AEMC Decisions and Greenhouse Gas Emissions

DISCUSSION PAPER ON METHODS FOR QUANTIFYING EMISSIONS IMPACTS UNDER THE NATIONAL ENERGY OBJECTIVES

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Executive Summary

The Commonwealth of Australia and all eight State and Territory Governments have made commitments to reduce economy-wide greenhouse gas (GHG) emissions to net zero, over the timeframe of 2030–2050 depending on the state or territory. The Commonwealth, State, and Territory Governments have variously adopted the Safeguard Mechanism, renewable electricity targets, and a variety of other policy mechanisms to help achieve these climate commitments.

The Australian Energy Market Commission (AEMC) is the agency with decision-making authority over the Rules that govern the natural gas, electricity, and retail energy markets, within the over-arching framework of the National Gas Law, the National Electricity Law and the National Energy Retail Law. 51% of Australia's GHG emissions are associated with these markets.[1]

When the AEMC receives a proposal to make a change to the Rules, it is required to make a decision on the rule change proposal that will contribute to the relevant energy objective, which is defined in legislation (the National Electricity Objective (NEO), the National Gas Objective (NGO), and National Energy Retail Objective (NERO), collectively the "National Energy Objectives").[2] In May 2023, Energy Ministers agreed to put forward legislation to amend the National Energy Objectives. If the proposed legislation is enacted as drafted (expected in September 2023), the National Energy Objectives will be modified to include achieving targets for reducing Australia's GHG emissions or that are likely to contribute to reducing Australia's GHG emissions. As a result, the AEMC will be required to consider the achievement of Commonwealth, State and Territory targets for reducing GHG emissions, alongside price, quality, safety, reliability, and security of supply of energy, when it considers changes to the National Electricity Rules, National Gas Rules, and National Energy Retail Rules.[3]

This paper, along with stakeholder responses to the associated AEMC consultation paper, will inform the AEMC's approach to assessing the impacts of its decisions on GHG emissions as part of the rule change process. This paper further provides a discussion of how a national policy value in $/tonne of CO_2e emissions could be incorporated into AEMC assessments,

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1 Emissions in Australia in 2021 from the combustion of gas, fugitive emissions associated with the gas supply chain, and combustion of fuel (other than gas) for electricity generation, expressed as a percentage of total emissions in Australia. Australian Government Clean Energy Regulator, Greenhouse and energy information by designated generation facility 2013–2021; Australian Government Department of Climate Change, Energy, the Environment and Water, Australian Energy Update 2022; Australian Government Department of Climate Change, Energy, the Environment and Water, Australia's National Greenhouse Accounts, Emissions Inventories, Paris Agreement inventory.

2 AEMC, National Energy Objectives.

3 AEMC, National Electricity Rules; AEMC, National Electricity Rules - Northern Territory; AEMC, National Gas Rules; AEMC, National Energy Retail Rules.

similar to the role that the $/kWh value of customer reliability (VCR) plays in valuing reliability.[4] It is out of the scope of this discussion paper to comment on whether and at what level a value of GHG emissions might eventually be established.

The primary questions AEMC asked us to examine are:

- What Australian greenhouse gas emissions should be considered, allowing for the different sectors in which they occur and the different scopes of emissions?
- How should interactions with Commonwealth, State, and Territory policies be accounted for?
- What timeframe and discount rates should be used to value emissions impacts?
- What analytical methods could be used for estimating emissions impacts?

In response to these questions, we discuss relevant considerations and have worked with AEMC staff to develop a proposal for how GHG emissions impacts could be estimated.

Table 1 summarises different categories of GHG emissions where each category may require a distinct regulatory treatment, due to the scope of the AEMC's remit and the need to consider interactions with existing policy mechanisms. The scope of emissions relevant for AEMC's consideration is the part of the economy-wide scope of emissions covered by the Commonwealth, State, and Territory commitments which can be influenced by AEMC decisions. This includes GHG emissions from the electricity and gas sectors directly affected by AEMC rules, upstream fugitive emissions associated with gas supply, and emissions from economic sectors that may be indirectly influenced by AEMC rule changes (e.g., via the electrification of transportation or other GHG-emitting energy uses). Overseas emissions such as those from the combustion of LNG and coal exports or emissions "leakage" in trade-exposed segments are not covered by relevant commitments (which relate to Australia's emissions only) and are therefore out of scope for the purposes of AEMC's decision-making.

Interactions with other Commonwealth, State, and Territory policies would be considered on a case-by-case basis, such that the incremental effect of AEMC rule changes can be assessed. Where AEMC rule changes mutually reinforce and support other policies, the outcome could be measured either in terms of GHG emissions impacts, impacts on gas and electricity prices, or both. In principle, the impact on emissions of AEMC rule changes might be offset via interactions with other policies. For example, mechanisms that require a fixed amount of emissions reductions (independent of cost) could result in AEMC actions being offset by less emissions reductions elsewhere. However, if there is a mechanism for the quantity of required emissions reductions to be modified and therefore influenced by AEMC rule changes, for example if costs change, then the offsetting effect may be smaller or removed. In general, we would expect most policies to be mutually reinforcing rather than offsetting, such that it would be reasonable for AEMC to assume that the impacts of its decisions on emissions would not be offset.

As with other aspects of the National Energy Objectives, the specific analytical or modelling approach used to estimate GHG emissions will differ depending on the rule-making context.

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[4] AEMC, Reliability.

If there are expected to be both price impacts and emissions impacts with different signs and which change over time (for example, an up-front increase in prices and a delayed reduction in emissions), then it may be necessary to discount the impacts in future years in order to arrive at an expected net present value (NPV) of the price impact and the emissions impact. The same discount rate would be used for both.

Consistent with historical practice when evaluating rule changes, the AEMC would continue to apply context-specific judgement on the nature, breadth, and depth of evidence and analysis required to assess contributions to the National Energy Objectives.

TABLE 1. PROPOSAL GUIDELINES FOR GHG EMISSIONS ESTIMATION METHODS

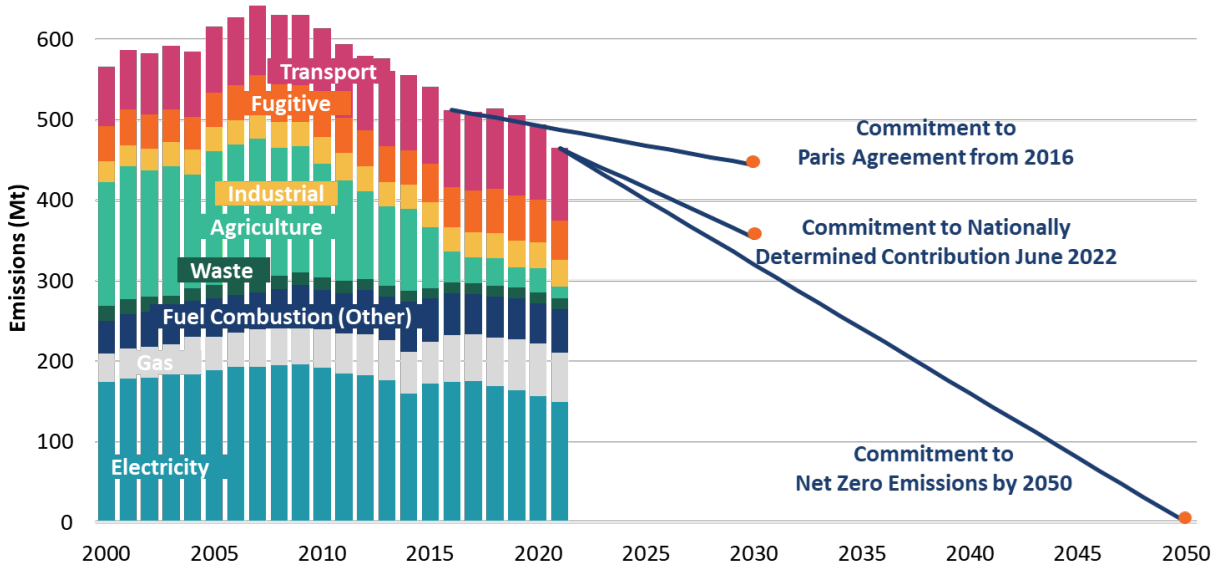
	Emissions Segment	Mt	AEMC Remit	Proposal Guidelines for GHG Emissions Estimation
Natural Gas / Electricity	**Electricity Emissions (Coal)**	**134**	Electricity markets subject to AEMC rules.	• Emissions impacts in scope (see also: gas used for electricity). • Overseas emissions associated with coal exports not considered in scope of National Energy Objectives benefit-cost assessments.
Natural Gas / Electricity	**Gas Used for Electricity Generation**	**16**	Both gas and electricity markets subject to AEMC rules.	• Emissions impacts in scope of National Energy Objectives benefit-cost assessments. • Electricity sector-wide Safeguard Mechanism cap assumed non-binding, full emissions impacts considered. • Context-specific assessment of interactions with renewable targets and end-use consumer renewable demand. Some AEMC rules may enable renewables at lower cost, while others may enable accelerated renewables.
Natural Gas	**Gas Demand (Residential, Commercial)**	**13**	Gas markets subject to AEMC rules.	• Emissions impacts from changes in Australia's gas consumption volumes or GHG intensity would be considered. • In electrification contexts: net GHG emissions impacts from gas and electricity consumption would be considered. • For trade-exposed industries: the potential for GHG leakage overseas not included in National Energy Objectives benefit-cost assessments.
Natural Gas	**Gas Demand (Industrial)**	**52**	Gas markets subject to AEMC rules.	• Emissions changes under Safeguard Mechanism facility-specific baselines considered in scope of National Energy Objectives benefit-cost assessments if future baselines are lowered.
Natural Gas	**Fugitive Emissions from Gas Supply**	**20**	Gas markets subject to AEMC rules.	• Emissions impacts in scope of National Energy Objectives benefit-cost assessments, including fugitive emissions from Australia's gas consumption and LNG exports.
Natural Gas	**LNG for Export**	**222**	Gas markets subject to AEMC rules.	• Overseas emissions from use of LNG exports not in scope of National Energy Objectives benefit-cost assessments.
	Transport & Other Sectors w/ Electrification Potential	**>90**	Not subject to AEMC rules, but emissions may be influenced by AEMC rule changes.	• Net GHG impacts across all affected sectors considered in scope of National Energy Objectives. • In transport electrification contexts: GHG reductions in the transport sector may be partially offset by increases in electricity sector emissions.
	Other Sectors	**<140**	Not subject to AEMC rules, but emissions may be influenced by AEMC rule changes.	• Material GHG emissions impacts considered in scope of National Energy Objectives benefit-cost assessments, even if sectors are not subject to AEMC rules.

I. Background and Policy Context

Australia produced approximately 465 Mt[5] of GHG emissions on an economy-wide basis in 2021, down from 616 Mt in 2005. Figure 1 summarises the profile of emissions over time by sector. Starting in 2015, Australia has adopted increasingly ambitious climate commitments, culminating in its current policy goal of net zero by 2050.

In August 2015, Australia made its first Nationally Determined Contribution (NDC) submission to the United Nations as part of the Paris Agreement. In the submission, Australia made an economy-wide commitment to reduce GHG emissions by 26 to 28 per cent below 2005 levels by 2030.[6] The Paris Agreement entered into force in late 2016 and required Australia to update its NDC in 2022. Following the 2022 update submission, Australia's current commitment is to achieve an economy-wide greenhouse gas emissions reduction of 43% compared to 2005 levels by 2030.[7] On September 8, 2022, the Climate Change Act 2022 was enacted by the Commonwealth Parliament that codified Australia's most recent Paris Agreement commitment of 43% economy-wide GHG reductions by 2030 and also adopted an additional commitment to achieve net zero economy-wide emissions by 2050.[8]

FIGURE 1. AUSTRALIA'S GHG EMISSIONS OVER TIME AND COMMITTED REDUCTIONS TO 2050



Source and notes: Emissions are reported in Megatonnes of CO_2e ($MtCO_2e$). Electricity includes all emissions from electricity generation. Gas includes all emissions from gas combustion in any setting other than electricity generation. Fuel combustion has been segmented into Transport and Other. Fuel Combustion (Other) includes emissions from coal (excluding electricity production), manufacturing and construction, and the manufacturing and extraction of fuels. Agriculture includes emissions and removals for the Agriculture and Land Use, Land Use

[5] Throughout this paper, GHG emissions are reported in Megatonnes of CO_2e ($MtCO_2e$).

[6] Australia's Intended Nationally Determined Contribution to a new Climate Change Agreement, August 2015.

[7] Australian Government, Australia's Nationally Determined Contribution Communication 2022.

[8] The Parliament of the Commonwealth of Australia, Climate Change Act 2022, Part 2, section 10.

Change, and Forestry (LULUCF) sectors. Industrial includes emissions (not arising from fuel combustion) from industrial processes, such as refrigeration and air conditioning, cement production, and aluminium production. Australian Government Department of Climate Change, Energy, the Environment and Water, Australia's National Greenhouse Accounts, Emissions Inventories, Paris Agreement inventory; Australian Government Department of Industry, Science, Energy and Resources, Australian Energy Statistics, Tables D and F, September 2022; Hannah Ritchie and Max Roser, Australia: CO_2 Country Profile Australia, What share of CO_2 emissions are produced from different fuels?, Our World in Data; Australian Government Clean Energy Regulator, CER Greenhouse and Energy energy information by designated generation facility 2013–2021.

The AEMC, along with other Commonwealth, State, and Territory government agencies, will play a role in supporting the achievement of Australia's GHG emissions reduction commitments, including the Commonwealth commitment to net zero by 2050.

The AEMC has decision-making authority over the Rules that govern the natural gas, electricity, and retail energy markets, within the over-arching framework of the National Electricity Law, the National Gas Law, and the National Energy Retail Law. [9] 235 Mt per year of GHG emissions, or 51% of Australia's total are associated with these markets.[10] When the AEMC receives a proposal to make a change to the Rules, it is required to make a decision on the rule change proposal that will contribute to the relevant energy objective, which is defined in legislation. The full text of the National Energy Objectives is in Table 2. Historically, these objectives have required that AEMC consider price, quality, safety, reliability, and security of supply (black text in Table 2). Amendments to the objectives have been proposed and, once enacted, will require the AEMC to consider the achievement of Commonwealth, State, and Territory GHG emissions targets within the National Energy Objectives (proposed amendments denoted in teal below). [11] While historical considerations of the objectives were sector-specific, the GHG emissions impacts will be estimated economy-wide. This paper offers a discussion of how these emissions impacts can be estimated and considered in AEMC decisions, alongside price, quality, safety, reliability, and security of supply.

[9] AEMC, Legislation.

[10] Emissions in Australia in 2021 from the combustion of gas, fugitive emissions associated with the gas supply chain, and combustion of fuel (other than gas) for electricity generation, expressed as a percentage of total emissions in Australia. Australian Government Clean Energy Regulator, Greenhouse and energy information by designated generation facility 2013–2021; Australian Government Department of Climate Change, Energy, the Environment and Water, Australian Energy Update 2022; Australian Government Department of Climate Change, Energy, the Environment and Water, Australia's National Greenhouse Accounts, Emissions Inventories, Paris Agreement inventory.

[11] Australian Government Department of Climate Change, Energy, the Environment and Water, *Information paper: Incorporating an emissions reduction objective into the National Energy Objectives*, May 2023.

TABLE 2. REVISED WORDING OF THE NATIONAL ENERGY OBJECTIVES

Revised Wording of the National Energy Objectives
National Electricity Objective "The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to— (a) price, quality, safety, reliability and security of supply of electricity; (b) the reliability, safety and security of the national electricity system; and (c) the achievement of targets set by a participating jurisdiction— (i) for reducing Australia's greenhouse gas emissions; or (ii) that are likely to contribute to reducing Australia's greenhouse gas emissions." **National Gas Objective** "The objective of this Law is to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to— (a) price, quality, safety, reliability and security of supply of natural gas; and (b) the achievement of targets set by a participating jurisdiction— (i) for reducing Australia's greenhouse gas emissions; or (ii) that are likely to contribute to reducing Australia's greenhouse gas emissions. " **National Energy Retail Objective** "The objective of this Law is to promote efficient investment in, and efficient operation and use of, energy services for the long term interests of consumers of energy with respect to— (a) price, quality, safety, reliability and security of supply of energy; and (b) The achievement of targets set by a participating jurisdiction— (iii) for reducing Australia's greenhouse gas emissions; or (iv) that are likely to contribute to reducing Australia's greenhouse gas emissions."

Sources and notes: Amendments are in teal. Australian Government Department of Climate Change, Energy, the Environment and Water, *Information paper: Incorporating an emissions reduction objective into the National Energy Objectives*, May 2023.

II. What Scope of Greenhouse Gas Emissions Should Be Considered?

A. Scope of Emissions Potentially Affected by AEMC Rule Change Determinations

The entirety of Australia's economy-wide GHG emissions presented in Figure 1 above are subject to the national net zero emissions target.[12] These emissions can be presented and categorised in various ways to illustrate the scope of emissions that may potentially be affected by AEMC rule change determinations. As summarised in Figure 2, these emissions can be categorised by:

- **Economic sector** (top bar), consistent with the United Nations Framework Convention on Climate Change categorisation used in Australia's National Greenhouse Accounts. This categorisation helps to illustrate the role and scope of economic activities associated with GHG emissions.
- **Scope of AEMC rule-making oversight** (middle bar), illustrating that the gas and electricity markets within the AEMC's remit are responsible for 51% of Australia's emissions: 32% associated with electricity generation, plus 19% associated with natural gas use (excluding electricity generation, including fugitive emissions).[13] Approximately 1/4 of all gas volumes produced in Australia are ultimately delivered to Australian businesses and consumers. The remaining 3/4 are exported as liquefied natural gas (LNG), the overseas combustion of which is not included in Australia's national GHG inventory. Other GHG-emitting segments of Australia's economy are not under AEMC remit but may be indirectly influenced by AEMC rule-making in some cases. For example, the transportation sector, representing 19% of Australia's GHG emissions, could be indirectly influenced by rules that might facilitate the uptake of electric vehicles.[14]
- **Safeguard Mechanism treatment** (bottom bar), the national policy that applies emissions caps to large GHG-emitting facilities and the grid-connected electricity sector, as discussed more fully in Section III.B. Grid-connected electricity generators do not receive a facility-specific baseline and are instead subject to a sector-wide baseline. Approximately 60% of

[12] Australia's National Greenhouse Accounts summarise Australia's greenhouse gas emissions and track progress toward the national emissions reduction targets. Under the Paris Agreement, emissions estimates can be categorised by the United Nations Framework Convention on Climate Change classification system (UNFCCC) and based on the IPCC Fifth Assessment Report (AR5). Australian Government Department of Climate Change, Energy, the Environment and Water, Australia's National Greenhouse Accounts, Emissions Inventories, Paris Agreement inventory.

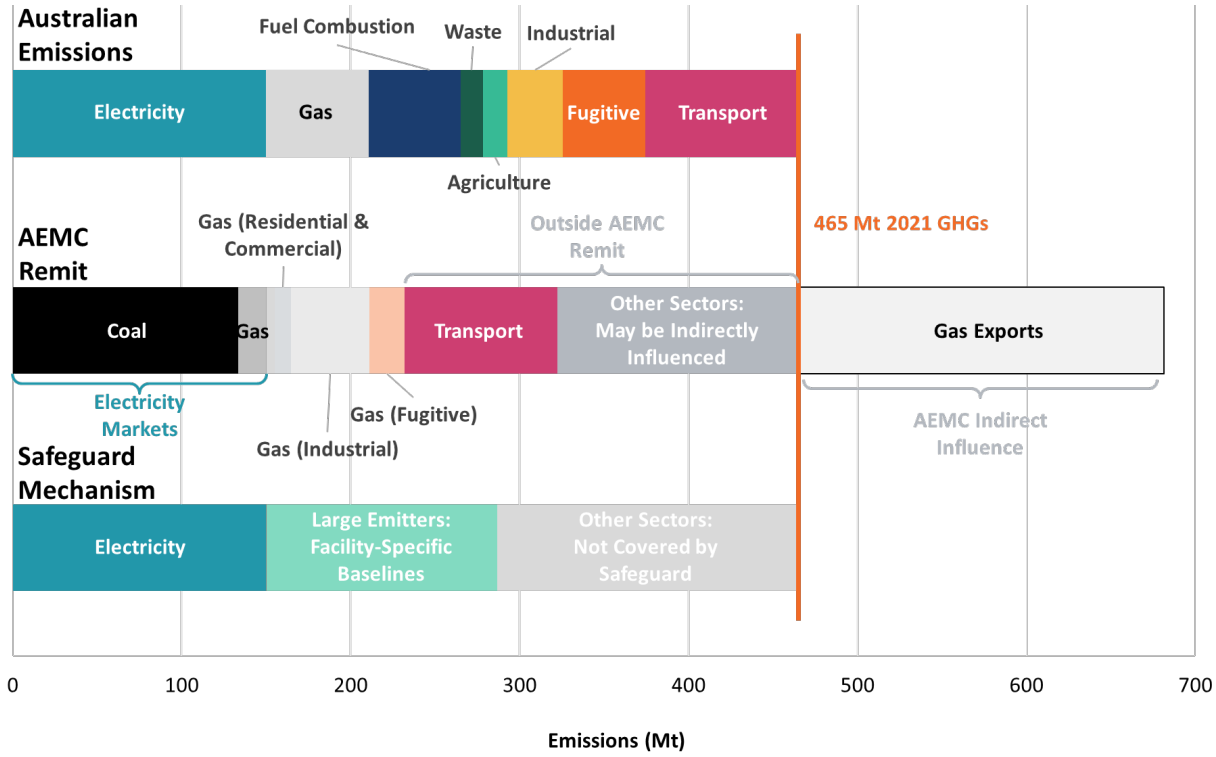
[13] The figure for emissions associated with electricity generation only takes into account emissions from facilities where the principal activity is electricity generation with a production of more than 100 MWh/yr. Emissions from facilities that do not meet these criteria are included in the figure for natural gas use.

[14] Australian Government Department of Climate Change, Energy, the Environment and Water, Australia's National Greenhouse Accounts, Emissions Inventories, Paris Agreement inventory.

Australia's emissions are covered by the Safeguard Mechanism (28% facility-specific, 32% electricity sector-wide).

The scale, applicable policy mechanisms, regulatory treatment, and interactions among these classes of GHG emissions may require distinct treatment for the purposes of assessing the GHG emissions impacts of AEMC rule changes.

FIGURE 2. SCOPE OF GHG EMISSIONS POTENTIALLY AFFECTED BY AEMC RULE CHANGES



Source and notes: Emissions are reported in Megatonnes of CO_2e ($MtCO_2e$). Electricity includes all emissions from electricity generation. Gas includes all emissions from gas combustion in any setting other than electricity generation. Fuel Combustion includes emissions from coal (excluding electricity production), manufacturing and construction, and the manufacturing and extraction of fuels. Agriculture includes emissions and removals for the Agriculture and Land Use, Land Use Change, and Forestry (LULUCF) sectors. Industrial includes emissions (not arising from fuel combustion) from industrial processes, such as refrigeration and air conditioning, cement production, and aluminium production. Transport includes all emissions from fuel combustion within the sector and may be indirectly influenced by AEMC (e.g., via electrification). Gas export emissions are emissions from the usage of Australia's LNG exports. Australian Government Department of Climate Change, Energy, the Environment and Water, Australia's National Greenhouse Accounts, Emissions Inventories, Paris Agreement inventory; Australian Government Clean Energy Regulator, Greenhouse and energy information by designated generation facility 2013–2021; Safeguard facility reported emissions 2020–2021; Australian Government Department of Climate Change, Energy, the Environment and Water, Australian Energy Update 2022; Australian Bureau of Statistics, Energy Account, Australia 2020–2021.

Table 3 provides a breakdown of emissions associated with the gas supply chain in Australia, specifically emissions associated with the consumption of gas in Australia, as well as fugitive emissions associated with the production, transport, storage and distribution of gas. Emissions outside Australia (from the combustion of exported LNG) are not shown in Table 3. The table also includes emissions from gas combustion in LNG liquefaction plants (in the "industrial" category), but does not include emissions associated with electricity consumption in these plants.

Table 3. 2021 emissions From the gas supply chain in Australia

Category	Emissions (Mt)
Electricity Generation	16.18
Industrial	51.73
Residential & Commercial	12.70
Fugitive Emissions	20.24
Transmission and Storage	*1.07*
Distribution	*1.23*
Venting	*9.82*
Flaring	*4.77*
Other	*3.35*
Total	100.85

Sources and notes: Emissions are reported in Megatonnes of CO_2e ($MtCO_2e$). Australian Government Clean Energy Regulator, Greenhouse and energy information by designated generation facility 2013–2021; Australian Government Department of Climate Change, Energy, the Environment and Water, Australia's National Greenhouse Accounts, Emissions Inventories, Paris Agreement inventory; Australian Government Department of Climate Change, Energy, the Environment and Water, Australian Energy Update 2022; Australia 2023 Submission Common Reporting Tables (CRTs) for 2021 Inventory. Greenhouse gas emissions converted into CO2-e using AR5 Global Warming Potentials from the IPCC 2014 Fifth Assessment Report (AR5). Electricity Generation includes emissions from all facilities where the principal activity is electricity generation with a production of more than 100 MWh/yr (CER data). DCCEEW data for all electricity generation estimates 26.89 Mt. We allocate the difference (10.71 Mt) to emissions from gas demand in the industrial sector.

Of the 52 Mt emissions from the Industrial category, a large fraction is likely to be covered by the Safeguard Mechanism. Unfortunately, however, we were not able to find data on the quantity of emissions associated with gas use in Safeguard Mechanism facilities.

B. Exported Emissions and Leakage

Australia was the world's second-largest exporter of coal and the largest exporter of LNG in 2021.[15] As shown in Table 4, the overseas combustion of Australia's exported fossil fuels produces approximately 1,206 Mt CO_2e annually (77% coal, 18% LNG, and 5% oil). These export volumes and associated emissions are in aggregate 2.6 times the size of Australia's emissions but are not covered by Australia's emissions targets to which the National Energy Objectives refer.[16]

TABLE 4. OVERSEAS EMISSIONS ASSOCIATED WITH FOSSIL FUEL EXPORTS IN 2021

Category	2021 Emissions Estimates (Mt)
Australian Emissions	465
Emissions from Gas Exports	222
Emissions from Coal Exports	929
Emissions from Oil Exports	55

Sources and notes: Emissions are reported in Megatonnes of CO_2e ($MtCO_2e$) and rounded to the nearest Mt. Australian Government Department of Climate Change, Energy, the Environment and Water, Australia's National Greenhouse Accounts, Emissions Inventories, Paris Agreement inventory; Australian Bureau of Statistics, Energy Account, Australia 2020–2021.

Given that the overseas GHG emissions from the combustion of fossil fuel exports are not covered by Australia's emission reduction targets, they are not relevant to the National Energy Objectives or AEMC's associated benefit-cost assessments.

For the most part, we would not expect AEMC rule changes to have material impacts on fossil fuel export volumes or associated overseas GHG emissions, in any case.

PROPOSAL: Overseas GHG emissions from the combustion of Australia's fossil fuel exports are out of scope relative to the National Energy Objectives. Continue current practice to develop gas market rules that apply in a consistent fashion to all Australian gas market participants regardless of whether the gas volumes are destined for export or Australian consumers.

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[15] Australia exported 403 Mt of coal and 81 Mt of LNG in 2021. Statista, Prices and Access, Chemical Resources, Fossil Fuels, Leading coal exporting countries worldwide in 2021; Australian Government Geoscience Australia, Gas.

[16] Under the Greenhouse Gas Protocol, Australia's GHG inventory includes the country's "direct" or "Scope 1" emissions that are produced within national borders, such as from fossil fuel combustion, manufacturing processes, or agricultural and land use activities. Emissions associated with fossil fuel exports that are eventually combusted overseas are considered "indirect" or "Scope 3" emissions; these exported emissions are included within other countries' direct emissions inventory. Australian Government Clean Energy Regulator, National Greenhouse and Energy Reporting, Greenhouse gases and energy, 14 April 2023; Australian Government Department of Climate Change, Energy, the Environment and Water, *Australian National Greenhouse Accounts Factors: For individuals and organisations estimating greenhouse gas emissions*, February 2023.

Emissions-intensive and trade-exposed (EITE) industries are those that are "constrained in their ability to pass through carbon costs due to actual or potential international competition."[17] These economic segments are often a particular focus of many GHG-related policies, including Australia's Safeguard Mechanism, to avoid unintended consequences where requiring costly GHG emissions reductions could drive industry overseas to jurisdictions that have less stringent climate change policies. While these GHG policies may reduce Australian emissions, there is no net reduction in global emissions. Climate policies often seek to avoid outcomes that could result in the loss of economic activity, without achieving the intended GHG reductions on a global basis. Examples of economic segments considered EITE include manufacturing, chemicals, mining, and commodity agriculture products. Many of these economic segments are also large users of electricity and natural gas in Australia, and so may be materially affected by AEMC rules and associated costs.

As discussed in the context of fossil fuel exports, only Australian GHG emissions are considered relative to the National Energy Objectives. For this reason, reduced emissions associated with EITE industry leakage would be counted as benefits, while overseas emissions increases would not be counted as costs within cost-benefit assessments under the objectives.

PROPOSAL: Overseas emissions, including any emissions associated with GHG leakage, are out of scope relative to the National Energy Objectives net benefits assessments.

C. Emissions Inside vs. Outside Gas and Electricity Markets

The AEMC makes and amends the rules for electricity, gas, and retail energy markets. Future AEMC decisions governing these markets may materially influence GHG emissions in these sectors, the impacts of which the AEMC would consider in future benefit-cost analyses under the National Energy Objectives, before making its final decisions.

While approximately half of Australia's GHG emissions are outside of the AEMC's remit, these other sectors, specifically those that would be impacted by electrification, may be indirectly influenced by AEMC rule changes. For example, if a rule change facilitates the uptake of EVs, there would be an indirect impact that reduces emissions in the transport sector (partly offset by increased electricity sector emissions). Similarly, fuel switching of industrial heat to electricity would reduce emissions in the industrial sector of the gas market (partly offset by increased electricity sector emissions). Conversely, a rule change imposing technical requirements for network connection may drive up EV costs and increase emissions in the transport sector due to lower adoption.

[17] Nina Markovic and Nick Fuller, *Climate change negotiations*, Parliamentary Library Background Note, 26 August 2008, updated 2 October 2008.

The revised National Energy Objectives will require consideration of all economy-wide emissions that are covered by Australia's emission reduction targets. Therefore, the indirect effects that rule changes may have on sectors outside of AEMC's remit would be considered in cost-benefit assessments, if those impacts are anticipated to be material.

PROPOSAL: Emissions changes considered in gas and electricity sectors directly subject to AEMC rules and in other sectors whose emissions could be indirectly influenced, such as via the electrification of transportation. In many or most AEMC rule-making decisions, such indirect impacts may be negligible, and so would not be explicitly quantified in those cases.

III. How Should Interactions with Commonwealth and State Policies Be Accounted for?

A. Overview of Likely Policy Interactions

The AEMC will be required to take into account the impact of its decisions on helping to achieve targets for reducing emissions and/or helping to achieve targets that are likely to reduce emissions, such as targets for increasing the proportion of renewables in the generation mix. Governments have already implemented a range of policies designed to help achieve these targets, and additional policies may be added in future. Therefore an important question is whether the impacts on emissions of AEMC decisions will be additional to the impacts of these other policies, or whether there could be a degree of offsetting or crowding out, such that the net effect on emissions of the AEMC decision is reduced or even zero.

In cases where there is likely to be a degree of offsetting as an existing policy has to "work less hard" to achieve a target as a result of an AEMC decision, the cost of that policy may be reduced. Any such cost reduction would not be relevant for AEMC decision-making unless the cost of the policy has an impact on electricity or gas prices.

The targets statement, which the AEMC will publish later this year, will list the Commonwealth, State, and Territory emission reduction targets and targets that are likely to reduce emissions. The most highly interacting policies that may need to be considered include the Safeguard Mechanism and policies designed to achieve renewable energy targets (e.g., Large-scale Renewable Energy Target (LRET)).

B. Safeguard Mechanism

The Safeguard Mechanism was first implemented in 2016 and reformed in 2023, and applies to any facility with emissions of more than 100,000 tonnes of CO_2 equivalent in a year. Each facility (other than grid-connected electricity generating plants) has a "baseline", which imposes a limit on their annual GHG emissions.[18] Baselines will decline at 4.9% per year, and the emissions reductions are expected to meet the Safeguard Mechanism's share of the national emissions budget and help achieve the Commonwealth's target of 43% GHG emissions reduction by 2030.[19]

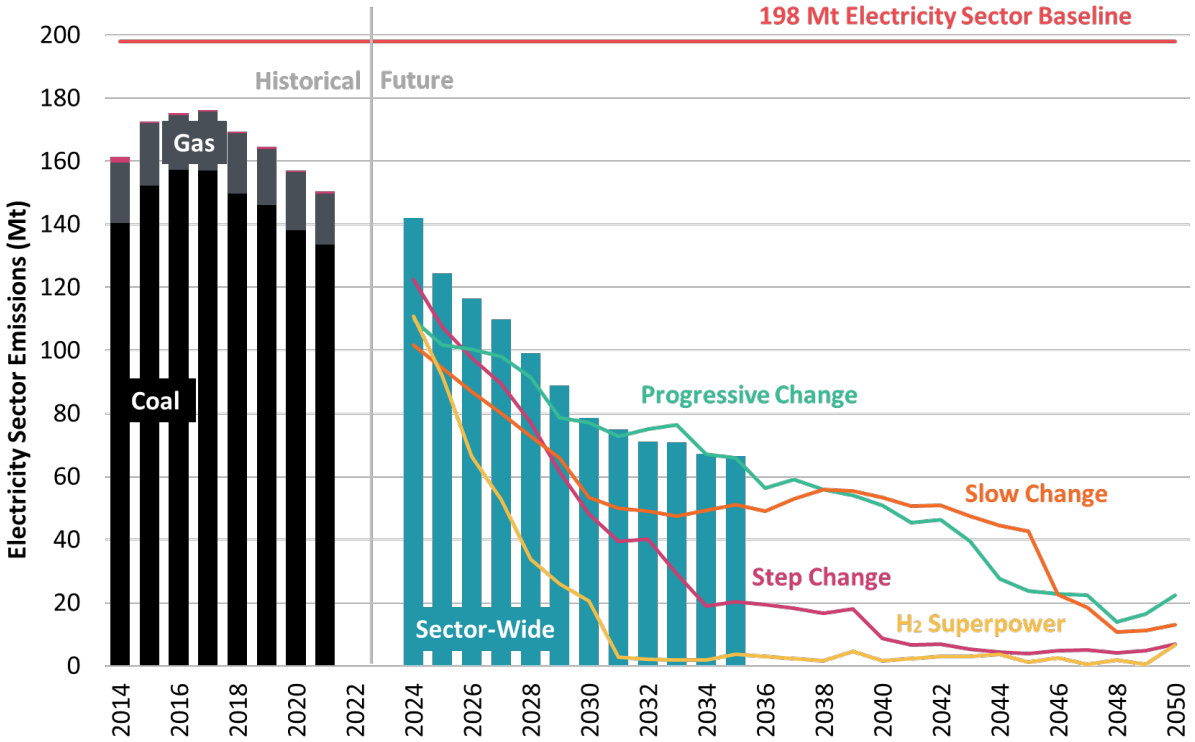
In the electricity sector, the Safeguard Mechanism utilises a sector-wide baseline emissions cap (rather than facility-specific baselines). The current baseline is set at 198 Mt CO_2e based on the sector's emissions from 2009–2010 to 2013–2014. As illustrated in Figure 3 below, this sector-wide cap is intended to prevent increases in GHG emissions in the electricity sector as a whole (even while accommodating individual generators' generation output changes over time). In practice, electricity sector emissions are far below the cap and trending down, so the sector-wide baseline is not anticipated to be exceeded for the foreseeable future. The electricity sector does not have a nationwide policy mechanism to enforce the net zero by 2050 objective, but does have GHG budgets considered in AEMO's 2022 Integrated System Plan (ISP), and continues to achieve steady GHG reductions due to government policies, consumer demand for renewable power, and economics.

For the purposes of GHG impact assessments within AEMC rule-making, the Safeguard Mechanism can be considered a non-binding cap in the electricity sector. Electricity sector emissions reductions projected in response to AEMC rule-makings would be considered in full, with no assumed offsets.

[18] After exceeding the baseline in any particular year, a facility can apply to commit to below-baseline emissions across the subsequent years to achieve a total equal to the baseline across the multi-year period. Australian Government Department of Climate Change, Energy, the Environment and Water, "Safeguard Mechanism Reforms", Fact Sheet, May 2023; Australian Government Clean Energy Regulator, National Greenhouse and Energy Reporting, Baselines, 5 May 2023. Australian Government Department of Climate Change, Energy, the Environment and Water, "Safeguard Mechanism Reforms", Fact Sheet, May 2023.

[19] Department of the Prime Minister and Cabinet, Office of Impact Analysis (OIA), Reforms to the Safeguard Mechanism, 8 May 2023.

FIGURE 3. ELECTRICITY SECTOR GHG EMISSIONS BY SOURCE COMPARED TO SECTOR-WIDE CAP AND AEMO ISP GHG EMISSIONS BUDGET FORECASTS



Sources and notes: Emissions are reported in Megatonnes of CO_2e ($MtCO_2e$). Four ISP Electricity Sector Budget Scenarios have been plotted against DCCEEW's sector-wide projected emissions for electricity. Step Change is deemed the most likely scenario. Other historical generation emissions have been grouped on top of Coal and Gas, including diesel, renewables, landfill gas, kerosene, bagasse, storage, and batteries. Australian Government Department of Climate Change, Energy, the Environment and Water, Australia's National Greenhouse Accounts, Emissions Inventories, Paris Agreement inventory; ISP 2022; Australian Government Clean Energy Regulator, Greenhouse and energy information by designated generation facility 2013–2021.

Facilities with a facility-specific annual baseline emissions cap can either reduce their emissions to the required level or purchase and surrender one of two types of emissions offsets: Australian Carbon Credit Units (ACCUs) and/or Safeguard Mechanism Credits (SMCs).[20] An ACCU represents one tonne of emissions avoided or sequestered. ACCUs can be generated by emissions-reducing activities pursued by another entity outside the Safeguard Mechanism that is not otherwise incentivised to pursue those activities. Another class of credit is SMCs. Following the 2023 Safeguard Mechanism Reforms, effective 1 July 2023, a facility obtains SMCs when its physical emissions are below its facility-specific baseline. Facilities can then surrender their SMCs to comply with the baseline in future periods or sell their SMCs to other facilities bound by the mechanism. SMCs do not expire and can be used for compliance in any year at least until 2030.[21] Facilities that are unable to reduce their own emissions can

[20] SMCs and ACCUs are the only offsets considered by the Safeguard Mechanism. International offsets or credits are not considered. Australian Government Department of Climate Change, Energy, the Environment and Water, "Safeguard Mechanism Reforms", Fact Sheet, May 2023.

[21] Their use after 2030 will be evaluated in the 2026–27 review of the mechanism. Australian Government Department of Climate Change, Energy, the Environment and Water, "Safeguard Mechanism Reforms", Fact Sheet, May 2023.

instead surrender ACCUs or SMCs to meet their baseline requirement.[22] To mitigate the risk of high compliance costs with the Safeguard Mechanism, facilities can purchase ACCUs from the Government at a fixed price of $75 in 2023–24, increasing with CPI plus 2% each year.[23]

For facilities other than grid-connected generators covered by the sector-wide Safeguard Mechanism, emissions reductions (or increases) as a result of an AEMC decision can be offset by the effects of trading. Facilities that reduce their emissions due to an AEMC rule would be eligible to produce more SMCs (or purchase fewer SMCs/ACCUs) and thereby enable other facilities to increase their emissions. However, baselines have been set only to 2030, and new baselines will be set (in five-year blocks).[24] It is therefore anticipated that AEMC decisions could have an impact to reduce future emissions through influencing the Government's decision on baselines post 2030. If AEMC considers that its actions will cause emissions from some Safeguard Mechanism facilities to go down, and that the Government is more likely to set a lower baseline for future periods as a result (for example, because compliance has become cheaper), it may be reasonable for AEMC to take these impacts into account.

PROPOSAL: Electricity sector emissions increases or decreases counted in full, since it is reasonable to assume the electricity sector-wide cap is non-binding. Emissions impacts under facility-specific baselines in all sectors other than electricity can be counted if AEMC considers that future baselines will reflect the impacts of its decisions.

[22] However, if a facility surrenders ACCUs worth more than 30% of their baseline, they must detail to the CER a reasoning as to why they are not reducing their emissions, but rather resorting to carbon offsets to meet their baseline target. Australian Government Department of Climate Change, Energy, the Environment and Water, "Safeguard Mechanism Reforms", Fact Sheet, May 2023.

[23] Australian Government Department of Climate Change, Energy, the Environment and Water, "Safeguard Mechanism Reforms", Fact Sheet, May 2023.

[24] Australian Government Department of Climate Change, Energy, the Environment and Water, "Safeguard Mechanism Reforms", Fact Sheet, May 2023.

C. Renewables Targets

Renewable development is proceeding rapidly in Australia as illustrated in Figure 4, supported by government policies, customer demand for clean energy, and improving economics. Commonwealth policy has supported renewable deployment through the LRET and Small-scale Renewable Energy Scheme (SRES), which together require electricity retailers to procure and retire renewable generation certificates from eligible generators and surrender them to the Clean Energy Regulator.[25] The 2023 required percentage of renewable energy is approximately 19%, derived from a required Renewable Energy Target of 33,000 GWh.[26] Existing policies designed to help meet renewables targets are having an important impact: for example, renewable generators qualifying for the LRET produced certificates worth about $38/MWh in 2021, and the average wholesale electricity price was $58/MWh in 2021.[27] The LRET is thus likely to have a significant influence on the economics of new renewable generators, and therefore to influence the rate at which renewable generation is increasing.

In recent years there has been rapid growth in renewable deployment, running ahead of the rate required to hit the sum of Commonwealth, State, and Territory renewable targets, assuming linearised yearly achievement until the respective target year, shown in Figure 4. This indicates that existing policies, including the LRET, are working to encourage renewable uptake.[28]

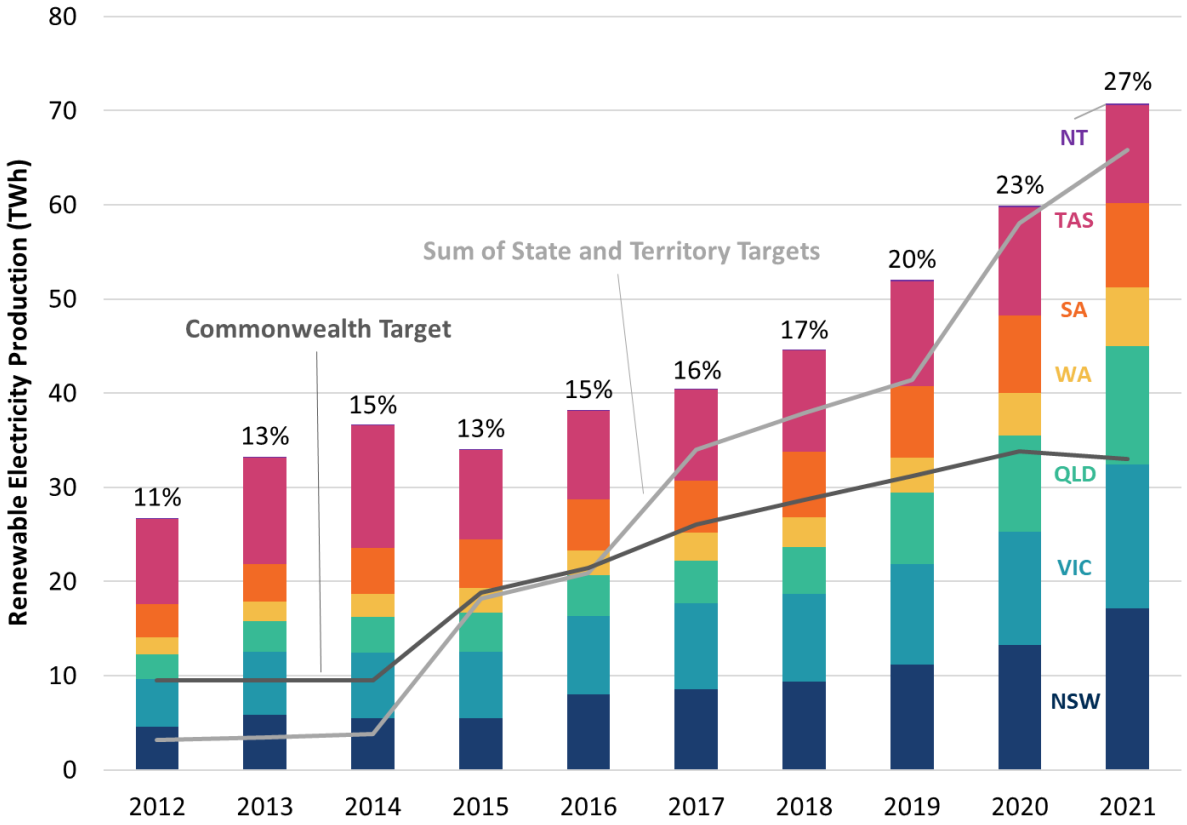
[25] Australian Government Clean Energy Regulator, Renewable Energy Target, Large-scale Renewable Energy Target, 2 August 2022.

[26] Australian Government Clean Energy Regulator, Renewable Energy Target, The renewable power percentage, 6 February 2023.

[27] Australian Government Clean Energy Regulator, Quarterly Carbon Market Reports, Quarterly Carbon Market Reports 2021; Australian Energy Market Operator (AEMO), Quarterly Energy Dynamics Q4 2021 workbook.

[28] Note that Figure 7 shows output from all renewable generation. Only some of this generation counts towards achieving targets for large renewable generation, some counts towards targets for small renewable generation, and some (e.g., large hydro installed some time ago) counts towards neither.

FIGURE 4. RENEWABLE DEPLOYMENT RELATIVE TO GOVERNMENT TARGETS



Sources and notes: Renewable sources include wind, small- and large-scale solar PV, hydro, bagasse, wood, and biogas. The Australian Capital Territory is included within New South Wales. The Sum of State and Territory Targets assumes linearised yearly achievement until the respective target year. Percentages above each bar are the proportion of total Australian electricity consumption produced by renewable sources. Australian Government Department of Climate Change, Energy, the Environment and Water, Australian Energy Update 2022, September 2, 2022. International Energy Agency, *Australia 2023: Energy Policy Review*. Australian Government Clean Energy Regulator, Renewable Energy Target, The Renewable Power Percentage, February 6, 2023. Clean Energy Council, *Clean Energy Australia: Report 2015*.

As with the Safeguard Mechanism, therefore, it will be important for the AEMC to consider whether the impacts its decisions have on helping to achieve renewables targets will be incremental or not.

Taking the LRET as an example, we think it likely that the impacts of AEMC decisions making it easier or cheaper for renewable generators to connect and/or use the system would cause incremental renewable generation. Although the aggregate obligation on retailers to surrender certificates under this scheme is a fixed quantity, in practice the demand for certificates may exceed the needs of the target and be responsive to cost (currently, the target for renewable generation under the LRET is being exceeded by a large amount).[29] Therefore, if, as a result of an AEMC decision, it becomes easier or cheaper to install and/or operate renewable generation, this will tend to cause the price of LGCs to go down and the total

[29] For example, in 2022 42 million LGCs were generated, while liability was 33.6 million LGCs and 7.4 million LGCs were cancelled voluntarily (see *Quarterly Carbon Market Report December Quarter 2022*). These figures do not net out because of carry-forward of both LGCs and liability from prior years and into future years.

number of LGCs to increase. Even if the downward pressure on LGC prices in turn causes some renewable projects to be delayed or abandoned, this would not fully offset the increase caused by the AEMC's decision. Therefore, overall more renewables would be built and/or would be built faster as a result of the AEMC's action. It is possible that the AEMC action would not help meet the Commonwealth target (since it is already being exceeded, as noted above). However, the additional renewable generation would still tend to reduce fossil generation and hence help meet emissions targets.

The cost of the LRET is paid in the first instance by electricity retailers and therefore has an impact on electricity prices. If AEMC's action causes the price of LGCs to be lower than it would otherwise be, electricity prices also would be lower (benefitting customers).

We note that the discussion above abstracts away from the question of the extent to which AEMC actions will influence renewables (that is, how to quantify the impact of AEMC decisions on renewable generation). This challenge is one the AEMC already has to meet as part of its work and is therefore beyond the scope of this paper.

In the case of the SRES, we understand that the quantity of certificates required to be purchased is adjusted each year. Therefore, again, we would expect AEMC actions to be incremental, since it seems likely that making it easier/cheaper to add qualifying renewables would tend to cause targets to increase.[30]

PROPOSAL: Context-specific assessment of whether and how AEMC rules may affect renewable deployment, the value of renewables in reducing emissions, and/or the impact of policies supporting renewables on electricity prices. The impact of AEMC decisions is likely to be fully incremental through reduced emissions.

[30] One of the factors taken into account in setting the target each year is the number of certificates produced. (See The small-scale technology percentage (cleanenergyregulator.gov.au).)

D. Other Government Policies

Other Commonwealth, State, and Territory policies may also interact with any given AEMC decisions; these interactions would be accounted for within GHG and economic impact assessments when those interactions are anticipated to be material. For example, almost every state and territory has a strategy focused on increasing the uptake of electric vehicles.[31] Similar to the approach discussed in the context of state renewable targets, the interaction of an AEMC rule change with such a policy may be measured based on GHG impacts over time (e.g., accelerating or expanding EV uptake), economic savings to energy market customers (e.g., reducing the impact of state policy goals on electricity and gas prices), or both. If, following an AEMC decision that supports EV uptake, existing state policies remained the same, it seems likely that the impact of the AEMC decision would be incremental. However, if following the AEMC decision, state policies were revised to reduce support for EVs, the impact of the AEMC decision might be partly or fully offset.

PROPOSAL: Material interactions accounted for when identified. AEMC rule-makings may be assessed based on GHG emissions impacts, based on reducing the impact of government policies on electricity and gas prices, or both.

[31] For example, New South Wales is currently targeting for 52% of vehicle sales to be electric vehicles by 2030–31. The current percentage of EV sales in New South Wales is 3.7%. To achieve its target, the New South Wales government is offering $3,000 rebates for the first 25,000 EVs purchased for under $68,750 and stamp duty exemptions for any EVs purchased for less than $78,000. Similar incentives are in place in all states and territories. International Energy Agency, *Australia 2023: Energy Policy Review*. See AEMC, *How the National Energy Objectives Shape Our Decisions*, October 2022.

IV. What Timeframe and Discount Rates Should Be Used to Value Emissions Reductions?

Historically, the AEMC has used a context-specific approach to determine the relevant timeframe and discount rates that should be used to assess net price and reliability benefits. This same approach can be extended to the estimation of GHG emissions benefits.

Different study timeframes (e.g., 10–30 years) may be most relevant depending on whether the rule-making may influence investments in electricity generation investments, transmission network expansion, customer devices, electric vehicles, or gas pipelines. Similarly, different discount rates may be considered, depending on the cost of capital for such projects. International practice supports the use of a "social rate of time preference" (i.e., a low rate of approximately 3%).[32] However, Commonwealth guidance generally requires a higher discount rate of 7%, though allowing for sensitivity tests, as the central rate for economic appraisals.[33] In addition, this type of discount is not the same as the discount of private costs. The latter is appropriate for determining industry costs that would then be passed onto customers in prices, but this would not be the appropriate rate for determining the NPV of price changes over time from the perspective of a current customer.

This same approach to establishing study timeframe and discount rates can be utilised in the context of assessing GHG emissions impacts. A typical study would be likely to compare up-front investment costs to the long-term benefits of improved reliability, operational cost savings, GHG savings, etc. The scale of GHG emissions benefits may change over the study timeframe as the clean energy transition progresses; the $/tonne policy value applied to GHG impacts may also increase over a defined yearly schedule.

Extending the AEMC's current practice to the context of GHG emissions will maintain consistency with the discount rates and investment horizons considered by private actors influenced by AEMC rules. This approach would also support a relatively uniform consideration of the policy value of avoiding GHG emissions over time across the gas, electricity, and retail market rules. In turn, these rules may tend to rationalise private decisions to pursue activities that can achieve GHG reductions if they can be achieved at a cost below the defined policy value (and defer more costly actions). Not all such low-cost, GHG-reducing actions would necessarily be pursued, however, unless the same GHG policy value would be more widely adopted across other Commonwealth and State policy mechanisms outside of the AEMC's remit.

An imprecision in GHG policy value may occur between different AEMC rule-makings, to the extent that different discount rates are applied to the policy value of future GHG reductions.

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[32] Council of Economic Advisers, Discounting for public policy: theory and recent evidence on the merits of updating the discount rate, Issue Brief, January 2017.

[33] Office of Impact Analysis, Cost-benefit analysis, Guidance Note, May 2023.

For example, the most pertinent discount rate to apply to a network investment may not be the most pertinent discount rate in the context of wholesale electricity generation investments. The same imprecisions can exist in the context of valuing customer cost savings and reliability value. These differences in discount rates across rule-makings are considered acceptable imprecisions and allow for the use of a single discount rate within each rule-making that is most aligned with the investment decisions most affected in each context.

PROPOSAL: Context-specific consideration of discount rates and study timeframe to account for the primary investment and operational impacts expected, consistent with the asset lifetime and cost of capital that would be relevant for investment decisions most influenced by a particular rule.

Appendix. What Analytical Methods Could be Used for Estimating Emissions Impacts?

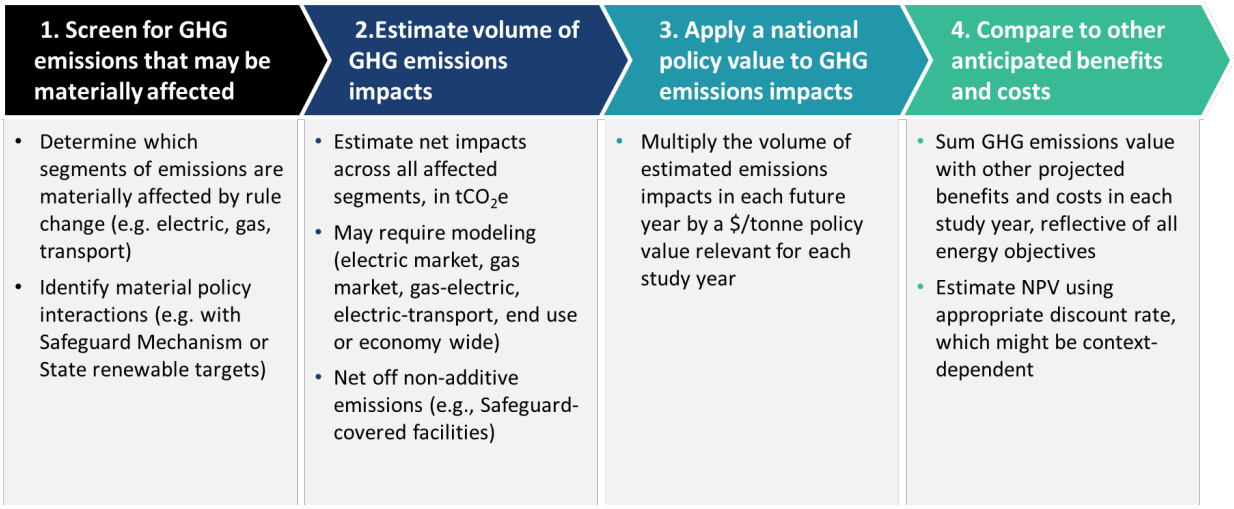
A. Overview of GHG Treatment in Benefit-Cost Analyses

The AEMC rule change processes follow a standardised approach to regulatory impact assessment for evaluating anticipated benefits and costs of any particular rule change, measured relative to the National Energy Objectives. Benefits and costs are measured relative to the National Energy Objectives because the AEMC can only make and amend the electricity, gas, and energy retail rules, or recommend changes to the national energy framework in reviews if doing so will contribute to the relevant energy objective.[34] These assessments consider qualitative and quantitative evidence submitted by stakeholders and government agencies and developed by AEMC staff. The nature and extent of benefit-cost analysis required in the impact assessment process are context-specific and depend on the scale and breadth of impacts anticipated.

Assessment of GHG emissions impacts can be incorporated into the AEMC's current regulatory impact assessment approach, but with impacts on achieving GHG emissions reduction targets now considered alongside price and the other elements of the energy objectives, as summarized in Figure 5 below. The AEMC would assess GHG emissions using the same framework of qualitative and quantitative assessments that it already applies to the other elements of the energy objectives, including: (1) conducting an initial screening assessment to determine whether and how GHG emissions may be materially impacted by the rule changes; (2) evaluating the expected quantity of GHG emissions impacts, such as by conducting market modelling of rule change effects; (3) applying a policy value to the emissions impacts, which may differ over the study timeframe; and (4) comparing GHG emissions to impacts on price and the other elements of the energy objectives over the same study timeframe to assess overall benefits or costs on an NPV basis. The determination of whether and to what extent a detailed analysis of GHG emissions must be pursued would be on a case-by-case basis, with the level of analysis dictated by the anticipated extent of emissions impacts and the scope of evidence needed to inform the AEMC's determinations relative to the National Energy Objectives.

[34] See AEMC, *How the National Energy Objectives Shape Our Decisions*, AEMC (October 2022).

FIGURE 5. PROPOSAL APPROACH TO CONSIDERING GHG EMISSIONS IMPACTS WITHIN THE NATIONAL ENERGY OBJECTIVES



As is the case under current regulatory impact assessments, the AEMC may sometimes determine that a detailed assessment of GHG impacts is not required either because no material GHG emissions impacts are anticipated or because the directional changes in emissions and other elements of the energy objectives are sufficiently aligned that a detailed assessment is not required to weigh trade-offs. In those circumstances, qualitative evidence or streamlined analysis of GHG emissions may be sufficient to inform AEMC decisions. In other circumstances, detailed analytical or modelling assessments may be needed, with the analytical modelling approaches tailored to the primary anticipated impacts. Different analytical approaches may be used to estimate gas sector GHG emissions, electricity sector GHG emissions, net GHG impacts from gas-electric fuel switching, and net GHG impacts from electrification of transportation or other sectors.

PROPOSAL: Generalized approach to estimating GHG emissions impacts includes: (1) conducting a screening assessment to determine whether and how GHG emissions may be materially impacted by rule changes; (2) estimating the projected quantity of net GHG emissions impacts across all materially affected sectors; (3) applying a policy value to emissions, the value of which may differ over the study timeframe; and (4) comparing GHG emissions value to consumer costs and reliability outcomes on an NPV basis.

B. Natural Gas Sector Emissions

The analytical methods that may be used to assess GHG emissions associated with Gas Market rule changes may be similar to the methods that have historically been used to assess the impacts of rule changes, which may require an assessment of gas consumption volumes by demand segment. Applying the proposal methods described in Sections 0 and III, a typical GHG impact assessment may require:

- **Identifying primary mechanisms by which the volume or GHG intensity of natural gas consumption may be affected.** A qualitative analysis of the potential rule change can be used to identify the primary intended or unintended impacts on resulting GHG emissions. Examples include: (a) rules that may directly affect gas consumption volumes such as by reducing producer barriers to entering the gas market, expanding gas network infrastructure, or improving the efficiency of gas networks or end-use consumption; (b) rules that affect the total delivered price of natural gas to consumers, in turn affecting end users' consumed volumes (with higher prices tending to reduce consumed volumes); and (c) rules potentially affecting the volume of upstream fugitive emissions or the prevalence of low/no-emissions fuel blending, both of which may impact the rate of GHG emissions associated with each GJ of end-user gas consumption.
- **Estimating impacts on the volume of gas consumption by customer segment.** The most appropriate methods for estimating the impacts of a rule change on consumed gas volumes will be context-specific, but may include methods such as: (a) projections of increased consumption volumes that may be enabled by expanding gas market infrastructure or market access, considering primary demand drivers such as population growth and economic growth in energy-intensive economic sectors; (b) application of consumer price elasticity to account for short-run or long-run behavioural changes in response to changes in delivered prices; and (c) scenario analysis across a range of plausible outcomes, particularly relevant when the rate or scale of impacts on consumption volumes is highly uncertain. Volumes of gas consumed to operate pipeline or gas network compressors would be estimated in addition to end-user consumed volumes.
- **Translating projected gas consumption volumes into associated GHG emissions**. For most purposes, gas consumption volumes can be translated to total GHG emissions on a one-to-one basis, using a standard rate of embedded CO_2e emissions associated with natural gas combustion. The rate of GHG emissions considers direct emissions from combustion as well as upstream fugitive emissions of methane and other greenhouse gases. Rule changes that may affect the blending of low/no-emission fuel or the scale of upstream fugitive emissions would utilise different embedded emissions rates per GJ of delivered gas to consumers.
- **Classifying emissions as in scope or out of scope relative to the National Energy Objectives.** Consistent with the discussion presented in Section II above, the emissions considered in scope for the purposes of benefit-cost assessments relative to the National Energy Objectives are those emissions included in the National Greenhouse Accounts and subject to Australian and State and Territory climate commitments, as follows:
  - *GHG Emissions in Scope* include GHG emissions from natural gas combusted in Australia, across all industries and customer segments. Emissions associated with gas

combustion for operating gas network compressor stations and upstream fugitive emissions are considered in scope (including the proportion of these upstream emissions that are associated with LNG exports).

  - *GHG Emissions Not in Scope* include overseas GHG emissions, such as overseas combustion of Australia's LNG exports, even if those emissions may be directly or indirectly affected by AEMC rules. Similarly, overseas emissions associated with leakage or the loss of energy-intensive economic sectors from Australia to overseas economies are not considered in scope.

- **Accounting for primary policy interactions.** The most prominent policy interaction to account for in estimating gas sector emissions relates to the Safeguard Mechanism's facility-specific baseline emissions caps as applied to large GHG emitters, with approximately 38% of these emissions associated with the combustion of natural gas. As discussed in Section III.B above, any estimated increases (or decreases) in emissions from these facilities are anticipated to be offset by the same quantity of emissions decreases (or increases) through the trading of SMCs and ACCUs. Hence, when tabulating the total emissions impact of an AEMC rule change, the net GHG emissions impact would be zero for these demand segments (even if there is a non-zero estimated impact on consumed volumes of natural gas). Even though no net GHG impact would be estimated for these customer segments, economic benefits may be estimated from synergistic policies that reduce gas customers' net costs of energy consumption including fuel consumption costs. Other policy interactions would be considered on a case-by-case basis where relevant.

Beyond these general guidelines on the most relevant methods for estimating gas sector emissions impacts, the AEMC will need to utilise a variety of methods to estimate the most relevant and material impacts as tailored to each rule-making context.

C. Electricity Sector Emissions

The analytical methods used to assess GHG emissions associated with electricity market rule changes may be largely similar to the methods that have historically been used to assess rule change proposals.

If needed to apply the proposal methods described in Sections II and III, an in-depth GHG impact assessment for a large rule change may require some or all of the following steps:

- **Identifying the primary mechanisms by which the quantity or GHG intensity of electricity consumption may be affected.** A qualitative analysis of the potential rule change can be used to identify the primary intended or unintended impacts on resulting GHG emissions. Examples include: (a) rules that may change the overall quantity of electricity consumption such as via a change to delivered prices or by affecting the pace of electrification; (b) rules that may accelerate the pace of renewable and clean energy resource deployments; (c) rules that that may induce fuel switching or different operational profiles in the resource mix; and (d) rules that may affect transmission or distribution network infrastructure, which may, in turn, affect resource mix or resource operations.
- **Estimating impacts on the quantity, profile, and flexibility of electricity consumption by customer segment.** Projections of changes to customer demand could consider: (a)

underlying drivers such as population growth, energy efficiency policies, and trends, economic growth, uptake rates of EVs, electric appliances, distributed resources, and other technologies; (b) short- and long-term customer elasticity of demand that may increase electricity consumption in response to lower prices (or decrease consumption in response to higher prices); (c) changes to customer demand patterns that may result from technology uptake or in response to alternative market rules (including load shifting and other forms of demand response); and (d) scenario analysis of the plausible range of outcomes. For rule changes that may attract more customer engagement in response to electricity market investment and operational signals, this potential for engagement can be incorporated into comprehensive electricity market modelling (see the following two bullets).

- **Projecting investment and retirement effects that may produce a different resource mix over time.** Rule changes that may affect the total quantity of resources or the mix of electricity supply resources can be examined with expansion plan models such as the capacity outlook modelling used by the AEMO to conduct the ISP.[35] In an expansion model, the difference in system-wide, zonal, or customer-side prices caused by a rule change will induce a different set of resource investment and retirement decisions. For example, a rule change that enables more customers and customer-side technologies to access wholesale market prices may make these resources relatively more economically attractive compared to the life-extension of existing coal resources. As another example, rule changes affecting the level of investment in transmission networks or the allocation of transmission network costs may cause renewable developers to shift resource development to different locations.
- **Projecting operational impacts that may change the relative share of energy served by different resources.** Electricity market rule changes affect the operational decisions of customers and electricity supply resource owners, the outcomes of which can be simulated in production cost models. Such production cost models can either consider operational outcomes in isolation (assuming a fixed resource mix) or in combination with investment effects (described above). The primary relevant output of such a production cost model is the annual quantity of energy production by electricity technology type. For example, a rule change to better integrate demand response or battery resources may result in fewer renewable curtailments across the study year. As another example, a rule change to improve unit commitment decisions may reduce fossil plant cycling.
- **Translating projected electricity sector investment and operational outcomes into associated GHG emissions.** The annual quantity of energy production can be translated into aggregate annual GHG emissions, after applying technology-specific or resource-specific emissions rates (e.g., coal, gas combined cycle (CC), gas combustion turbine (CT), and oil-fired CT plants). In addition, upstream and fugitive emissions from each fuel would also be considered (for example, see the breakdown of gas sector emissions in Table 3 above).
- **Accounting for primary policy interactions.** We assume that the Safeguard Mechanism's electricity sector-wide cap will remain non-binding for the foreseeable future as discussed in Section III.B above, such that all GHG changes estimated in the electricity sector would

[35] See Australian Energy Market Operator (AEMO), *ISP Methodology*, June 2023.

be considered. Interactions with government renewable targets and related electricity sector policies will be more nuanced, and may be addressed in one or more of the following ways depending on the context:

- As an initial presumption, AEMC assessments can assume that State and Territory renewable targets and other electricity supply goals will be achieved, and in some cases can be assumed to be achieved on a defined schedule. Some targets can be assumed to be achieved on a total percentage of delivered load basis, such that a fixed demand forecast can be translated to a fixed volume of renewable development over time. Some AEMC rule-makings may produce savings associated with achieving renewable targets more cheaply, without changing the quantity or timeframe of renewable deployment or the volume of GHG emissions associated with the fleet.
- Even if the share of renewables over time can be assumed constant for the purposes of a specific rule-making, it may be that the rule could achieve GHG emissions reductions, such as by: (a) causing other operational changes in the fleet such as reduced fossil cycling or coal-to-gas fuel switching; (b) shifting the location of renewable development to reduce the share of coal production or system-wide line losses; (c) shifting incentives toward a different mix of onshore wind, offshore wind, grid solar, distributed solar, or other renewables, which may produce a different net load profile and different system-wide emissions rates; and/or (d) improving the operations of battery, demand response, or distributed resources to reduce the frequency of renewable curtailment. These effects would be examined only in rule-making contexts where the GHG impacts are anticipated to be material.
- In some cases, AEMC rule-makings will be expected to produce changes in the total quantity of renewables deployed or the timeframe of deployment. These changes could occur, for example, if: (a) a rule change would address material barriers to entry or deployment costs are otherwise preventing or delaying States from achieving targets; (b) States' renewable procurements are in some fashion price-sensitive or timing-sensitive, such that lower net achievement costs associated with AEMC rule changes may enable more renewables sooner; and/or (c) lower costs or easier access to renewable supply would unlock higher volumes of voluntary customer demand for renewables, which may exceed States' minimum targets. Again, these potentially complex interactions would be examined on a case-by-case basis, and explicitly quantified only when GHG impacts are anticipated to be material.

- **Classifying emissions as in scope or out of scope relative to the National Energy Objectives.** Consistent with the discussion presented in Section II above, the emissions considered in scope for the purposes of benefit-cost assessments relative to the National Energy Objectives are those emissions included in the National Greenhouse Accounts and subject to Australian and State climate commitments, as follows:
  - *GHG Emissions in Scope* include GHG emissions from natural gas, coal, petroleum products, and other fossil fuels combusted in Australia for the purposes of electricity production. Upstream and fugitive emissions associated with fossil fuel production and transportation are considered in scope. As discussed further in Section II.C above, emissions changes in transportation or other economic sectors potentially affected by AEMC rules are in scope.
  - *GHG Emissions Not in Scope* include overseas GHG emissions, even if those emissions may be directly or indirectly affected by AEMC rules. For example, changes in coal, LNG,

or other fossil fuel export volumes would not be considered. Overseas emissions associated with the leakage or loss of business activity in electricity-intensive and trade-exposed sectors would not be considered in scope.

The AEMC could apply these or other methods to estimate the most relevant and material impacts as tailored to each rule-making context. In some cases, the analytical or modelling approaches historically used to assess rule change proposals can also be used to estimate GHG impacts.

D. Electrification and Other Multi-Sector GHG Emissions Assessments

In some cases, AEMC's GHG impact assessments may need to consider the net effects across more than one economic sector. For example, if an AEMC rule may incentivise the electrification of transportation, building heat, or industrial process heat, the net GHG impacts across these economic segments would be considered. These GHG impacts would be considered both in the gas and electricity sectors directly affected by AEMC rule changes, and other economic sectors that may be indirectly affected.

In these contexts, a multi-sector assessment may be required to estimate the net GHG emissions impacts from such policies. Examples of rule changes that may require a multi-sector analysis could include:

- **Gas-electric fuel switching**, where an AEMC rule change covering gas, electricity, or retail markets could incentivise end users toward greater (or lesser) levels of electrification. Depending on the rule in question, the level of electrification anticipated in each customer segment could be projected using methods such as: (a) applying short- and long-run elasticity of substitution estimates to each affected customer segment, with higher price differentials inducing greater levels of gas-electric fuel switching; or (b) projecting the uptake rate of electrification technologies such as heat pumps, electric appliances, or thermal energy storage and applying the relevant ratio of energy consumption to gas and electricity demand projections. Revised demand projections and demand profiles would be translated into net increases in electricity-sector emissions (and decreases in gas sector emissions) using methods similar to those described above.
- **Electrification of transportation,** such as through electricity or retail market rules that may reduce barriers or reduce costs of EV adoption. If such a rule-making could incrementally accelerate the pace of EV adoption, it would result in lower petrol/diesel consumption and associated GHG emissions for transportation. These reductions could be estimated using a projection of EV uptake rates, vehicle kilometres travelled, and fuel economy by vehicle segment, before and after the rule change. Such a rule-making would also cause increases in electricity sector demand and alter the profile of electricity demand, consistent with assumed EV charging patterns.

The net effect of GHG emissions reductions (from reduced natural gas and petrol/diesel combustion) and GHG emissions increases (from increased electricity consumption) would form the basis for AEMC's GHG impact assessment.

Electrification assessments may require care in developing the most appropriate study timeframe and treatment of investment effects to accurately capture several offsetting drivers of GHG emissions. These factors include:

- **Energy efficiency benefits of electrification.** Many electrification measures double as energy efficiency measures. For example, heat pumps can support space heating with a much lower ratio of delivered electricity GJ compared to the GJ of natural gas required for the same buildings. As another example, EVs travel more kilometres per GJ of electricity compared to GJ of petrol. These energy savings do not translate directly into emissions savings because there is a partial offset since some of the corresponding increase in electricity demand may be met by fossil generation.
- **Share of incremental electricity demand served by fossil vs. clean energy over time**. If electrification occurs overnight with no change in the electricity supply mix, a near-term analysis may assume that incremental electricity demand is primarily supported by increased production from natural gas plants that are available but presently operating at low-capacity factors. However, a longer-term analysis would consider that electricity demand increases will be at least partly served by increases in renewable supply (consistent with States' renewable targets) and that these renewable targets increase over time. For these reasons, the net GHG savings from electrification may be modest (or conceivably even negative) in the initial year but increase over time with the achievement of electricity sector decarbonisation. To assess the net GHG benefits from incentivising the purchase of one more EV (rather than one new petrol vehicle), the analysis would consider the net effects over the 20+ year lifespan of the vehicle. Existing literature suggests that EV uptake will reduce Australian emissions even in the short term.[36] For example, a paper evaluating net emission reductions in 59 world regions over time found that under 2015 carbon intensities of electricity generation, EVs are less emission-intensive than fossil fuel-based alternatives in Australia.[37] Similarly, using a probabilistic life-cycle assessment, another study considered three variations in Australia's fuel mix ranging from a 100% fossil-fueled electricity mix to a 90% renewable electricity mix. Under all three Australian scenarios and seven states and territories, EVs reduced emission rates (per km) relative to conventional fossil-fueled vehicles. [38]

For AEMC rules that have material GHG impacts on multiple economic sectors, the net GHG emissions impact would be used for benefit-cost analysis (regardless of whether the sector is directly or indirectly affected by AEMC rules). Given the relatively targeted impacts of most AEMC rule-makings, multi-sector analysis is unlikely to be required in most cases.

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[36] The Electric Vehicle Council, PwC, NRMA and St Baker Energy Innovation Fund, *Recharging the economy. The economic impact of accelerating electric vehicle adoption*", 2018; ClimateWorks Australia, *The path forward for electric vehicles in Australia*, 2016.

[37] Knobloch, Florian, Steef V. Hanssen, Aileen Lam, Hector Pollitt, Pablo Salas, Unnada Chewpreecha, Mark AJ Huijbregts, and Jean-Francois Mercure, "Net emission reductions from electric cars and heat pumps in 59 world regions over time". *Nature sustainability* 3, no. 6 (2020): 437–447.

[38] Smit, Robin, and Daniel William Kennedy. "Greenhouse Gas Emissions Performance of Electric and Fossil-Fueled Passenger Vehicles with Uncertainty Estimates Using a Probabilistic Life-Cycle Assessment". *Sustainability* 14, no. 6 (2022): 3444.

List of Acronyms

ACCU	Australian Carbon Credit Unit
AEMO	Australian Energy Market Operator
AR5	IPCC Fifth Assessment Report
CBA	Cost-benefit analysis
CER	Clean Energy Regulator
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
EITE	Emissions-Intensive and Trade-Exposed
ETS	Emissions Trading System
GHG	Greenhouse gas
GW	Gigawatt
GWh	Gigawatt-hour
IPCC	Intergovernmental Panel on Climate Change
LRET	Large-Scale Renewable Energy Target
LNG	Liquefied natural gas
LULUCF	Land Use, Land Use Change, and Forestry
Mt	Megatonne
MWh	Megawatt-hour
NDC	Nationally Determined Contribution
NEO	National Electricity Objective
NERO	National Energy Retail Objective
NGO	National Gas Objective
NPV	Net present value
SMC	Safeguard Mechanism Credit
SRES	Small-Scale Renewable Energy Scheme
tCO_2e	Tonnes of carbon dioxide (CO_2) equivalent, where the global warming impact of various GHG is used to report quantities of different GHG on a consistent basis
TEBA	Trade Exposed Baseline Adjusted
UNFCCC	United Nations Framework Convention on Climate Change
VCR	Value of customer reliability

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