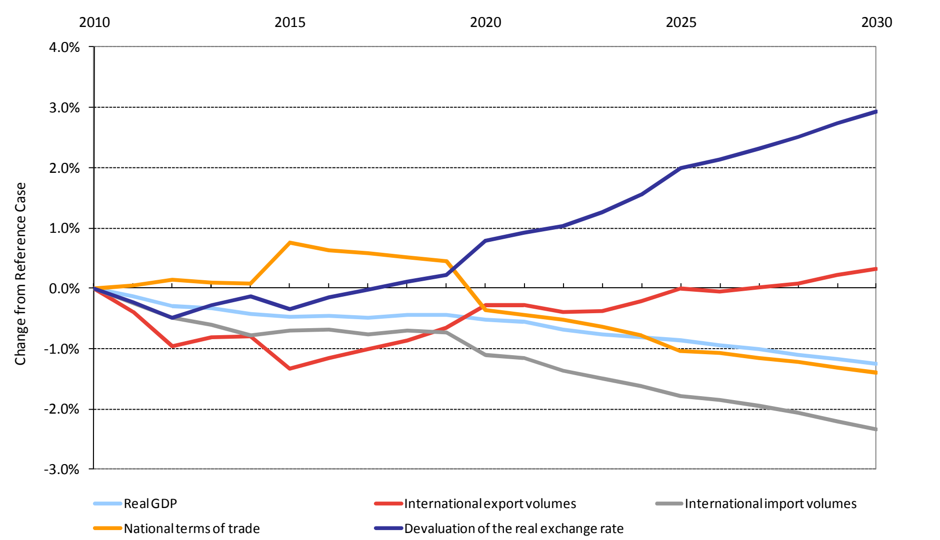
Another characteristic of the modelling that limits the economic impacts of the CPRS is that the model's agents are assumed to respond to the introduction of the CPRS by factoring its real burden into behaviour patterns that are substantially the same as those assumed to prevail in the Reference Case. Because the CPRS reduces the return to primary factors overall and because wage

28 Note that MMRF-GREEN has no specific information about the input structure of abatement technologies. One implication of this is that the model may misestimate the change in the real wage that is required to insulate the unemployment rate from the ETS. For example, if abatement requires a capital-using shift in technology rather than an all-input-using shift, the decline in the real wage shown in Figure 31 would be an overestimate.

flexibility is assumed to stabilise the unemployment rate at its Reference Case level, producers on average reduce their capital stocks relative to the reference-case level. But it is not assumed that upon the introduction of the CPRS producers now require higher rates of return than they required in the Reference Case. If a change in required rate of return was assumed, the fall in the capital stock and in GDP would be larger than is indicated in Figure 26 and the macro economic results would be more severe than report here. Indeed, if the CPRS-Intensity is expected to have less severe results for producers than, say, the Commonwealth's CPRS (as evidenced above), it would be expected that any change in the required rate of return would be less for the CPRS-Intensity than for the Commonwealth's CPRS. As such, given that there is no treatment of the effect of the change in the require rate of return means that the differences between the Commonwealth's CPRS and the CPRS-Intensity scenarios appear to be more narrow than likely to be in the case in reality.

Figure 27 shows the implications of the CPRS for the balance of payments. A key feature of the scheme is that full global trading of permits is assumed from 2012. At the assumed global permit price, a share of the emissions-reduction target is met by the purchase of permits from the global market rather than by domestic abatement.

Figure 27: Trade: Scenario 1 relative to Reference Case



For the latter part of the projection period, the domestic economy must run a balance-of-trade surplus to pay for the purchase of permits from the global market. Moreover, the shifts in the positions of Australia's export-demand and import-supply schedules that reflect assumptions in the CPRS simulations about the emissions-reduction policies being undertaken overseas imply deterioration in the terms of trade. To generate the required trade-account surplus, in Figure 27 import volumes decline relative to their value in the reference case more than do export volumes. To facilitate this, the real exchange rate depreciates.

The effects of the CPRS on the demand side of the national accounts are shown in Figure 28. To make room for the trade-account surplus that is required for the purchase of emissions permits from the global market, domestic absorption (consumption *plus* investment) must decline relative to GDP, especially in view of the deterioration in the terms of trade. Hence in Figure 28, real private consumption and real investment both deviate further below their Reference Case levels than does real GDP. Underlying the CPRS simulation is the assumption that nominal government consumption moves with nominal GDP. In real terms, government consumption declines less relative to its Reference Case level than does GDP. This reflects the labour intensity of government consumption and the decline in the real wage rate that is shown in Figure 26.

Figure 28: Demand: Scenario 1 relative to Reference Case

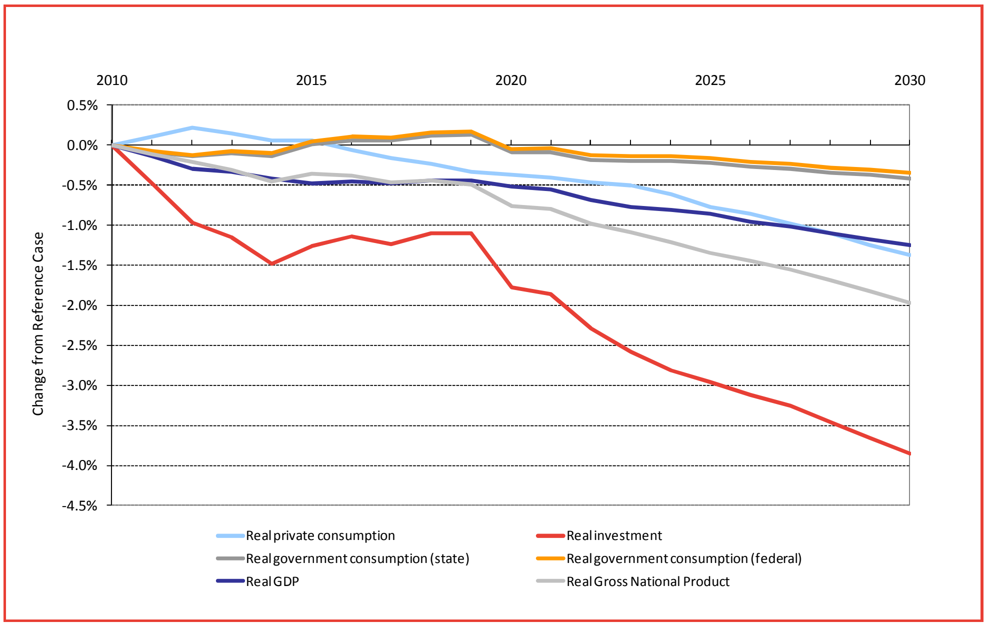
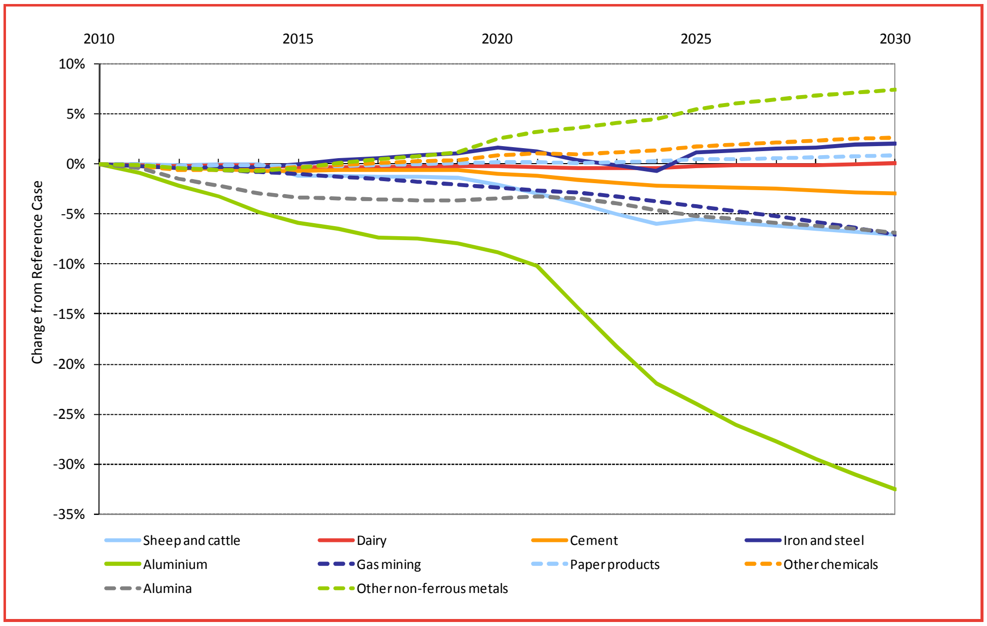


Figure 29 shows the effects of the CPRS on the output levels of the main EITEI. Solid lines refer to category-1 sectors (industries that initially receive free permits for 94.5% of their direct and indirect CPRS costs). Dashed lines refer to category-2 sectors (industries that initially receive 66% of permits). The results for the relevant sectors in Figure 29 reflect just the sector-wide implications of compensation for the relevant sub components[29].

Under the proposed CPRS, shielding rates gradually decline until 2019 and are then removed between 2020 and 2024. Agricultural sectors are not covered by the CPRS until 2015. The implications of these assumptions are evident in Figure 29. Output in the most trade-exposed of the EITE industries (*Aluminium* and *Alumina*) declines sharply as compensation is removed. For the agricultural industries (e.g., *Sheep and cattle*) the decline in output does not begin until agriculture is included in the CPRS in 2015. Broadly, this chart highlights the extent of structural change in the economy, as emissions intensive sectors contract and other sectors expand. These changes are strongest when the compensation is removed.

Figure 29: EITEI: Scenario 1 relative to Reference Case

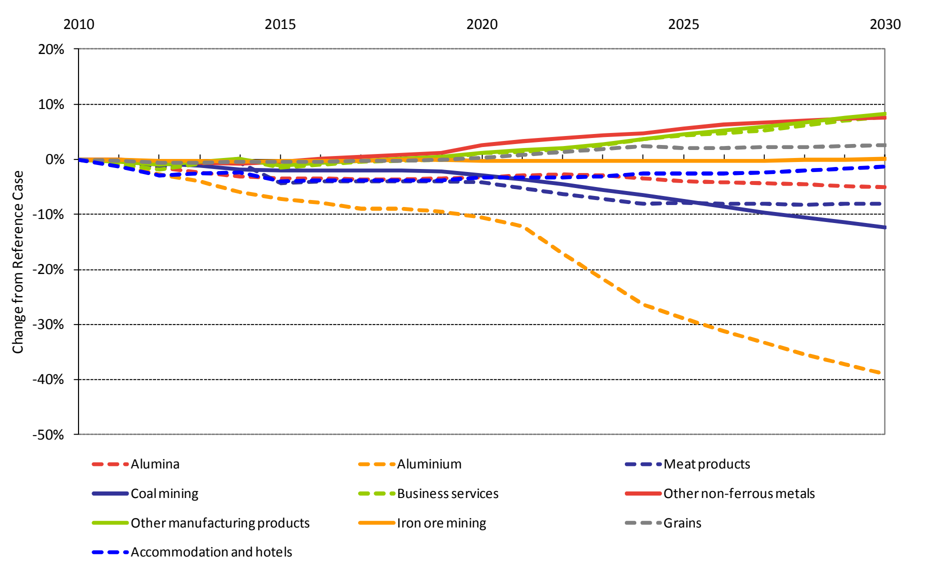


The effect of the CPRS on the structure of the economy's exports is shown in Figure 30. Again, the changes indicate considerable structural change from the CPRS. Although this is partly the objective of the CPRS (to encourage a transition to a lower emission economy), this transition needs to be managed carefully to avoid simple carbon leakage and prevent unnecessary transitional costs. Management of these structural transition problems are also necessary to ensure continued support for emissions reduction policies.

29 For example, if 50% of a sector received 90% compensation, then the sector in total would receive 45% compensation.

The major energy emissions-intensive mineral exports (e.g., *Aluminium*, *Coal*[30] and *Alumina*) contract significantly, as do the livestock-based exports (e.g. *Meat products*) after the agricultural sector is included in the CPRS in 2015. On the other hand, there is a range of other exports (including manufacturing and service exports) that are stimulated by the depreciation of the real exchange rate that is generated by the CPRS (see the discussion of Figure 27). Tourism exports (represented in Figure 30 by *Accommodation and hotels*) decline in the short run because of the effects of the CPRS on transport costs.

Figure 30: Exports: Scenario 1 relative to Reference Case

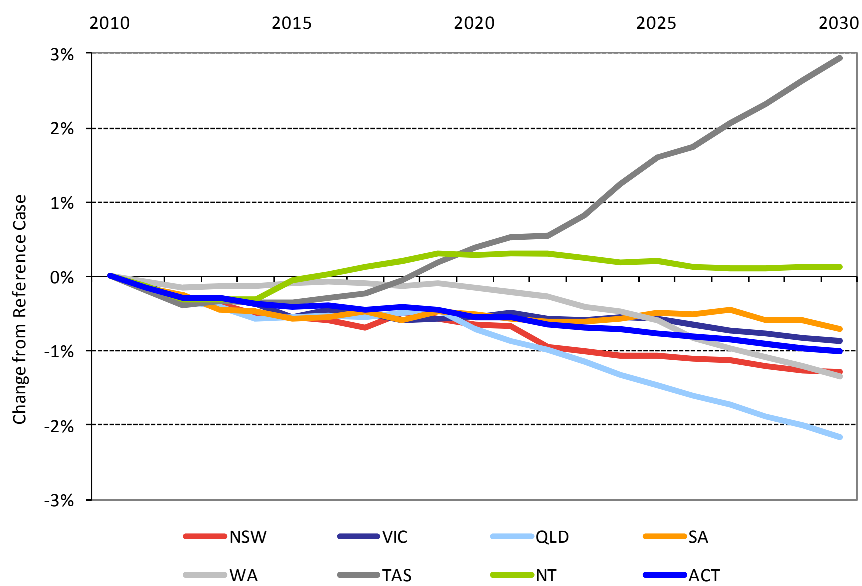


3.8.1 Overall State impacts

The effects of the CPRS on gross product for the States and Territories, together with the GDP effect, are shown in Figure 31. The effects of the CPRS on the largest, most diversified regions (NSW and Victoria) are similar to the effect on GDP. The most severely effected region is Queensland, reflecting its dependence on emissions-intensive mineral and agricultural sectors. A particular factor is the decline in the coal export price that is generated by the adoption of emissions-reduction policies in the rest of the world. Tasmania, South Australia and Northern Territory are the regions least affected by the ETS. Tasmania is especially favoured by its availability of hydroelectric power.

30 Note that our assumptions about emissions policy adopted overseas reduce the world price of coal in the CPRS simulation.

Figure 31: Gross Regional Product: Scenario 1 relative to Reference Case



3.9 Scenario 2: CPRS Adjusted

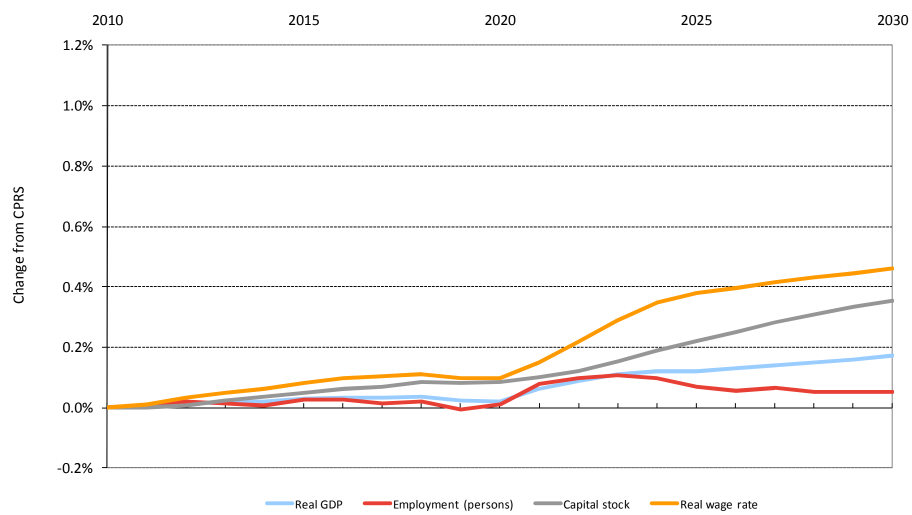
This section presents the results of Scenario 2 (CPRS Adjusted) relative to Scenario 1 (rather than the Reference Case).

These charts largely support the summary results from above: the adverse effect of the CPRS on both GDP and real wages is less in this Scenario than in Scenario 1. Another notable difference from Scenario 1 is the structural change in the economy, which is most evident in Figure 35 (EITEI) and Figure 36 (Exports). The positive amounts in those charts tend to represent sectors that are declining (or growing more slowly) in Scenario 1 – for example Aluminium, Coal Mining, Other non-ferrous metals, and conversely. This suggests a narrower band of change compared with the spread in the comparable charts for Scenario 1 (Figure 29 and Figure 30). In other words, the declining sectors shrink by lesser amounts, and the expanding sectors grow by lesser amounts, in Scenario 2 than Scenario 1.

Although some might argue that significant reductions in production from emissions intensive industry are required, if the emissions intensity of these sectors improve significantly then supply-side abatement is far more effective than reducing domestic production (particularly if the sectors simply relocate to nations without emissions controls). The current CPRS proposals suggest that the proposed compensation to EITEI to address this issue will wind down around 2020, though the terms of this transition are far from clear (which presents a significant risk to investors). Even if all developed nations have adopted emissions trading schemes, this may still encourage emissions intensive industry to relocate to developing nations without controls.

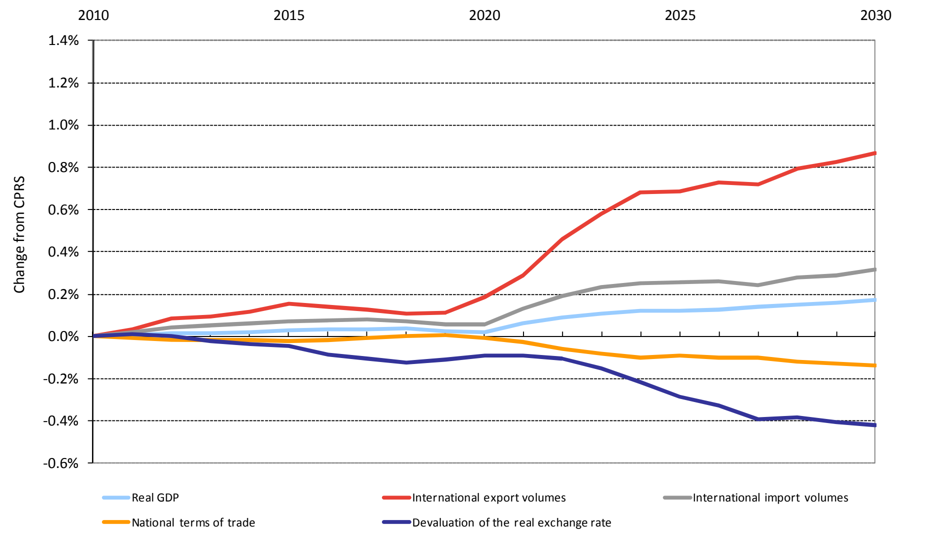
Figure 32 shows higher GDP and real wages in Scenario 2 compared to the Commonwealth CPRS reflected in Scenario 1. This alleviates some of the contractionary pressure evident in Scenario 1.

Figure 32: Supply: Scenario 2 relative to Scenario 1



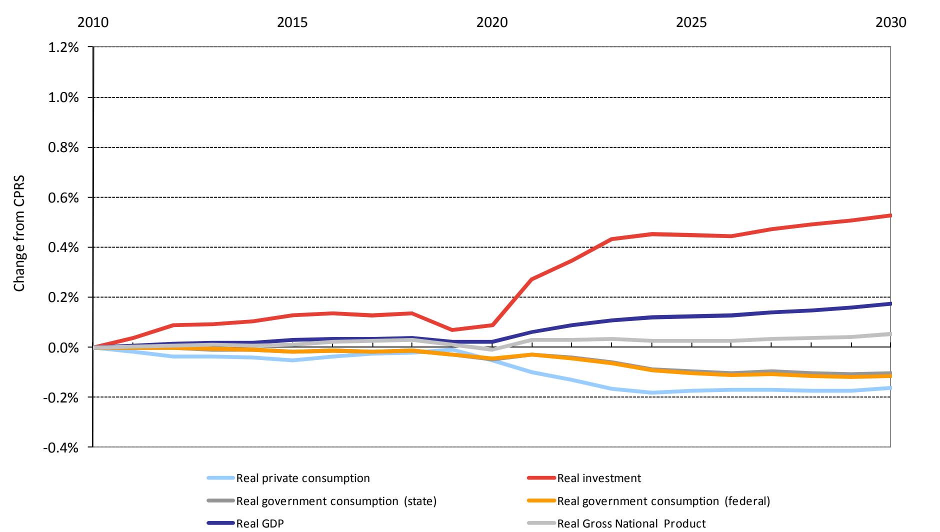
Export volumes are higher in Scenario 2 than Scenario 1, though this is despite a lower depreciation in the exchange rate: Figure 33. This is because of the competitive benefits of the extended shielding measures adopted in this scenario.

Figure 33: Trade: Scenario 2 relative to Scenario 1



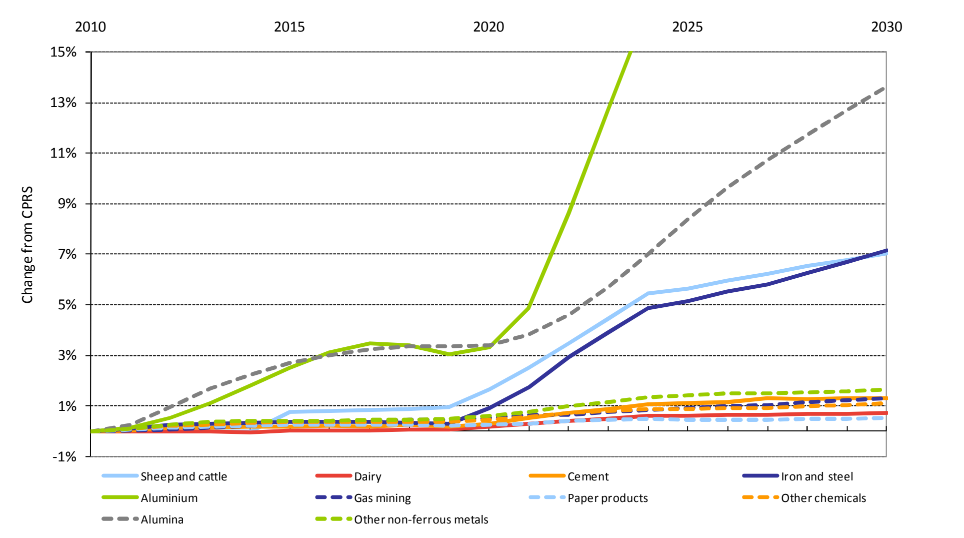
Higher investment is an important driver of the relative improvement in real GDP compared with Scenario 1 (though investment growth is still lower relative to the Reference Case) – see Figure 34.

Figure 34: Demand: Scenario 2 relative to Scenario 1



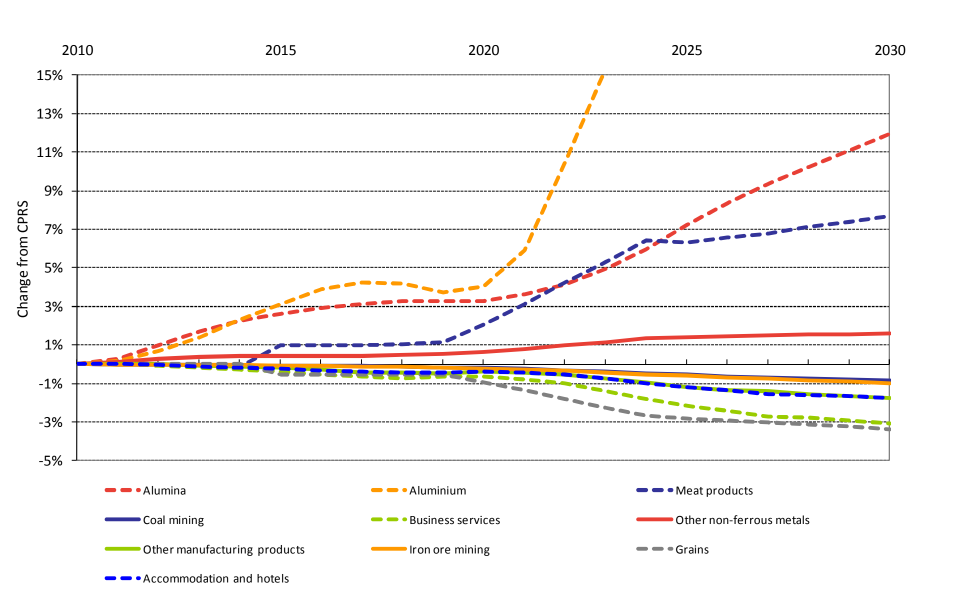
Under Scenario 2, trade exposed energy intensive trade exposed sectors fare better than under the CPRS (Figure 35 and Figure 36). This is to be expected given that the increased shielding measures contribute to maintaining competitiveness, though in most instances growth is still slower relative to the Reference Case.

Figure 35: EITEI: Scenario 2 relative to Scenario 1



Note: Aluminium increases to 30% in 2030 relative to Scenario 1

Figure 36: Exports: Scenario 2 relative to Scenario 1



Note: Aluminium increases to 36%

Figure 37 presents the Gross Regional Product (GRP) impacts of Scenario 2 compared with the Reference Case; Figure 38 presents the difference between Scenario 2 relative to Scenario 1 (CPRS as proposed). The modelling suggests that almost all regions see improvement in GRP, which is possible due to the national improvement in GDP. Scenario 2 has more favourable (or less negative) impacts on those regions most affected by the CPRS, such as Queensland and NSW.

Figure 37: Gross Regional Product: Scenario 2 relative to Reference Case

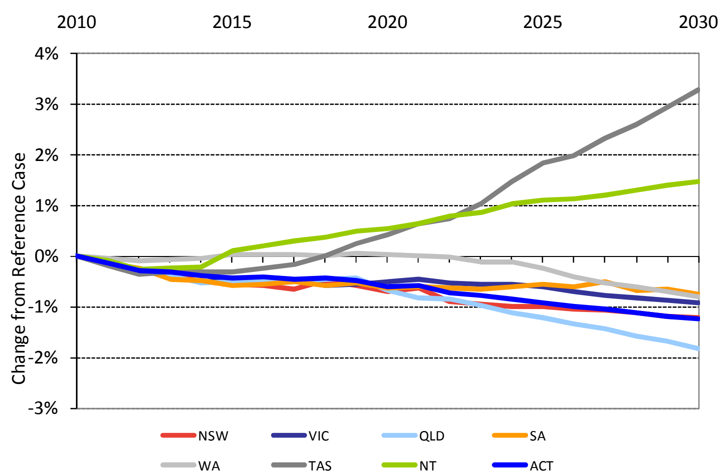
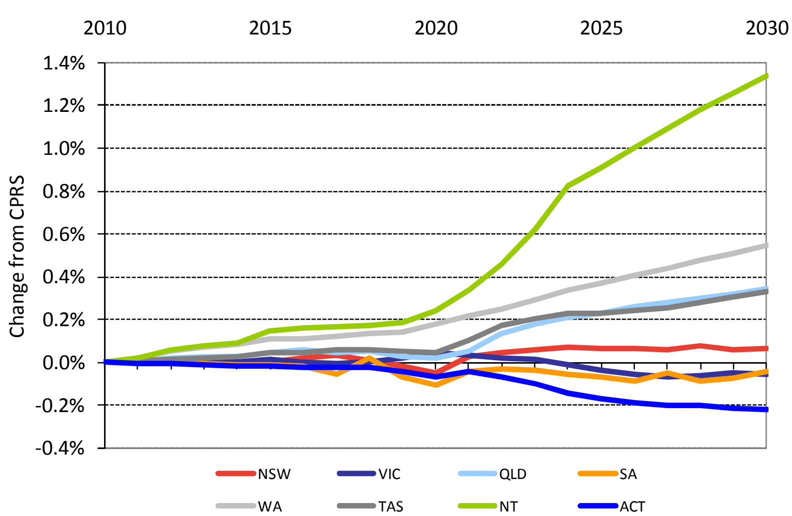


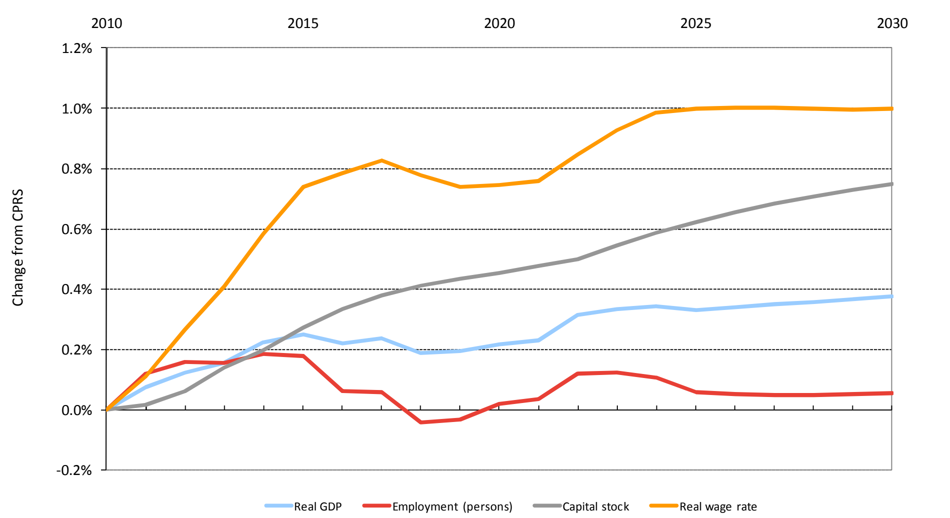
Figure 38: Gross Regional Product: Scenario 2 relative to Scenario 1



3.10 Scenario 3: CPRS-Intensity

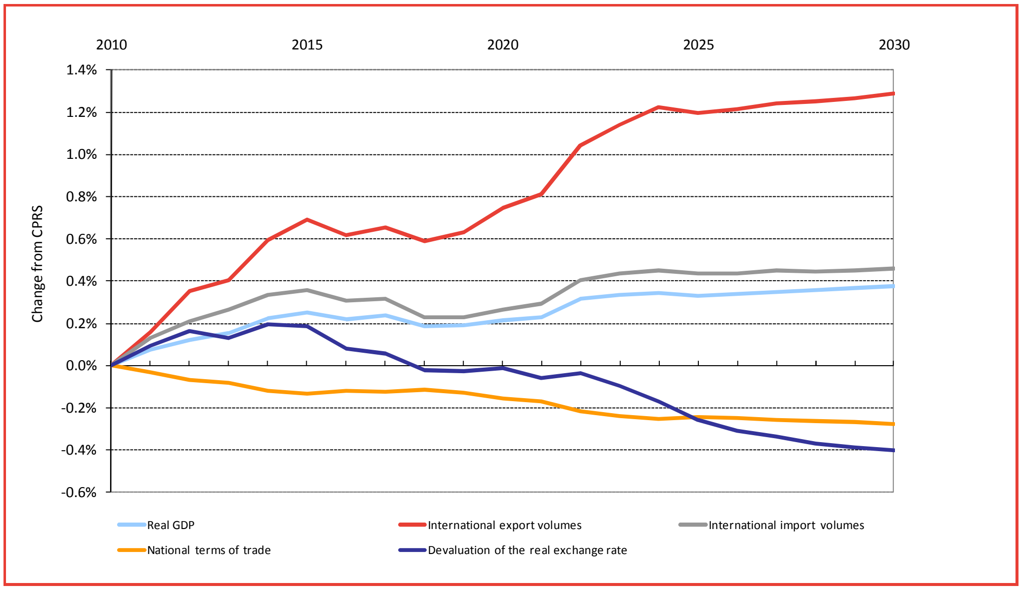
This section presents the results of Scenario 3 (CPRS Intensity) relative to Scenario 1. The adverse effect of the CPRS on both GDP and real wages is less in this Scenario than in Scenario 1. The directional changes evident in Scenario 2 are generally more pronounced in this scenario, reflecting further relative improvements in productivity, investment and growth (see Figure 39).

Figure 39: Supply: Scenario 3 relative to Scenario 1



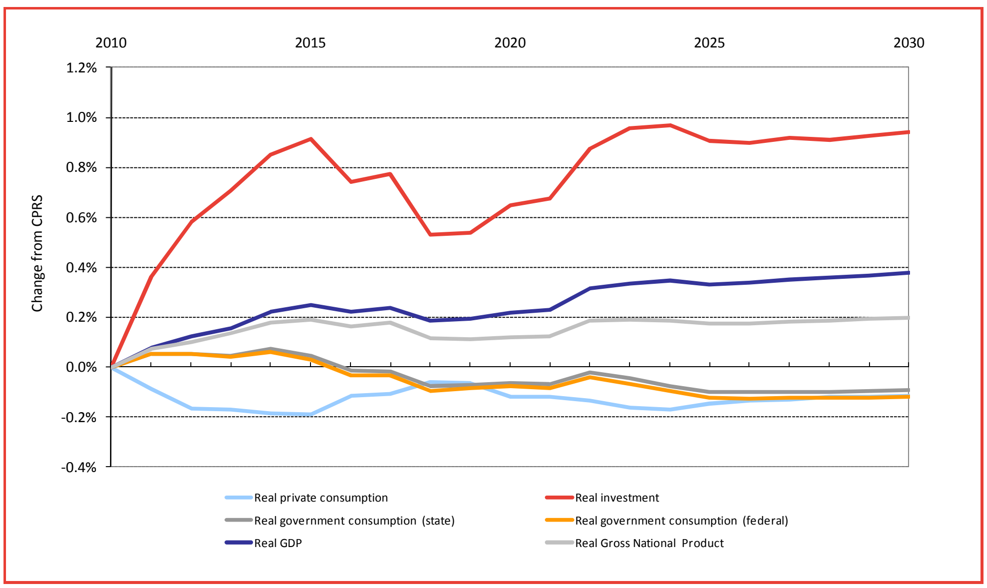
Export volumes are higher in Scenario 3 than Scenario 1, despite a lower depreciation in the exchange rate (see Figure 40). This is partly attributable to the competitive benefits of the extended shielding measures adopted in this scenario, and partly due to the productivity improvements of the electricity baseline allocation to subdue rising energy costs.

Figure 40: Trade: Scenario 3 relative to Scenario 1



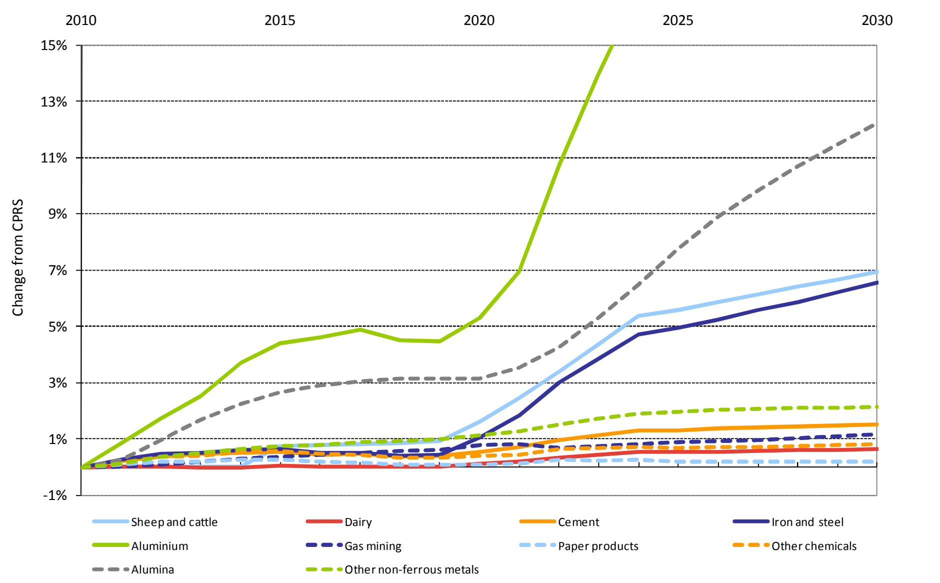
Higher investment growth causes improvement in real GDP compared with Scenario 1 (though investment growth is lower relative to the Reference Case): Figure 41.

Figure 41: Demand: Scenario 3 relative to Scenario 1



Trade exposed energy intensive trade exposed sectors fare better in Scenario 3 than under the CPRS (see Figure 42 and Figure 43). This is expected for EITEI given that the increased shielding measures contribute to maintaining competitiveness. Exports of non-EITEI (such as Business Services) fare marginally worse in this Scenario relative to Scenario 1, though they still increase relative to the Reference Case. The reason for this result is a lower depreciation in the exchange rate compared with Scenario 1; this explains the relatively lower increase in exports, although domestic output from non-EITEI (e.g. business services, trade services, construction) generally increase by a greater amount compared to Scenario 1.

Figure 42: EITEI: Scenario 3 relative to Scenario 1



Note: Aluminium increases to 22%

Figure 43: Exports: Scenario 3 relative to Scenario 1

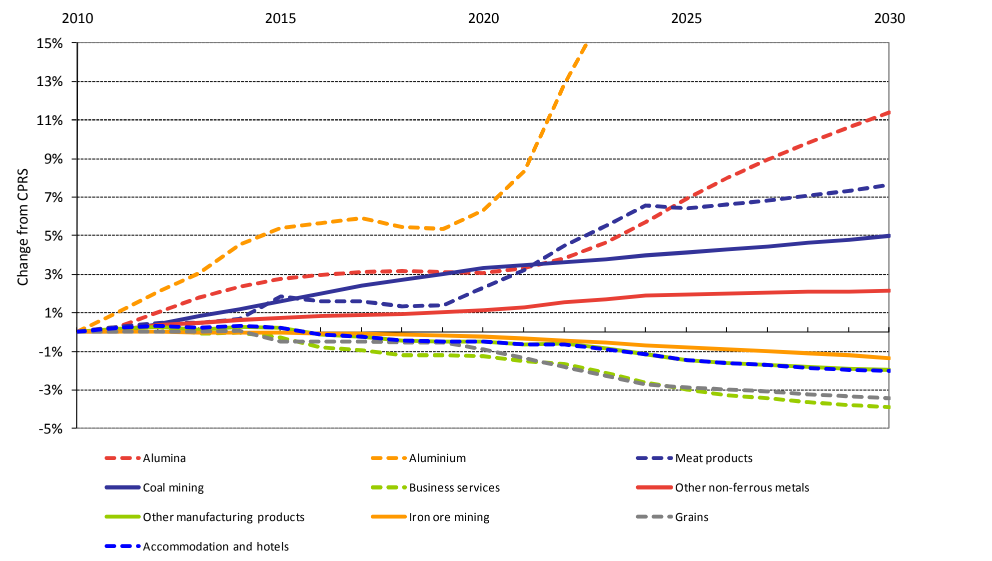


Figure 44 presents the Gross Regional Product (GRP) impacts of Scenario 3 compared with the Reference Case. Figure 45 presents the difference between Scenario 3 relative to Scenario 1 (CPRS as proposed). Almost all regions see improvements in GRP.

Figure 44: Gross Regional Product: Scenario 3 relative to Reference Case

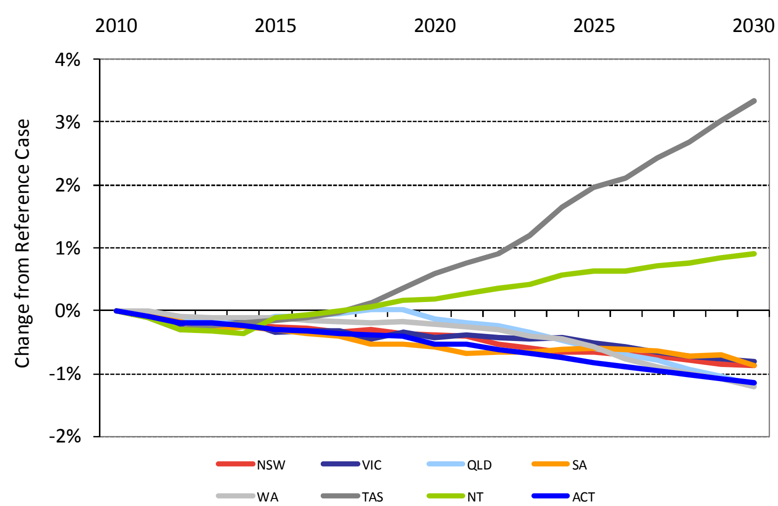
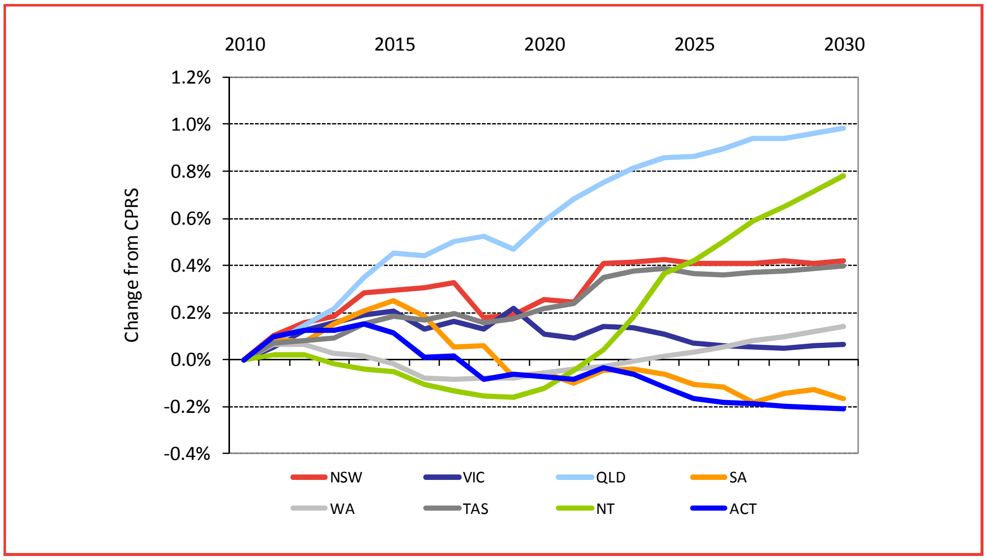


Figure 45: Gross Regional Product: Scenario 3 relative to Scenario 1



4 Energy security

This section provides a summary of the impact on electricity generators across the various Commonwealth Treasury modelling sources (MMA, ACIL Tasman and Roam) compared with the Frontier Economics electricity modelling results. The implications for the proposed Electricity Sector Adjustment Scheme (ESAS) are discussed in this section.

4.1 Generator losses

4.1.1 Commonwealth Treasury results

Table 9 provides a summary of the estimated generator losses reported in Table 13.2 of the CPRS White Paper. The results for Black Coal plant are particularly divergent: MMA modelling suggests the CPRS will ***increase*** the aggregate value of black coal plant by $2,197m, while ACIL and ROAM project losses of $5,954m and $5,258m respectively. In some instances, the MMA results appear negatively correlated with the other results. The various modelling results have been graphed in Figure 46 to show the relationship between the estimated values. The cause of this divergence is most likely the extent of cost-pass-through predicted by each model. It appears that MMA predicts greater than 100% pass-through of carbon costs for most black coal generators, while ACIL and ROAM predict less than 100%. Hence the larger the generator output, the greater the impact of carbon costs on value: for ACIL and ROAM this is negative, but for MMA this is positive.

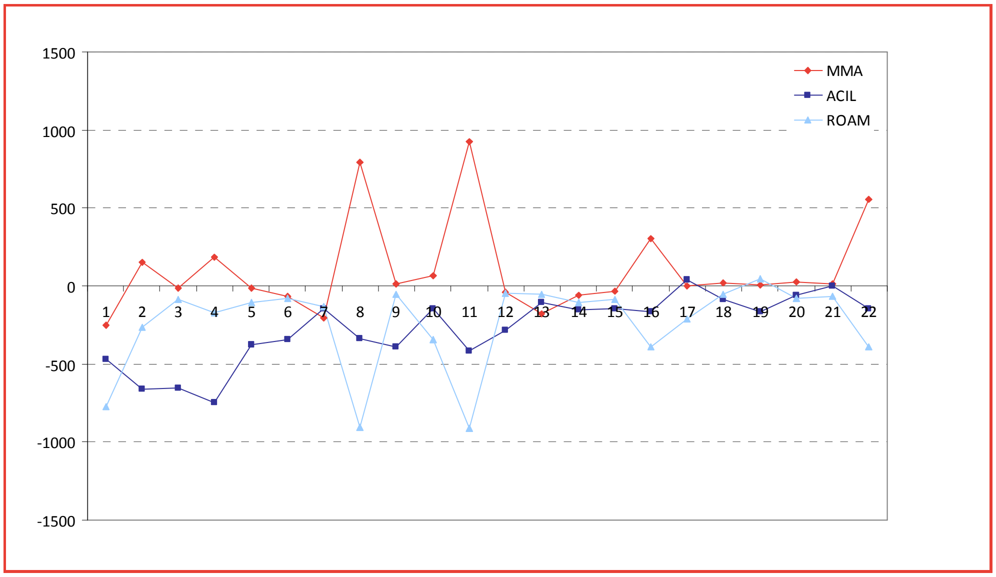
Table 9: Comparison of loss estimates: CPRS 5

Generator ($m)	MMA	ACIL	ROAM
Brown Coal Total	-2,344	-4,552	-4,100
Black Coal Total	2,197	-5,954	-5,258
Black Coal losses*	-864	-5,992	-5,304
Total Losses	-3,208	-10,544	-9,404

Source: Table 13.2, CPRS White Paper

* Black coal losses represents the sum of generator losses, excluding generators with increases in value

Figure 46: Comparison of black coal damages by generator ($m)



Source: Adapted from Table 13.2, CPRS White Paper

4.1.2 Frontier Economics modelling results

Frontier Economics has also modelled the generator value effects of the CPRS 5, using the carbon permit prices provided by the Department of Climate Change/Treasury. The Frontier Economics modelling assumptions differ from the Commonwealth modelling in two main areas:

- Frontier Economics has used its own capital cost assumptions, while Commonwealth results all use MMA's new entrant capital cost assumptions[31];
- All results rely on CGE generated electricity demand projections (using the MMRF-Green model), though the Frontier Economics results may differ slightly in this regard since it depends on the iterative process of estimated electricity prices;
  - ACIL reported different demand forecasts: Policy scenario 1 and 2 involved an immediate fall in demand (which ACIL discarded) while Policy Scenario 3 involved a slower growth in demand, which they used as the basis for their loss estimates;
  - It seems that these demand forecasts were the result of the MMA price forecasts. Since MMA predicted higher relative electricity price effects from the CPRS than the other modellers, this would suggest that the fall in demand (or slowing of growth) resulting in the CPRS scenario is larger

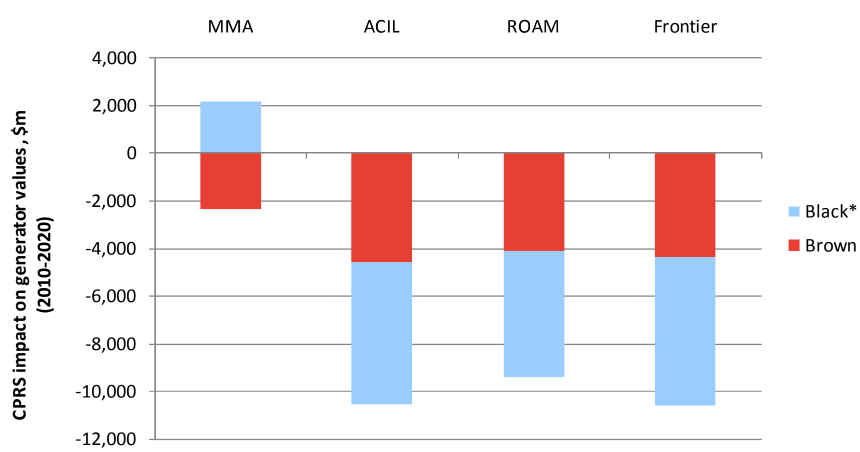
31 We note that the new entrant technology capital costs reported by ACIL (Table 12, p12) include the low estimate of USC with Post-Combustion Capture of $2,482/kW. This assumption was included in the earlier MMA assumptions but was later revised up to $3,044/kW

than would have been the case if the ACIL or ROAM price forecasts had been used.

An allocation of permits to electricity generators on the basis of an emissions intensity baseline (as adopted in Scenario 3) does not materially change the estimates for generator losses: average generator costs are reduced as a result of the allocation, though prices are reduced by the same amount. The net effect on values (and losses) is neutral.

The Frontier Economics results are more consistent with the ROAM and ACIL results, both in terms of the total size of losses and the division of losses between black and brown coal. ACIL, ROAM and Frontier Economics project total loss of value to black and brown coal plant of $9B to 10.6B, with an approximate split between brown/black coal damages of 60/40 to 50/50 (Figure 47). In contrast, MMA predict total damages across brown and black coal plant of only $3.2B - or just $200m if black coal plant that increase in value are included. The MMA estimated split in damages is roughly 70/30 towards brown coal (or 100% to brown coal if black coal plant that increase in value are included). The Commonwealth appear to have used the modelling results of MMA to base their generator compensation arrangements.

Figure 47: Comparison of estimated generator losses, (NPV 2010-2020, $m)



Source: Frontier, CPRS White PAper

The key to these losses is the estimated cost pass-through of carbon costs into electricity prices, discussed in detail below. MMA predict average pass-through of carbon costs (or an electricity allocation factor) of 0.99tCO2/MWh over the modelling period. This is enough for black coal plant to recover their full carbon costs, on average, but not enough for brown coal plant to recover costs. In contrast, ACIL, ROAM and Frontier estimate average cost pass-through of 67% to 75%, which is insufficient for black or brown coal to recover their carbon costs.

All of these loss estimates only consider the first ten years of operation of the CPRS, though the potential for losses is much greater in the second ten years when (a) the carbon price is higher and (b) the emissions intensity of the market falls significantly due to new entrant plant, restricting the scope for pass-through of carbon costs via wholesale electricity prices.

4.2 Explaining the differences

The differences between most modelling results of generator losses and those of MMAs, which are adopted by the Commonwealth are difficult to explain as MMA provides little information about how they form their views on carbon cost pass through. Given the potential magnitude of the losses to generators this lack of information about how the Commonwealth have formed their position on compensation for generator losses is surprising.

The following seeks to describe, from the little information provided by MMA or the Commonwealth, the key reasons for the differences in model outcomes are summarised below.

4.2.1 Summary review of MMA approach

The MMA modelling attempts to incorporate strategic bidding into the electricity market price modelling. The approach (described below) mentions Bertrand and Cournot bidding, and appears to change depending on "when new plant are needed":

> "A range of bidding options for thermal plant to maximise profit from trading in the spot market is assumed up to the time new plant are needed. After new plant are needed, all new base load plants follow Bertrand bidding with the remaining plants bid at short run marginal cost plus an additive factor in all regions. For existing plants, (sic) and were formulated based on a Cournot gaming algorithm which allowed generators to adjust plant availability to maximise profits" (p5) [32]

Prices (and generator values) are highly dependent on these assumptions, though there is insufficient information to comment in detail. The "additive factor" is not explained. It is mentioned in Section 3.6 that assumed bidding strategies are an important driver of results:

> "small changes in bidding strategies could have marked impacts on profitability of each unit (some units higher, some units lower) without affecting greatly the aggregate variables such as electricity prices and resource costs." (p33)

Given that there will be more opportunities for new entrant plant over time, and that the average emissions intensity of the market will be falling over time, the

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32 P5, Impacts of the Carbon Pollution Reduction Scheme on Generator Profitability, December 2008, http://www.climatechange.gov.au/whitepaper/supporting-documents/pubs/mma-report.pdf

opportunity for cost pass-through could be expected to decline over time. This is not the case in the MMA modelling, which shows the electricity allocation factor increasing over time. The high pass-through is also inconsistent with the assumptions regarding demand-side response, since a higher elasticity of demand (as implied by the MMA modelling) would suggest lower potential for cost-pass through.

One possible explanation for MMA's rising cost pass-through over time is the increased prevalence of new plant, since different bidding assumptions are adopted for new plant (Bertrand bidding) compared with existing plant (Cournot bidding). A footnote states that "in previous studies undertaken by MMA, strategic bidding only occurred until around 2016. Thereafter, short run marginal cost bidding was assumed." This may explain why the results differ from MMA's previous work for the NETT.

Other results

ACIL are explicit in their cost pass-through estimates, which are generally 60-80% (p vii, p15-16). These results and drivers are discussed in detail in Section 3 of the ACIL report. This is generally more consistent with Frontier and ROAM estimates. The ACIL and Frontier results also show pass-through declining over time, as could be expected with new low emissions-intensive entrants. The ROAM results suggest otherwise, particularly in NSW and Queensland, though the reason for this is not clear.

Table 10: Electricity allocation factors derived from modelled price estimates CPRS 5

Region	Report	2010-2015 (tCO2/MWh)	2015-2020 (tCO2/MWh)	2010-2020 (tCO2/MWh)
NSW	MMA	0.92	1.16	1.04
	ACIL	0.84	0.77	0.81
	ROAM	0.44	0.9	0.67
	Average	**0.73**	**0.94**	**0.84**
QLD	MMA	0.74	1.03	0.88
	ACIL	0.49	0.53	0.51
	ROAM	0.64	1.17	0.9
	Average	**0.62**	**0.91**	**0.77**
SA	MMA	0.91	0.97	0.94
	ACIL	0.79	0.54	0.66

Table 10: Electricity allocation factors derived from modelled price estimates CPRS 5

Region	Report	2010-2015 ($tCO2/MWh$)	2015-2020 ($tCO2/MWh$)	2010-2020 ($tCO2/MWh$)
	ROAM	0.56	0.33	0.45
	Average	**0.76**	**0.61**	**0.68**
TAS	MMA	0.54	1.04	0.79
	ACIL	0.27	0.12	0.2
	ROAM	0.22	0	0.08
	Average	**0.34**	**0.58**	**0.35**
VIC	MMA	0.86	1.28	1.07
	ACIL	0.76	0.73	0.74
	ROAM	0.8	0.8	0.8
	Average	**0.81**	**0.94**	**0.87**
WA	MMA	0.37	0.54	0.45
	ACIL	0.69	0.63	0.66
	ROAM	0.8	0.8	0.8
	Average	**0.62**	**0.66**	**0.64**
Weighted NEM	MMA	0.84	1.14	0.99
	ACIL	0.7	0.65	0.67
	ROAM	0.57	0.85	0.71
	Average	**0.7**	**0.88**	**0.79**
Weighted ALL	MMA	0.8	1.09	0.95
	ACIL	0.7	0.65	0.67
	ROAM	0.59	0.85	0.72
	Average	**0.7**	**0.86**	**0.78**

Source: Table 12.2, CPRS White Paper

Table 11: Frontier estimates of cost-pass through

Scenario	Region	2010-2015 (tCO2/MWh)	2015-2020 (tCO2/MWh)	2010-2020 (tCO2/MWh)
CPRS 5	NSW	85%	73%	79%
	QLD	87%	71%	79%
	SA	93%	87%	90%
	WA	62%	56%	59%
	TAS	77%	62%	70%
	VIC	83%	77%	80%

Source: Frontier modelling (assuming competitive bidding)

4.3 Electricity Sector Adjustment Scheme (ESAS)

The CPRS proposes an Electricity Sector Adjustment Scheme (ESAS) to maintain future energy security. The proposed size of the compensation pool (approximately $3.9B) is based on the MMA results. The division of the compensation pool between brown and black coal plant is determined by a proposed baseline of 0.86tCO2/MWh. This baseline is based on the average emissions intensity of fossil fuel fired generation in Australia. Hence the higher a generator's emissions intensity, the larger its share of the ESAS pool. Given that brown coal generators have emissions intensity (on average) closer to 1.25tCO2/MWh, while black coal generators have emissions intensity closer to 0.9tCO2/MWh, this choice of baseline will result in an approximate split of compensation of around 80% for Brown Coal and 20% to Black Coal. This rough calculation assumes:

- Output contribution of 30% Brown Coal / 70% Black Coal, and
- Average emissions intensity of 1.25tCO2/MWh for Brown Coal and 0.9tCO2/MWh for Black Coal

This division of compenstion may be appropriate under the MMA results, where the estimated split in losses is 70/30 (or 100/0) in favour of brown coal. However, the other results suggest a more appropriate division of losses is closer to 60/40. The alternate modelling results suggest that the baseline adopted for the ESAS division of compensation does not fully account for the source of losses to generators (which is driven by the entry of new low emissions plant with lower emissions intensities that restrict the ability of coal plant to pass through their carbon costs).

Using a simple average of cost pass through from the Commonwealth modelling of 0.78tCO_2/MWh, this changes the mix of compensation to approximately 63% Brown Coal / 37% Black Coal. However if the MMA results are discarded as an outlier then the baseline (as estimated by ACIL and ROAM) would be closer to 0.7, which would be more like 54% Brown Coal / 46% Black Coal.

Appendix 1: International comparisons

In the below tables are the greenhouse gas emissions reduction targets of Australia, Canada, US and the EU for 2020. The stated objective of each country has been shown, as well as the target expressed in the years 1990, 2000 and 2006. For example Australia's 2020 target is to reduce emissions to 5% below 2000, which represents a 9% reduction on 2006 levels (because emissions levels have increased). The following figures were determined using data on absolute emissions of Greenhouse Gases (GHG's) including Land Use Land Use Change and Forestry from the listed nations extracted from the UNFCCC site [33]

Commentary

Given that Australia's reduction targets are expressed as a percentage reduction on **2000** levels (551mtCO2), every 5% lowering of the target results in approximately 27mt less emissions in 2020. This refers to a target for all of Australia's emissions.

In practical terms, the proposed CPRS covers approximately 75% of all emissions, so every additional 5% reduction in the target will roughly reduce the number of permits sold by the government by around 20m. At a projected permit price of around A$33/tCO2e by 2020, this translates to approximately $660m less government revenue from carbon permit sales in 2020. (Less revenue will be earned from permit sales in years between 2013-2020, but the difference will be much less).

If the target is lower, it is unlikely that Australia's domestic emissions will actually fall by 20mt in 2020 – firms will likely import an additional 20mt from overseas (since modelling suggests it is cheaper for Australia to pay others to abate in 2020, even at the current targets). It is also safe to assume that carbon prices will not rise: Australia will be a price taker on global carbon markets (based on all modelling), so increasing the abatement target will not increase the global carbon price. The increased demand for permits from Australian firms will have minimal effect on global prices, hence costs to firms will not rise.

Targets

Each country expresses the 2020 target relative to cuts in a reference year, though the reference year differs for each. For example, Australian cuts are relative to 2000 levels while the cuts are EU relative to 1990 levels.

33 United Nations Framework Convention on Climate Change http://unfccc.int/national_reports/annex_i_natcom_/items/1095.php

The columns translate this target to equivalent reference years; percentages marked in red reflect the reference year for that country. For example, Australia's cuts of 5% relative to 2000 reflect a 3% reduction relative to 1990, or a 9% cut relative to 2006. Waxman-Markey has very recently been revised to 17% below 2005 levels.

Table 12: Comparison of 2020 targets, expressed as a change on year by column

Region	Stated objective (2020)	1990	2000	2006
Australia	5% below 2000 levels[34]	-3%	**-5%**	-9%
Australia	10% below 2000 levels[35]	-8%	**-10%**	-14%
Canada	20% below 2006 levels[36]	+24%	-3%	**-20%**
European Union (EU)*	20% below 1990 levels[37]	**-20%**	-14%	-13%
United States (Waxman—Markey)	20% below 2005 levels*	-4%	-16%	**-17%**

EITE treatment

Table 13 provides a comparison of proposed approaches to EITEI in the EU ETS and the US (Waxman-Markey).

34 Australian Government Department of Climate Change http://www.climatechange.gov.au/whitepaper/index.html

35 Australian Government Department of Climate Change http://www.climatechange.gov.au/whitepaper/index.html

36 Australian Government Department of Climate Change http://www.climatechange.gov.au/whitepaper/index.html

37 Australian Government Department of Climate Change http://www.climatechange.gov.au/whitepaper/index.html

Table 13: Comparison of EITEI treatments

	EU ETS Phase III	Waxman-Markey	CPRS
Emissions intensity	Permit costs > 5% of gross value added	Energy intensity > 5% [Electricity +Fuel costs] / $ Revenue OR Emissions intensity > 2500 tCO2e per $m of revenue;	"High" Emissions intensity > 2000 tCO2e per $m of revenue; OR Emissions intensity > 6000 tCO2e per $m of value added "Low" Emissions intensity > 1000 tCO2e per $m of revenue Emissions intensity > 3000 tCO2e per $m of revenue
Trade exposed	Non-EU trade intensity > 10%	Trade intensity > 15% [Value of imports and exports] divided by [Value of domestic production + value of imports]	Trade intensity > 10% [Value of imports and exports] divided by [value of domestic production]
Baseline rate	100% of benchmark (cleanest 10% in the EU)	Up to 100% of baseline rates (subject to overall cap)	94.5% / 66%
Rate of decline	N/a	N/a	1.3%/year 4.5%/6% reduction after year 5

Appendix 2: Carbon prices, abatement and auction revenue

This Appendix describes the theory underlying carbon price determination with and without international trade, and the implications of increased abatement targets on carbon prices and government revenue.

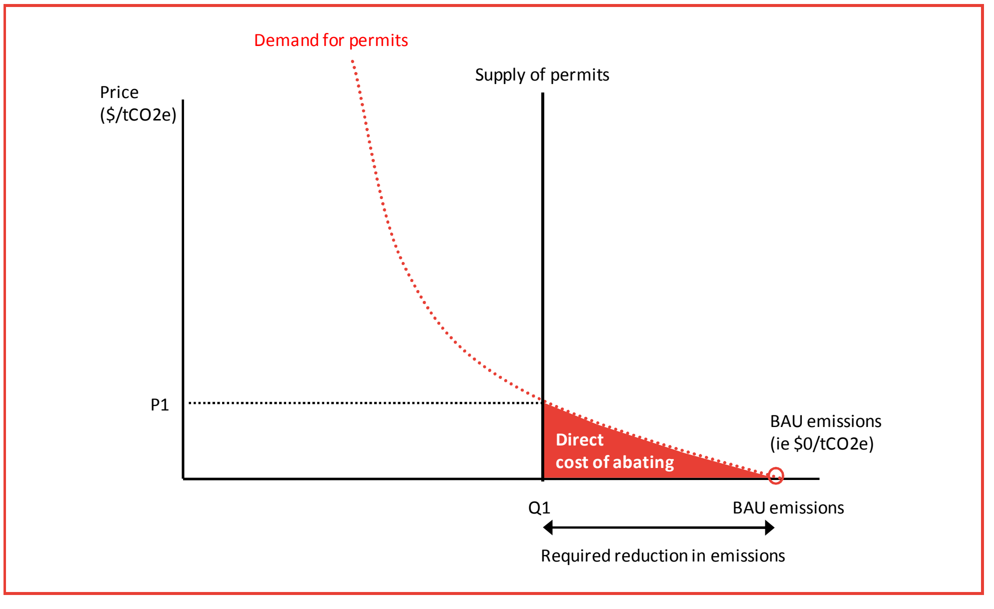
Without international permit trade

Permit price determination is a function of the cost of reducing emissions and the amount of permits sold. In the absence of emissions trading, there is an implied unlimited supply of permits and the carbon price is zero.

Business as Usual (BaU) emissions – or Reference Case - is marked on the simple example in Figure 48 where the carbon price is zero. Emitters may take actions to reduce emissions, though these actions are costly. If a carbon price is introduced, emitters will prefer to take action to reduce their emissions if the cost of doing so is less than the carbon price. As such, demand for permits is downward sloped: demand for permits falls as the carbon price rises. Conversely, emitters take greater action to reduce emissions as the carbon price increases.

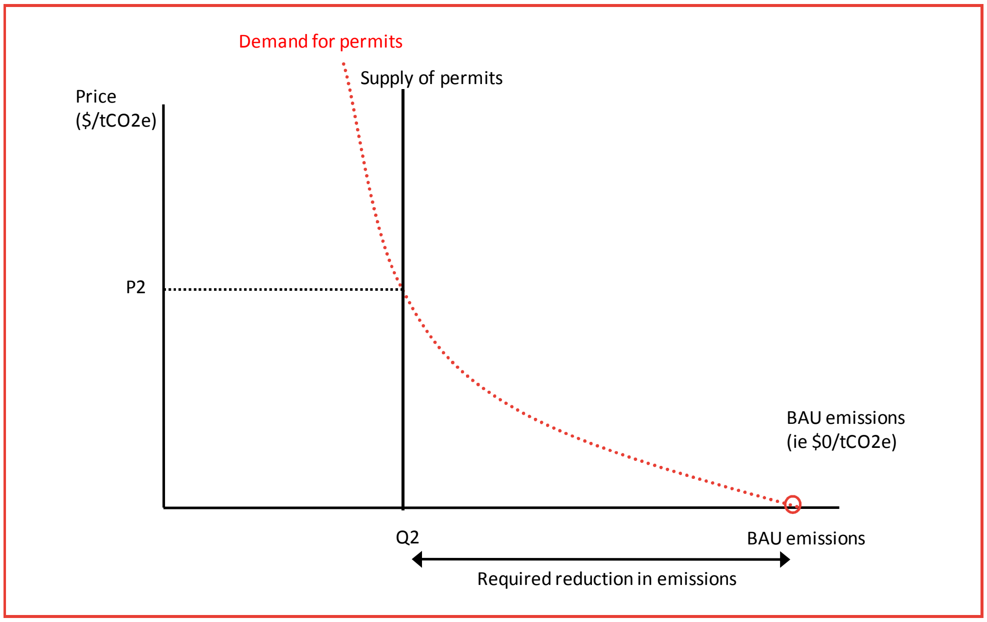
Supply of permits is determined by the target set by the government, which is fixed. In this example, restricting supply of permits to Q1 results in a carbon price of P1. This is the price necessary to encourage the required reduction in emissions from BaU to Q1.

Figure 48: Carbon prices and abatement (Target 1)



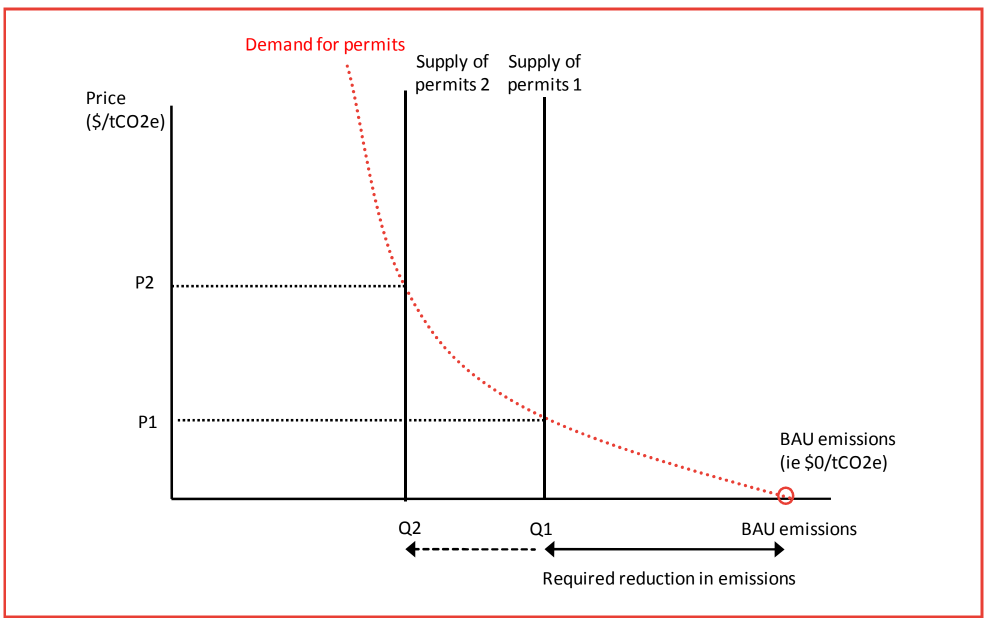
In the second example (Figure 49), the supply of emissions is reduced to Q2 as the Government sets a greater abatement task. In this example, where there is no international trade of permits, the cost of further reducing emissions increases and the carbon price rises to P2.

Figure 49: Carbon prices and abatement (Target 2)



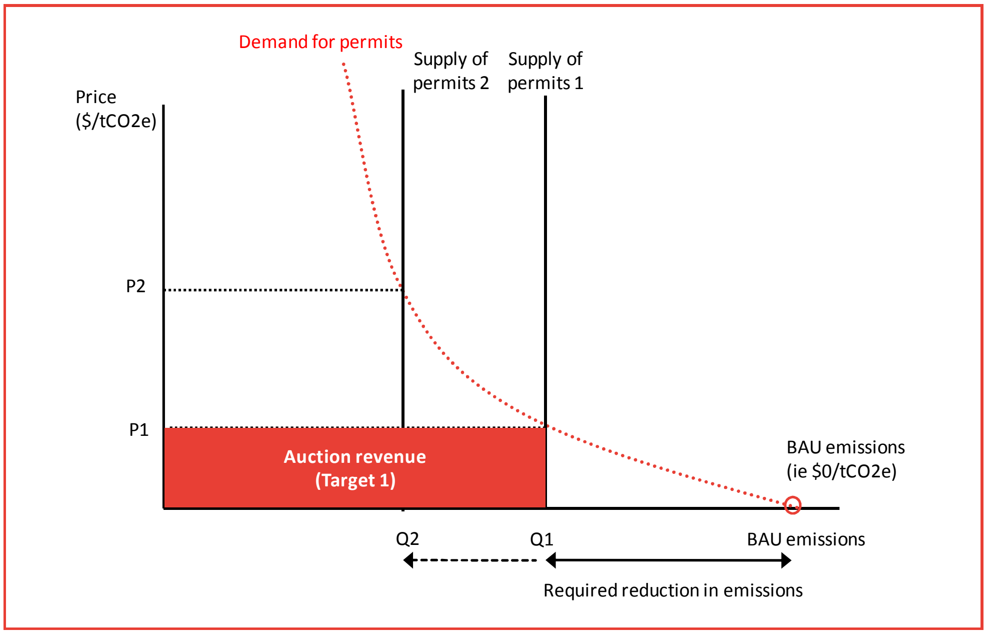
These hypothetical targets are compared in Figure 50.

Figure 50: Carbon prices and abatement – comparison of targets



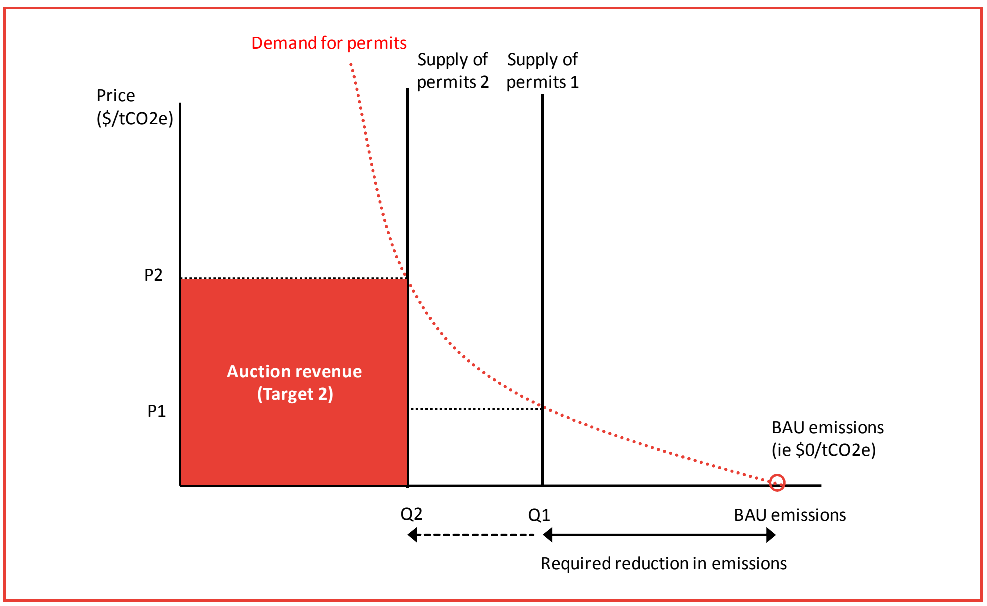
The auction revenue accruing to the Government in each case is a function of the number of permits sold (Q1) multiplied by the market carbon price (P1).

Figure 51: Auction revenue (Target 1)



If the supply of permits is reduced (the abatement target is increased) then it is not clear whether auction revenue increases or falls: the carbon price increases (to P2) but this is offset by a reduction in permits sold (to Q2).

Figure 52: Auction revenue (Target 2)



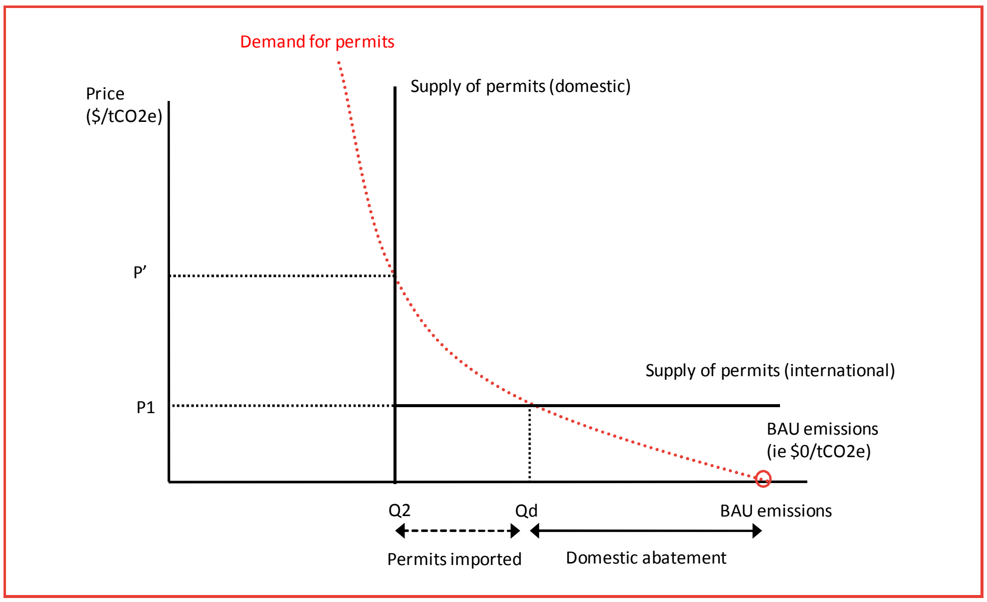
All of this suggests that an increase in Australia's abatement targets (a reduction in permits sold) will increase carbon costs to businesses and the economy *in the absence of international trade of permits*. However, this simple example ignores the impact of international permit trade, which is considered below.

With international permit trade

When international trade is considered the effects are quite different. Since the supply of world permits will be substantially greater than the Australian supply, Australia can expect to be a price taker in global markets. Australia will abate up to the point that it is less costly than paying other countries to abate. Given Australia's relatively small share of global emissions, Australia will generally be able to purchase permits without affecting global prices.

This being the case, if Australia sets a harder abatement task (and sells less domestic permits) then Australia will only abate up to the price of international permits and will import the remainder. Hence in Figure 53, Qd represents domestic emissions and (Qd –Q2) represents permit imports. The carbon price faced by Australian companies is the same as if the domestic supply of permits were Q1, and the amount of domestic abatement is the same. Industry will be generally indifferent between the two situations, since they will emit a similar amount and pay a similar carbon price.

Figure 53: Carbon price and domestic abatement – with international trade



The main difference between this example and the example without international trade is that if the abatement target is increased (domestic supply is reduced) then fewer permits will be sold by Government and more permits will be purchased from the international markets: see Figure 54 and Figure 55. This effectively represents a transfer from the Government to international markets, though in practice the magnitude of this transfer will be relatively small (see discussion later).

Figure 54: Auction revenue: Target 1

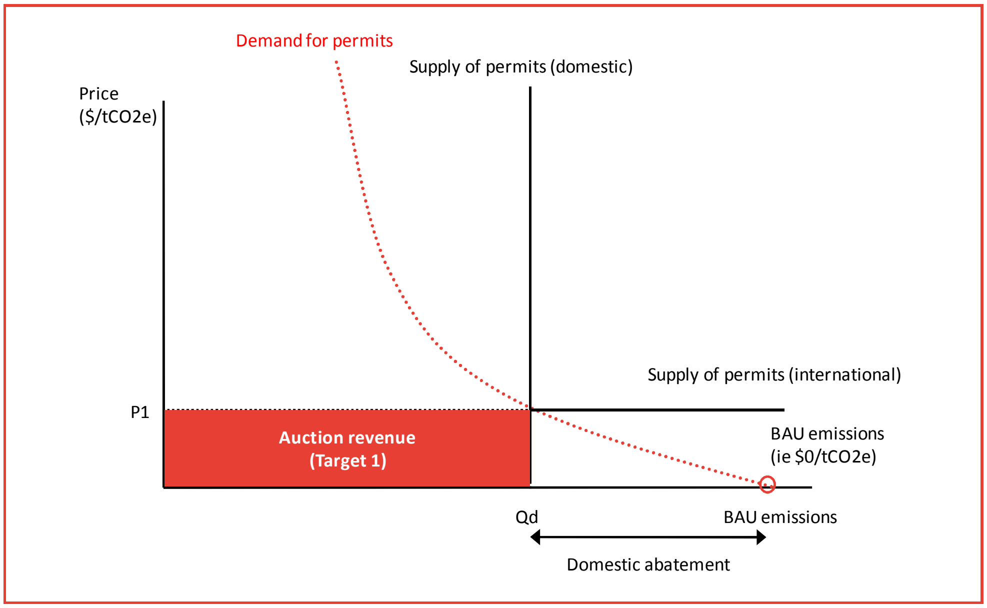
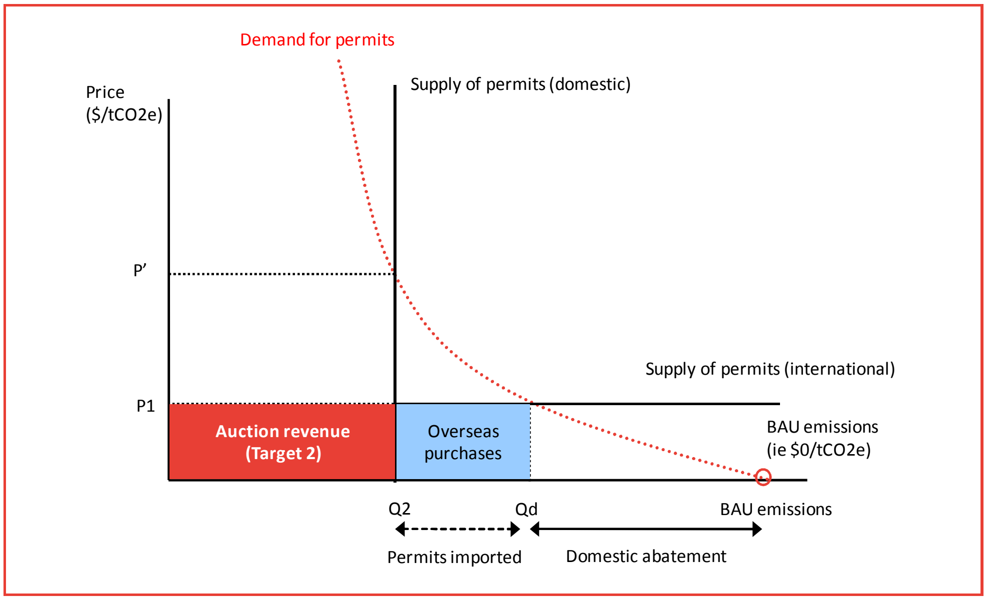


Figure 55: Auction revenue: Target 2 (greater reduction)



Appendix 3: Emissions baselines

This Section provides an introduction to output base rebates or intensity targets. The key message is that a baseline conditional on output retains exactly the same incentive to reduce production emissions (improve efficiency) as a full auction or full grandfathering of permits. The only difference is a potentially reduced incentive to mitigate consumption emissions due to more muted prices. However, since Australia is generally a price taker in most markets, international consumption emissions are largely out of Australia's hands. Hence, any net increase in production costs will result in reduced margins (and production) in Australia which, if international prices remain the same, will be offset by increased production elsewhere. This is the rationale for the treatment of emissions intensive trade exposed industry in the EU ETS and in the proposed Waxman-Markey Bill in the United States (referred to as the Inslee-Doyle provisions).

Figure 56 presents a simple example of a relatively high emitter (producer 1) and a relatively lower emitter (producer 2), each producing the same good. In the absence of a carbon price, neither emitter pays anything for these emissions. Note that total emissions are a function of the total number of goods produced (and consumed) and the emissions intensity of production. Hence it is possible to reduce emissions by (a) reducing consumption (reducing output from Producer 1 and Producer 2) and/or (b) reducing the emissions intensity of production, for example decreasing production from Producer 1 and increasing production from Producer 2.

Figure 56: Simple example – cost impact on different emitters

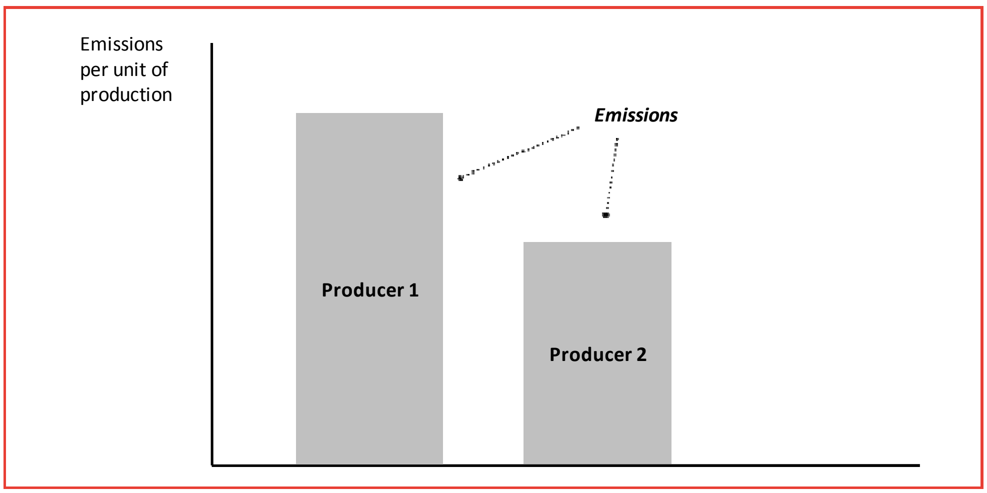


Figure 57 presents the impact on each producer where a carbon price is introduced and all permits are auctioned. Both producers see an increase in their costs, though the costs of the higher emitter increase by a larger amount. If these producers are price setters in the market then the price of the product will rise.

Each producer would receive the same increase in price, so the margins of the higher emitter will be reduced relative to the low emitter. This should encourage increased output from Producer 2 and decreased output from Producer 1. This reduces overall emissions for the same number of goods produced, hence a reduction in overall emissions intensity. This is a reduction in production emissions. There may also be a reduction in consumption in response to the increased prices; hence a reduction in overall goods produced. [38]

Figure 57: Simple example – cost impact of full auctioning

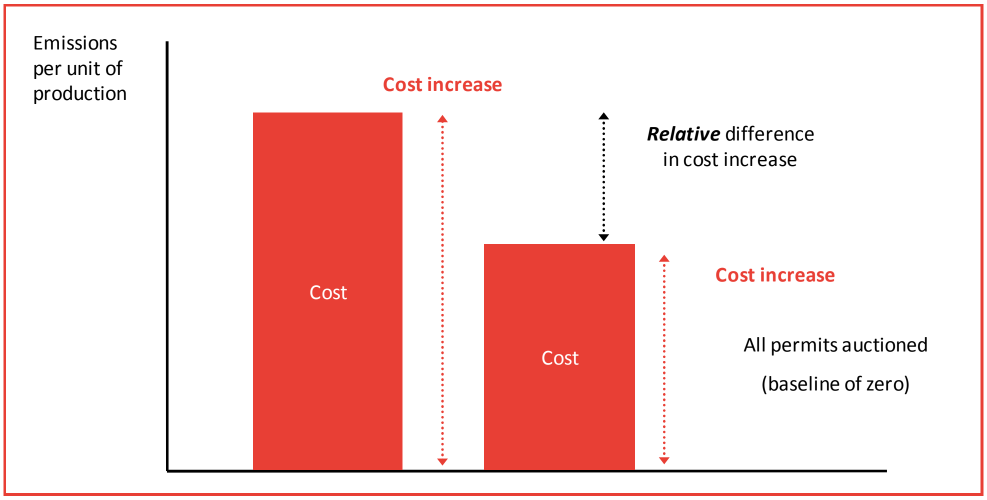
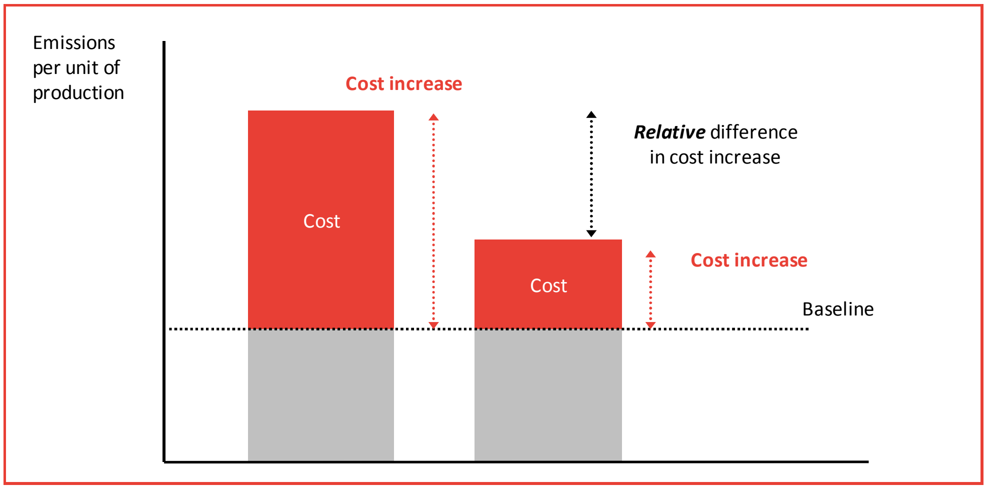


Figure 58 presents the case where permits may be allocated up to a baseline number of permits per unit of production. In this example, the baseline is below the emissions of each producer. Each producer is liable only for their emissions above the baseline. The increase in costs for each producer is less than in the previous example, hence the price effects (assuming they are price setters) will be less pronounced. Importantly, the relative change in costs is exactly the same as in the previous example; hence the incentive to substitute production from the high emitter to the low emitter is just as strong. The revenue accruing to the permit distributor (ie the Government) is less in this example, but then so is the need to compensate consumers for any price increase.

38 If these producers are price takers (for example, in global markets), then unless there is a concurrent increase in costs for global competitors then there would be no increase in prices, nor any decrease in global consumption. Gross margins would be reduced for each producer, and production would decline for each. If global consumption for the product doesn't fall, this fall in production would be met with an increase in overseas production.

Figure 58: Simple example – cost impact of partial auctioning



A higher baseline is represented in Figure 59. In this example, Producer 2 is below the baseline and receives credits for the difference. The increase in costs to Producer 1 is lower than in the previous examples but again, the relative change in costs is exactly the same because of the credits to Producer 2. The end-product price effects (assuming price setters) will be lower in this example than in the examples above.

Figure 59: Simple example – cost impact of partial auctioning

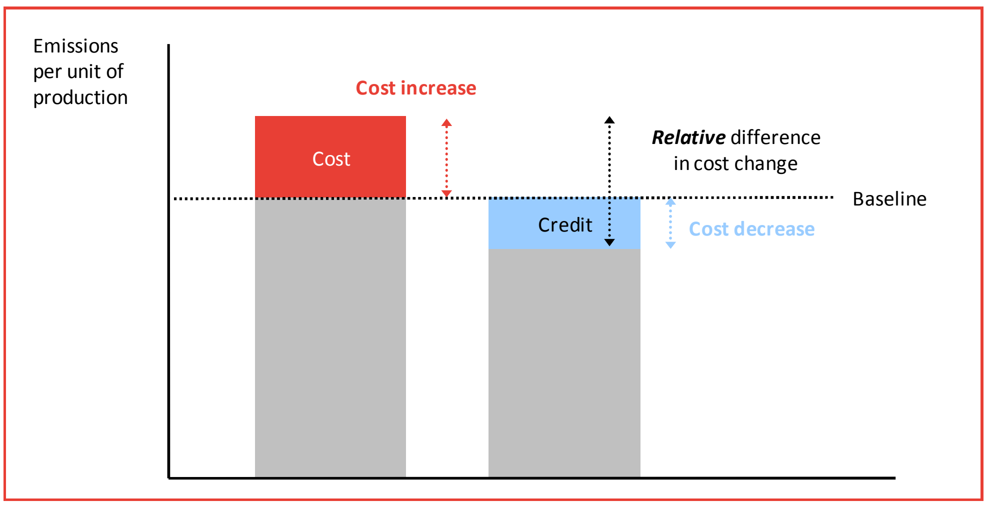
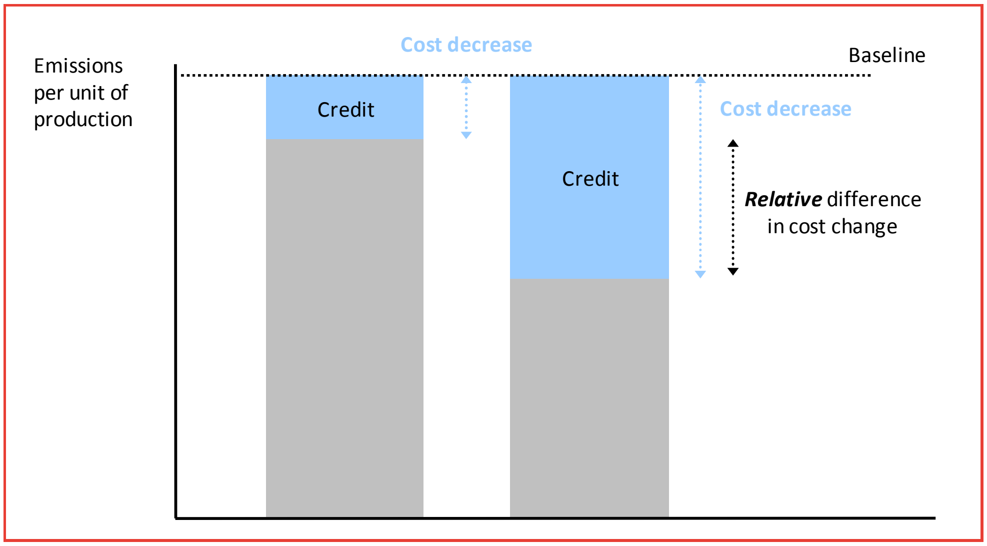


Figure 60 shows the baseline above the emissions of all – this is equivalent to a pure offset arrangement (or baseline and credit, such as the Kyoto Clean Development Mechanism or the Renewable Energy Target). In this example, funds must be raised from another source to pay for the credits.

Figure 60: Simple example – cost impact of partial auctioning



The point of this example is to demonstrate the difference between production abatement and consumption abatement, and how the incentive to reduce production emissions is just as strong regardless of where the baseline is set.

The difference between the different baselines will be reflected in final product price (where the producer is a price setter), or in the margins of producers (if price takers).

Adopting a baseline for the electricity sector will result in lower price effects than adopting an implicit baseline of zero. The higher prices under the CPRS as proposed are transfers from consumers to the Government – the additional abatement resulting from this price increase is minimal (as the results show), though it significantly increases tax churn and this has greater cost implications for the economy as a whole.

Appendix 4: Competitiveness and carbon leakage

Consumption versus production emissions

The challenge for reducing emissions can be divided into production and consumption decisions. A reduction in the emissions intensity of production will reduce emissions for a given level of future growth. Alternatively, reduced consumption of emissions intensive products will also reduce emissions (for a given level of emissions intensity).

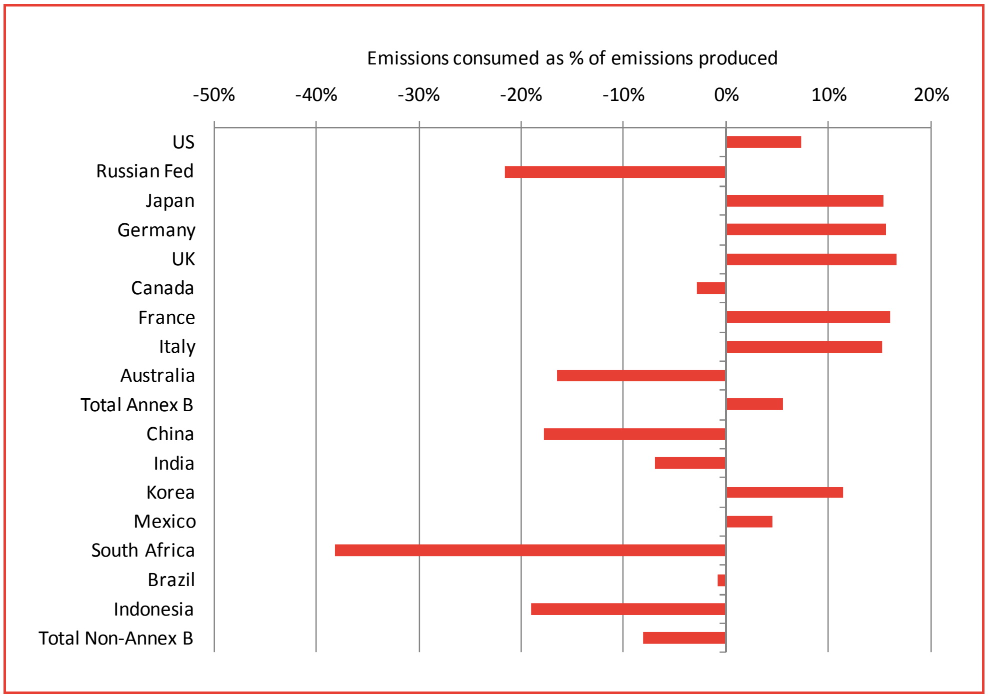
Industry will have incentive to reduce production emissions so long as there is a relative difference in emissions liability. As discussed in Appendix 3, this incentive is the same whether producers are liable for all of their costs, or whether intensity targets are used. This is consistent with the notion of "clean growth".

Consumption emissions may be reduced (potentially) as a result of an increase in final prices which aims to discourage consumption of more emissions intensive goods. In practice, most demand for energy intensive products is relatively insensitive to prices, hence most gains will be achieved on the production side or through complementary measures to reduce demand.

Unlike most developed nations, Australia's production emissions are significantly larger than consumption emissions (Figure 61). In other words, most of the emissions that Australia produces are contained in export goods that are consumed in other nations. This is typically more common for developing nations and reflects Australia's comparative advantage in natural resources. Since Australia exports a significant share of the emissions it produces and is a generally a price-taker in global markets, this makes it extremely difficult to reduce emissions through reduced consumption, hence our view that the focus of Australia's efforts should be on reducing the emissions intensity of production until other nations take action to reduce their consumption.

Since Australia is a small, open, emissions intensive economy, partial rebates for EITEI will not change global prices, and hence they will not change global consumption emissions. If consumption of Australia's emissions intensive exports does not fall then there is unlikely to be any value in Australia reducing its production because demand would dictate that the products would be produced elsewhere. The only potential for environmental benefit is if the overseas alternative can be produced with fewer emissions - this is less likely to be the case if the substitutes are from nations without comparable emissions reduction schemes.

Figure 61: Emissions by production/consumption



Source: Peters and Hertwich, CO2 Embodied in International Trade with Implications for Global Climate Policy, *Environmental Science and Technology* (2009)

This will be a more material issue for larger economies which may have a greater influence on global prices (e.g. the EU or the US), however there would appear to be more value in reducing the emissions intensity of Australian production rather than reducing Australian production ("clean growth").

This is implicitly acknowledged in the proposed Garnaut approach, which attempts to set shielding rates to reflect the change in global prices. This will be a function of changes in policy in other (larger) nations. In practice however this approach is extremely difficult given that there will be differences in approaches to climate change policies, particularly with regard to developed/developing nations and the treatment of EITEI. Even if the EU and the US adopt emissions trading schemes, if they also adopt measures to address carbon leakage then the increase in global prices for energy intensive products will be only small.

Ideally, similar benchmarks/baselines could be adopted across countries with emissions trading schemes. This is more reflective of sectoral agreements.

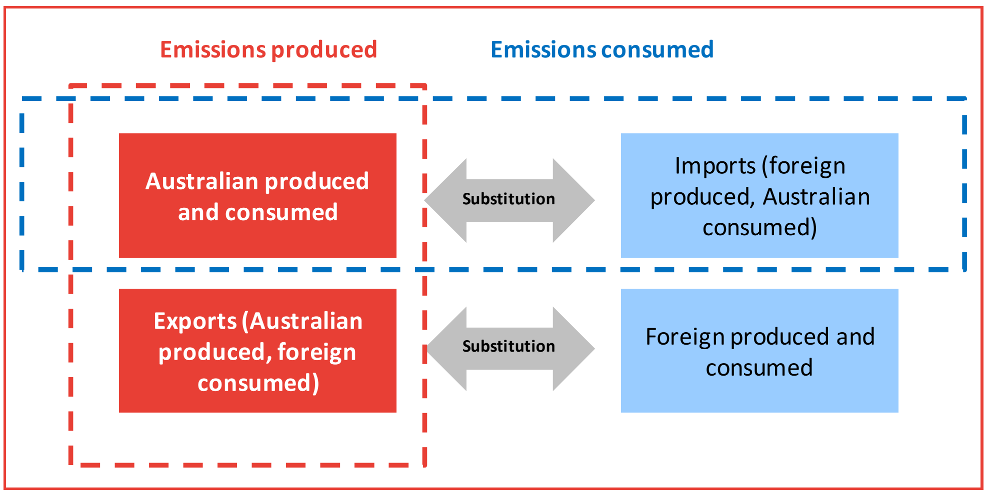
There is certainly no value in adopting different thresholds with partial measures to address carbon leakage, as proposed in the CPRS with the 90/60 thresholds, when the proposed treatment in the US and the EU is higher.

Consumption tax

One alternative scheme design that has been proposed is a consumption tax, which is intended to address the carbon leakage issues discussed above. This section provides a summary of the key differences between the approaches and the implications.

Firstly, products (and associated emissions) can be divided by categories according to where they are consumed and where they are produced. In Figure 62, Australian production emissions are associated with goods consumed in Australia and those exported for consumption elsewhere. Australia's consumption emissions include those associated with goods produced locally and those that are imported. Note that all Australian production can be substituted for foreign produced goods regardless of where the goods are consumed, (though this won't necessarily reduce global emissions). This is the basic notion of carbon leakage. From the discussion above, Australia produces and exports a greater amount of emissions than it consumes.

Figure 62: Emissions and trade



If Australia increases the cost of producing goods due to a carbon price and other nations do not, this increases the possibility of substitution from Australian production to foreign production. This may result in increased imports and reduced exports.

Given the limited history of operating emissions trading schemes (and the very low carbon prices in the first phase of the EU ETS) it is too early to conclude that carbon leakage is not a risk. Certainly, it would be prudent to insure against this risk.

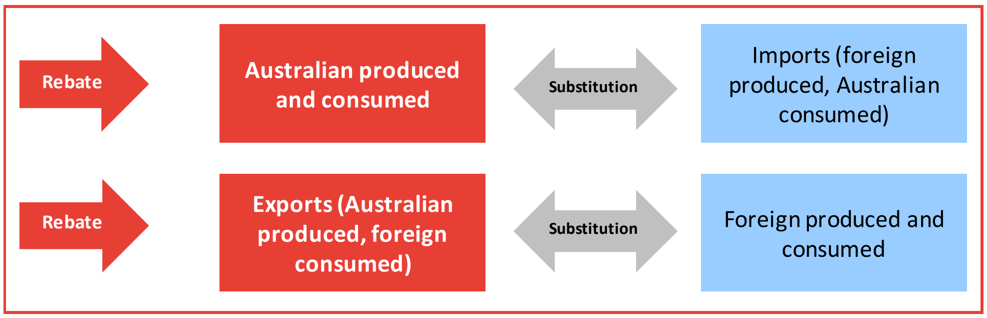
Options for reducing this risk both involve offsetting the loss of competitiveness of local products versus foreign substitutes. Very briefly, these include:

- Rebates on locally produced goods to offset the increase in costs: these operate to reduce the cost of locally produced goods, though it is important to note that are tied to output, not emissions, hence they preserve the incentive to reduce emissions (since a reduction in emission intensity will still lower costs)

- Border taxes to increase the costs of foreign produced goods

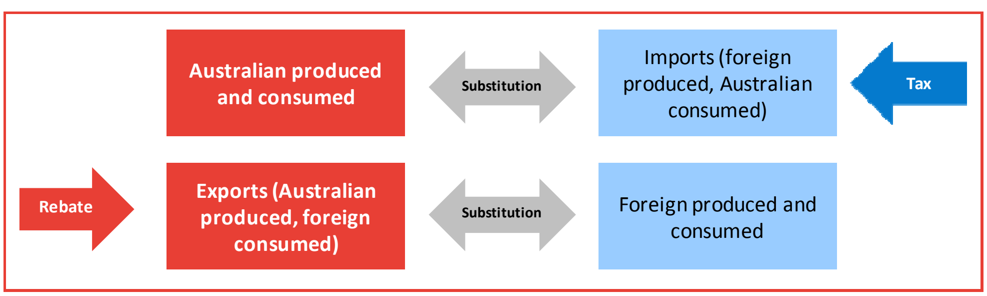
The proposed EITEI treatment under the CPRS is an Output Based Rebate on locally produced goods (both exports and locally consumed). This is illustrated in Figure 63.

Figure 63: Output based rebate



The modified Consumption tax (as proposed by Geoff Carmody) proposes to adopt a similar approach to the CPRS for dealing with exports (an output based rebate) but proposed a border tax adjustment on foreign imports (at a rate that reflects the Australian average emissions intensity for the same good. This is the fundamental difference between the two (hence the difference is not significant enough to warrant modelling). Moreover, the border tax adjustment methodology is problematic, since it in effect imposes an Australian average emissions intensity on imported goods. This is problematic from the point of view of international trade law.

Figure 64: Border tax adjustment



FRONTIER ECONOMICS AUSTRALIA
BRISBANE | MELBOURNE | SYDNEY | LONDON | BRUSSELS | COLOGNE | MADRID
Frontier Economics Pty Ltd 395 Collins Street Melbourne Victoria 3000
Tel. +61 (0)3 9620 4488 Fax. +61 (0)3 9620 4499 www.frontier-economics.com