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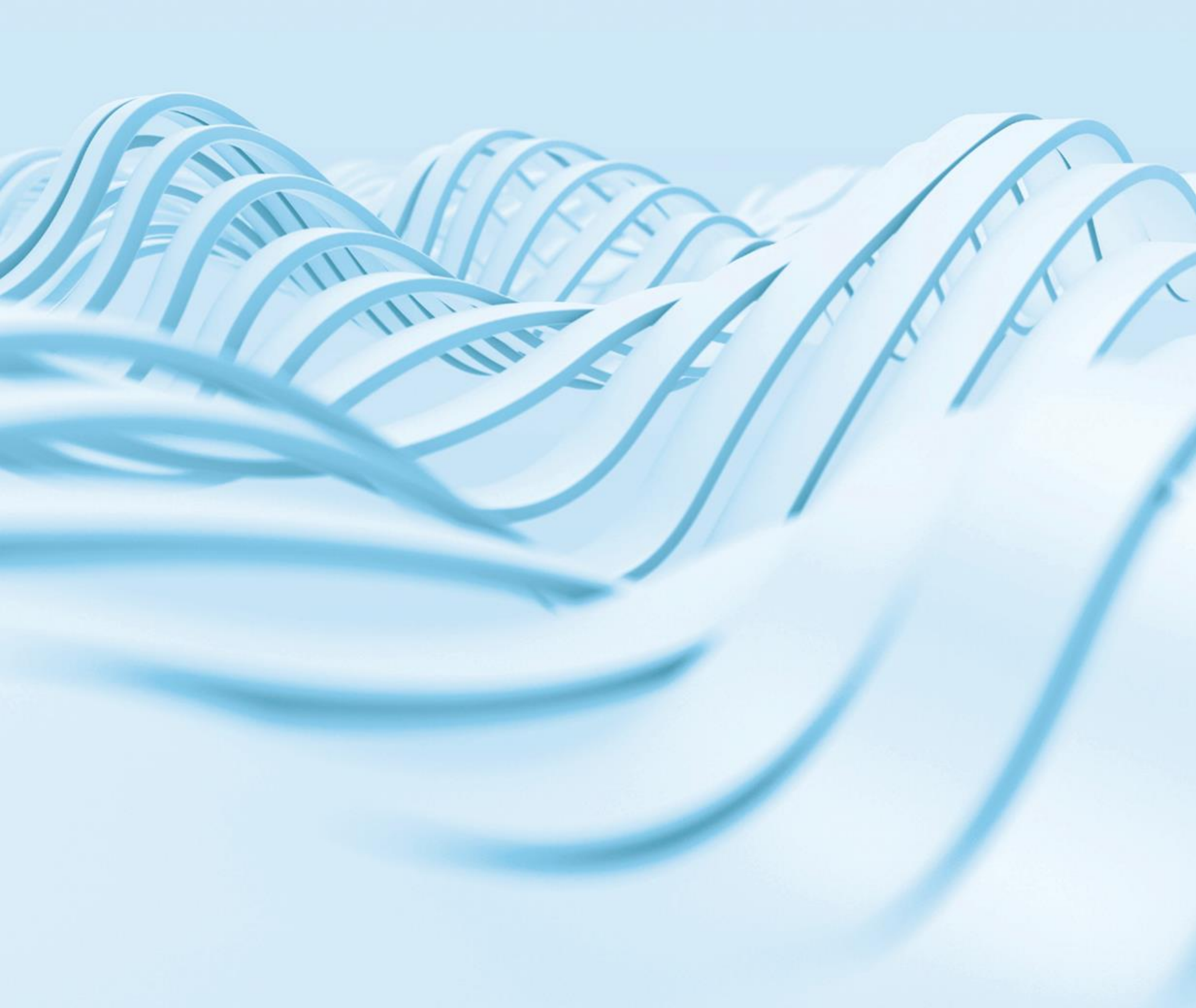
5-year Productivity Inquiry: Managing the climate transition

Inquiry report – *volume 6*



The Productivity Commission acknowledges the Traditional Owners of Country throughout Australia and their continuing connection to land, waters and community. We pay our respects to their Cultures, Country and Elders past and present.

The Productivity Commission

The Productivity Commission is the Australian Government's independent research and advisory body on a range of economic, social and environmental issues affecting the welfare of Australians. Its role, expressed most simply, is to help governments make better policies, in the long term interest of the Australian community.

The Commission's independence is underpinned by an Act of Parliament. Its processes and outputs are open to public scrutiny and are driven by concern for the wellbeing of the community as a whole.

Further information on the Productivity Commission can be obtained from the Commission's website (www.pc.gov.au).

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The Commission’s report is divided into 9 volumes: an overview document (volume 1) that presents our policy agenda, and inquiry content volumes (volumes 2–9) that explain in greater detail the reforms that make up the policy agenda, including a modelling appendix. The full report is available from www.pc.gov.au.

Preface

Australia's contribution to global decarbonisation efforts, and our need to adapt to a changing climate, will inevitably bring costs, uncertainties and opportunities. Policy settings will be critical for promoting least-cost pathways and providing the capacity and the flexibility to manage risks and harness opportunities.

Decades of competing approaches to climate policy have left Australia with a hodgepodge of narrowly applied, sometimes inconsistent sectoral abatement measures that not only impose an unnecessarily high cost on the community but often are ineffective in achieving abatement. Investments in key sectors like electricity generation have been delayed and distorted by the lack of clear policy direction.

The economic costs of this approach are increasingly apparent: laying bare the reality that decisions to avoid technology 'neutral' economy-wide abatement mechanisms do not avoid the pricing of emissions — they only lead to a myriad of very high implicit or 'shadow' emissions prices.

Pursuing a least-cost approach to net zero emissions and adapting to a changing climate will be a key productivity challenge for Australia. With climate-related investments over coming decades to be measured in the tens and hundreds of billions of dollars, policy settings that distort even a small proportion of this investment will significantly impact our productivity growth performance over the decades ahead.

This volume seeks to identify a path from existing policy settings to a sustainable climate policy architecture for Australia — that is, one that provides greater certainty, clarity and enduring support for efficient abatement and adaptation decisions over the decades ahead.

This includes progressively recalibrating the Safeguard Mechanism to become Australia's principal economy-wide mechanism for achieving national abatement targets. Among other things this will entail taking steps to strengthen the integrity of recognised emissions offsets, expanding sectoral coverage, allowing the transfer of emissions rights within and between covered sectors and phasing out other abatement policies that are not complementary to it.

Efficient adaptation to the effects of climate change will require giving individuals, households and businesses the information they need to make decisions in their own interests to adapt to a changing climate and avoiding policy settings that inadvertently constrain those decisions.

1. Managing the climate transition

Key points

- **Climate change looms large over Australia's productivity performance. Its potential physical impacts, and the policy steps taken in response, will affect Australia's productivity growth over coming decades.**
  - Climate change is expected to directly impact productivity in agriculture, fisheries, tourism and in those sectors that rely on physical labour in heat-exposed environments.
  - Alongside these expected physical impacts, policy efforts to contain the costs of climate change, by both reducing emissions and by adapting to a changing climate, will also impose costs.
  - Climate policies of the world's major economies risk reducing demand for key Australian exports.
- **A key productivity challenge will be achieving our 2030 and 2050 emissions reduction targets as efficiently as possible. Continued reliance on a suite of ad hoc sectoral policy measures will unnecessarily reduce productivity growth and living standards. Economy-wide settings that create enduring incentives for credible abatement could achieve our emissions targets at lower cost.**
- **The centrepiece of Australia's abatement policy should be a Safeguard Mechanism (SM) that (i) is broadened to include the electricity sector at the facility (rather than sector) level and the transport sector; (ii) includes lower greenhouse gas emission thresholds, to increase the range of facilities captured by the SM; and (iii) lets facilities earn credits for abatement below their baselines.**
- **Abatement policies outside the Safeguard Mechanism framework should show how they are complementary to it and have their implicit carbon abatement costs independently estimated and made public. Policies found not to be complementary should be phased out.**
- **Public support for R&D into new technologies stands to be complementary to an expanded SM. But with an economy-wide incentive in place, the case for public support will be strongest in the case of frontier technologies where market failures are most apparent, though risks will need to be managed.**
- **Improving the integrity of offsets will be needed to achieve real emissions reductions through an expanded Safeguard Mechanism, including tighter requirements to ensure additionality, permanence and transparency of abatement projects that generate Australian Carbon Credit Units.**
- **Managing the intermittence challenges of an increasingly renewable electricity grid should move back over time toward relying principally on price movements in wholesale electricity markets to balance electricity supply and demand. The Capacity Investment Scheme should be subject to a 5-year sunset clause and would better support supply reliability if technology-neutral.**
- **Adaptation policy should support individual, household and business decisions about what regions, sectors, and occupations they are best placed to transition into. Governments have a role in helping people make informed adaptation decisions and should avoid policy settings that inadvertently constrain them.**

Climate change looms large over Australia's productivity performance over coming decades. Its physical impacts, and the international and domestic policy steps taken to limit them, will affect productivity growth. The physical impacts of climate change stand to be profound (chapter 2) and will directly constrain productivity growth in sectors that are important to Australia, including agriculture, fisheries, tourism and sectors that rely on the exertion of physical labour in heat-exposed settings (box 2.1).

Alongside these impacts, policy efforts to contain the costs of climate change, either by reducing emissions or by adapting to a changing climate, will also affect productivity growth. Efficient adaptation measures would improve productivity growth, relative to what would otherwise be the case, by mitigating the economic impacts of a changing climate. Some individual emissions abatement measures, such as a distributed renewable electricity grid that is less exposed to disruptive international energy price volatility, may prove to have a long-run positive impact on productivity. But abatement measures will generally increase the direct costs of production and thereby weigh on measured productivity growth. These costs are being incurred as part of Australia's contribution to the international effort to reduce the unmitigated economic, environmental and social costs of climate change, likely benefiting all countries including Australia.

In this way, the productivity impacts of higher production costs can be viewed as the price of reducing the chance of even greater climate-related productivity costs in the future. Global emissions abatement policy should be viewed as a global cost-minimisation exercise, and sound domestic climate policy should be viewed as a part of Australia's contribution to that collective effort. Given Australia's commitment to this collective effort, a key policy challenge will be ensuring that the productivity costs of our emissions reduction actions are kept as low as possible. This will maximise our flexibility as we contend with dynamic climate challenges over coming decades and will help to increase the likelihood that the benefits we derive from global action to address climate change will outweigh any cost to Australian living standards.

Finding 6.1
Sound climate policy represents a part of Australia's contribution to global efforts to contain the long-run costs of climate change

Having committed to achieve net zero greenhouse gas emissions by 2050, and an interim target of 43% below 2005 emissions levels by 2030, the economic costs of that contribution to global abatement would be minimised by taking a principles-based, least-cost approach to emissions reductions. This would be complemented by multilateral oversight of the contributions of other nations.

2. Physical impacts

The average temperature of the Earth has increased by 1.1 degrees celsius since the industrial revolution. This warming has flowed from an increase in the stock of heat trapping greenhouse gases in the atmosphere, from about 280 parts per million of CO_2 prior to the industrial revolution, to 414.4 parts per million of CO_2 in 2021 (CSIRO and BOM 2022, p. 3).

The increase in atmospheric greenhouse gases has come from: the release of geological stores of carbon due to coal, oil and natural gas combustion; the release of terrestrial stores of carbon (forests, soil, peat) from deforestation for agriculture and human settlements, and the increased production of methane from the agriculture-related increase in ruminant livestock populations; and the anaerobic decomposition of waste.

It is important to distinguish between annual emissions and the stock of greenhouse gases in the atmosphere. The former are flows, the latter are stocks. The lag between a given increase in the stock of greenhouse gases in the atmosphere and the subsequent increase in the average global temperature means that, even if the world achieved net zero emissions tomorrow, an additional 0.3–1.7 degrees of global warming is estimated to be already 'locked in' (Zhou et al. 2021). As a result, Australia will have to prepare for at least some degree of additional warming, regardless of the speed of global emissions abatement over coming decades. That is, global emissions abatement will be necessary to avoid the worst effects of global warming, but it will not avoid warming entirely.

This 'locked-in' warming is expected to continue to drive structural shifts in the Earth's natural resource systems, which will reduce the availability of some resources, increase the availability of others, and alter their distribution between and within countries. For example, rising temperatures are projected to:

- reduce the availability of land as the melting of land-based ice and the thermal expansion of liquid water drive sea-level rise
- alter the geographical distribution of rainfall, with some regions experiencing increased rainfall while others experience decreased rainfall
- alter the temporal distribution of rainfall, with potentially higher peaks in rainfall at particular points in time
- exceed habitable ranges for some plant and animal species, threatening the viability and productivity of some crops, and the broader ecosystems that agriculture relies upon
- increase the geographical range of pests and diseases that can harm human agricultural production and productivity
- increase the frequency of days with temperature and humidity levels that are hazardous to human health ('wet bulb days')
- increase the geographical range of tropical diseases, and threaten to release pathogens frozen in tundra, to the potential detriment of human and animal health
- increase the frequency and severity of bush and forest fires
- weaken global ocean currents, which combined with increased ocean acidification and deoxygenation, is projected to threaten the viability of some marine species.

Some of these physical impacts have already affected Australia and are projected to continue doing so (box 2.1).

Box 2.1 – Physical climate impacts on key Australian industries

Climate impacts that will be particularly important for Australia include a reduction in agricultural productivity in some regions, as temperature and humidity levels move beyond habitable ranges for some crops. For example, Ortiz-Bobea et al. (2021) estimate that global warming has already decreased global agricultural productivity by 21% since 1961, relative to what would otherwise be the case. Hochman, Gobbett and Horan (2017) estimate that climate change has reduced Australian wheat yields by about 27% since 1990, and Hughes et al. (2022) estimate that climate change over the last 20 years has reduced average Australian farm profits by 23%.

For Australian fisheries, ocean deoxygenation, increases in ocean temperature and increased ocean acidification are likely to push marine environments beyond the habitable range for some species, weakening broader ecosystems in the process. CSIRO (2021) estimates that 70% of key species in Australian fisheries are moderately to highly sensitive to climate change over coming decades.

Ongoing warming also risks degrading Australia's stock of physical capital. Mallon et al. (2019) assessed the degree of climate risk (riverine flooding, coastal inundation, bushfire, subsidence and wind risk) facing 15 million addresses in 544 Australian local government areas between 2020 and 2100, based on topography, biomass coverage, meteorological patterns and climate projections out to 2100. The authors classified 383 300 addresses as high-risk properties and projected that number to increase to 735 654 by 2100, warning that ongoing development … 'in high hazard areas or continued use of inadequate building standards … will substantially increase this number' (ibid, p. 5).

Perhaps the most direct way in which Australians will experience the physical impacts of climate change is through a rise in average daily temperatures, and an associated increase in the number of 'extreme heat' days over the course of the year. The number of extreme heat days that occur each year (days where the average daily temperature is in the warmest 1% of days for each month, measured over the period 1910 to 2019) has grown from 1 in 1910 to more than 40 in 2019, and is projected to continue rising as global warming continues (CSIRO 2020, p. 4). Public awareness of the phenomenon of 'wet bulb days', where temperature and humidity levels exceed the threshold beyond which the human body can cool itself, will grow over the decades ahead. Extreme heat has already been responsible for more deaths in Australia than any other natural hazard. Sectors that have been identified as being particularly exposed to rising temperatures include those reliant on:

- outdoor workers such as construction, agriculture, gardening and landscaping, emergency services, and professional sports
- indoor workers exposed to heat-radiating equipment such as manufacturing, laundries, and professional kitchens (Humphrys et al 2020).

3. Promoting efficient adaptation

Within the evolving environment, an adaptation policy that seeks to promote productivity growth should focus on helping individuals, households and businesses make informed adaptation decisions; and avoid policy settings that inadvertently constrain them.

The vast majority of adaptation-related decisions will be made by individuals, households and businesses in the natural course of their future planning. Individuals are the primary decision makers about which sectors they will work in, households are the primary decision makers about which regions they will live in and businesses are constantly making judgements about the likely course of consumer preferences and the business environments they will likely face in the future, when choosing which goods and services to produce and how to produce them.

3.1 Helping to promote informed adaptation decisions

As a trusted provider of information, and important funder of research, governments are well placed to help inform household and business level adaptation decisions. This is already occurring in a number of helpful ways. The CSIRO and the Bureau of Meteorology publish a biennial *State of the Climate Report* that tracks Australian climate developments and provides updated climate projections every two years. This resource is included on the *Climate Change in Australia* website, which acts as a single source for a wide range of national and regional climate projection information and tools designed to help individuals, households, businesses and governments plan for the decades ahead. Diverse and targeted approaches to the dissemination of climate impact information to households and businesses would be supported through developments such as smartphone applications to provide site specific climate projections for farmers, fisheries managers, town planners and other businesses and professions.

The compulsory disclosure of climate risks, particularly where competing interests preclude the voluntary provision of such information, may be warranted in some cases. The pre-sale disclosure of the climate-related exposures of individual residential and commercial properties is a clear candidate. Mandatory disclosure of the climate-related risks facing a property — such as the likelihood of coastal inundation, riverine flooding, subsidence, destructive winds, bushfire and other natural disasters — would help potential buyers of a property make more informed decisions. Such analysis is already available and could be provided cost-effectively. However, the risk of subsequent reductions in the values of particularly climate-exposed properties might preclude voluntary disclosure by existing owners, and a general lack of awareness may prevent potential buyers from seeking it. Compulsory disclosure could also limit the degree to which government is called upon to become an insurer of last resort for particularly exposed properties, first by making these exposures clear to potential buyers, and second by helping private insurance companies to more accurately price climate risk (box 3.1).

Box 3.1 – Private insurance markets and climate change

Australian natural disaster-related insurance claims rose notably between 2005 and 2022, from an annual average of $1.5 billion to $3 billion in real terms over the period. Some have partly attributed this rise to the early effects of climate change. A continuation of this trend would see insurance claim values quadruple in real terms between 2022 and 2050 (Reinhard and Lefebvre 2022, p. 19).

The Insurance Council of Australia has claimed that 'at present no region in Australia is uninsurable, however worsening extreme weather events are driving up premiums in parts of the country most exposed to extreme weather risk and rendering insurance unaffordable for some' (ICA 2022). Relative changes in insurance premiums play an important systemic role in helping households and businesses understand the climate risks that they face. While rising premiums are undesirable for individual households and businesses, they will be able to identify when high insurance premiums render unviable a proposed investment (either the addition to an existing structure or development of a new structure), or more generally reduce an investment's commercial feasibility.

Increasingly detailed climate projections will be important in helping insurers accurately price climate risks over the years ahead. An inability to accurately price physical climate risks may lead private insurers to stop offering insurance products that cover the effects of particular climate events in particular regions altogether, being unable to judge whether they are taking on an acceptable level of risk.

The retreat of private insurers from particular regions or activities will weigh on productivity growth, by removing one of the mechanisms by which people are able to assess and manage risk, and will leave governments vulnerable to becoming insurers of last resort for any under-insured activity that remains. The 1 July 2022 commencement of the Northern Australia Reinsurance Pool risks falling into this category. However, subsequent government interventions in private insurance markets should be avoided. Subsidising insurance premiums risks distorting investment decisions to the detriment of productivity growth, and inadvertently encouraging communities to make decisions that can increase the costs of future climate events.

Recommendation 6.1
Avoid government subsidised insurance schemes

Australian governments should avoid expansion of climate-related insurance sector interventions and set a medium-term time frame for the phase out of the Northern Australia Reinsurance Pool. Government interventions in private insurance markets risk subsidising the movement of individuals, households, and businesses into harm's way, and increasing overall adaptation costs. Setting a medium-term time frame for the phase out of the Northern Australia Reinsurance Pool would provide time for private insurance providers to secure alternative reinsurance services.

3.2 Avoiding policies that discourage private adaptation decisions

Policy settings that distort private transitions — such that households and businesses transition toward more climate-exposed activities — will increase adaptation costs over time. The adverse effects of such policy settings may be direct or indirect. Direct effect policy settings may prevent individuals and businesses from transitioning into new activities. For example: unduly restrictive occupational licensing can constrain the movement of labour between different occupations and sectors (see volume 7); 'just-transition' inspired enterprise agreements can constrain business transitions towards alternative product markets (see volume 7); and foreign investment constraints can limit the pursuit of new opportunities, while protecting incumbent industries that fail to pursue them (see volume 3). Indirect effect policy settings can include industry assistance and transfer system settings that impose high effective marginal tax rates on movement between activities. It was partly on these grounds that the Commission previously recommended reforming Australia's approach to drought assistance (PC 2009).

Economy-wide policy settings, such as household income assistance provided through the transfer system, are generally preferable to sector-specific transitional assistance. Nevertheless, calls for sector-specific assistance are likely to emerge where climate-affected industries comprise a large proportion of a local or regional economy. In such scenarios, policy makers should guard against providing enduring assistance to increasingly unviable activities and regions. Doing so risks impeding adaptation-related transitions away from those activities and regions, raising long-run adaptation costs, and weighing on productivity growth in the process. Assistance that supports productivity is generally neutral across sectors — allowing individuals, households and businesses to make their own judgements about which sectors, and regions, they are best placed to transition into. For this reason, any transitional assistance package provided by governments should not be made conditional on recipients committing to a particular region, sector or occupation.

Public investments aimed at sheltering incumbent businesses and population centres from climate impacts, such as building sea walls to defend towns against coastal inundation; investments in irrigation infrastructure to defend agricultural regions from shifting rainfall patterns; and building or raising dam walls to defend businesses and households from riverine flooding, can risk locking in higher future adaptation costs. Such responses are less likely to pass rigorous cost-benefit assessments in at least four scenarios:

- **where the investment is likely to be insufficient to defend against all relevant climate impacts** — this could occur when an industry faces multiple climate-related challenges, but infrastructure investment is only capable of addressing one of them. For example, investment in increased water supply might help address growing water availability concerns in some regions, but it may prove ultimately ineffective if temperature rises in these regions, and an increase in the geographical range of pests and disease, push the region beyond the habitable range for key crops
- **where the cost of that investment negates or undermines the comparative advantage of an industry** — when infrastructure investments are capable of addressing all climate-related challenges but the costs of doing so negate or undermine the comparative advantage that the industry once enjoyed
- **where the infrastructure investment inadvertently encourages excessive risk taking** — building infrastructure to defend an existing area from climate impacts can encourage excessive risk taking in the area, potentially negating the overall value of the investment. This might be the case where the building of dams, or the raising of existing dam walls, to defend a valley from flooding encourages further residential and commercial development in that valley, raising the expected future cost of remaining flood risk
- **where the building of new facilities and population centres in other areas would be more cost-effective** — when the infrastructure investments required to defend existing capital exceed the cost

of rebuilding this in an area that is less-prone to climate risks. For example, it might be that the costs of rebuilding part of a town on higher ground (including the transitional and social costs associated with the relocation) are less than the cost of building a system of sea walls to defend an existing coastal town from rising sea levels. Rigorous cost-benefit analyses that consider the broad range of costs and benefits (including cultural, social and environmental values) of defending existing centres relative to relocating those centres, can help inform these decisions.

Appropriate risk allocation and the potential for moral hazard will be important considerations for new development in areas vulnerable to rising sea levels, riverine flooding, bushfire and extreme weather events. Some of these risks will impact communities periodically, such as riverine flooding, bushfires and extreme weather events. Others will be more permanent, such as rising sea levels. Whether new developments should be allowed to go ahead in those areas particularly exposed to future climate impacts is ultimately a question of 'acceptable risk.' While markets will play a key role in allocating risk efficiently, questions of acceptable risk, and the social desirability of alternative risk mitigation measures, are often a collective choice, communicated through democratic processes.

However, a move towards cost-reflective pricing of developments in such areas could help to avoid inadvertently placing businesses and households in harm's way. For example, incorporating the cost of risk reduction measures into the cost of new developments on coastal plains vulnerable to sea level rise (e.g sea walls) could help to optimise risk management within the development as a whole and ensure that remaining climate risks were borne knowingly. The approval of defensive infrastructure should be subject to broader social acceptance of its external costs, such as loss of amenity for neighbouring communities or reduced accessibility to public lands.

Imposing developer levies to fund climate risk reduction measures is one way of moving new developments towards cost-reflective pricing. Similarly, ensuring that the cost of emergency responses services, like fire services in bushfire prone area, are incorporated into local council rates would support cost-reflective pricing.

Nevertheless, even with risk mitigation measures in place, climate impacts will still occur. While such risks are best managed through private insurance markets, it is plausible that private insurers will progressively retreat from these markets as climate impact risks increasingly manifest over time (box 3.1). To ensure that Commonwealth and State Governments do not inadvertently and unnecessarily become insurers of last resort, additional developer levies could be used to finance local funds, designed to cover future shortfalls in private insurance coverage.

Recommendation 6.2
Helping to inform adaptation investment decisions

Households and businesses should be provided with the information they need to make informed adaptation decisions. State and Territory governments should mandate the pre-sale disclosure of climate risks for all residential and commercial property sales.

- Such disclosure should be based on existing climate change projections and cover a range of physical risks including riverine flooding, sea level rise, subsidence, fire and other natural disasters.
- This disclosure could operate in the same way that States and Territories mandate the pre-sale disclosure of building reports.

For new greenfield developments, the cost of climate risk reduction measures should be incorporated into the price of buying into the new development, through mechanisms like developer levies, which will help ensure that future residents face cost-reflective pricing.

Community relocations and adaptation-related infrastructure

There will likely be cases where least-cost adaptation policy supports the defence of existing developments. However, the desirability of relocating some particularly climate-exposed communities will be increasingly debated over coming years. For example, climate change is estimated to increase the severity of rainfall, and subsequent flooding, of particular regions. This reflects the increased ability of the atmosphere to hold moisture, subsequently released as heavier rainfall, as the atmosphere warms. Communities that were previously assessed to be subject to ‘1-in-100-year’ weather events may now be subject to such events on a more frequent basis (Visser et al. 2022). The same will likely be true for communities exposed to bushfire (Canadell et al. 2021), cyclones (Bruyere et al. 2022) and rising sea levels (Hague et al. 2022).

In such regions, automatically rebuilding communities impacted by natural disasters could inadvertently bring a greater level of risk than might be acceptable in greenfield developments, place communities at a greater level of risk than might be commonly appreciated and drive capital misallocation over time, raising long-run adaptation costs, and weighing on productivity growth in the process. Ensuring that planning approval processes are updated to incorporate the latest available climate projections will be part of the answer. Another part will be undertaking cost-benefit analysis that factors in the future likelihood of natural disasters based on climate projections for the region and that considers the broad range of costs and benefits (cultural, environmental and economic) of rebuilding in-situ with more stringent increased building standards and community-wide defensive infrastructure, relative to rebuilding in less climate-exposed areas.

As a general principle, if the decision is taken to relocate a community, it is those levels of government responsible for the initial approval of these developments that should be responsible for the costs of their relocation. This will generally be State, Territory and Local Governments, who control land use planning and land registries. Deviations from this principle, such as calls for the Commonwealth Government to fund future community relocations in situations where the Commonwealth did not have policy responsibility for the establishment of those communities, risks creating moral hazard issues in State, Territory and Local Government planning systems. Calls for Commonwealth financial assistance to State Governments are often justified on the grounds of the greater financial capacity of the Commonwealth. However, questions of appropriate cost allocation are best resolved by consideration of responsibility for the policy area in question, not which level of government has the greatest access to financial resources. Moreover, such calls often overlook the various tax bases available to other levels of government, their ability to access public debt markets, and existing Commonwealth transfers to other levels of government.

Recommendation 6.3
Transitional assistance should not distort adaptation decisions

If transitional assistance is provided to climate-impacted regions, industries, and workers, it should be structured in a way that lets people decide which regions, sectors, and occupations they are best placed to transition into. It should not be made conditional on recipients committing to live or work in a particular region, sector, or occupation.

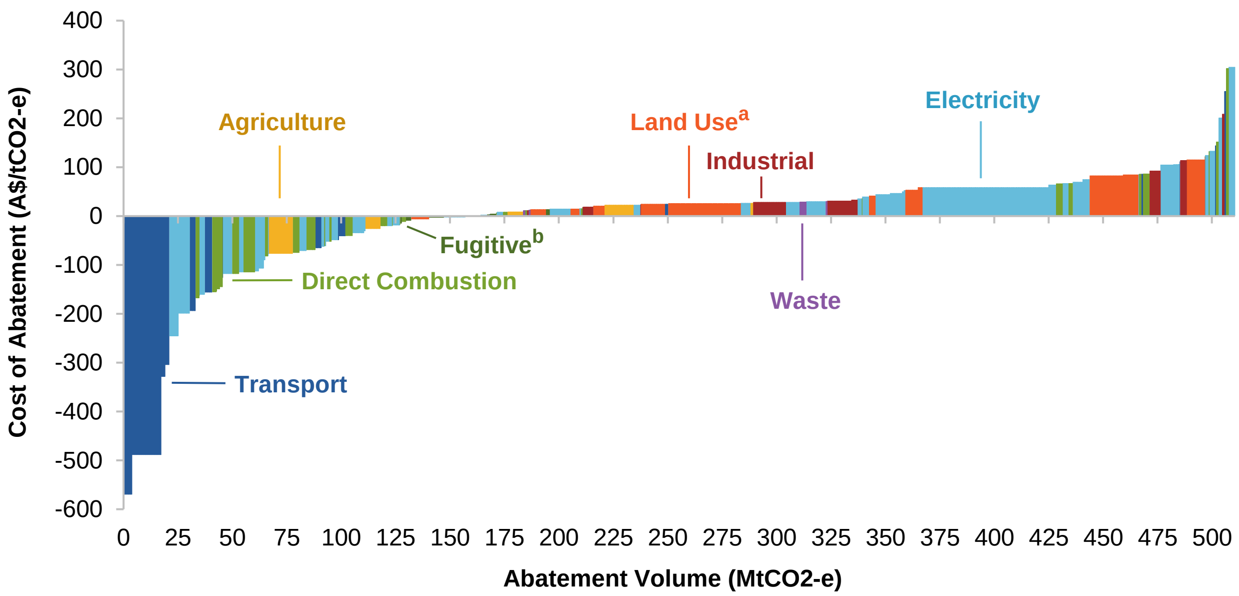
Recommendation 6.4
Cost-benefit analysis for adaptation-related infrastructure projects

Proposed adaptation-related infrastructure projects (including projects to rebuild or relocate communities impacted by large scale natural disasters) should be subject to rigorous cost-benefit analysis that incorporates plausible climate projections over the projected life of the asset and compared with that of alternative options. In the case of community rebuilding proposals, a rigorous cost-benefit analysis would consider the broad range of costs and benefits – cultural, social, economic, and environmental – of rebuilding in-situ with increased defensive measures, relative to rebuilding in an alternative location.

4. Productivity-enabling emissions reductions

The Australian Government has set a national greenhouse gas emissions reduction target of 100% (in net terms) by 2050, and an interim target of 43% below 2005 emissions levels by 2030. These targets constitute Australia's Nationally Determined Contribution to the Paris Agreement, the global treaty that seeks to limit global warming to 1.5 degrees by the end of the century. The question now facing policy makers is how best to achieve these targets. Achieving these targets at least-cost will increase the likelihood that emissions reductions prove a net positive for Australian productivity growth, relative to a world of avoidable climate change. While acknowledging the uncertainty around technology costs and new technologies, a least-cost approach to emissions abatement requires pursuing abatement options broadly in line with prevailing estimates of Australia's marginal cost of abatement curve — starting with low (or even negative) cost abatement options before pursuing higher cost options in later years (figure 4.1).

Figure 4.1 – Australia's projected marginal cost of abatement curve, 2030



a. 'Land use' includes land use change and forestry. **b.** Fugitive emissions are emissions associated with production of natural gas, oil and coal.

Source: Reputex Energy (2019).

Leaving higher cost abatement options to the later years of Australia's decarbonisation journey would give time for ongoing technological developments to lower the long end of our emissions abatement cost curve, reducing the cost of currently high cost abatement options before they are required to be pursued. However, even with ongoing technological gains it might be that some long-run domestic abatement costs remain higher than so-called offsets generated by ‘negative emissions’ technologies (box 4.1), the use of which would allow for the achievement of net zero emissions even while some gross emission sources remain.

Box 4.1 – The role of ‘offsets’ and negative emissions in a net zero world

Offsets can help businesses, and countries, to achieve ‘net zero’ emissions even when they find it too costly to eliminate all emissions sources. For example, an individual mining business could achieve net zero emissions by reducing their (gross) emissions as much as is cost effective (by, say, 70%) and then paying another business, say a commercial property fund, to install enough solar panels to ‘offset’ the remaining 30% of the mining company’s gross emissions.

However, this example would not be possible in a country that was operating at net zero emissions. In a net zero emissions country, both the mining company and the commercial property fund would need to achieve net zero emissions, leaving the commercial property fund unable to produce a legitimate offset. The mining company could notionally find an overseas commercial property fund to produce an offset, but this option would be similarly unavailable if the world as a whole was operating at net zero.

In a net zero world the only projects capable of generating genuine offsets would be ‘negative emissions’ projects that extract carbon dioxide from the atmosphere. A range of natural processes, such as reforestation and soil carbon projects, are capable of drawing-down carbon dioxide from the atmosphere and storing carbon in biomass and mineralised matter.

There also exist industrial draw-down processes, such as ‘direct air capture’ (DAC) technologies. DAC involves removing carbon dioxide from the air, typically using industrial fans to concentrate airflow and then using a solvent or other separation method. Once carbon dioxide has been captured, it can be notionally stored in geological formations deep underground. There are several types of geological formation amenable to storage, including: saline formations deep below freshwater aquifers; depleted oil and natural gas reservoirs; coal seams that are uneconomic to extract from; igneous basalt formations, with concentrations of magnesium and calcium’ and organic-rich shales with similar properties to coal.

Storage is typically made permanent by either a ‘cap rock’ layer that covers the reservoir or saline formation to prevent leakage, or by relying on chemical reactions between the carbon dioxide and basalt, coal or shale, to mineralise or absorb the carbon and permanently lock it in the stratum.

While often proposed as an emissions reduction option, these draw-down technologies have also been identified as a key technology required beyond 2050 — to reduce excess stocks of greenhouse gases in the atmosphere and thereby reduce the likelihood of the worst effects of climate change (IEA 2020a; Johansson et al. 2020; van Vuuren et al. 2013). Using these technologies to achieve reductions in atmospheric concentrations of greenhouse gases will require that at least some portion of draw-down projects are not used as offsets. If used as offsets, the atmospheric carbon dioxide that was drawn down would simply be replaced by the emissions they were seeking to offset.

Prior to achieving net zero emissions, there will remain a role for a broader range of offsets, not just negative emissions offsets. The credibility of these offsets will depend on their measurability, permanence and additionality (discussed further below).

The credibility of such an approach to achieve our net zero target would depend on the credibility of offsets used towards the achievement of these goals, which would ultimately turn on the perceived additionality, measurability and permanence of those offsets, characteristics discussed in greater detail below.

Because many of these abatement opportunities will be best identified and pursued by households and businesses, those closest to their own consumption preferences and production processes, it will be important that Australian climate policy produces enduring abatement incentives across a wide range of sectors. The broader the range of sectors brought to the national abatement task, the greater the number of lower cost abatement options, and the lower the abatement burden on individual sectors. Carbon pricing mechanisms that establish a consistent unit price for emissions are generally accepted to be the most efficient means of generating least-cost abatement across an economy.

Finding 6.2
An efficient abatement path prioritises lower cost abatement options before higher cost abatement options are pursued

Setting a long-run emissions target does not mean that all emissions sources need to be reduced at the same time. Pursuing low-cost abatement options before proceeding to higher cost options provides time for innovation to reduce the cost of those higher costs options before they need to be pursued. Broad-based emissions pricing schemes can be an efficient way of ordering abatement actions in this way.

4.1 The implications of Australia's recent approach to emissions abatement policy

Australia's political experience with explicit carbon pricing has encouraged Commonwealth, State, and Territory governments to implement and maintain a suite of alternative sectoral abatement policies — renewable energy targets, feed-in tariffs, energy efficiency trading schemes, public funding of sectoral abatement projects, tax concessions for domestic biofuel production, and more recently, tax concessions for electric vehicles, to name a few. While these measures do not place an explicit price on carbon, they all impose indirect, implicit or 'shadow' carbon prices on the Australian economy, many higher than would be expected to be delivered via an emissions trading scheme (box 4.2). In this way, Australia's current approach to achieving our emissions reduction targets is coming at a higher overall cost than is necessary.

Some of these higher costs can result from a 'charismatic abatement' problem where more government support is provided to more 'visible', but higher cost, abatement technologies than the less visible, but more cost-effective, options that would be elicited by an emissions trading scheme (box 4.3). This charismatic abatement problem might help explain the high levels of government support provided to home solar panel installation during the late 2000s, and the high levels of government support being provided to electric vehicles today, despite these being some of the highest cost abatement options available (box 4.2, 4.4).

Box 4.2 – Indirect carbon prices in Australia, selected policies

Australia's political experience with explicit carbon pricing has encouraged Commonwealth, State and Territory Governments to implement a range of alternative policies to address emissions. These alternative policies impose a wide range of indirect carbon prices on the Australian economy, some many times higher than what would be expected to emerge from economy-wide explicit carbon pricing that achieved the same amount of abatement.

Level of Government	Policy	$ per tonne of CO_2-e [a,b]
Commonwealth	Exemption of EVs from fringe benefits tax	$987 – 20 084 [c] ($905 – 13 580)
	Renewable energy target — Small-scale technology certificates	$57 – 209 [d]
	Renewable energy target — Large-scale generation certificates	$60 – 220 [d]
	Emissions Reduction Fund (ACCUs) — Average fixed-delivery price[e] — Spot price[f]	 $12 – 59 [g] $29 – 144 [g]
	Discounted excise for E10[h]	$128 – 274 [i]
	Discounted excise for B20[h]	$135 – 152 [i]
New South Wales	Energy savings certificates[j]	$41 in range $32 – 59
	$3000 EV subsidy and stamp duty exemption	$271 –4914 [c] ($222 – 3323)
Victoria	Victorian energy efficiency certificates[k]	$69
	$3000 EV subsidy and registration discount	$287 – 4807 [c] ($217 – 3250)
Queensland	$3000 EV subsidy, stamp duty discount, registration discount	$282 – 4933 [c] ($222 – 3335)
Tasmania	EV stamp duty exemption	$134 – 2137 [c] ($96 – 1445)
South Australia	$3000 EV subsidy and registration exemption for three years	$209 – 3647 [c] ($164 – 2466)

a. Estimates have been rounded to the nearest dollar. **b.** Bracketed prices reflect incorporation of 100% renewable energy assumption, provided for sensitivity analysis. Given the opportunity cost of using renewable energy for EV charging, the unbracketed prices are arguably more relevant. **c.** For simplicity, this estimate reflects fiscal costs per tonne of abatement, not the broader economic cost per tonne of abatement. The latter would also incorporate the impact of reduced taxation on the economy provided by tax concessions. Some of these differ from the preliminary estimates provided in the interim report, reflecting greater consideration of abatement generated by EVs once in the secondary market, and a slightly narrower range of additionality assumptions (75% to 5%). The high *level* of estimates for demand-side EV policies reflect their generosity relative to their abatement benefits, while the notable *range* in prices reflects a spectrum of additionality and bring-forward assumptions ahead of assumed mainstreaming of EVs in new car sales by 2035. See appendix A for further details on the estimation approach. **d.** The range presented reflects three different emissions intensity factors as

Box 4.2 – Indirect carbon prices in Australia, selected policies

well as additionality ranging from 50–100% (appendix A) **e.** The most relevant ACCU price for the Emissions Reduction Fund — the biggest buyer of ACCUs — is the average fixed delivery contract price, which is $11.70. **f.** The spot ACCU price might be more relevant for offset sellers and private buyers and was equal to $28.75 on 5 September 2022. **g.** The upper bound estimate accounts for additionality concerns relating to common emissions reduction methods. Macintosh, Butler and Evans (2022) suggest that up to 80% of credits issued under three of the ERF's most popular methods (which account for about 75% of total credits issued) do not represent genuine emissions cuts that would not have happened otherwise. **h.** The discounted rate of excise only applies to domestically produced ethanol and biodiesel. **i.** Lower bound estimate considers only scope 1 greenhouse gas emissions. Upper bound estimate considers lifecycle emissions and is consistent with PC (2011). The excise rates used are those that were in place prior to the reduction that took place on 30 March 2022. **j.** The certificate price used is the penalty rate, which should represent an upper bound, though the spot price sometimes exceeds the penalty rate. A range is calculated using the emissions intensity of Australian coal generation as a lower bound, the average emissions intensity of electricity generation in New South Wales in 2019-20 as a central estimate and the emissions intensity of gas generation as an upper bound. **k.** The price listed is the spot price, which is likely higher than the price involved in long-term contracts.

Sources: Chalmers (2022); Demand Manager (2022) NSW Government (2022); DELWP (2021); Queensland Government (2022a, 2022b, 2022c); TCCO (2021); Department of Treasury and Finance (2022); Department for Energy and Mining (2022); Government of South Australia (2021); DWER (2021); Fisk (2021).

In addition, a less visible approach to climate policy risks exposing Australian industry to additional carbon pricing overseas. This possibility is apparent in the emerging design of the European Union's (EU's) Carbon Border Adjustment Mechanism (CBAM), which is planned to be progressively implemented between 2023 and 2026. The EU CBAM aims to impose carbon prices on imports of particular goods that are broadly comparable to those faced by EU producers. The stated intent of the policy is to level the playing field between domestic and foreign producers competing with one another in the EU market, taking into consideration carbon prices already paid by foreign producers in home countries.

However, it appears that the EU might only recognise direct carbon prices faced by foreign producers, not the range of indirect carbon prices currently imposed on the Australian economy. While the impact of the EU CBAM on Australia is likely to be limited, those impacts will grow if it applies to a wider range of imports over time, and if the EU example is followed by other major economies. In this way, Australia's current approach to climate policy risks exposing our economy to a double cost — the first through a range of indirect carbon prices that may be higher than available alternatives, and the second through the subsequent imposition of direct carbon prices on our exports.[1]

Consistent and enduring incentives to reduce emissions across the economy are needed

Australia's current suite of domestic policies, along with the longer standing emissions abatement policies of the major economies, and the global technological developments they have supported, have started to shape Australia's future decarbonisation path. The uptake of renewable energy is projected to rapidly decarbonise our electricity system over the next decade,[2] in turn supporting the decarbonisation of transport

[1] While the EU CBAM might recognise carbon prices imposed on facilities captured by the Safeguard Mechanism (discussed below), the fact that the Safeguard Mechanism only applies a carbon price to those facility emissions that are above that facilities baseline, and provides free emissions allowances for all emissions below the facility baseline, means that Australian exporters captured by the CBAM might only receive a partial discount on CBAM liabilities.

[2] AEMO's 2022 Integrated System Plan (ISP) projects several scenarios for Australia's electricity system between now and 2050. Under the scenario considered 'most likely' renewables and storage are projected to account for 86% of Australia's energy in 2030-31, 95% in 2040-41 and 97% in 2050-51, with the remainder made up of peaking gas (AEMO 2022).

through electric vehicle uptake, and the production of ‘green hydrogen.’ In time, ‘green hydrogen’ might also support the decarbonisation of some parts of heavy industry and transport, though its most efficient applications are likely to be revealed in time. Remaining ‘hard-to-abate’ sectors such as livestock might be offset through the uptake of negative emissions technologies, though ongoing technological development and shifting consumer preferences might ultimately reduce the need.

While most of these technological developments are being driven by international policy settings, which will naturally accrue to net technology importers like Australia, a domestic policy architecture that creates enduring incentives to pursue emissions reductions across the economy will be important in driving their efficient domestic application. Moreover, creating enduring abatement incentives may become increasingly important as the global move away from fossil fuels leads to structural declines in the price of coal, oil and gas — a development that might otherwise encourage their increased use in Australia, at the potential expense of longer-run emissions reduction objectives.

Box 4.3 – Why economy-wide pricing mechanisms deliver least-cost abatement

All policy interventions aimed at generating emissions abatement impose carbon prices on the economy. However, in many instances, these prices are hidden (so-called ‘shadow’, ‘implicit’ or ‘indirect’ carbon prices) and apply only to a narrow set of actions. The narrow coverage of many interventions allows other emissions source to expand, reducing their overall effectiveness. Moreover, piecemeal interventions that target particular sources of emissions, or that promote the application of particular technologies lead to a greater range of abatement ‘prices’ across the economy, driving higher cost abatement than is necessary to achieve near-term emissions reduction goals. Piecemeal interventions can also overlap with other piecemeal measures, unnecessarily increasing the economy-wide cost of abatement in the process.

The application of a consistent carbon price across a broad range of sectors, whether implemented by carbon taxes or cap-and-trade schemes, reduces the economy-wide cost of abatement (or enables greater abatement for the same total cost) for several reasons. First, by allowing the concentration of abatement efforts in the most cost-effective options available and thereby transferring remaining emissions rights to those sectors that generate the greatest value-add from their use. Second, the application of a consistent price across a broad range of sectors reduces the scope for avoidance or ‘leakage’ into what would otherwise be uncovered sectors. More generally, an explicit price is also more observable and can be more readily factored into production and investment decisions.

Because businesses can be expected to pass on these increased costs to the consumers of their goods and services, emissions trading schemes provide a means of internalising the externalities associated with consumer choices. This move to more cost-reflective pricing will likely drive consumers towards less emissions-intensive goods and services, on price grounds alone, further reducing the emissions-intensity of economies with broad-coverage emissions trading schemes.

Linking a domestic emissions trading scheme with that of other countries, either by allowing for the transfer of emissions permits between the two countries or by allowing the importation of offsets from other countries, can establish the international price of permits as the upper bound for domestic permit prices. Doing so further lowers domestic abatement costs to the extent that the permits are credible, and that the international price is generally lower than the domestic permit price.

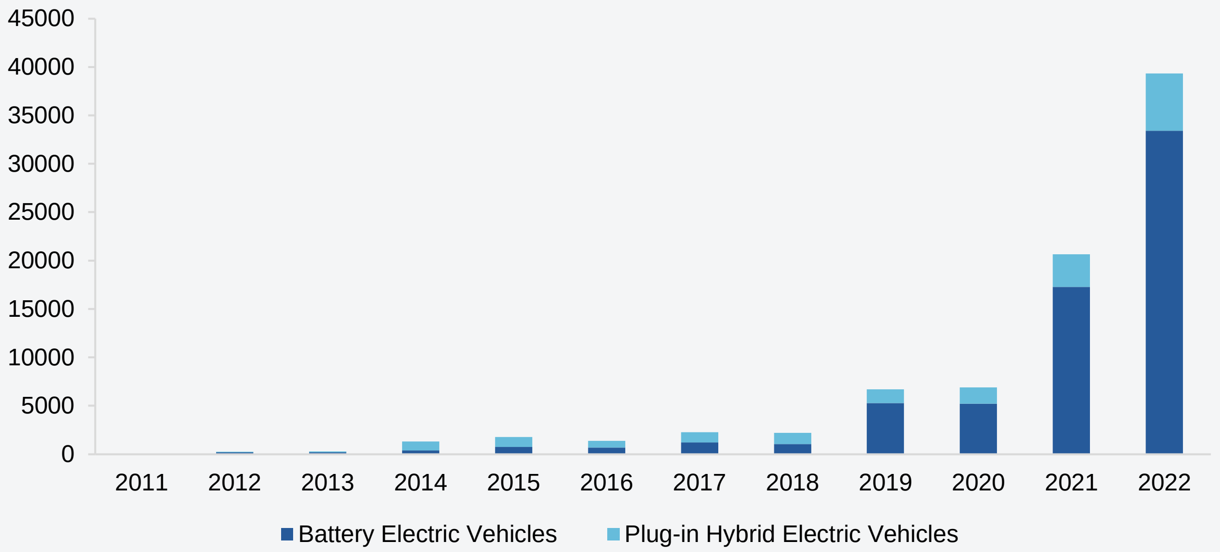
Box 4.4 – Case study: Why demand-side Electric Vehicle (EV) policies are an inefficient way to reduce emissions

In the absence of mechanisms that directly price emissions, governments have implemented various measures to encourage the uptake of low-emissions technologies such as EVs. While EVs stand to make an important contribution to Australia's decarbonisation, a key policy question is whether demand subsidies to expedite their uptake represent an efficient and effective means of achieving additional abatement, or whether alternative approaches might prove more desirable.

EVs will reduce emissions by leveraging the decarbonisation of our electricity system to reduce Australia's consumption of liquid fossil fuels. EV uptake might also reinforce the decarbonisation of the electricity grid by providing for a growing stock of second-hand EV batteries that could be reused to stabilise an increasingly renewable electricity grid. More generally, the transition to EVs stands to improve health outcomes associated with local air quality and improve energy security by reducing vulnerability to international oil supply disruptions.

The transition from internal combustion energy (ICE) powered cars to EVs is already underway in Australia, where the number of new car sales that are Battery Electric Vehicles (BEVs) or Plug-In Hybrid Electric Vehicles (PHEVs) has risen from less than 50 in 2011 to almost 40 000 in 2022 (figure below). While only 3.8% of total new car sales in Australia in 2022, the accelerating demand for EVs apparent since 2020 appears consistent with EVs reaching the second phase of the four-phase 'product lifecycle.' The four-phase product lifecycle comprises a preliminary 'market development' phase where a product is largely unproven and sales are low, a second 'market growth' phase where demand accelerates as the new product gains broad-based acceptance, a third 'market maturity' phase where demand largely grows in line with that of the overall market and a final 'market decline' stage where the product is superseded by a new technology.

New electric vehicle sales in Australia, by type and year



Sources: EV Council (2022); FCAI (2023).

Moving from the 'market growth' phase of the product lifecycle to the third 'market maturity' phase, might be particularly apparent from 2035 as many of the world's major car makers switch to majority share (or even 100%) EV production, driven by EV-only new car sale mandates in many of the world's major car markets — the European Union, Japan, California, and the 16 States that reference Californian vehicle standards

Box 4.4 – Case study: Why demand-side Electric Vehicle (EV) policies are an inefficient way to reduce emissions

(IEA 2022). As a net transport technology importer, it seems likely that any broad-based global transition towards EV production will naturally translate to broad-based Australian EV uptake along a similar timeline.

With EVs appearing to have reached the second phase of the product lifecycle, the principal constraints to their broader uptake before 2035 will be supply, not demand. Indeed, reports of extended waiting times for EVs are commonplace in Australia. With supply the principal constraint for EV uptake in Australia, policy efforts to increase the demand for EVs, such as tax concessions and rebates for EV purchases, run the risk of simply adding more people to the proverbial queue, subsidising people who are already in the queue, or in the case of tax concessions that are selectively available to some groups, simply pushing those selected groups to the front of the queue — all for no appreciable gain to the overall number of EVs on Australian roads, relative to what would have otherwise been the case.

This basic dynamic contributes to the high indirect carbon prices that are commonly estimated for demand-side EV policy measures. However, even if we assume that demand-side policies were capable of driving largely commensurate increases in EV purchases, brought forward from 2035 to today, they would still constitute a relatively expensive emissions abatement policy (box 4.2). Limited near-term emissions abatement available from switching from a petrol-powered vehicle to an emissions-intensive electricity grid powered EV plays a part. However, even if we were to assume that an EV was charged by emissions-free renewable energy that was incapable of being used for alternative purposes (and therefore constituted truly additional renewable energy capacity), the estimated indirect carbon price of these measures would only fall by between 8 and 33% (depending on the measure), remaining amongst the most expensive option for emissions abatement.

These findings are broadly consistent with a range of studies and publications that have noted the relatively high cost of demand-side EV measures, or have questioned the value of demand-side EV measures more generally.[a]

The high cost of demand-side EV subsidies ultimately reflects the underlying generosity of the subsidies of such programs relative to each tonne of abatement potentially available from passenger vehicles. In Australia, this is particularly apparent in the case of the recently legislated exemption of some EVs from Fringe Benefits Tax (FBT), relative to the more modest, though still potentially high cost of abatement, state-level subsidies. Factoring in more conservative assumptions about the likely additionality and degree of bring-forward of those additional purchases, and the emissions intensity of the power source for EVs, simply increases the indirect carbon cost of these policies. While this analysis does not make assumptions about the likely bring-forward or additionality of EV purchases under these policies, it does make apparent the indirect carbon price implications of low additionality, and the degree of bring-forward of any additional EV purchases. The lower the assumed additionality, and the greater any bring-forward, the greater the cost per tonne of abatement (see appendix for further discussion of estimation approach).

Demand-side EV measures can also raise equity concerns when the chosen policy instrument is disproportionately relevant to higher income cohorts. This might be relevant to the FBT exemption for some EVs, to the extent that FBT is disproportionately relevant to higher income households. More generally, the purpose of the FBT system is to protect the integrity of the personal income tax system, dissuading higher income individuals from attempting to avoid personal income tax liabilities by taking a share of their income in the form of goods and services. Using the FBT system for alternative policy goals like attempting to drive EV uptake risks compromising the degree to which the FBT system protects the integrity of the personal income tax system, potentially reinforcing equity concerns in the process.

Box 4.4 – Case study: Why demand-side Electric Vehicle (EV) policies are an inefficient way to reduce emissions

Given that the principal constraint to the uptake of EVs in Australia is supply, due to both limited global production and the prioritisation of that limited supply to other car markets around the world, a more efficient approach to supporting EV uptake would be to take available steps to increase EV supply in Australia. This could include increasing fuel efficiency standards in Australia, which could potentially lead global EV producers to prioritise a greater share of global EV production to the Australian market (Martin, 2022). With appropriate protections, liberalising the importation of second-hand EVs into the Australian market would also open an alternative channel for EVs to enter the Australian market.

a. See for example Camara, Holtsmark and Misch (2021), Fournel (2022), Nunes, Woodley and Rossetti (2022), and Freebairn (2022).

4.2 Foundational elements of Australia's emissions abatement tool-kit

There are three components of Australia's framework for emissions abatement that are well placed to be recalibrated to form an economy-wide abatement mechanism over time:

- **the Safeguard Mechanism** — the policy tool that requires Australia's largest greenhouse gas emitters to keep their emissions below an emissions limit (a baseline)
- **Australian Carbon Credit Unit offsets (ACCUs**) — a tradeable financial product awarded to eligible projects that reduce greenhouse gas emissions
- **the Emissions Reduction Fund** — a Commonwealth government fund that purchases ACCUs, thereby indirectly funding emissions abatement activities that help to reduce Australia's emissions.

Australia's Emissions Reduction Fund (ERF) and Safeguard Mechanism (SM) began operation in 2016. The ERF was developed to contribute to the achievement of Australia's emissions reduction goals by providing a mechanism by which the Australian government can purchase emissions abatement from eligible abatement projects. Projects that generate abatement in accordance with methodologies recognised by Australia's Clean Energy Regulator (CER) can earn Australian Carbon Credit Units (ACCUs), which are eligible to be purchased by the ERF.

The biggest buyer of ACCUs is currently the Australian Government, through the ERF. However, a growing source of demand is from industrial facilities captured by the Safeguard Mechanism (SM). The SM was developed to protect against the possibility that the emissions abatement purchased by the ERF was not simply counteracted by an increase in emissions from industrial facilities. It attempts to do so by giving 'baselines' — effectively emissions budgets — to greenhouse gas producing facilities captured by the SM. These emissions budgets can be met either by pursuing internal emissions reductions at the facility, or by purchasing enough ACCUs to bring net emissions into line with facility baselines.

The SM does not have pre-defined sectoral coverage per se: it applies to all facilities that produce 100 000 tonnes of CO_2-e per annum, spanning a number of sectors. Facilities covered by the SM operate in mining, oil and gas, manufacturing, construction, waste and some transport sub-sectors (large rail companies and domestic airlines). The electricity sector is notionally included in the SM but is treated differently than other sectors (see detail below). The baselines that apply to these facilities have been set in several ways over the life of the SM, but are currently set in emissions intensity (that is emissions per unit of output) terms, not absolute emissions terms. Most of these baselines are non-binding as they are above current facility emissions. The most notable example is the electricity sector, which has a baseline above the sector's aggregate emissions. Given the rapid decarbonisation of the electricity grid currently underway, it is likely that the current sectoral baseline will never become binding on the electricity sector.

A number of arrangements exist that have limited the degree to which the baselines are binding in any given year, including: allowing facilities to average out their emissions over several years; allowing for exemption from baselines in the case of 'exceptional circumstances'; and, in some cases, allowing facilities to apply for new baselines if their existing baselines are exceeded. In addition, the SM does not prevent new facilities from being built in these sectors. These arrangements mean that overall emissions can increase in sectors covered by the SM. Indeed, since the beginning of the SM, emissions from covered sectors have grown by 7% from 2005 levels, and have been projected to be 17% higher than 2005 levels by 2030 if the current scheme design is maintained (Reputex 2021). As the central policy tool for emissions abatement policy, ensuring that the SM's emissions baselines remain consistent with Australia's abatement goals will require ongoing adjustments to SM baselines over time.

4.3 Reforming Australia's Safeguard Mechanism

Recognition of these features, combined with an increase in Australia's 2030 emissions reduction target, has led the Australian Government to consider reforms to the SM that might better position it to contribute to the achievement of Australia's emissions reduction goals. While Government has announced its intention to retain many of the basic features of the existing SM, such as maintaining the schemes existing sectoral coverage, facility thresholds and emissions intensity baselines, the Review's discussion of the SM and its subsequent recommendations are offered in the possibility that the scheme will continue to evolve over time, perhaps following the next scheduled review of SM policy settings in 2026-27 (DCCEEW 2023).

Reforms to the SM could help move Australia towards a lower-cost approach to achieving its 2030 and 2050 emissions abatement goals, helping to safeguard productivity growth in the process. Implemented together, the broadening of the SM to include a greater range of facilities (by sector and facility-size), moving from emissions intensity ('production-adjusted') baselines to absolute emissions ('fixed') baselines, allowing for the generation of sub-baseline credits (credits granted to SM facilities that achieve emissions abatement below their baselines) and not providing additional assistance through the SM to emissions intensive trade-exposed entities (EITEIs), would increase the efficiency and equity of the scheme, reduce its complexity and better position the SM to contribute to Australia's economy-wide abatement task. The degree to which the SM credibly and efficiently contributes to the achievement of Australia's emissions abatement goals will also depend on the integrity of the Australian Carbon Credit Unit (ACCU) offsets recognised by the scheme (more below).

Moving from emissions intensity baselines to absolute emissions baselines

The Safeguard Mechanism effectively imposes emissions budgets on the facilities that it applies to. These budgets are expressed as 'baselines' and are defined in emissions intensity terms, not absolute emissions terms. Emissions intensity refers to emissions per unit of output while absolute emissions are total emissions from the facility. While they often tend to move together, they can diverge depending on what happens to output levels. For example, lower emissions intensity need not translate to lower aggregate emissions when output rises.

The SM's current use of emissions intensity baselines ('production-adjusted' baselines in the language of the SM) has been argued to have a lower economic impact on individual facilities than absolute emissions baselines (‘fixed’ baselines in the language of the SM) in so far as it allows captured facilities to increase production without exceeding their baselines, and precludes facilities from using production cuts to stay below their baselines. By doing so, the argument goes, an emissions intensity baseline minimises the overall impacts of the policy on production levels, thereby reducing the economic impacts of emissions constraints.

However, the strength of this argument diminishes once a country decides to pursue an absolute emissions reduction goal. Given that Australia has a nationwide emissions reduction target, the ability for SM-covered sectors to increase their overall emissions either imposes greater absolute abatement burdens on sectors not covered by the mechanism, or undermines achievement of the overall emissions target. Emissions intensity baselines may also raise overall abatement costs by not creating an incentive for businesses with multiple facilities to reduce output in their more emissions intensive facilities, and increasing their output in their less emissions intensive facilities. More fundamentally, it is incorrect to suggest that absolute emissions baselines prevent individual businesses and sectors from expanding output. Doing so would simply require facilities wishing to compete with other emissions generating facilities for the right to do so, contributing to the efficient allocation of increasingly scarce emissions rights in the process.

In addition, using emissions intensity baselines to target an aggregate emissions reduction target could complicate medium-to-long term investment planning. While an individual facility may know that Australia has a 2030 and a 2050 emissions reduction target, it may be less clear what that means for the facility’s emissions intensity baseline over coming decades. Facility owners would not only need to form a view on what those aggregate emissions reduction pathways would mean for facility level baselines but would have to make long-run output estimates to assess what abatement options they would need to pursue in order to meet those future baselines. They would have to do this over a period in which consumption and production patterns will likely be changing as Australia enters a more carbon constrained world.

The shortcomings of emissions intensity baselines have been recognised for some time now. The 2008 Garnaut Review noted that a system with emissions intensity baselines ‘introduced a high and unavoidable degree of arbitrariness’ into the design of emissions reduction policy and would ‘raise transaction costs and encourage rent-seeking behaviour’ (Garnaut 2008).

Transitioning the SM to operate on the basis of absolute emissions baselines would avoid these issues. It would increase the transparency and predictability of periodic adjustments to SM baselines, providing a somewhat clearer road ahead for SM facilities, abatement technology providers, offset producers in uncovered sectors, and investors more generally. The move to absolute emissions baselines would also reduce the administrative burden of the system by avoiding the need to report production levels alongside emissions levels and removing the need for facilities to provide third party audited production projections for new and significantly expanded facilities. Increased transparency around any periodic resetting of facility baselines would also promote integrity and public confidence in the process.

Should crediting of sub-baseline abatement be allowed (more below), an absolute emissions baseline could also act as a transitional assistance mechanism for covered facilities. This is because an absolute emissions baseline would allow facilities to achieve sub-baseline emissions by reducing output, regardless of the reason for that reduction of output. If a facility was closed down, and the associated sub-baseline abatement was eligible to generate credits, the sale of those credits would provide a form of exit payment for the owners of the closed facility. This would not be possible under a system of emissions intensity baselines.

Sub-baseline-abatement should be creditable

Under the current design of the SM, captured facilities need only prevent their emissions from rising beyond their baseline, either by pursuing internal abatement options, or by purchasing a sufficient number of Australian Carbon Credit Unit (ACCU) offsets. This presents something of an asymmetry for facilities, in that facilities are required to purchase ACCUs for any emissions that exceed their baseline, but cannot earn credits for any emissions abatement below their baseline. Providing symmetry in the SM would increase the efficiency of abatement by increasing the pool of commercially viable abatement opportunities and allowing the transfer of economy-wide abatement burdens to the least-cost abatement options within the SM, likely reducing economy-wide abatement costs, and safeguarding productivity growth in the process.

Sub-baseline crediting would sit most comfortably within a system of absolute emissions baselines. A SM that imposed emissions intensity baselines, while allowing those facilities to generate sub-baseline credits denominated in absolute emissions terms, would risk allowing SM facilities to generate sub-baseline credits while increasing their overall emissions. This could occur when a SM facility increased output in such a way as to fall below their emissions baseline while still increasing overall facility emissions. This might occur if output was increased in a less emissions-intensive way than average production. If this was undertaken by enough facilities it would be possible for total SM facility emissions to fall short of the absolute emissions reduction task asked of it, in turn imposing greater abatement burdens on non-SM emissions sources, or requiring a future ‘catch-up’ recalibration of SM facility baselines, presenting a source of uncertainty for all emissions generating entities in the process. Policy back-stops to limit this possibility, such as building an emissions buffer or reserve into the SM, would likely add to the overall abatement costs of the mechanism.

As set out above, if sub-baseline crediting were coupled with absolute emissions baselines it would also provide some degree of automatic transitional assistance for facilities that choose to markedly reduce their production in the presence of carbon constraints. The resulting reduction in emissions would generate credits that could be sold to facilities operating beyond their emissions baseline. This feature would not be present in the case of an emissions intensity baseline, given that output reductions cannot impact the emissions intensity of a facilities output. Neither would it be present in the case of an absolute emissions baseline that did not allow sub-baseline crediting.

These observations should not be taken as presenting a public policy case for industry assistance to SM facilities, but a simple drawing out of foreseeable interactions between possible SM design features. Future carbon constraints have been part of Australian policy discourse for several decades, and emissions abatement policy has been in place for much of this time. The case for transitional assistance is strongest when industries are acutely impacted by unforeseen developments, and where those impacts risk producing broader costs for society. Entry into long anticipated, and progressively implemented, carbon constraints does not appear to have these features. Nevertheless, were governments pre-disposed to providing transitional assistance to industry, the combination of sub-baseline crediting and absolute emissions baselines may be judged sufficient to do so, reducing further calls on limited fiscal capacity.

Expanding sector coverage

The sectoral coverage of the Safeguard Mechanism is currently limited. This is particularly apparent in its treatment of the electricity sector and its omission of much of the transport sector. Broadening the coverage of the SM would move Australia towards a lower cost approach to emissions reductions.

Electricity sector

As noted above, the electricity sector is notionally included in the SM. However, it is treated differently than other sectors. While facilities in other sectors are captured by the SM once they emit 100 000 tonnes or more of CO_2-e per annum, in the electricity sector the SM baseline only applies to the sector as a whole, and is currently set at 198 million tonnes of CO_2-e per annum. That is, the individual electricity generators that comprise the sector do not currently face facility level baselines. Under its current design, it is only once the sector wide baseline is breached that the SM will impose facility level baselines on individual power stations.

However, the steady decarbonisation of the electricity sector underway will likely preclude the sector wide baseline from being breached.

The current treatment of the electricity sector has been justified on the basis that ‘the electricity sector behaves more like a single entity, where the output produced is centrally coordinated to meet demand in real time’ (CER 2022). However, this characterisation overlooks the notable difference in emissions intensities of the electricity generators that compete with one another in Australia’s electricity markets. Failing to account for these emissions differentials within the SM reduces the extent to which low emissions electricity sources can compete with high emissions electricity sources, relative to what would otherwise be the case.

Facility level coverage of individual electricity generators would move Australia towards a lower cost abatement path. It would do so by bringing a greater pool of potential abatement options to the SM’s overall abatement task. These benefits would be compounded by allowing for sub-baseline crediting, which would enable the transfer of scarce emissions rights from those facilities that are readily able to reduce emissions, to those that are less able to do so. The incorporation of the electricity sector into the SM would also reduce the policy case for additional sectoral interventions that can add to the cost of Australian emissions reductions (discussed further below). Finally, facility level coverage of electricity generators would promote enduring abatement incentives for the sector, which could prove important in constraining any future rebound in electricity sector emissions were coal and natural gas prices to undergo structural declines as the world progressively decarbonises. Failing a move to facility level coverage, a reduction in the sectoral baseline would remove existing headroom above current sectoral emissions, thereby helping to limit any future rebound in electricity sector emissions. However, this would not be as efficient as facility level coverage because it would not allow for the transfer of emissions rights between sectors and would not efficiently price emissions differentials between competing generation technologies.

The inclusion of a rapidly decarbonising electricity sector in the SM might prompt concerns about markedly reducing abatement burdens on existing SM facilities. However, given that the SM imposes baselines on all captured facilities, and that these baselines are proposed to be collectively calibrated to Australia’s overall national emissions reduction goals, there is little reason to expect this to occur. That is, industrial facilities would continue to face their own individual baselines if electricity generators are included or excluded from the SM. Moreover, given that Australia has set itself the goal of achieving net zero emissions by 2050, within one lifecycle of a 30-year industrial facility, the abatement incentives facing industrial facilities would ultimately be determined by the credibility of Australia’s 2050 net zero emissions target.

Transport sector

Given its focus on emissions directly produced by facilities (‘Scope 1 emissions’) that produce more than 100 000 tonnes of CO_2-e per annum, the SM currently applies to only some elements of the transport sector, such as large rail companies and domestic airlines. But as it is individual cars, buses and trucks that produce Scope 1 emissions in the ground transport sector, all of which individually fall below the 100 000 tonne threshold, the ground transport sector is effectively uncovered by the SM.

Yet transport emissions are a substantial, and growing, source of Australian emissions, increasing from less than 10% of Australian emissions in 1990 to 18.6% in 2021. All else equal, expanding the Safeguard Mechanism to include the transport sector, by imputing all downstream Scope 1 emissions from vehicles to upstream fuel wholesalers, would reduce the economy-wide cost of emissions abatement.

Were electricity generators included at facility level in the SM, inclusion of fuel wholesalers would also restore the transport technology neutrality of the SM — being imposed on the electricity used to power electric vehicles, and the liquid fuels used to power conventional internal combustion engine vehicles. In addition, the extension of the SM to fuel wholesalers would further reduce the already limited policy case for the high shadow carbon price policy measures aimed at promoting electric vehicle uptake (box 4.3).

Lowering facility thresholds

The Safeguard Mechanism currently applies to facilities that produce greenhouse gases equal to or above a threshold of 100 000 tonnes of CO_2-e per annum. Reducing this facility threshold to 25 000 tonnes of CO_2-e would capture a greater number of facilities and increase the proportion of emissions covered by the scheme. Under the 100 000 tonne facility thresholds, the SM covered 212 individual facilities that collectively accounted for about 27% of Australia's annual greenhouse gas emissions in 2020-21. Including the grid-connected electricity sector, covered by the SM at a sectoral level, increases this proportion to about 57% of national emissions.

Reducing the facility threshold from 100 000 to 25 000 tonnes of CO_2-e would increase the proportion of national emissions covered by the SM to about 60%. Arguments against the reduction of thresholds might note the diminishing returns to increased coverage as moving to a 25 000 tonne facility threshold while adding more than 300 additional facilities to the SM would only increase emissions coverage by about 3 percentage points. However, the optimal number of covered facilities is not determined by the ratio of emissions coverage to facility coverage, but by comparing the marginal social benefit of including more facilities to the marginal social cost of covering those additional facilities.

Lowering facility thresholds would share Australia's overall abatement task between a greater number of facilities. It would also place a wider range of facilities on a more level playing field, thereby limiting any future migration of domestic production towards smaller, less efficient facilities, as carbon constraints become increasingly binding. It would also reduce the extent to which decarbonising facilities 'drop out' of Safeguard Mechanism emissions controls once their emissions fall below 100 000 tonnes of CO_2-e. The additional compliance burden of moving to a 25 000 tonne facility threshold would be limited, given that that these facilities are already required to report their emissions through the National Greenhouse and Energy Reporting Scheme (NGERS).

Carbon leakage and emissions-intensive trade-exposed industries

Concerns about 'carbon leakage' are commonly raised in response to domestic climate policy proposals. The threat of carbon leakage is said to emerge when domestic climate policy places domestic producers at a competitive disadvantage to foreign producers that do not face comparable carbon constraints in their home countries. In this situation, the imposition of domestic carbon constraints could lead to domestic producers losing market share to foreign producers that do not face carbon constraints, with associated emissions simply being transferred to (or 'leaking' into) those countries — all to no benefit to global emissions. Carbon leakage concerns are most pronounced for emissions intensive businesses that face international competition, so called Emissions-Intensive Trade-Exposed Industries (EITEIs).

Common responses to carbon leakage concerns have been to make EITEIs at least partly exempt from domestic climate policy. In countries with emissions trading schemes, this commonly takes the form of providing a percentage of emissions permits required by EITEIs for free. Carbon Border Tariffs (CBTs) are an alternative approach to addressing carbon leakage concerns, not by protecting domestic producers from domestic climate policy, but by making foreign producers also subject to domestic climate policy, through the levying of import tariffs that are broadly equivalent to the carbon costs faced by domestic producers. While a range of countries have expressed some degree of openness to the CBTs, the most advanced proposal is the European Union's Carbon Border Adjustment Mechanism (CBAM), which is planned to be progressively implemented between 2023 and 2026.

However, there are questions about the extent to which carbon leakage will occur in response to domestic climate policy, given that production location decisions are based on a range of factors, and that many countries have adopted carbon constraints. Moreover, as the world's major economies pursue emissions reduction goals it is plausible that products produced under carbon constraints will come to enjoy a competitive advantage over those that are not. In addition, if major economies are to meet their net zero emissions targets, EITEIs will need to collectively contribute to emissions abatement. Failing to impose carbon constraints on EITEIs will simply transfer the cost of emissions abatement to other sections of the economy, or to taxpayers if government is left to purchase a greater number of offsets to achieve national net zero targets. Any special treatment of EITEIs under the Safeguard Mechanism should weigh the risks of carbon leakage against the costs of transferring additional abatement burdens to non-EITEI producers.

Moreover, it should be noted that Australia's Safeguard Mechanism is effectively a 100% free emissions permit allocation system for sub-baseline emissions. The Safeguard Mechanism caps facility emissions and requires those facilities to either pursue internal abatement options or purchase ACCU offsets to bring emissions down to their relevant baseline. Facilities do not need to pay for any emissions below this baseline. In this way, the Safeguard Mechanism is effectively a 100% free permit system for all sub-baseline emissions. This treatment is provided to all captured facilities regardless of whether they are considered EITEIs or not.

Over time, Australian EITEIs will need to pay for a growing proportion of their carbon emissions as baselines are progressively reduced in line with Australia's nation-wide emissions reduction goals. However, this is broadly the same treatment as is commonly applied to EITEIs captured by emissions trading schemes, with the percentage of free permits allocated under emissions trading schemes progressively falling over time.

For example, under Australia's Carbon Pricing Mechanism (CPM), which operated between 1 July 2012 and 30 June 2014, EITEIs were divided into two categories, highly emissions intensive trade exposed ('high EITEIs') and moderately emissions intensive trade exposed ('moderate EITEIs'). When the CPM first began operation on 1 July 2012, high EITEIs received 94.5% of average sectoral emissions for free, and moderate EITEIs received 66% of average sectoral emissions for free. Both rates of free permit allocation were scheduled to fall by 1.3% per annum (Talberg and Swoboda 2013; Talberg, 2013). At that rate, high EITEIs would have received 81.5% of average emission for free by 2022-23, and moderate EITEIs would have received 53% of average sectoral emission for free in the same year.

Similarly, the EU emissions trading scheme (EU ETS) distinguishes between 'highly exposed' EITEIs and 'less exposed' EITEIs (European Commission nd). The former currently receive 100% of permits up to their relevant benchmark for free, and the latter receive 30% of permits up to their relevant benchmark for free. However, the 'relevant benchmark' under the EU ETS is the average emissions intensity of the sectors best performing 10% (least emissions intensive) facilities (IEA 2020b). Similar to the CPM, this approach helps ensure that those facilities that have previously invested in emissions abatement technologies and processes are not placed at a competitive disadvantage for having done so, while also ensuring that some abatement incentives are placed on the less efficient facilities in the sector. However, by choosing the average emissions of the best performing 10% of the sector, these effects were greater than that elicited by the CPM's average sectoral emissions intensity benchmark.

It follows that the SM's current system of providing 100% free emissions up to facility baselines is more generous than the EITEIs provisions of both the EU emissions trading scheme and Australia's former Carbon Pricing Mechanism, casting doubt on the need for further EITEIs assistance under the SM.

Finally, providing special treatment to EITEIs is unlikely to protect Australian EITEIs from carbon prices in markets that impose carbon border tariffs. For example, the EU's planned CBAM appears set to only recognise explicit carbon prices borne by foreign producers in their home market. To the extent that some of Australia's carbon-intensive exports to the EU are captured by the CBAM, the Australian Government should consider measures that ensure this revenue is collected by the Australian government, not the EU. Provisions that further lower the effective carbon price imposed by the SM on Australian exporters to the EU, may be simply offset by higher border adjustments under the CBAM. If a carbon price will be imposed on Australian exports to the EU in any case, the welfare of the Australian community will be best served by the Australian Government being the one to collect the associated revenue.

Given these features, the policy case for additional EITEI protections under the Safeguard Mechanism is unclear. Notable levels of public investment in abatement technologies that may prove crucial for abatement by Australian EITEIs (section 4.7) further diminishes the case. To the extent that decisions are made to provide further support to EITEIs, providing this assistance outside of the SM through budget appropriations, rather than through less stringent SM baselines, would increase the public transparency of this support, while retaining the abatement incentives generated by the SM. It might also offer greater flexibility for policy makers, with budget appropriations being potentially less enduring than the longer lasting effects of less stringent SM baselines.

Similarly, calls for Australia to implement its own CBAM should be resisted, recognising that the SM's system of free sub-baseline emissions allocations already provides protection against carbon leakage for SM facilities. Given this context, an Australian CBAM would risk simply acting as a form of trade protectionism that would ultimately result in higher input prices for Australian businesses, and higher goods and services prices for Australian households.

Recommendation 6.5
Make the Safeguard Mechanism Australia's primary emissions abatement mechanism

To increase certainty, reduce investment risk, and promote least-cost abatement, the Australian Government should progressively make the Safeguard Mechanism (SM) Australia's primary economy-wide abatement mechanism. To this end, the Government should collectively implement the following changes to the SM over time:

- define SM baselines, the total amount of annual net emissions that captured facilities are allowed to produce, in absolute emissions terms, not emissions intensity terms
- expand SM coverage by reducing SM facility thresholds, the total amount of annual emissions that a facility can produce before becoming subject to the SM, from 100 000 to 25 000 tonnes of CO_2-e
- impose SM baselines on individual electricity generators, not at the sectoral level. Failing that, the sectoral baseline for the grid connected electricity sector should be reduced, removing the bulk of the headroom between current emissions and the sectoral baseline, though this would not have the same efficiency benefits as directly including individual electricity generators in the SM
- expand transport sector coverage: once electricity generators are covered at facility level, the SM should be extended to liquid fuel wholesalers, with downstream vehicle emissions imputed to them
- allow generation of sub-baseline abatement credits. If SM baselines are expressed in absolute emissions terms, SM facilities should be allowed to generate emissions credits for emissions abatement below their SM baseline
- no additional Emissions Intensive Trade Exposed Industries (EITEIs) protections should be provided through the SM. The SM already provides the majority of emissions rights for free, and will continue to do so for the foreseeable future.

4.4 Promoting the integrity of Australia's offsets arrangements

As noted above, projects that generate abatement in accordance with methodologies recognised by Australia's Clean Energy Regulator (CER) can earn Australian Carbon Credit Units (ACCUs).

While the biggest buyer of ACCUs is currently the Australian Government, through the ERF, a growing source of demand is from industrial facilities that are captured by the Safeguard Mechanism.

The Clean Energy Regulator currently allows 37 abatement activities to generate ACCUs. However, about 75% of ACCUs generated under the program have been generated through three methodologies — avoided deforestation, human-induced regeneration of native forests and landfill gas capture.

Given the ability of Safeguard Mechanism facilities to meet their baselines by using ACCUs, the degree to which the Safeguard Mechanism credibly contributes to Australia's emissions reduction goals will depend, at least partly, on the integrity of ACCUs. Generally speaking, the integrity of an offset project increases with the extent to which it satisfies three factors — additionality, measurability and permanence.

- *Additionality* — an offset project is not additional if the project would have gone ahead without the ACCU revenue, either because it was a commercially viable project in the absence of ACCU revenue, or because it was required by existing laws and regulations.
- *Measurability* — an offset project is measurable if its associated abatement can be reliably measured. If the offset project generates a wide range of potential abatement outcomes, then its value cannot be reliably measured, and the risk of over-crediting will emerge.
- *Permanence* — an offset project is permanent if its emissions abatement cannot be reversed at a future point in time. Permanence concerns are particularly relevant for carbon sequestration projects in forests, vegetation and soil. Carbon stored in forests, vegetation and soils can be released in the case of fire, disease and changes in rainfall patterns. If the carbon sequestered in trees, vegetation and soil are subsequently released at some point in the future then the project has not offset emissions, it has simply delayed the release of those emissions. Make-good provisions, requiring that any release of sequestered emissions is subsequently re-sequestered, help to reduce permanence concerns with such projects.

The degree to which ACCUs methodologies deliver actual emissions abatement has faced some scrutiny, with some observers detailing what they regard as systemic flaws in the ACCU generation process (Macintosh 2022; Macintosh et al. 2022b, 2022a; Macintosh, Butler and Ansell 2022), and concluding that much of the abatement claimed under the three most common ACCU methodologies does 'not represent real and additional abatement' (Fearon 2022).

The *Independent Review of Australian Carbon Credit Units* (The 'Chubb Review') released by Government in January 2023, made a series of recommendations aimed at improving the integrity of ACCUs, including the discontinuation of the current avoided deforestation method for generating ACCUs (recommendation 9), an opt-in approach to strengthening additionality baselines for ACCU generating landfill gas project methods (recommendation 10), considering the merits of implementing a scheme-wide ACCU buffer to reduce the chance of system wide over-crediting due to mismeasured or non-additional offset projects (recommendation 7), emphasising the need for human-induced regeneration ACCU projects to be administered in a way that provides for permanent storage of sequestered emissions (recommendation 8), greater project level data availability and transparency (recommendation 4) and reforms to the institutional arrangements governing the scheme (recommendations 1, 2, and 3) (Chubb et al. 2022). The Australian Government has declared in-principle support for all recommendations of the Chubb Review (Bowen 2023).

A number of measures stand to assist with the implementation of these reforms. The recommended opt-in to stronger additionality thresholds for ACCU-generating landfill gas capture projects could be assisted by State and Territory regulators stipulating the volume or proportion of biogas that needs to be captured by existing landfill gas capture facilities under existing regulations. Doing so would protect against the possibility that some landfill gas capture project operators will opt-in to the higher baselines while others will not, and thereby place project operators within the sector on a more level playing field.

Ensuring that sequestration-related ACCU projects operate in a way that is consistent with expectations that the project area will permanently store carbon would be assisted by the alignment of ACCU scheme 'permanence' provisions with the more enduring permanence provisions of the biodiversity market. Under the schemes current permanence provisions, sequestration-related project proponents can opt-in to either a 25-year or 100-year 'permanence period', with make-good requirements only placed on emissions reversals during the chosen permanence period. For example, if a project proponent opted-in to a 25-year permanence period, and bushfire or insufficient rainfall led to the release of emissions previously sequestered by the project in year 24 of the project, the project proponent would have to undertake measures to re-sequester those released emissions. If the emissions reversal occurred in year 26, they would not. Similarly, if the project proponent opted-in to the 100-year permanence period and an emissions reversal event occurred in any year within that 100-year period, they would have to re-sequester those released emissions. If the reversal occurred outside of the 100-year period, they would not.

Currently, 55% of vegetation-related ACCUs, and 98% of soil-carbon related ACCUs, have opted in to the 25-year permanence period. The remainder have opted in to the 100-year permanence period (DCCEEW, pers. comm., 6 December 2022). Given that Australia has 27 years to achieve its 2050 net zero target, sequestration-related projects that have opted in to a 25-year permanence period present a potential contingent liability for the Australian government, were shifting rainfall patterns, rising temperatures and increased bushfire frequency to lead to emissions reversals from sequestration-related projects in the years between the end of the 25-year permanence period and 2050. Were emissions reversals to occur within this period, it would potentially fall to the Australian Government to make up for these emissions reversals through the purchase of a proportionate volume of ACCUs, thereby placing a contingent liability on the Commonwealth budget.

Aligning the permanence provisions of the ACCU market with the more enduring permanence requirements of the biodiversity market would help to increase community confidence in sequestration-related ACCU projects. They would also help to manage the extent to which they inadvertently place contingent liabilities on the Commonwealth budget. While permanence requirements can vary, it is relatively common for biodiversity projects to have perpetuity-based permanence requirements placed on them, often implemented through biodiversity covenants on the land hosting the biodiversity project (Hardy et al. 2017). Alternative principles include requiring the biodiversity offset project to last for at least as long as the biodiversity impact being offset. For example, if a proposed development imposed a biodiversity impact that was estimated to last for 75 years, the offset project should last for at least 75 years. If the biodiversity impact was estimated to last for 125 years, the offset project should operate for at least 125 years (OECD 2016).

Given that CO_2 emissions can last for between 300 and 100 years in the atmosphere (Buis 2019) the current 25- and 100-year permanence periods of sequestration-based ACCUs appear to arbitrarily fall short of reasonable permanence expectations, and of the standard asked of biodiversity offsets.

Finally, delivery on the Chubb Review's call for greater project-level transparency and data sharing could be given effect to by requiring the publication of project-level offset reports submitted to the Clean Energy Regulator for the purpose of claiming ACCUs, and periodic audits that ACCU projects are subject to.

Recommendation 6.6
Increase the integrity of carbon offsets recognised by the Safeguard Mechanism

To make emissions reductions credible, the Australian Government should discontinue the 25-year permanence period for sequestration-related ACCU projects, introduce an additional class of sequestration-based ACCUs that align with the more enduring permanence provisions of the biodiversity market, and publish offset reports and project audit reports required by the Clean Energy Regulator. State and Territory Governments should stipulate the proportion of biogas that needs to be captured by existing ACCU-generating landfill gas capture projects under existing regulations.

4.5 Distributional considerations

The absence of economy-wide abatement policies places pressure on policy makers to implement sectoral and sub-sectoral policies such as subsidies for home solar panel installation, subsidies for low emissions technology deployment by industry and tax concessions for electric vehicles. These measures are not only more costly than economy-wide alternatives, but they can also raise several distributional concerns. First by imposing higher overall abatement costs on Australia that fall disproportionately on different sections of the community; and second, by selectively benefiting some sections of the community more than others. For example, electric vehicle subsidies channelled through salary sacrifice and fringe benefits tax arrangements might be expected to principally benefit higher income individuals who tend to have the greatest interest in salary sacrifice and fringe benefits arrangements.

By contrast, distributional impacts of economy-wide carbon pricing measures will mainly reflect impacts on prices of goods and services. As lower income households spend a higher proportion of their incomes they may bear a disproportionate burden, but regressivity may be moderated by the higher emissions intensity of high income household consumption patterns and once impacts over the lifecycle are accounted for.[3]

Moreover, the fact that the Safeguard Mechanism does not price sub-baseline emissions allowances should help to mitigate such concerns. While falling baselines will progressively impose greater abatement goals on captured facilities, all sub-baseline emissions will continue to be unpriced. Moreover, the key household assistance measure implemented following the introduction of the Carbon Pricing Mechanism on 1 July 2012 — the tripling of the tax-free threshold from $6000 to $18 200 — remains in place today, despite the Carbon Pricing Mechanism ceasing operation on 1 July 2014.

4.6 The role of other measures

With a national emissions reduction target in place, and a broad-based emissions abatement mechanism implemented to achieve it, the public policy case for additional sectoral interventions would rely on those additional interventions being genuinely ‘complementary measures’: that is, measures that either efficiently address non-price barriers to abatement, or that deliver broader non-carbon abatement social benefits. For example, were the Safeguard Mechanism to be made more binding on the electricity generators, the ongoing

[3] Given that incomes tend to rise and fall over the course of an individual's life, assessing the regressivity of a particular policy change at a given point in time can generate a higher regressivity estimate than when total lifetime income and total lifetime income are taken into consideration.

need for additional policy support for renewable energy would be brought into question, unless it could be shown that it efficiently remedied non-price barriers to renewable energy uptake or drove non-carbon social benefits.

Similarly, were an amended Safeguard Mechanism to be extended to the transport sector, or covered by a broadly comparable mechanism, the policy case for Commonwealth tax concessions for electric vehicles (which, given their high cost per tonne of abatement, is weak even without a broad-based abatement mechanism) would be further diminished.

This would also be true for the range of state and territory measures that are currently in place, including jurisdictional emissions targets. Once a national emissions abatement target is established, and an economy-wide abatement policy is implemented to achieve it, these measures would impose a range of costs on the Australian economy, for little or no benefit to the national emissions abatement task. While such state measures may be publicly justified on the grounds that they would allow states to capture a desired share of the new industries and the 'green jobs' associated with them, such motivations are likely to render such measures a form of industry assistance that would likely add to Australian abatement costs for little actual gain to nationwide emissions reduction efforts (box 4.5).

Given the potential for such policy interactions, it will be important that Australian governments (Commonwealth, State, and local) take a coordinated and disciplined approach to policy development. Sound policy development would include demonstrating how new and existing policies complement the SM central mechanism or target additional emissions abatement measures in sectors not covered by the Safeguard Mechanism. Policies that are found not to be complementary to the SM should be phased out, and all remaining policies should have their expected implicit carbon price independently estimated and independent and made public.

Box 4.5 – 'Green jobs' and industry policy under an emissions cap

Once national emissions reduction targets are in place, economy-wide policy settings to achieve those goals are implemented, and the credibility of any associated offset regime is ensured, the value of additional state-based measures will depend on the extent to which they are complementary measures — either efficiently addressing non-price barriers to abatement or delivering non-carbon abatement benefits.

States and territories pursuing individual abatement policies that do not satisfy these conditions would not make additional contributions to national decarbonisation but would simply alter the distribution of that national abatement between the states and territories — driving increased abatement in their own states while simultaneously freeing up emissions space for other states and territories to use – likely at greater overall cost. Doing so would constitute a form of state-based industry policy, directing resources to abatement industries in that state or territory, for no benefit to the overall emissions abatement task.

Such industry policy might be communicated as supporting 'green jobs' or 'clean energy jobs' in that state or territory but the value of doing so would be of questionable value for several reasons. First, pursuing sectoral jobs targets typically does not lead to additional overall employment, it simply reallocates workers from one industry to another, likely at the expense of the comparative advantage of those workers, weighing on productivity in the process. This reallocation effect is starker in a near full employment economy.

More generally, once an economy is pursuing a national emissions reduction target the notion of 'green jobs' begins to lose meaning. First, because lower emissions intensity jobs in one jurisdiction simply

Box 4.5 – 'Green jobs' and industry policy under an emissions cap

allow others to engage in higher emissions intensive activity, and second because some emissions intensive activities will be required to pursue longer-run emissions reductions e.g. coking coal, iron ore, bauxite and rare earths extraction and processing are all currently required for the deployment of renewable energy and battery technology.

Whether a country should be regarded as a 'green' economy or a 'clean energy' economy is more meaningfully judged by the overall emissions intensity of the economy, not the emissions intensity of the individual jobs and industries that comprise it.

Recommendation 6.7
Phase out policy measures not complementary to the Safeguard Mechanism

Policy measures that are not complementary to the Safeguard Mechanism (SM) should be phased out to lower the overall cost of abatement. A review of existing measures should be undertaken to assess their complementarity to a reformed SM and recommend a timetable for the removal of non-complementary measures identified by the review. A 'complementary measure' would be one that drives emissions abatement from emissions sources not covered by the SM, addresses market failures that constrain the pursuit of abatement from emissions sources covered by the SM, or that delivers broader non-carbon abatement related benefits. Remaining non-Safeguard Mechanism policies should (1) stipulate how they are complementary to the SM, and (2) have their estimated abatement costs independently estimated and made public.

Least-cost electricity grid stability

Growing renewable energy uptake has raised questions about the future reliability of the electricity grid, given the intermittence features of individual wind and solar panel installations. This has led some to emphasise the importance of introducing stabilising technologies to the electricity grid as it becomes increasingly renewable. To this end, on 8 December 2022, Commonwealth and State Governments announced their intention to introduce a Capacity Investment Scheme (CIS), by the second half of 2023. The final design of the CIS is yet to be made public, but the plan appears to be to pay suppliers of dispatchable renewable electricity (renewable electricity that can be made available at short notice), to pre-commit to making that electricity available as needed. It appears that non-renewable sources of electricity, like coal and gas fired power stations, will be excluded from the scheme.

Capacity mechanisms generally make capacity payments in advance of that capacity being required. In this way it can be considered a kind of retainer system, paying dispatchable electricity providers to commit to provide capacity during periods in which the demand for electricity exceeds supply. By contrast, statements to date suggest that the CIS will principally operate through a revenue underwriting mechanism, the value of which will be determined through periodic auctions, and which will be subject to both a price floor and ceiling. A mechanism might be designed to pass on the cost of these capacity/underwriting payments to network providers or retailers, and ultimately to household and business end users. Equally, these costs may simply be funded through taxation revenue.

It is not yet clear whether the announced CIS will be open to distributed household and business battery installations, aggregated and coordinated through 'virtual power plant' (VPP) platforms. Nor is it clear whether demand side participation, either by large electricity users, or by large numbers of small users aggregated through VPP platforms, will be allowed. Demand side participation could stabilise the electricity grid not by bringing supply into greater alignment with demand at each point in time, but by bringing demand into greater alignment with supply. For example, a VPP operator could fund the installation of technology required to simultaneously reduce non-essential sources of electricity demandthroughout hundreds of homes and businesses and provide readily reducible demand, the demand side equivalent of dispatchable electricity supply, during periods of grid instability. Maximising the number of technologies and approaches that are allowed to bid into the mechanism would be consistent with a least-cost approach to managing intermittence challenges in the electricity sector.

The CIS would mark a move away from Australia's current system of principally relying on variable wholesale prices to balance supply and demand in Australia's electricity markets. While wholesale electricity prices are capped in the National Electricity Market (NEM), that cap is relatively high by international standards (ESB 2022, p. 11). The higher that prices are allowed to rise in the wholesale market, the greater the commercial feasibility of dispatchable electricity suppliers being purpose built to only generate electricity during unusually high price periods, either due to unusually high levels of electricity demand, or due to unexpected disruptions to electricity supply. Similarly, the higher that prices are allowed to rise, the greater the likelihood that energy users would make the investments required to notably reduce electricity demand during high price periods.

One of the advantages of relying on price signals to coordinate the matching of electricity supply and demand is that higher prices only need to be paid during those times when demand is greater than supply (see box 4.6 for discussion of the value of variable prices). By contrast, capacity payments to dispatchable electricity providers are to retain that potential capacity 24 hours a day, 7 days a week, and 365 days a year.

Box 4.6 – The benefits of price variability for grid stability, and broader policy goals

Prices act as a coordinating mechanism, helping to align the supply of a good or service in an economy with the demand for that good or service. An increase in prices for a particular good or service signals that demand is greater than supply, encouraging additional supply from producers, and reducing demand from users that no longer value the good or service at the higher price. Similarly, price falls signal that supply is greater than demand, encouraging increased demand from users looking to take advantage of lower prices, and reduced supply from producers that require higher prices to remain viable. These demand and supply side responses combine to align supply and demand over time.

The coordination benefits of variable prices are just as applicable to the electricity sector, which can be broadly broken down into three separate markets — the market for generation fuels, the wholesale market for electricity and the retail market for electricity. However, a range of price caps currently operate in all three markets in Australia, which run the risk of detracting from system reliability in some circumstances. These risks should be weighed against the perceived benefits of price caps when deciding whether to maintain existing price caps or proceed with the application of new price caps.

Generation fuel market — Price variability in the generation fuel market, largely coal and gas in Australia, allows the market share of competing generation types to vary so as to minimise the average cost of electricity produced by the wholesale market. For example, all else equal, as the price of coal and gas increases, the proportion of electricity supply delivered by coal and gas fired generators can be expected to fall, and the proportion delivered by renewable energy to rise. Similarly, as the price of coal

Box 4.6 – The benefits of price variability for grid stability, and broader policy goals

and gas falls, the share of electricity produced by coal and gas fired generators can be expected to rise, and that from renewables to fall.

Restrictions on this mechanism, like the December 2022 imposition of price caps on coal and gas sold to coal and gas fired generators, risks impeding this mechanism. While designed to be only a short-term measure to deal with energy market disruptions, interventions designed as short-term measures frequently become long-run policy settings. All else equal, depending on supply responses as discussed below, the longer that such price caps remain in place the greater the likelihood that they will artificially constrain the ability of renewable electricity producers to compete with subsidised coal and gas fired generators, potentially constraining the uptake of renewable energy to some degree.

The amount of coal and gas supplied to electricity generators at the capped price could also decline were supply diverted to export markets where higher, uncapped, prices are on offer. While some coal mines are not in a position to do so, if those coal mines that are positioned to divert supply to the uncapped export market were to do so, it may cause output disruptions for generators that are unable to secure the fuels that they require. Were that to occur, price caps aimed at placing downward pressure on wholesale electricity prices could have the unintended consequence of reducing grid reliability, thereby placing upward pressure on wholesale electricity prices.

Wholesale electricity market — The value of variable prices for grid reliability is also apparent in the wholesale market, by helping to bring supply and demand into alignment over the course of the day. In the extreme, the ability and probability of wholesale prices rising to very high levels might be sufficient to justify investment in dispatchable capacity just for periods of elevated market stress, even if only occurring several times per year. While wholesale prices are capped in the National Electricity Market, they are relatively high by international standards (ESB 2022).

The Capacity Investment Scheme announced by Commonwealth and Energy Ministers in December 2022 appears set to operate alongside existing wholesale price caps. If the scheme operates as intended, the range of prices experienced in the wholesale market should moderate, albeit with much of the associated decrease in average prices offset by capacity payments. It follows that were the scheme to be phased out at a future date, perhaps once the generation fleet had completed the transition from coal fired power stations to renewables and storage technology, the range of prices observed in the wholesale market would widen, all else equal, taking on much of the coordination required for grid stabilisation previously provided by the scheme.

Retail electricity market — Price variability in the wholesale market can create challenges for electricity retailers when they interact with harder price caps in the retail markets, imposed through annual Default Market Offer (DMO) regulatory determination processes, which caps the price of electricity for households and businesses that opt-in to standard contracts. While only about 10% of households and about 18% of businesses were on standard contracts in 2022 (AER 2022), they can constrain prices for non-standard electricity contracts by acting as a point of reference, and by acting as a substitute product.

The combination of variable wholesale prices and constrained retail prices presents a financial risk that retailers generally use derivatives to hedge away, though this can prove challenging during extended periods of pronounced market stress. DMO-related constraints on retailer prices are designed to protect consumers from being overcharged by electricity retailers. However, they also constrain the degree of price variability that could encourage a greater proportion of households and businesses from contributing to grid

Box 4.6 – The benefits of price variability for grid stability, and broader policy goals

stability, by reducing electricity usage during those times in the night when prices are high, and increasing use while prices are low. Under standard contracts, price variability is limited to off-peak, shoulder and peak pricing over the course of the day.

Constraints on retail price variability may become an increasingly important consideration as Australia's transport fleet progressively moves to electric vehicles (EVs), which could either contribute positively or negatively to grid stability. EVs could contribute to grid stability if they were charged at those times of the day when electricity demand is low and supply is high, and partly discharged during peak periods when demand on the electricity grid is high. If the reverse charging pattern emerges, charging EVs during peak periods, then the rise of EVs may compound pressures on the electricity grid. Price variability in the retail electricity market may prove the most effective means of encouraging EV charging patterns that contribute to grid stability. This may be sufficiently encouraged by peak, shoulder and off-peak price differentials over the course of the day but will warrant monitoring as the transport fleet electrifies.

A well-functioning CIS would reduce the range within which wholesale electricity prices would move, with CIS-underwritten capacity being called to market as wholesale prices start to rise, which could notionally leave average electricity prices unchanged relative to what would otherwise be the case. However, reliance on a high-profile CIS for electricity grid resilience may lead to 'over-insurance', supporting more investment in dispatchable capacity than is necessary to provide grid stability, and thereby delivering electricity system resilience at a higher average cost than might have been delivered by variable prices alone.

It is also unclear to what extent the CIS will be required to drive investment in storage capacity, given previous Commonwealth and State government commitments to invest in storage capacity, and the likely uptake of battery technology by households and businesses over coming years. For example, the NSW Government Renewable Energy Zones program includes support for large chemical battery storage facilities such as the 700 MW Waratah Super Battery, Victoria has committed $119 million to the delivery of a 2.6 GW battery storage target by 2030 and 6.3 GW by 2035, and the Australian Renewable Energy Agency (ARENA) has set aside $176 million for its Large Scale Battery Storage investment stream, through which it has either provided or pledged financial support for the installation of a fleet of large scale batteries throughout Australia. In addition, according to the Australian Energy Market Operator (AEMO) Integrated System Plan, more than two thirds of grid stabilising capacity required by 2050 could plausibly come from small scale distributed sources such as home battery installations, a rapidly growing fleet of electric vehicle batteries which could contribute to grid stability by recharging during the middle of the day when solar power output is relatively high and running a proportion of the battery down at night when electricity demand is relatively high, and smart-meter supported demand side responses by households and businesses, reducing the amount of power they use when electricity demand is high and relaxing these constraints as electricity supply increases. It remains to be seen how well these sources of grid stability will be directly accessed by the CIS, or how efficiently they will indirectly reduce stabilisation demand through the CIS.

Finally, when considering the grid stability challenge ahead, it is worth distinguishing between two distinct sources of potential grid instability. The first phase is transitional, relating to uncertainty around the sequence in which existing coal-fired power stations shut down and exit from the grid, potentially before an offsetting quantity of renewable generation capacity becomes operational. The second is more structural and relates more strictly to the intermittence features of individual photovoltaic and wind installations. The design of the CIS might differ on the basis of which of these sources is of greatest concern. If the transitional grid stability challenge is the dominant concern, a least-cost capacity mechanism might be more short-lived in nature and be open to participation by existing coal and gas fired power stations. If the latter is the greatest concern, then there might be calls for the CIS to be more enduring.Given that these questions will only be resolved with time, there might be value in placing a five-year sunset clause on the proposed CIS and committing to an independent public review of the effectiveness of the CIS before deciding to extend it. That review could weigh the magnitude of ongoing costs of the CIS against the costs of potential grid disruption events in the future, and the extent to which the CIS has delivered greater grid stability at lower overall cost than price variability in wholesale electricity markets.

In the meantime, a least-cost CIS would be technology neutral, allowing both supply and demand side participation. While inclusion of the coal and gas fired power stations in the CIS appears to have been ruled out, it is possible that governments will weigh the merits of policy interventions aimed at extending the life of these generators. Inclusion of coal and gas fired power stations in the CIS would come with the benefit of providing some transparency around the cost of any such interventions. If they are not included, governments should be transparent about the value of any such support. In addition, when reviewing the effectiveness of the CIS, the grid stabilising effects of the CIS should be distinguished from the grid stabilising effects of interventions to extend the life of coal and gas fired power stations.

Recommendation 6.8
Pursue a least-cost approach to securing electricity supply

The proposed Capacity Investment Scheme should be implemented with a five-year sunset clause, and independently reviewed ahead of any decision to extend its life. It should be implemented on a technology neutral basis, allowing for both supply and demand-side participation by households and businesses.

4.7 Public support for research and development

There is a clear public policy case for government support of climate-change related research and development, particularly in frontier technologies where market failures are most relevant. As for any R&D support – whether to businesses, universities and other research bodies — clear criteria and transparent oversight are important, albeit recognising that failures at this early experimental stage are to be expected.

The case for public support of commercialisation of new technologies is generally weaker because, distinct from basic research, businesses are usually well placed to assess market risks and to capture the benefits. But where clear and consistent pricing of greenhouse emissions is absent, commercialisation of new low emissions technologies is made riskier and some government support may be appropriate. However, such contributions bring their own risks. Contributions should be transparent, and subjected to cost benefit analysis. In particular, it is important that governments have a mechanism to ‘move on’ once it becomes clear that a particular frontier technology is unlikely to meaningfully reduce long-term abatement costs (at least on a timeline that is relevant to climate policy) or indeed that the new technology has become commercial. Sunk costs should not determine whether funding continues. Mechanisms to prompt a ‘moving on’ from such technologies include making further funding conditional on the meeting of pre-defined progress thresholds and introducing formal institutional arrangements, such as sunset clauses, to allow reconsideration and assessment of the costs and benefits of additional funding.

Such an approach might prove useful for the hydrogen sector, which has received substantial investments from both Commonwealth and State Governments, and CCS technologies which have received the highest amount of public support to date (box 4.7). The efficiency of investment into CCS technologies that has already taken place has been questioned by research institutions and public commentators (Browne and Swann 2017; Macdonald-Smith 2022a, 2022b; Turnbull 2017). However, irrespective of whether CCS makes a meaningful contribution to the pre-2050 abatement task, it may be important for the post-2050 'draw-down' of excess atmospheric stocks of greenhouse gases (IEA 2021; IPCC 2022; Macdonald-Smith 2021).

Once a broad-based emissions abatement mechanism is in place, consistent with achieving targets, all projects utilising low emissions technologies, new or old, have a commercial advantage over emissions producing ones, thereby reducing the policy case for ongoing government support.

Box 4.7 – Public R&D support for abatement technologies

Government can play an important role in supporting research and development into new technologies when market failures constrain private activity. This role is strongest in the case of frontier technologies, where market failures are most pronounced. To date, Commonwealth and State Government investment has provided support for a range of emissions abatement technologies, including carbon capture and storage, and more recently, hydrogen.

Australian climate technology support

Level of Government	Technology	Value of assistance
Commonwealth	Hydrogen fuel	$1 billion in direct Australian Government assistance (excluding CCS).[a]
	Future fuels and vehicles	$2.1 billion[b]
	Large-scale energy storage	$100 million[c]
	Ultra low-cost solar	Up to $40 million[d]
	Carbon capture and storage	Between 2003 and 2017, the Government committed over $3.5 billion to CCS and over $1.3 billion was distributed.[e] More recently, the Government has invested over $300 million to fund carbon capture, use and storage (CCS) projects and advance technologies, including establishing CCUS hubs near industrial areas.[a]
	Soil carbon	$1.6 million[f]
New South Wales	Hydrogen fuel	$70 million[a]
Victoria	Hydrogen fuel	$10 million[a]
Tasmania	Hydrogen fuel	$0.2 million[a]
Western Australia	Hydrogen fuel	$47.5 million[a]

a. DISER (2021i, pp. 24, 34, 37, 40, 44). **b.** DISER (2021f, p. 10). **c.** ARENA (2022, pp. 3–4). **d.** ARENA (2022b). **e.** Browne and Swann (2017). **f.** Taylor (2022).

Appendix

A. Indirect carbon price estimation

This appendix details the methodology used to estimate the indirect carbon prices reported in volume 6. We use the term indirect carbon prices to refer to the fiscal cost of the policy per tonne of CO_2-e abatement. Our estimates can be thought of as similar to the implicit abatement subsidies estimated by the Commission previously (PC 2011). The indirect carbon prices listed in the chapter and detailed here are not meant to be exhaustive. There are many policies for which an indirect carbon price has not been estimated.

A.1 Fringe Benefits Tax exemption

The indirect carbon price associated with the policy to exempt electric vehicles (EVs) from Fringe Benefits Tax (FBT) ranges from $987 to $20 084, depending on the assumptions used in the estimation process.

When an employer makes a car available for an employee's private use they are liable to pay FBT. The taxable value is equal to the base value of the car, multiplied by the 'statutory percentage' (20%). This value is then grossed-up to reflect the gross salary employees would have to earn at the highest marginal tax rate (including Medicare levy) to pay for the benefits after paying tax (ATO 2019). Fringe benefits are taxed at the top marginal income tax rate (47%). Alternatively, when an employee acquires the car through a salary-sacrificing arrangement, the taxable value is not grossed-up and FBT is levied at that employee's marginal income tax rate (ATO 2021).

The *Treasury Laws Amendment (Electric Car Discount) Bill 2022* passed into law in December 2022. It exempts Battery Electric Vehicles (BEV) and Plug-in Hybrid Electric Vehicles (PHEV) from FBT. To be eligible for the exemption, the value of the car at the first retail sale must be below the Luxury Car Tax threshold for fuel efficient cars, which is currently set at $84 916 (Chalmers 2022). The current eligibility of PHEV's under the scheme will sunset from 1 April 2025. The policy reduces the annual cost of leasing an EV for employees that choose to do so through a salary sacrifice package and for employers that choose to provide an EV for the private use of an employee. Though these savings are ultimately financed by the Australian community through foregone tax revenue collections.

Fiscal cost

The fiscal cost of the FBT exemption is based on Government estimates that a $50 000 EV leased via a salary sacrifice arrangement would save employees $4700 per annum (Chalmers 2022). This figure was then multiplied by 4 years, aligning with the assumed lease life used in the Parliamentary Budget Office (PBO) costing of the policy (PBO 2022), to arrive at an overall fiscal cost of $18 800 per EV. This estimate is likely conservative, given that it assumed a $50 000 electric vehicle and that the FBT exemption is available for EVs priced up to the LCT threshold for fuel efficient vehicles, currently set at $84 916.

Emissions abatement

The emissions abatement resulting from this policy can be measured as the difference between emissions produced by the extra EVs that are purchased because of this policy and the average emissions of the vehicles that they replace. EV emissions are those emissions associated with the grid electricity required to charge the EV, factoring in the projected decarbonisation over the electricity grid over the period out to 2050 (more below). While some EV recharging stations are powered solely by renewable energy, and some EVs will be charged from homes and workplaces with onsite renewable generation capacity, this will not be universally the case. Moreover, in most cases, the use of onsite renewable energy to charge EVs would preclude the export of that renewable energy to the electricity grid, or lead to increased demand on the grid to source the electricity to provide for non-EV charging uses, that would have otherwise been supplied by the onsite renewable energy generation. Nevertheless, to identify the proportion of the indirect carbon price that is attributable to the emissions intensity of the electricity grid, we undertake a sensitivity test of our baseline indirect carbon price estimates by assuming that grid emissions are zero. These numbers are provided in brackets in table 4.2.

Emissions from internal combustion energy (ICE) powered cars arise come from the burning of liquid fossil fuels. The parameter values used in our estimate is the average emissions intensity of new passenger vehicles in 2021 and the average number of kilometres travelled by vehicles each year in 2018, the latest pre-COVID year for which data is available. The latest pre-COVID year was chosen given that widespread supply chain disruptions, lockdowns, and border closures likely contributed to the reduction in the average number of kilometres travelled by passenger vehicles in 2020. Broader lifecycle emissions, those generated throughout the supply chain in the process of manufacturing vehicles, were not considered.

To estimate the amount of abatement, the following parameters and assumptions were used (table A.1).

Table A.1 – Assumptions underpinning the emissions abatement estimate

Parameter	Description	Assumed value	Source
km	Average kilometres driven per year	12 600 km	ABS 2020
$EVefficiency$	Electricity consumption per kilometre	151 Wh/km	EV Database 2022
$ICEefficiency$	Emissions per kilometre	146.5 g/km	NTC 2022
EF	Emissions factor	See table A.2	
A	Additionality[a]	5–75%	
BF	Bring-forward[b]	3–13 years	

a. Additionality refers to the proportion of abatement — in this case the proportion of EVs — that would not have occurred in the absence of the policy. **b.** Bring-forward refers to the difference between when the car is acquired with the policy in place and when it would have been acquired in the absence of the policy.

The equation for calculating the amount of emissions abatement is as follows:

$$Emissions\ Abatement = \sum_{t=1}^{BF} (ICEefficiency - EVefficiency \times EF_t) \times km \times A$$

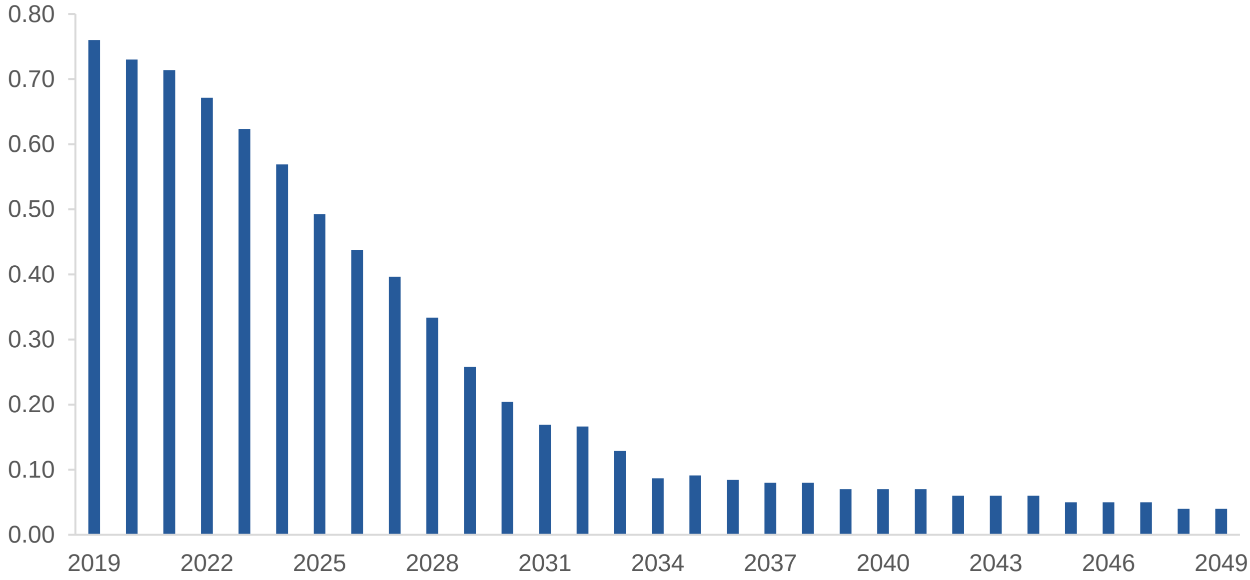
Underpinning the emissions abatement estimate is an assumption about how the emissions intensity of the electricity grid evolves over coming years. Our modelling used the development path AEMO viewed as most likely, *Progressive Change least-cost DP with actionable Marinus Link, and staged VNI West and HumeLink* (AEMO 2022). This development path is used to calculate the share of electricity generation coming from renewable and non-renewable sources. In turn, these shares are used in a simple linear regression to estimate the emissions factor for each year until 2049-50:

$$\widehat{EF}_t = \widehat{\beta_1} ShareNonRenewables_t$$

The emissions factor associated with consumption of purchased electricity or loss of electricity from the grid is forecast to fall from 0.73 in 2019-20 to 0.04 in 2049-50 (figure A.1).

Figure A.1 – Forecasted average emission factors for Australian electricity

Kilograms of CO_2-e per kilowatt hour



Source: Productivity Commission estimates using DISER (2021b); AEMO (2022).

Each EV taken up under the policy is assumed to last for 15 years. This reflects an assumption that after the 4-year lease term, the EV is sold into the used car market and thereby continues to generate emissions abatement relative to what would have otherwise been the case.

Assumptions about the degree of additionality and the degree of bring forward of EVs (ultimately) purchased through the policy are also relevant to the estimated abatement of the policy.

Additionality refers to the proportion of EVs demanded through the policy that would not have otherwise been demanded. An EV sourced through a salary sacrifice arrangement under the policy would not be additional if that EV would have otherwise been purchased or leased by that person without the FBT exemption, or purchased or leased by another individual, household, or business in Australia. If the policy supported non-additional demand for EVs then the abatement associated with that demand could not be attributed to the policy. Bring-forward is conditional on additionality and refers to the number of years that an additional EV leased as a result of the policy would have been brought forward from 2035, from when it is assumed that EVs will dominate the new car market and when an EV would have been sourced in the absence of the FBT exemption. This degree of bring-forward is relevant to the level of abatement that can be expected from an EV over its assumed 15-year life, given that the decarbonisation of the electricity grid will be less progressed the greater the bring-forward, and more progressed the lower the level of bring-forward.

The Commission has not sought to estimate the likely additionality or bring-forward elicited by the FBT exemption for EVs, but has sought to provide the reader with an indication of the indirect carbon price impacts of a range of additionality and bring-forward assumptions. The lower bound indirect carbon price estimate assumed 75% additionality, meaning that 75% EV's leased under the FBT exemption would not have otherwise been purchased or leased in the absence of the FBT exemption. The upper bound estimate assumed only 5% additionality, relevant to a world in which supply side constraints will continue to be the dominant barrier to EV uptake in Australia (see box 4.4 for discussion). This range is not a forecast per se, but provides the reader with a sense of the indirect carbon price implications of key additionality assumptions. Bring-forward assumptions range from 13 years (from 2035-36 to 2022-23) to 3 years (from 2035-36 to 2032-33), reflecting an assumed 10-year life for the FBT exemption policy, aligning with the 10-year policy assumption used for policy costing purposes PBO (2022). While government has not set a time limit for the FBT exemption for battery electric vehicles, the 10-year life assumption is useful for constraining our range of 'bring-forward' assumptions. The lower bound indirect carbon price estimates includes a 3-year bring-forward assumption, while the upper bound includes a 13-year bring-forward assumption.

Finally, these estimates relate to Battery Electric Vehicles (BEV) only. Given that Plug-in Electric Vehicles (PHEVs) will be eligible for FBT exemption until 1 April 2025, and that they will continue to generate emissions while running off the ICE-based component of their engine, the 100% BEV assumption further acts to render these estimates conservative.

Bringing fiscal cost and emissions abatement together

The indirect carbon price associated with the policy was estimated on a per-unit basis and calculated according to the following formula:

$$Implicit\ Carbon\ Price = \frac{Tax\ Foregone}{Emissions\ Abated}$$

Our lower bound estimate of the indirect carbon price is $987 per tonne of CO_2-e and the upper bound estimate is $20 084 per tonne of CO_2-e.

Implications of assumptions about parameters

Conducting sensitivity analysis by adjusting the parameters helps illustrate which parameters most effect the estimated indirect carbon price. Some are far more important than others. Table A.2 shows the change in the indirect carbon price that occurs if each parameter is decreased by 10%. The baseline from which these effects are measured is the lower bound estimate, that is, additionality is assumed to be 75% and bring-forward is assumed to be 3 years.

What if grid emissions were zero?

Though our model allows for an increasing share of renewables in electricity generation over time, it assumes that the emissions intensity of non-renewable generation remains constant. This assumption is likely to bias upwards our estimate of the carbon price because gas, which is less emissions intensive than coal, is likely to make up a larger share of non-renewable generation in the future (AEMO 2022). The bias is likely to be small. Even if we assumed that emissions associated with electricity generation were zero — or equivalently, that all EVs are charged using renewable energy sources — which provides an absolute and unrealistic lower bound, the estimated indirect carbon price only falls by 8.3% in the case of the FBT exemption. If the emissions factor associated with consumption of purchased electricity or loss of electricity from the grid is 10% lower than forecast each year, the indirect carbon price would be 3.3% lower (table A.2).

Table A.2 – Effects of decreasing parameters by 10%

Parameter	Description	Effect of a 10% decrease on the estimated indirect carbon price (%)	Effect of a 10% decrease on the estimated indirect carbon price ($/t)
$Value$	Value of the EV	-10.00	-99
$Lease$	Average lease period	-10.00	-99
km	Average kilometres driven per year	11.11	110
$EVefficiency$	Electricity consumption per kilometre	-3.30	-36
$ICEefficiency$	Emissions per kilometre	15.50	153
EF	Emissions factor	-3.30	-36
A	Additionality	7.48	74
BF	Bring forward	-4.66	50

What if the average lease length was not four years?

The estimation approach implicitly assumes an average lease length of four years. There is no change to the annual amount of fringe benefits tax payable for each of the first four years of a lease. Hence, reducing the average lease length by one year causes the estimate of the indirect carbon price to fall by 25%. In the fifth year of a lease, the base value of the car can be reduced by one third. Hence, increasing the average lease length by one year causes the estimate of the indirect carbon price to increase by 20%.

What if the typical EV cost more than $50 000?

Our estimates implicitly assume a $50 000 EV price, which is assumed in Treasury estimates of the financial impact of the policy (Chalmers 2022). However, there are currently very few EV models available in Australia for less than $50 000. The recommended retail price for the entry-level model of Australia's highest selling EV — the Tesla Model 3 — is $65 500. Using this figure instead increases the indirect carbon price by 30%. The threshold for being eligible for the FBT exemption is $84 916, using this figure results in an indirect carbon price that is 69.8% higher than the indirect carbon price based on a $50 000 EV. Alternatively, if the average EV price fell to $40 000, the indirect carbon price would be 20% lower.

What if the average new ICE-powered vehicle is more efficient?

The base model assumes that the typical ICE-powered vehicle emits 146.5 g of CO_2-e per km. This was the average emissions intensity of new passenger vehicles in Australia in 2021. If the emissions intensity of new passenger vehicles was to fall to by 10%, the estimated indirect carbon price would increase by 15.5% at the lower bound.

A.2 State EV policies

The states also have a suite of policies designed to incentivise the uptake of EVs (table A.3). We have estimated indirect carbon prices for three types of policies — upfront subsidies or rebates, stamp duty exemptions or discounts and registration exemptions or discounts. The cost of each policy per EV has been aggregated by state because the policies are complementary rather than exclusive. That is, buyers making use of one policy can also make use of the others. As with the estimates related to the FBT exemption, an EV value of $50 000 has been assumed.

Table A.3 – State and Territory EV policies[a,b]

State or Territory	Upfront subsidy or rebate	Stamp duty discount/exemption	Registration discount/exemption
New South Wales	$3000	$1600	-
Victoria	$3000	-	$100 per year
Queensland	$3000	$500	$74.5 per year
South Australia	$3000	-	$138 per year for three years
Tasmania	-	$2000	-

Sources: NSW Government (2022); DELWP (2021); Queensland Government (2022a, 2022b, 2022c) TCCO (2021); Department of Treasury and Finance (2022); Department for Energy and Mining (2022); Government of South Australia (2021); DWER (2021); Fisk (2021).

Upper and lower bound estimates of the indirect carbon price have been calculated in the same way as they were for the FBT exemption. The main difference is the minimum bring-forward dates, which have been set at the scheduled or likely end date (for quantity limited subsidies) for the highest value subsidy offered by the state or territory. For simplicity, the forecast emissions factors associated with consumption of purchased electricity or loss of electricity from the grid that were used were the same as those used to estimate the indirect carbon price associated with the FBT exemption. This effectively assumes that each state follows the same emissions reduction path within the electricity sector. While this is unlikely to be the case, changing this assumption would have only small effects for each state, particularly given that the listed states are linked to the NEM. The indirect carbon price associated with each state policy is high compared with other abatement measures but not as high as the indirect carbon price associated with the Commonwealth FBT exemption for EVs (box 4.2) because the tax expenditure is lower (table A.4), though the lower value of these concessions reinforces questions about the likely additionality of these policies.

Table A.4 – Indirect carbon prices for State and Territory EV policies

State or Territory	Cost over 15 years	Indirect carbon price ($/tonne CO_2-e)
New South Wales	$4600	$271–4,914
Victoria	$4500	$287–4,807
Queensland	$4617	$282–4,933
South Australia	$3414	$209–3,647
Tasmania	$2000	$134–$2,137

Source: Productivity Commission estimates.

A.3 Fuel excise discounts

Domestically produced ethanol and biodiesel attract discounted rates of excise duty and composite fuels made using ethanol and biodiesel have a lower emissions intensity (table A.5).

Table A.5 – Excise rates and emissions intensities for fuels

	Excise rate[a]	Scope 1 emissions intensity (kg/CO_2-e/litre)	Lifecycle emissions intensity (kg/CO_2-e/litre)
Petrol	0.442	2.38	3.02
Ethanol	0.145	0.06	1.94[b]
E10	0.412	2.15	2.91
Diesel	0.442	2.72	2.92
Biodiesel	0.088	0.09	0.60
B20	0.371	2.19	2.46

a. Discounted excise rates apply only to domestically produced ethanol and biodiesel. **b.** Lifecycle emissions intensity estimates for ethanol were calculated using a weighted average of lifecycle emissions of wheat, sorghum and molasses because an estimate for the lifecycle emissions intensity of barley, which accounts for 9% of ethanol production in Australia, was not available.

Sources: Productivity Commission estimates based on DISER (2021b); PC (2011); PC (2022); USDA (2020).

The indirect carbon price associated with the discounted rates of excise duty can be estimated as follows:

$$\frac{EX_p - EX_e}{EM_p - EM_e} \times 1000$$

$$\frac{EX_d - EX_b}{EM_d - EM_b} \times 1000$$

where:

- EX_p indicates the excise rate for petrol
- EX_e indicates the excise rate for ethanol
- EX_d indicates the excise rate for diesel
- EX_b indicates the excise rate for biodiesel
- EM_p indicates the emissions intensity for petrol
- EM_e indicates the emissions intensity for ethanol
- EM_d indicates the emissions intensity for diesel
- EM_b indicates the emissions intensity for biodiesel.

The scope 1 emissions intensity was used to estimate a lower bound, while the lifecycle emissions intensity was used to estimate an upper bound. The estimated indirect carbon price for E10 is $127.91–273.66 and for B20 is $134.55–152.02 (table A.6).

Table A.6 – Indirect carbon prices for biofuels

	Indirect price (scope 1 emissions)	Indirect price (lifecycle emissions)
E10	127.92	273.65
B20	134.55	152.02

Source: Productivity Commission estimates.

A.4 Renewable energy target

The renewable energy target (RET) has two components, the large-scale renewable energy target, backed by large-scale generation certificates (LGCs) and the small-scall renewable energy scheme, backed by small-scale technology certificates (STCs). The RET aimed to achieve 33 000 gigawatt hours of additional electricity from large-scale renewable sources by 2020 — equivalent to 20% of energy supply. That target was reached in September 2019 and is now being maintained through until 2030.

This section estimates the indirect prices associated with the RET up until 2020. The period after 2020 is not considered because — with the target having already been met — it is unlikely that new generation could be considered additional. The Commission (2011) has previously estimated the indirect price — or indirect abatement subsidy — associated with both the LGC and STC schemes.

Large-scale generation certificates

The Commission (2011) estimated the indirect carbon price associated with LGCs using both the 'spot' price ($37.03 at the time) and the long-term contract price. The long-term contract price was not readily available and hence was estimated as the price needed to induce wind generation to enter the market ($60).

Since then the economics of electricity generation have changed, with renewables now having a lower levelised cost of energy than coal (Bleich and Guimaraes 2016, p. 6). This finding is also true domestically, with each of CSIRO's GenCost reports identifying renewables as the lowest cost 'new build' (Graham et al. 2018, 2020, 2021, 2022). Consequently, we have adjusted our methodology and only estimated indirect carbon prices based on the 'spot' price. As of 5 September 2022 the price of an LGC was $59.50 (Northmore Gordon 2022).

The Commission (2011) used three emissions intensity factors to estimate a range of indirect prices. The average emissions intensity of the grid (0.92) was used for the central estimate, while the weighted-average emissions intensity factor for coal generation (1.00) was used for the lower bound estimate and the emissions intensity factor for gas generation (0.54) was used for the upper bound estimate.

Currently, the average emissions intensity factor of the non-renewable component of the grid is 0.87. The weighted-average emissions intensity factor of coal generation is 0.99 and the emissions intensity factor for gas is 0.54. The emissions intensity factor of the non-renewable component has decreased because gas makes up a larger share than it did in 2011. The emissions intensity factor of coal generation has decreased because black coal makes up a larger share of coal production relative to brown coal than in 2011.

The indirect carbon prices are calculated using the following formula:

$$\frac{LGC\ Price}{Emissions\ Factor}$$

The central estimate is $68 per tonne of CO_2-e, with a range of $60–110.

Additionality

The Commission (2011) took the view that all LGCs were additional — that is, the renewable energy generation would not have occurred in the absence of the policy — because, at the time, the cost of renewable energy generation was far greater the non-renewable generation. That is no longer the case. The cost of renewables has fallen faster and further than expected and as of 2016 was less than the cost of fossil fuel generation (Bleich and Guimaraes 2016, p. 6; Graham et al. 2018, 2020, 2021, 2022). Hence, it is likely that not all renewable energy generation installed after 2016 was additional. That is, some of the generation installed would likely have been installed even in the absence of LGCs.

In 2016, approximately 17 500 gigawatt-hours of renewable energy that counted towards the large-scale component of the RET was generated — 53% of the 2020 target (CEC 2017). Taking the extreme view that none of the generation installed after 2016 was additional, we can calculate a lower bound estimate of additionality. If the additionality of LGCs was only 50%, the estimated indirect carbon price would rise by 100% to $136, with a range of $120–220.

Small-scale technology certificates

STCs differ to LGCs in that certificates accounting for 15 years' worth of abatement (fewer years if the technology was installed post-2016) were created upfront and those certificates could be sold to retailers immediately. This policy can be thought of as a capital subsidy. The subsidy equivalent has been estimated as equal to what it would have cost a private actor to fund investment in the technology in the absence of the policy. To estimate an indirect carbon price it is best to think in annual terms, hence the cost of the policy has been transformed into equivalent annual cost terms. This conversion relies on the following formula:

$$\frac{STC_t \times P_t^{STC}}{1-(1+\delta)^{-n}}$$

where:

- STC_t refers to the number of certificates issued in year t
- P_t^{STC} refers to the price of STCs in year t
- δ refers to the discount factor
- n refers to the economic life of the asset.

The Commission (2011) used three discount factors (3%, 7% and 11%) as well as varying the emissions intensity of the electricity replaced (as described above) to estimate a range for the indirect carbon price. We have adopted the same approach and used the 2015 STC data to inform our estimates (table A.7).

Table A.7 – STC indirect prices

Discount rate	Lower bound	Central estimate	Upper bound
3%	$41	$46	$75
7%	$57	$65	$105
11%	$76	$86	$139

Sources: Productivity Commission estimates based on Clean Energy Regulator (2022b, 2022a); PC (2011); Northmore Gordon (2022).

The generation eligible for STCs was not wholly additional because of overlaps with state and territory feed-in-tariffs. The state and territory policies affected the indirect carbon price of solar photovoltaic generation specifically (PC 2011, p. 83). This issue has not been addressed in these estimates.

Of all STCs created between 2011 and 2020, 43% were issued after 2016. Hence, and to be consistent with our LGC estimates, we have used an additionality parameter of 50% to provide a lower bound for the indirect price associated with STCs. Doing so increases the estimated indirect carbon price by 100%. That is, the central estimate using a 7% discount rate is $129, with a range of $114–209.

A.5 NSW Energy Savings Scheme

The NSW energy savings scheme requires certain entities to obtain and surrender energy savings certificates (ESC). Certificates represent one notional megawatt hour (MWh) (Kean 2022). Accredited certificate providers receive certificates in accordance with the following formula:

$$\begin{aligned} &Number\ of\ certificates \\ &\quad = \sum(electricity\ savings\ \times electricity\ conversion\ factor \\ &\quad + gas\ savings\ \times gas\ certificate\ conversion\ factor) \end{aligned}$$

The indirect price estimated reflects electricity savings only. It is calculated as the penalty rate, which reflects the upper bound for covered entities, divided by the emissions intensity factor and multiplied by the electricity conversion factor (1.06) to transform the price into dollars per tonne of CO_2-e.

$$Indirect\ Carbon\ Price = \frac{Penalty\ Rate}{Emissions\ Factor} \times Electricity\ Conversion\ Factor$$

Similar to previous estimates, our estimates consider only scope two emissions and three intensity factors were used to estimate a range of indirect carbon prices: the average emissions intensity of electricity generation in New South Wales, which represented a central estimate and then the emissions intensity of coal generation (an upper bound) and the emissions intensity of gas generation (a lower bound). The emissions intensity factor for coal generation is 0.99 and resulted in a indirect price of $32 per tonne. The average emissions intensity factor for electricity generation in New South Wales in 2019-20 was 0.78 and equated to an indirect price of $41 per tonne (DISER 2021b). The average emissions intensity factor for gas production is 0.54 and equated to an indirect price of $59 per tonne.

Victoria has a similar system where certain entities are required to purchase Victorian energy efficiency certificates (VEECs). VEECs are measured in tonnes of CO_2-e, hence, no transformation is required. As of 5 September, one VEEC cost $69 in the spot market (Northmore Gordon 2022). It is possible that the long-term contract price is lower than the ‘spot’ price.

Abbreviations

ACCU	Australian Carbon Credit Unit
AEMO	Australian Energy Market Organisation
BEV	Battery Electric Vehicle
CIS	Capacity Investment Scheme
CBAM	Carbon Border Adjustment Mechanism
CBT	Carbon Border Tariff
CCS	Carbon Capture and Storage
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
CPM	Carbon Pricing Mechanism
CER	Clean Energy Regulator
EU	European Union
EITEI	Emissions-Intensive Trade-Exposed Industry
ERF	Emissions Reduction Fund
ETS	Emissions Trading Scheme
EV	Electric Vehicle
FBT	Fringe Benefits Tax
ICE	Internal Combustion Engine
ISP	Integrated System Plan
LGC	Large Scale Generation Certificate
Mt	Megatonne
NEM	National Electricity Market
NGERS	National Greenhouse and Energy Reporting Scheme
PHEV	Plug-in Hybrid Electric Vehicle
RET	Renewable Energy Target
SM	Safeguard Mechanism
STC	Small Scale Technology Certificate
VEEC	Victorian Energy Efficiency Certificate
VPP	Virtual Power Plant

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