MODELLING RESULTS & IMPACTS AUSTRALIAN CARBON CREDIT UNIT MARKET ANALYSIS

Final report for Climate Change Authority, August 2023

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1. ABOUT THIS DOCUMENT

1.1 Background and scope of work

Recommendation 7 of the Independent Review of Australian Carbon Credit Units (Chubb Review) stated that the Climate Change Authority (the Authority) provide advice to the Minister on the merits of a mechanism at the scheme level to provide further assurance of additionality and conservativeness of carbon offsets.

Specifically, it noted a scheme-level buffer may help to ensure that abatement credited is appropriately conservative across the scheme portfolio. However, the mandatory cancellation of a percentage of ACCUs would reduce supply, and risk upward pressure on market prices, with implications for the broader cost-effectiveness of abatement.

SJT Consulting and RepuTex (the Project Team) have been engaged to undertake scenario modelling and sensitivity analysis of the implementation of a buffer on Australian carbon market fundamentals and price dynamics. Analysis includes:

Development of a Reference Case forecast(s) for market development prior to the implementation of possible buffer scenarios:

- Presentation of three scenarios (H/M/L) accounting for variation in the pace and scale of industrial decarbonisation under the Safeguard Mechanism.
- Forecast compliance demand for ACCUs to 2035, and demand from other sources such as investors and liquidity providers, and voluntary buyers.
- Forecast supply of ACCUs by scenario to 2035 and forecast annual average ACCU prices by scenario to 2035.

Modelling and sensitivity analysis of the implementation of a buffer on Australian carbon market fundamentals and price dynamics:

- Consideration of three theoretical buffer value scenarios, applied at the scheme-level, equivalent to a mandatory withholding of 5%, 10% and 20% of issuance.
- Modelling of the annual supply-demand balance between available ACCUs and forecast demand across each buffer scenario.
- Alternative forecast ACCU prices to 2035.

1.2 About this report

This report provides detailed discussion of market outcomes and implications, including analysis of the effects of potential buffer measures on ACCU market outcomes, such as forecast supply-demand balance and annual average spot prices; along with discussion of interaction with other policy considerations, such as the cost containment measure, and assumptions for the release of ACCUs under the ERF exit arrangement.

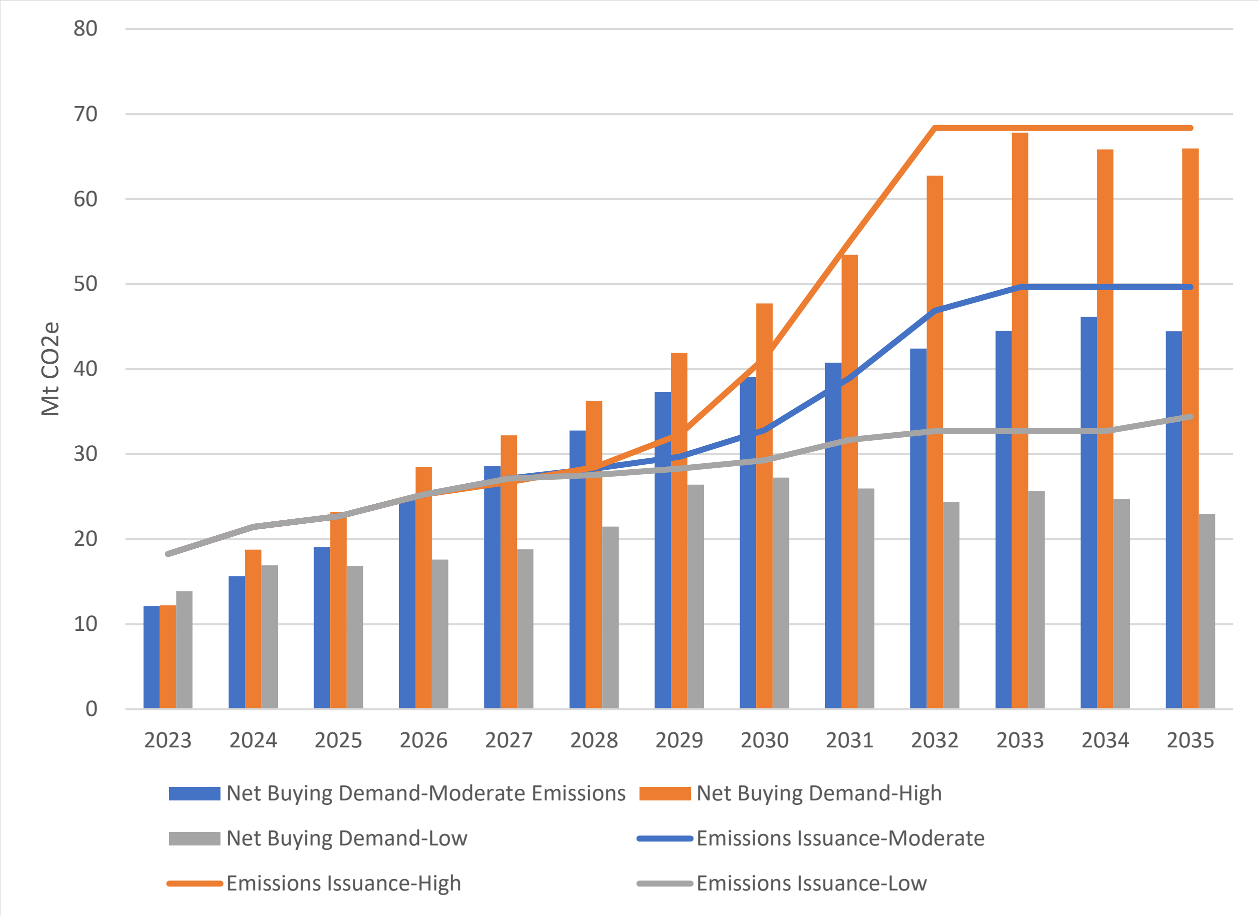
Part one of this report introduces the project. Part two provides a summary of modelled outcomes with the Reference Case. Part three presents modelled outcomes and analysis of the implementation of buffer scenarios. Part four provides further information on our modelling process, key inputs, and assumptions. Sections five and six provide more detail on sensitivities and other appendices.

Refer to the accompanying Excel Workbook for outcomes in support of this analysis.

2. SUMMARY OF KEY FINDINGS

- We currently forecast annual ACCU issuance to outpace annual buying demand in all scenarios over the next two to three years, underpinned by continuing issuance to existing projects anchored to carbon abatement contracts (CACs) with the Commonwealth.
- This pool of ‘firm supply’ from existing projects will provide near-term liquidity for the Australian carbon market, supplemented by issuances to new projects over time.
- In the near term, surplus issuance means that ACCU holdings could accumulate to be multiple times the size of annual cancellation demand, with buying demand shown to begin to exceed annual issuance from around 2027, subject to the timing and scale of new compliance demand attributed to the Safeguard Mechanism.
- Given uncertainty around the timing and scale of on-site action by high emitting companies covered by the Safeguard Mechanism (and therefore uncertainty about residual demand for ACCUs), we model three scenarios – prior to the consideration of theoretical buffer scenarios – to account for possible “slow” (High emissions scenario), “progressive” (Moderate emissions scenario) or “accelerated” (Low emissions scenario) on-site emissions reduction actions by industry.
- Modelled outcomes indicate that (prior to the implementation of possible buffer scenarios) ACCU demand is predicted to grow faster than ACCU issuance, resulting in a tightening ACCU market. In turn, this tightening market is projected to raise prices, incentivising additional ACCU supply to be developed in as in a classical market dynamic.
- Unlike classic markets, however, new ACCUs issuance increases after a multi-year lag relative to the intra-annual demand signal and does not typically respond to declines in demand.

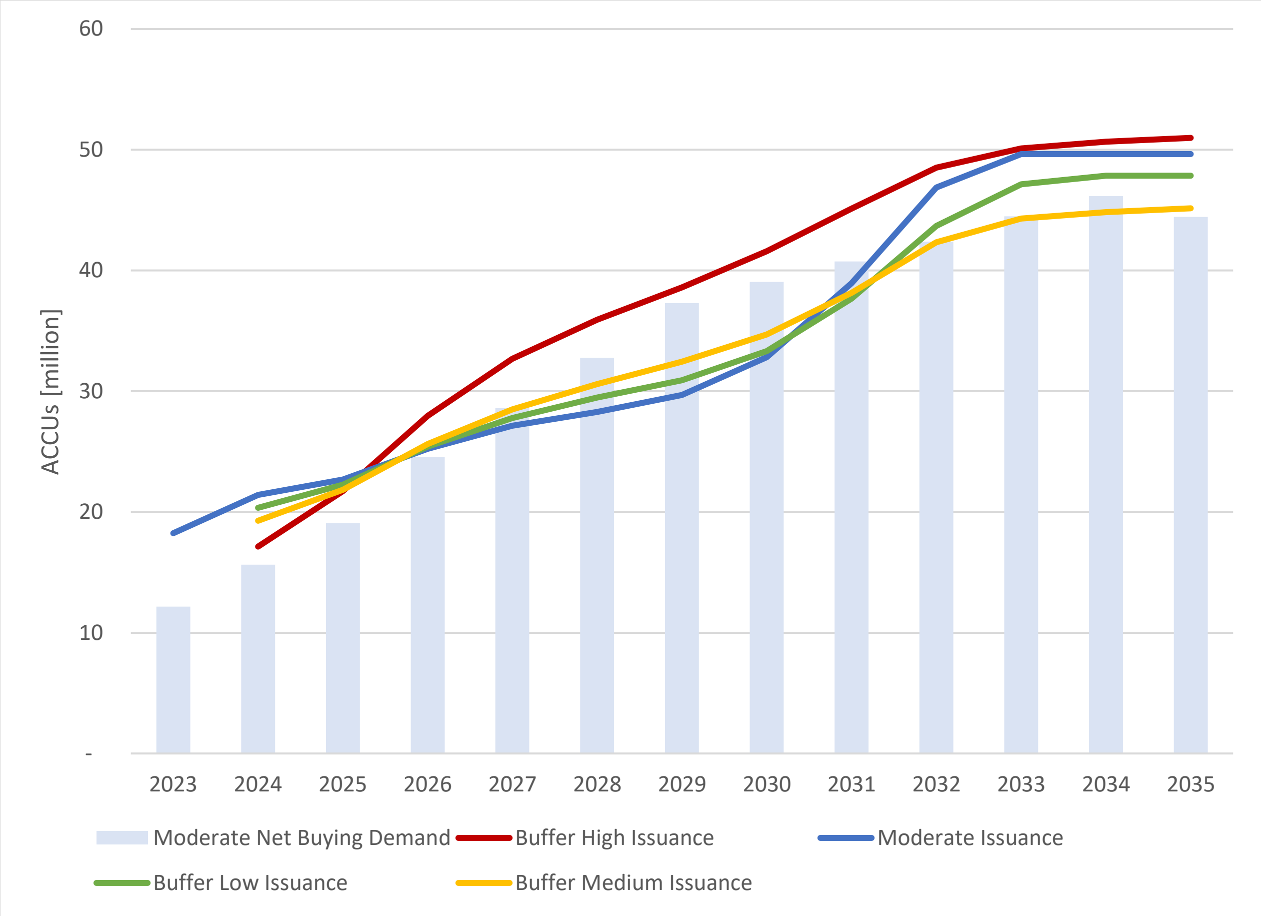
Figure 1: ACCU annual buying demand vs. ACCUs annual issuance 2023-35.



Source: RepuTex, Clean Energy Regulator, 2023.

- In line with Recommendation 7 of the Chubb Review, modelling considers the implementation of a potential buffer on Australian carbon market fundamentals, applying RepuTex's Central Case outlook as a basis.
- Modelling considers three theoretical buffer value scenarios, applied at the scheme-level, equivalent to a mandatory withholding of 5%, 10% and 20% of issuance.
- Findings indicate that applying potential buffer scenarios, set against growing demand, will initially tighten market balance and lift prices, before the higher price environment has the effect of bringing forward new project development, triggering higher ACCU supply than the modelled Reference Case.
- In each buffer scenario, this early pressure to increase in ACCU supply is modelled to increase ACCU issuance to keep pace with the predicted increases in demand, partially overcoming the inherent lag in ACCU supply.
- The effect of this dynamic is proportional at lower levels (e.g. 5-10 per cent), however, a 20 per cent reduction in issuance would significantly reduce the current supply overhang, immediately triggering a large increase in prices, and incentivising new projects that are economically viable to up to double current spot price levels.
- Although they take different pathways, ACCU issuance under each scenario is still calculated to reach approximately 50 million per annum, in line with annual demand.

Figure 2: RepuTex ACCU issuance forecast by buffer scenario (relative to Moderate Emissions scenario)



Source: RepuTex Energy, 2023.

3. REFERENCE CASE ANALYSIS

3.1 Summary of forecast scenarios

To understand the impact of current policy on the ACCU market (before the implementation of buffer scenarios), analysis presents three scenarios for market development, accounting for variance in the pace and scale of on-site emissions reduction action by high emitting facilities covered by the Safeguard Mechanism.

Modelled scenarios present three pathways for GHG emissions, including a Moderate Emissions scenario (or in-house view), High Emission and Low Emission scenarios, described in more detail in Table 1.

Each scenario assumes Australia's 2030 target to reduce emissions by 43% on 2005 levels, is implemented via declining baselines under the Safeguard Mechanism, with covered facilities incrementally accountable for an increasing proportion of their annual emissions. Beyond 2030, we apply Australia's 2050 target to reduce emissions to net-zero. Policy design assumptions are fixed across all scenarios, described in the sections below.

The primary focus of the Reference Case scenarios is to evaluate the market's response to the imposition of an emissions constraint for large emitting facilities, and the implications for industrial decisions to invest in in on-site decarbonisation projects. The timing and scale of internal actions to reduce GHG emissions subsequently informs demand for external emissions reductions, guiding long-term price development.

Analysis presents three scenarios:

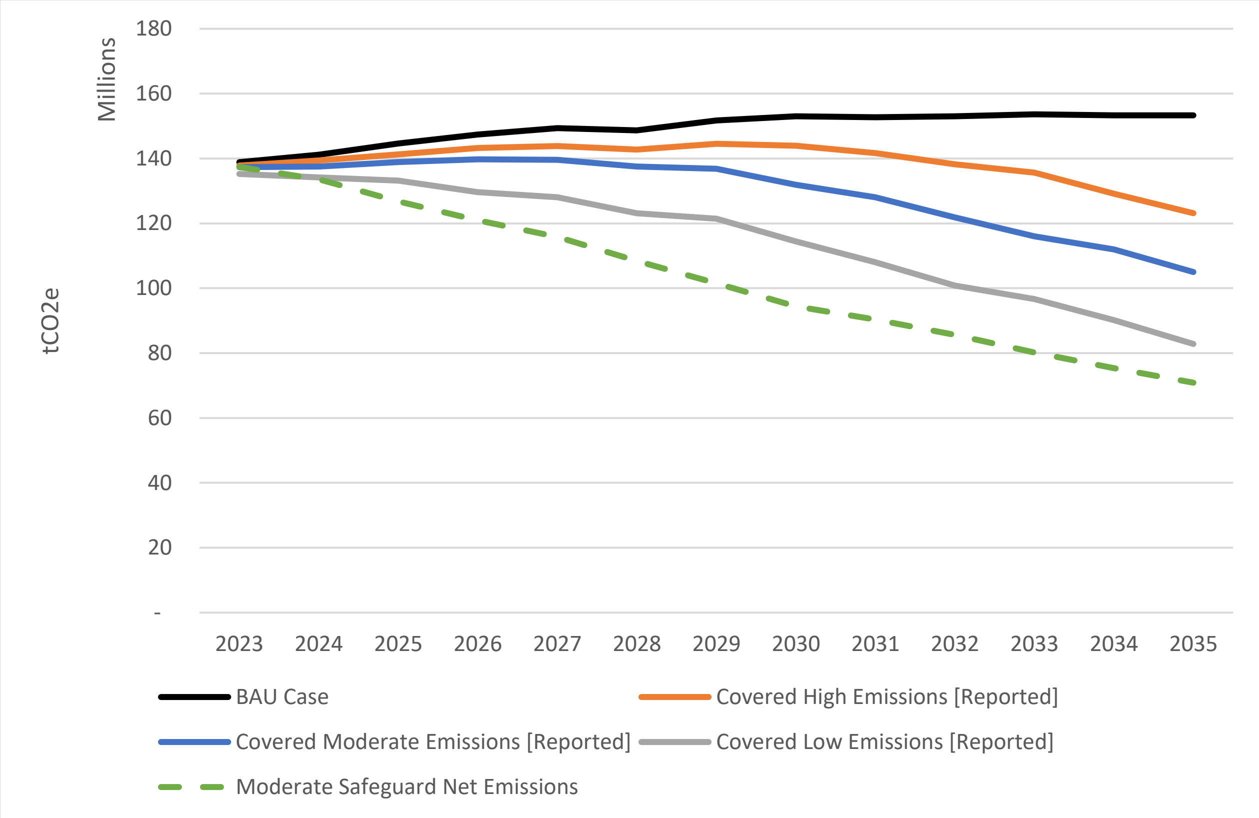
Table 1: Summary of modelled scenarios.

Scenario	Summary
Moderate Emissions scenario: "Progressive" industry transition	Covered facilities take a "progressive" approach to implementing on-site emissions reductions, initially prioritising low-cost process improvements and small equipment upgrades (where available) before gradually investing in larger-scale projects as policy and price certainty grows. Investments are backed by dedicated funding under the Safeguard Transformation Stream of the Powering the Regions Fund, effectively bringing forward decarbonisation activities that may not otherwise be cost-effective. Demand for external ACCU offsets is also supported by continued growth in voluntary buying demand.
High Emissions scenario: "Slow" industry transition	Covered facilities take a "slower" approach to implementing on-site emissions reductions, focusing on the deployment of low-cost process improvements, with industry instead utilising external abatement (carbon credits) ahead of investment in step-change emissions reductions later in the decade. High demand for external offsets (due to lower direct emission reductions) is supported by continued growth in voluntary demand, driving higher investor participation in the ACCU market over the decade.
Low Emissions scenario: "Accelerated" industry transition	Direct emission reduction investment occurs in an "accelerated" manner, with large-scale investments triggering a faster step-change in emissions, supported by the Powering the Regions Fund and low-cost financing via the National Reconstruction Fund. Lower offset demand (due to higher direct emission reductions) is mitigated by growth in commercial and Commonwealth demand.

Refer to Section 4 for a more detailed description of our modelling approach.

3.2 Forecast emissions from covered sectors

Figure 3: Forecast covered emissions by scenario to 2035.



Source: RepuTex Energy, 2023.

To understand the technical potential for covered facilities to reduce emissions, we model three scenarios, considering the different pace and scale for industry to implement GHG emissions reduction actions using currently available and emerging technologies. Investment decisions are supported by Commonwealth funds, including the Safeguard Transformation Stream of the Powering the Regions Fund, and the implementation of a robust demand signal under the Safeguard Mechanism.

Covered emissions are forecast to range between 82 – 124 million tonnes by 2035. Under our Central Case, covered facilities are modelled to progressively invest in process improvements and small equipment upgrades, with some investment in transformative projects - including catalytic reduction of nitric oxide, reducing fugitive emissions from gas extraction, and renewable energy and vehicle fuel switching at mining facilities - as carbon prices move from the high $40s toward $70 per tonne of CO2. This sees emissions reductions averaging two million tonnes per annum (Mtpa), with emissions in 2035 reaching 105 Mt, or 48 Mt lower than the business-as-usual (BAU) case.[1]

Under our Low Emissions (fast transition) scenario, covered facilities are modelled to undertake more proactive investment in emissions reductions wherever economically feasible. This supports the accelerated deployment of low carbon technologies, while helping to shift investment from the purchase of offsets toward on-site reductions. This sees emissions reductions average four Mtpa, or about twice the rate of the Moderate Emissions scenario. Annual emissions by 2035 reaching 83 Mt in the Low Emissions case, or 70 Mt below the BAU case, supported by the development of more transformative projects, including carbon (re)capture and storage, electrified transport,

[1] See Section 5 for further detail on the BAU case.

fuel switching, 'green' alumina and steel manufacturing, and NOx reduction, resulting in significantly lower emissions.

The inverse of this is considered within our High Emissions (slow transition) scenario, with covered facilities modelled to implement emission reduction activities more slowly, and instead rely on external abatement in place of the transformational technologies needed to decarbonise. Under this scenario, emissions reduction actions are assumed to be limited to the implementation of "higher return" opportunities, such as process improvements, catalytic reduction of nitric oxide, and reducing fugitive emissions from gas extraction – with carbon prices moving from around $60/t into the low $80s per tonne of CO2. This sees emissions reductions averaging just one Mtpa, or about half the rate of the Moderate Emissions scenario. Annual emissions by 2035 reach 123 Mt in the High Emissions case, or 30 Mt below BAU.

Across all scenarios, large capital expenditure decisions are assumed to be subject to long lead times. For most businesses, investments in new technologies are generally assumed to take place two years[2] after the carbon market price reaches the required level, which approximates the inter-temporal effects of industry investment decisions[3]. Therefore, in all scenarios we calculate it will take several years for emissions reductions to develop, leading to higher initial reliance on carbon offsets. Refer to Section 4 and Appendix A for further discussion of abatement measures and assumptions.

Table 2: Annual direct [on-site] emissions reductions by scenario

	Low Emissions Scenario	Moderate Emissions scenario	High Emissions Scenario
2023	2	0	-0
2024	1	-0	-2
2025	1	-1	-2
2026	4	-1	-2
2027	2	0	-1
2028	5	2	1
2029	2	1	-2
2030	7	5	1
2031	6	4	2
2032	7	6	3
2033	4	6	3
2034	6	4	7
2035	7	7	6
Annual Average 2023-2030	4	2	1
Reduction from BAU 2035 (cum.)	70	48	30

Source: RepuTex Energy, 2023.

[2] This timeframe is associated with typical decision-making inertia, financing, planning, and establishment of emission reduction activities on the industrial demand side. Not to be confused with a similar 'two-year' lag that is common between registration of an ACCU Scheme project and first ACCU issuance. In the case of ACCU supply, this delay does not include decision making and planning, but is associated with the timeline for a project to become established, the abatement to occur, and measurement and verification processes.

[3] We note that decision making is also subject to external factors – e.g., global uncertainty following the Ukraine-Russia conflict, volatile gas and electricity prices, the continuing threat of COVID-19 and a global economic downturn, export demand, and price certainty. A slower or more progressive transition pathway, where industry utilises a greater mix of offsets, therefore, remains a highly plausible option for the local market.

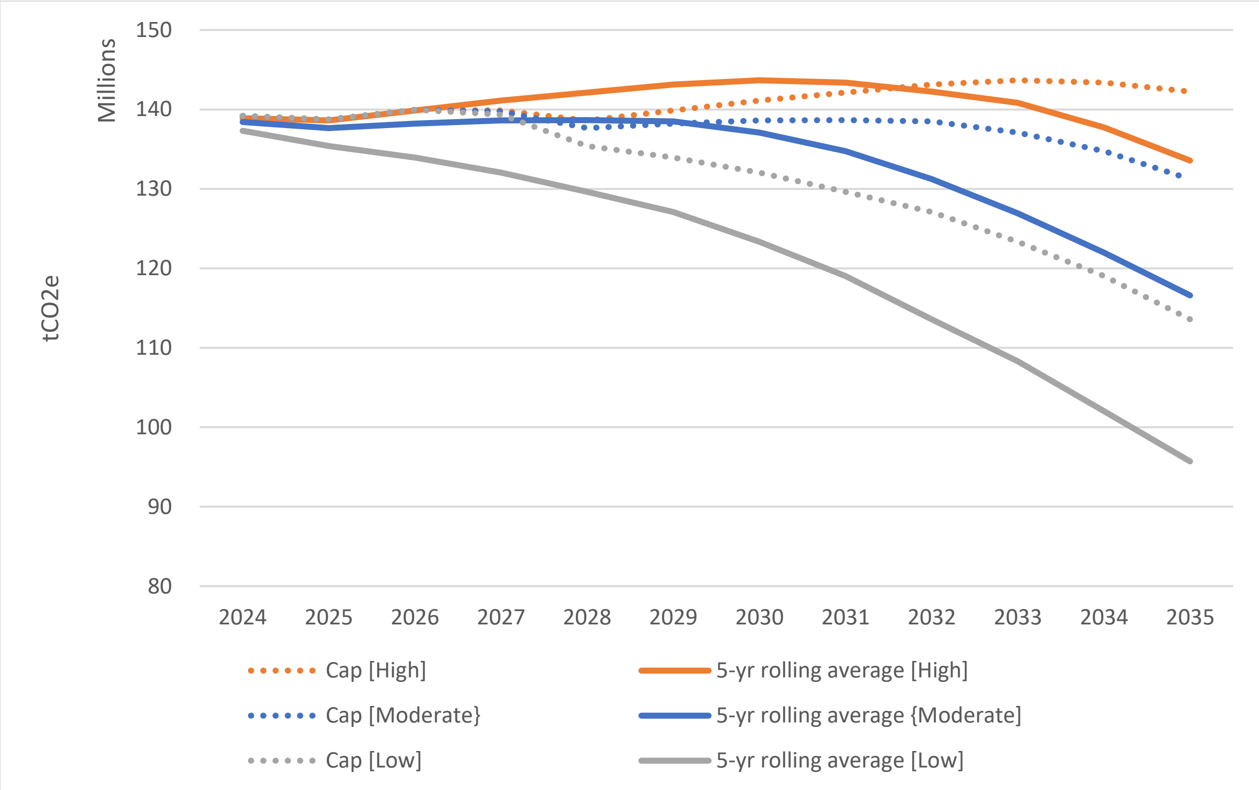
Interaction with the emissions cap

To ensure that the Safeguard Mechanism drives down gross industrial emissions, the objects of the NGER Act now include provisions for the government's calculated emissions budget to act as an emissions limit under the scheme. In aggregate, net emissions from Safeguard facilities are not to exceed 100 Mt of CO2e by 2029-30 (zero by 2050), and 1,233 Mt CO2e over the decade to 2030.

Total gross emissions from Safeguard facilities must reduce over time, measured by comparing a historic 5-year rolling average to the current one. As a result, the emissions cap is modelled to vary by scenario beginning in 2027. This is depicted in the figure below. Under the High Emissions scenario, we note potential for the cap to be significantly breached due to the combined impact of new entrants and higher reliance on carbon offsets in 2027. In this situation, the Minister is required to consult and amend the Rules or take other policy actions to ensure the objects are met (however, those actions are not modelled here).

In the Moderate Emissions scenario, the cap is also modelled to be breached in 2028, however, by less than one million tonnes, or less than one per cent. In the Low Emissions scenario, the cap is not predicted to be breached.

Figure 4: Modelled emissions cap by scenario.



Source: RepuTex Energy, 2023.

3.2.1 Creation of Safeguard Mechanism Credits

Increased investment in direct emission reductions by industry is anticipated to result in the issuance of Safeguard Mechanism Credits (SMCs) for below-baseline performance[4]. Covered facilities may sell SMCs to other facilities (or to external buyers[5]) or bank them

[4] Crediting will only occur for emissions reductions below a facility's baseline. .
[5] The benefit of an SMC may only be claimed by a covered facility, however there is no restriction on the sale of SMCs to third parties outside of the Safeguard Mechanism (e.g. investors).

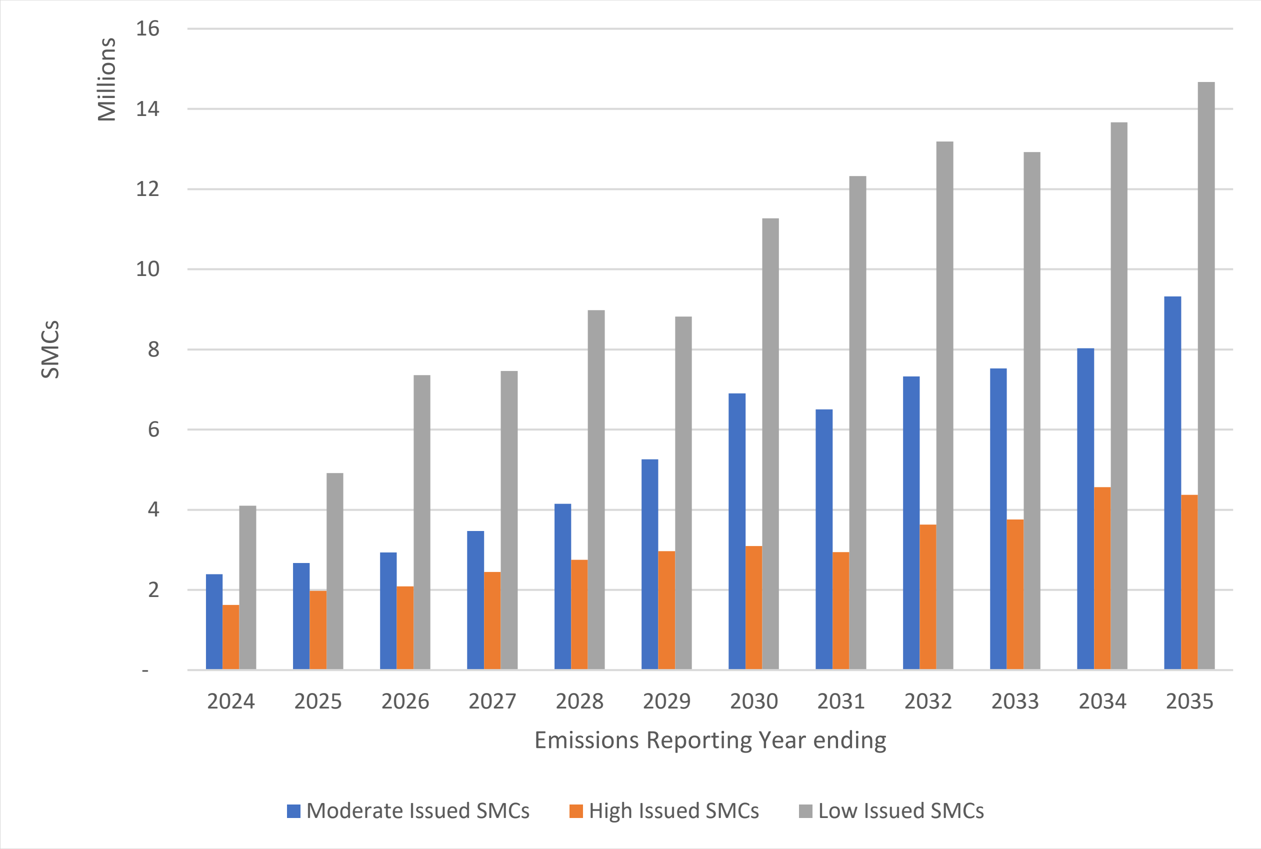
to use in future years (prior to 2030[6]). Crediting therefore provides an important economic incentive for facilities to undertake on-site abatement, even where they out-perform their emissions baselines.

Because of the design of Safeguard Mechanism reforms, with baselines initially weighted toward historical reported emissions levels, large capital investments are expected to be required to generate SMCs at scale[7]. While there will inevitably be some SMCs issued for 'headroom' under initial emissions baselines, the compounding nature of annual baseline declines makes it implausible for facilities to keep pace with increasing emissions accountability over several years through only energy efficiency, low-cost behavioural, and operational changes.

In some cases, large capital investments are already underway, which is forecast to result in between one and five million SMCs being issued for the first 2023-24 emissions reporting year (in early 2025), with the larger volumes likely from gassy coal mines and other facilities in the process of reducing GHG with High global warming potential.

While SMC creation is uncertain, we forecast that crediting will grow for the next several years. In our Moderate Emissions scenario we project early crediting for direct emission reductions will be concentrated at facilities in mining business, such as coal, gas, and iron. As baselines continue to decline after 2030, crediting is likely to shift towards more emerging low-emissions technologies in metals manufacturing – e.g., alumina and steel. As this occurs, we expect SMC issuance to grow to between 3 - 12 million by the 2030s.

Figure 5: Annual below-baseline carbon credit issuance as SMCs by scenario (2024 to 2035).



Source: RepuTex Energy, 2023.

[6] Unlimited banking of SMCs is allowed to 2030. The 2026-27 review will consider whether SMCs can be banked for use after 2030.

[7] There is inevitably some small potential for 'headroom' issuance to facility's that already abate at well above their industry's average potential emissions.

Banking and availability of SMCs

Although SMC issuance grows in each of our scenarios, the continuous decline of baselines is anticipated to constrain SMC creation. In addition, the ability for companies to bank SMCs will further reduce their availability in the market, with credits expected to be heavily banked as companies seek to hedge against increasing liabilities to 2030, and the higher cost of ACCU offsets.

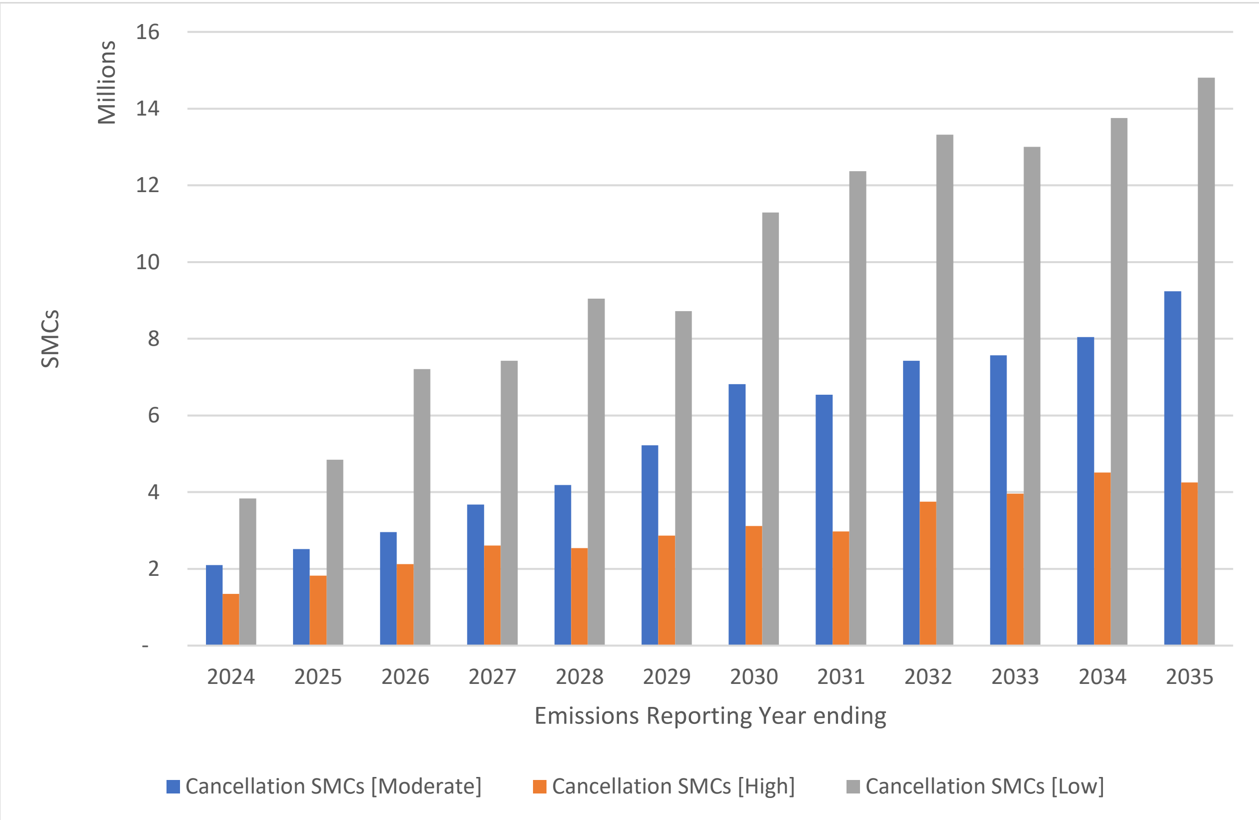
The marginal cost of undertaking an activity to be issued a new ACCU offset may be lower relative to the marginal cost of reducing emissions intensity sufficiently to be issued an SMC in any given year. The value of each activity to reducing future liability, however, is different. For example, ACCU generating activities are inherently limited by their crediting period, whereas emission reduction activities typically result a permanent reduction in future liability.

While some facilities are likely to trade SMCs where they do not face a forecast liability prior to 2030, this is likely to be a small component of the market. For the purposes of this analysis, we assume that facilities bank sufficient SMCs to meet their forecast liability over a rolling six-year window, with surplus SMCs made available to the market.

Aside from displacing ACCU demand, the relatively small quantity of SMCs that are made available to the market are not calculated to affect ACCU pricing. As the much larger and more liquid carbon credit, ACCU contracting costs are instead modelled to guide price development. Refer to Section 3.6 for further discussion on price dynamics.

We envisage between one-half and seven million SMCs being made available to the market annually in the 2030s (assuming the continued banking of SMCs beyond 2030 for at least six years). We therefore expect the larger and more established ACCU market to support carbon credit liquidity in the first several years under the new Safeguard Mechanism framework, and to continue to fulfill the main carbon credit role thereafter.

Figure 6: Cancellation of SMCs (not banked against future liability).



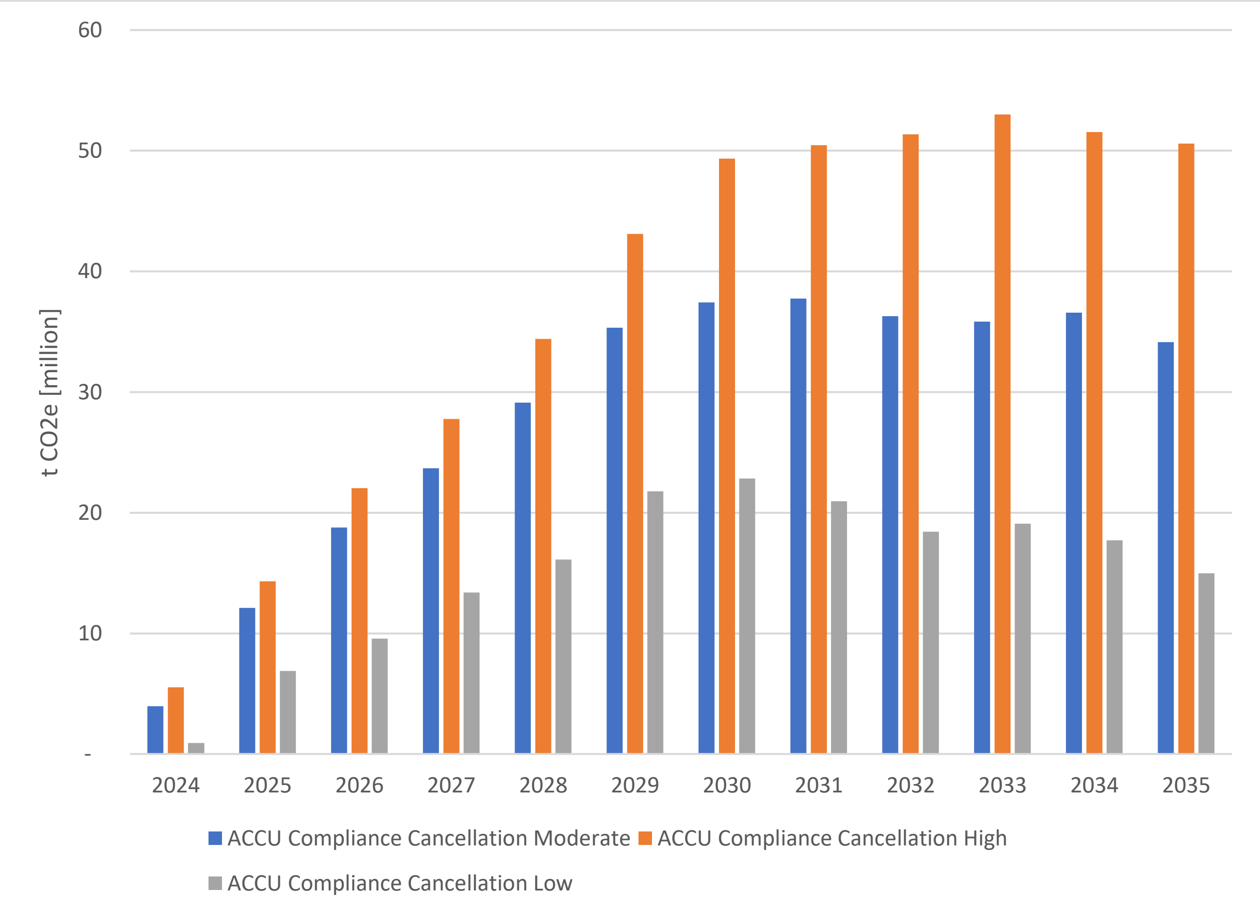
Source: RepuTex Energy, 2023.

3.3 Residual compliance demand

After accounting for direct emission reductions by high emitting facilities, our modelling indicates that total reported emissions covered by the Safeguard Mechanism could fall between 134 to 140 Mt in FY24, necessitating about five to seven million carbon units[8] for compliance demand need to be surrendered against the first year of the new regulatory framework.[9] Annual carbon unit compliance demand is likely to grow to approximately 35 to 63 Mtpa by 2035, with compliance demand plateauing earlier in the Low Emissions scenario because of industrial decisions to directly invest in new emissions reduction technologies.

Although any SMCs already held by a facility are assumed to be surrendered first before procuring additional carbon units, there may be no distinction in offsetting residual compliance demand with ACCUs or SMCs, as both units represent an equivalent tonne of abated CO2e. ACCUs are modelled to make up most compliance surrenders because of their higher availability, as shown in the difference between Figures 6 and 7.

Figure 7: Annual compliance cancellation for ACCUs to meet baselines 2024 to 2035.



Source: RepuTex Energy, 2023.

The fossil fuel industries are expected to have the hardest GHG emissions to abate while also representing the biggest source of emissions. As such, most coal mining, LNG, and oil extraction facilities are projected to surrender ACCUs for more than 30 per cent of

[8] Of this initial amount, SMCs are estimated to make up approximately one to four million, which would be around 20 to 81% of carbon units. This implies ACCU are envisaged to be make up roughly one to six million, or 62 to 92% of surrenders. Note that because compliance liability grows year-on-year, however, we expect ACCU buying for compliance purposes in 2024 to be about four to nine million.

[9] Note that the surrender of the carbon units against the first year of liability [FY24] doesn't occur until nine months later in March 2025.

their facility baselines within the next several years (and will therefore be required to report to the Regulator). As baselines continue to decline, more facilities will begin to trigger this reporting threshold in the first half of the 2030s, with only a small number of industries, such as Aluminium and Chemicals, able to avoid triggering the 30 per cent threshold given their assumed deep decarbonisation activities over the next decade.

Table 3: Safeguard Mechanism market balance (Moderate Emissions scenario) FY24-35.

	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35
Covered emissions BAU	**141**	**145**	**147**	**149**	**149**	**152**	**153**	**153**	**153**	**154**	**153**	**153**
Less direct reductions (Moderate Emissions scenario)	*4*	*6*	*8*	*10*	*11*	*15*	*21*	*25*	*31*	*38*	*41*	*48*
Less residual emissions to baselines)	*4*	*12*	*19*	*24*	*29*	*35*	*37*	*38*	*36*	*36*	*37*	*34*
Aggregate baselines (net emissions)	**134**	**127**	**121**	**116**	**108**	**101**	**94**	**90**	**86**	**80**	**75**	**71**

Source: RepuTex Energy, 2023.

Even though most facilities are calculated to rely on offsets to drive more marginal abatement each year, a significant number of direct emissions reductions will also be happening in parallel. For example, as shown in the table above, by the end of our analysis period more annual abatement is attributed to direct emissions reductions than offsets in our Moderate Emissions scenario. The significant portion of residual offset demand continues to provide the price signal for further innovation in emissions savings, while importantly maintaining Australia's net emissions on a downward trajectory. This is by design in a baseline and credit system and would suggest the policy is effectively reducing emissions.[10]

3.4 Other sources of demand for ACCUs

Accounting for demand from all sources - including corporate voluntary buyers; investors, traders, and other intermediaries; and the Commonwealth - we estimate that total annual buying demand for ACCUs has potential to grow to between 27 and 48 million by 2030, reaching 23 to 66 million by 2035, as illustrated in Figure 8. A further breakdown of this demand illustrated Figures 9 through 11.

Voluntary corporate demand (including state regulation)

In addition to Commonwealth compliance demand from high emitting companies (facilities >100,000tpa Safeguard Mechanism threshold), 'voluntary' corporate demand is assumed to capture businesses under the Climate Active Carbon Neutral Standard, along with state regulation (such as EPA conditions and make-good requirements), and state-government activities.

There is also increasing interest in the Agricultura sector where emissions reduction can be a win-win for land managers. There are several financial opportunities for the sector that also provide environmental benefits while improving productivity and increasing

[10] Although, difficult to forecast, a strong carbon price signal should increase the chances that breakthroughs and innovations driving a greater proportion of emissions reductions than we can reasonably model from today's perspective. Historically, emissions have consistently been lower than original modelled by carbon pricing.

resilience to a changing climate. ACCUs are well placed to allow farms to show that their farm operations, or their food products, are carbon neutral.

Under Climate Active, companies can surrender a wide range of units to meet their voluntary commitments, including domestic ACCUs, and international units such as Certified Emissions Reductions (CERs) issued under the Clean Development Mechanism, Verified Emission Reductions (VERs) under the Gold Standard framework, and Verified Carbon Units (VCUs) developed under the Verra program.

At present, 90% of all Australian voluntary cancellations within the Australian National Registry of Emissions Units (ANREU) occur in the form of low-cost international Certified Emissions Reductions (CERs). Voluntary cancellations of ACCUs within ANREU, encompassing the above demand sources, grew to 1,477,527 in CY 2022, up from 949,275 in 2021. We currently forecast total cancellation demand from the voluntary segment will reach 2.4 million in CY 2023, growing to approximately 8 million by 2035.

Demand from investors, traders, and intermediaries

Over the past 12-months ACCU speculative long-positions have more than doubled to just over 17 million at the beginning of 2023, with between 25 and 30 per cent held by non-project proponents. The positive macro environment, and expected growth in compliance demand for offsets, has therefore begun to impact the local market, with the number of active institutions growing to their highest-ever level, including almost all the large Australian banks, which have begun to build liquidity and product offerings.

Continued demand growth from this segment is likely, with the Australian market becoming more attractive to long-term investors. As this occurs, we estimate investor participation to grow from around 8 per cent of holdings in 2022 to one-third by 2030. This is assumed to be supported by the launch of a carbon exchange in 2023-24, facilitating liquidity, and market access.

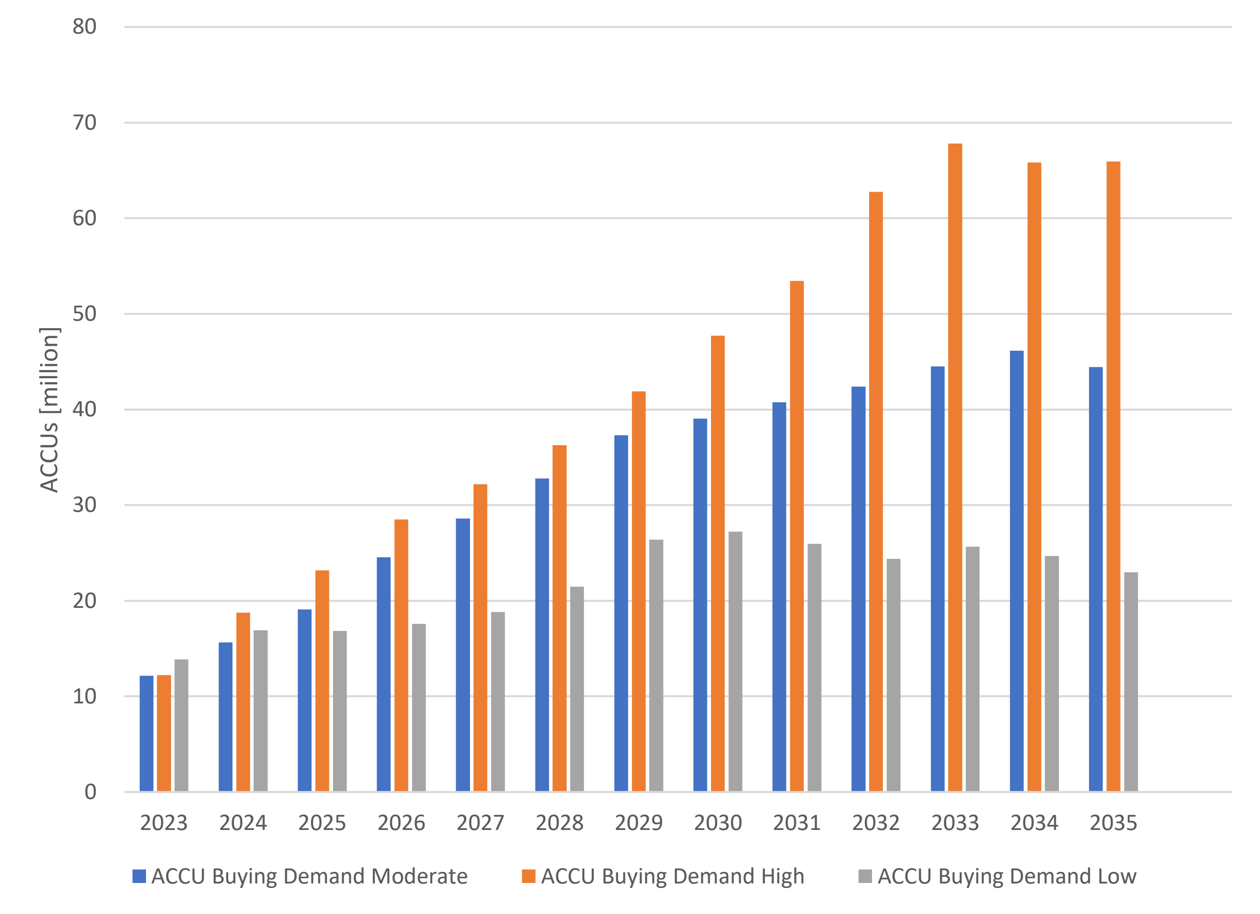
Demand from the Commonwealth

Following changes to the ACCU scheme that allow for contracts to exit their fixed deliveries, we expect less than one million ACCUs to continue to be delivered to the Commonwealth in 2023, out of around 13 million still scheduled for delivery. The Regulator held the 15th ERF auction on 29 and 30 March 2023, contracting 7.9 Mt ACCUs for optional delivery over the next 10 years at an average price of $17.12 from 24 projects.

Commonwealth contracting is assumed to be supported by the Powering the Regions Fund. Over the budgeted years to 2026-2027 we assume approximately $384 million is budgeted of the $1.9 billion fund, deducting announced measures.

From January 2023, ACCUs delivered under contract are assumed to be set-aside by the Government under the proposed ‘cost containment measure’, to balance ACCU shortages at Safeguard facilities (if required). Refer to Section 4 for further discussion.

Figure 8: Projected buying demand for ACCUs by scenario in calendar year.



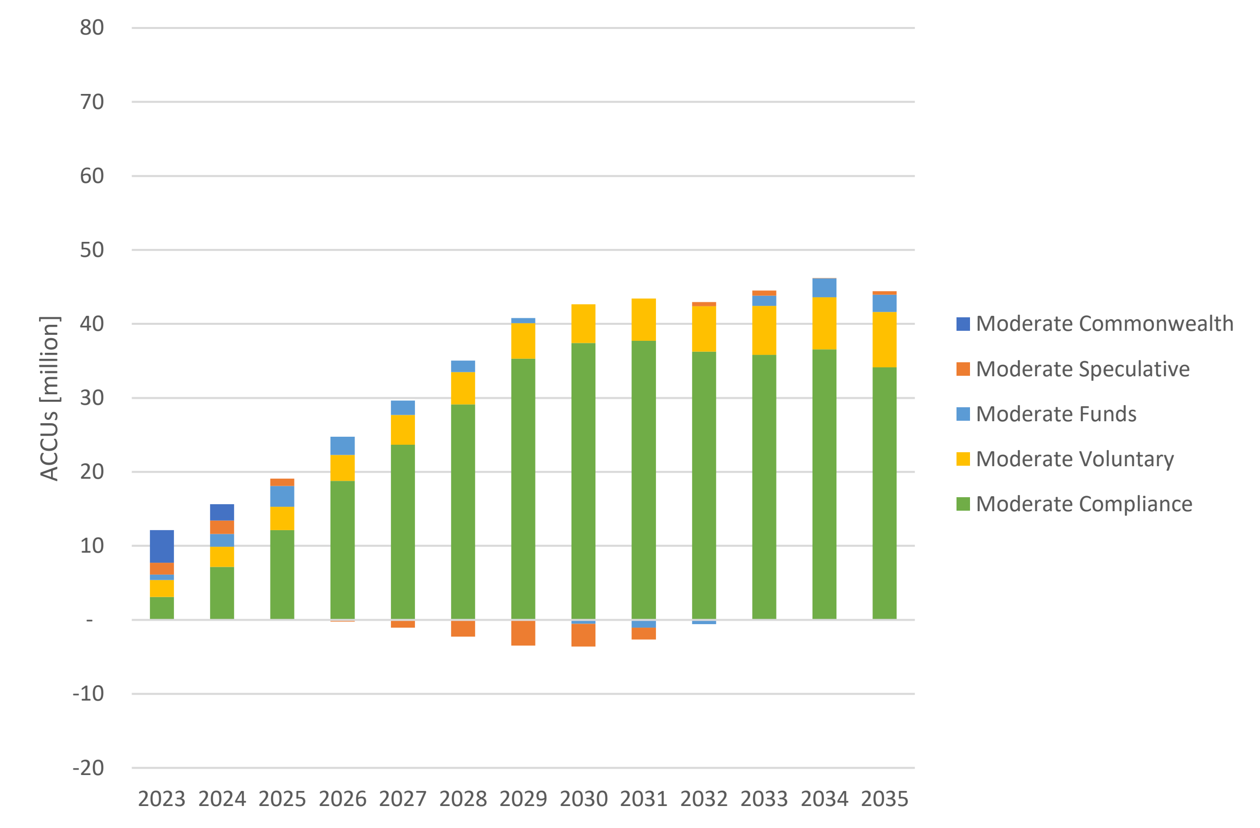
Source: RepuTex Energy, 2023.

Table 4: Forecast total buying demand for ACCUs by scenario in calendar year (Millions).

	Low Emissions Scenario	Moderate Emissions scenario	High Emissions Scenario
2023	14	12	12
2024	17	16	19
2025	17	19	23
2026	18	25	28
2027	19	29	32
2028	21	33	36
2029	26	37	42
2030	27	39	48
2031	26	41	53
2032	24	42	63
2033	25.7	45	68
2034	25	46	66
2035	23	44	66
Total 23-30	**159**	**209**	**241**
Total 23-35	**283**	**427**	**556**
Average	22	33	43

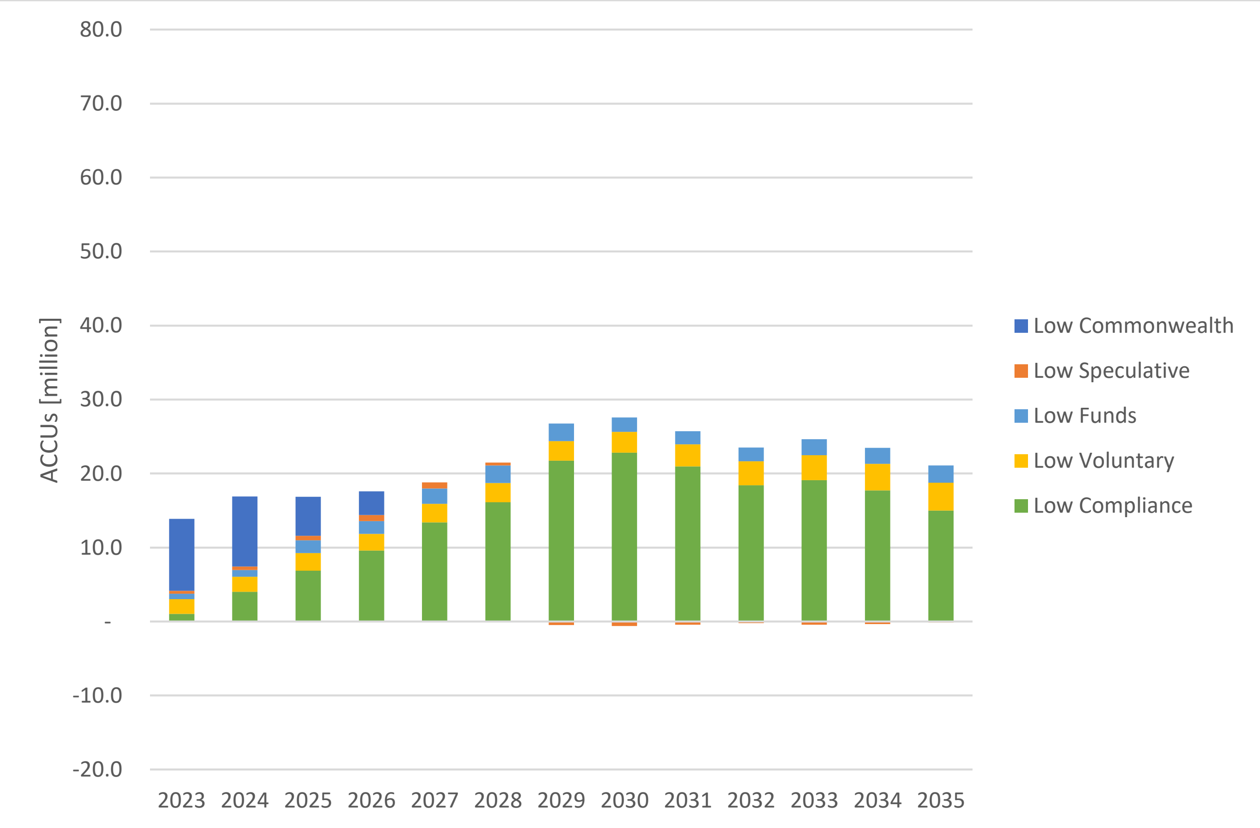
Source: RepuTex Energy, 2023.

Figure 9: Forecast demand for ACCUs - Moderate Emissions scenario (progressive industry transition)



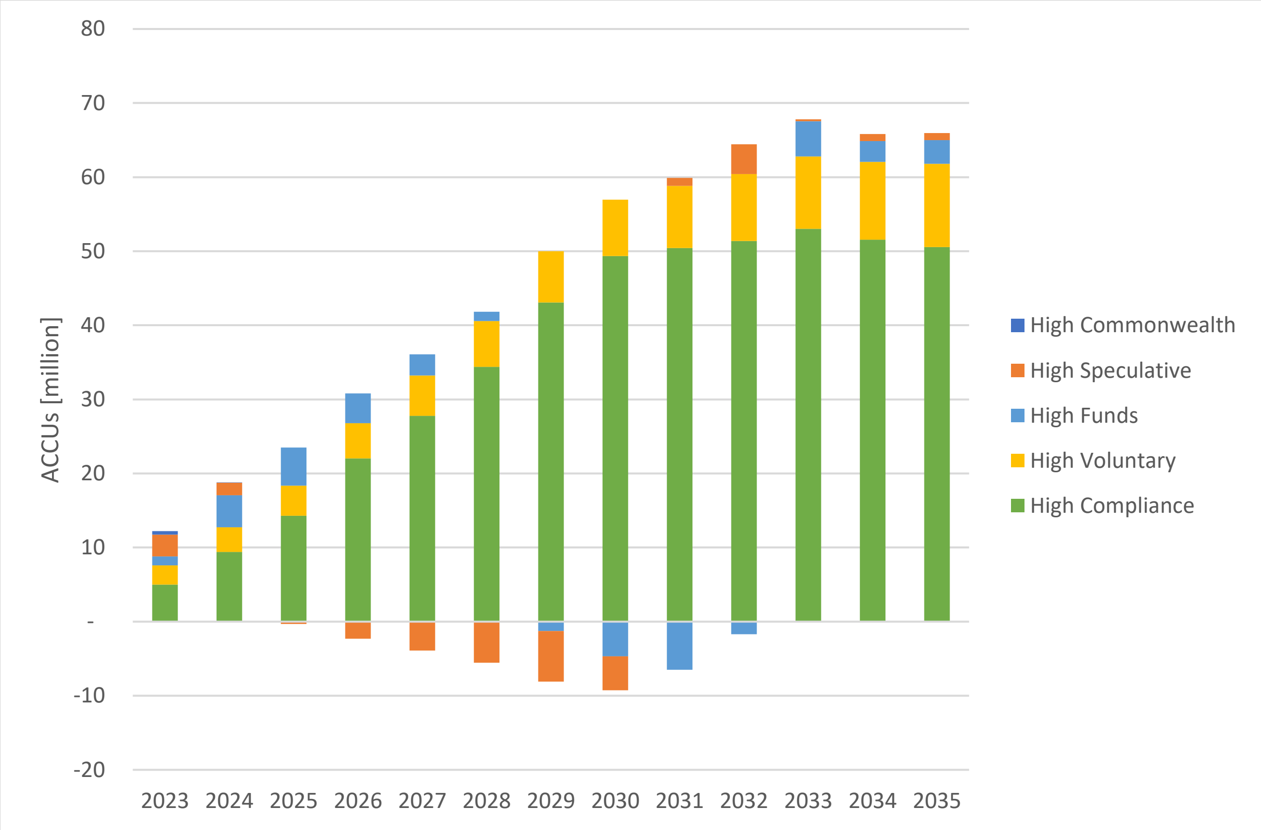
Source: RepuTex Energy, 2023.

Figure 10: Projected demand for ACCUs - Low Emissions scenario (accelerated industry transition)



Source: RepuTex Energy, 2023.

Figure 11: Projected demand for ACCUs - High Emissions scenario (slow industry transition)



Source: RepuTex Energy, 2023.

3.5 Forecast supply of ACCUs

Within our modelled scenarios, ACCU issuance is forecast to be derived from the existing supply pipeline (currently registered projects), and future supply to new projects (existing methods and method development priorities[11]), with new projects developed in response to market signals for future prices and contracting demand.

As shown in Figure 10, we forecast annual ACCU issuance to outpace annual buying demand in all scenarios over the next two to three years. This initial surplus of supply is underpinned by continuing issuance to existing projects, most of which are anchored to carbon abatement contracts (CACs) with the Commonwealth (refer to Section 2.5.2). This pool of 'firm supply' from existing projects will therefore provide near-term liquidity for the Australian carbon market, supplemented by issuances to new projects over time.

In the near term, surplus issuance means that ACCU holdings[12] could accumulate to be multiple times the size of annual cancellation demand, with buying demand shown to begin to exceed annual issuance from around 2027, subject to the timing and scale of new corporate compliance demand entering the market.

[11] Integrated farm and land management and savanna fire management. Refer to Section 2.5.2 "supply from new projects"

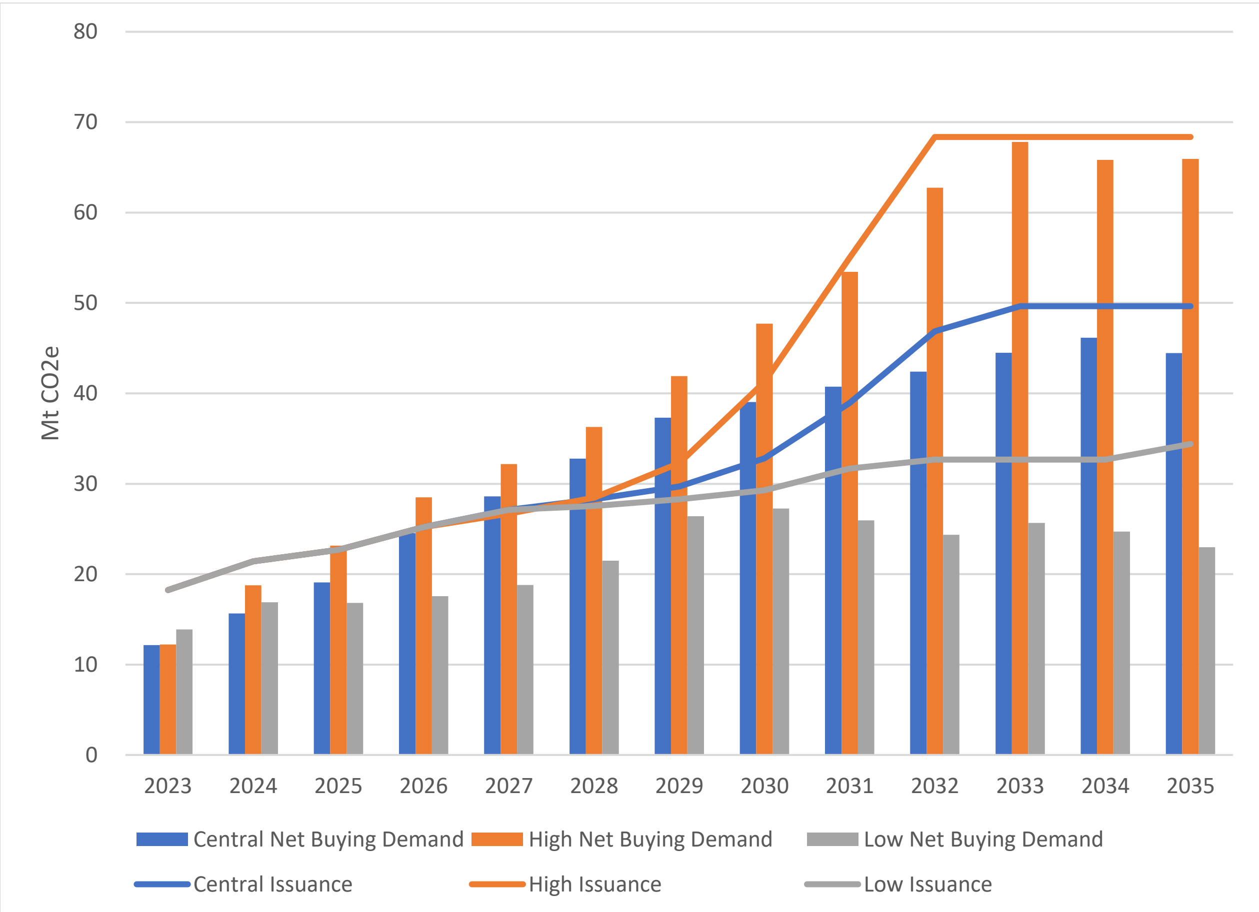
[12] ACCU holdings at the end of Q1 2023 totaled 23.8 million, whereas by the end of Q2 2023 this is anticipated to have grown to about 26 million.

Table 5: Forecast total issuance for ACCUs by scenario in calendar year (Millions).

	Low Emissions Scenario	Moderate Emissions scenario	High Emissions Scenario
2023	18	18	18
2024	21	21	21
2025	23	23	23
2026	25	25	25
2027	27	27	27
2028	28	28	28
2029	28	30	32
2030	29	33	41
2031	32	39	55
2032	33	47	68
2033	33	50	68
2034	33	50	68
2035	34	50	68
Total 23-30	**200**	**205**	**216**
Total 23-35	**364**	**440**	**545**
Average	28	34	42

Source: RepuTex Energy, 2023.

Figure 12: ACCU annual buying demand vs. ACCUs annual issuance 2023-35.



Source: RepuTex, Clean Energy Regulator, 2023.

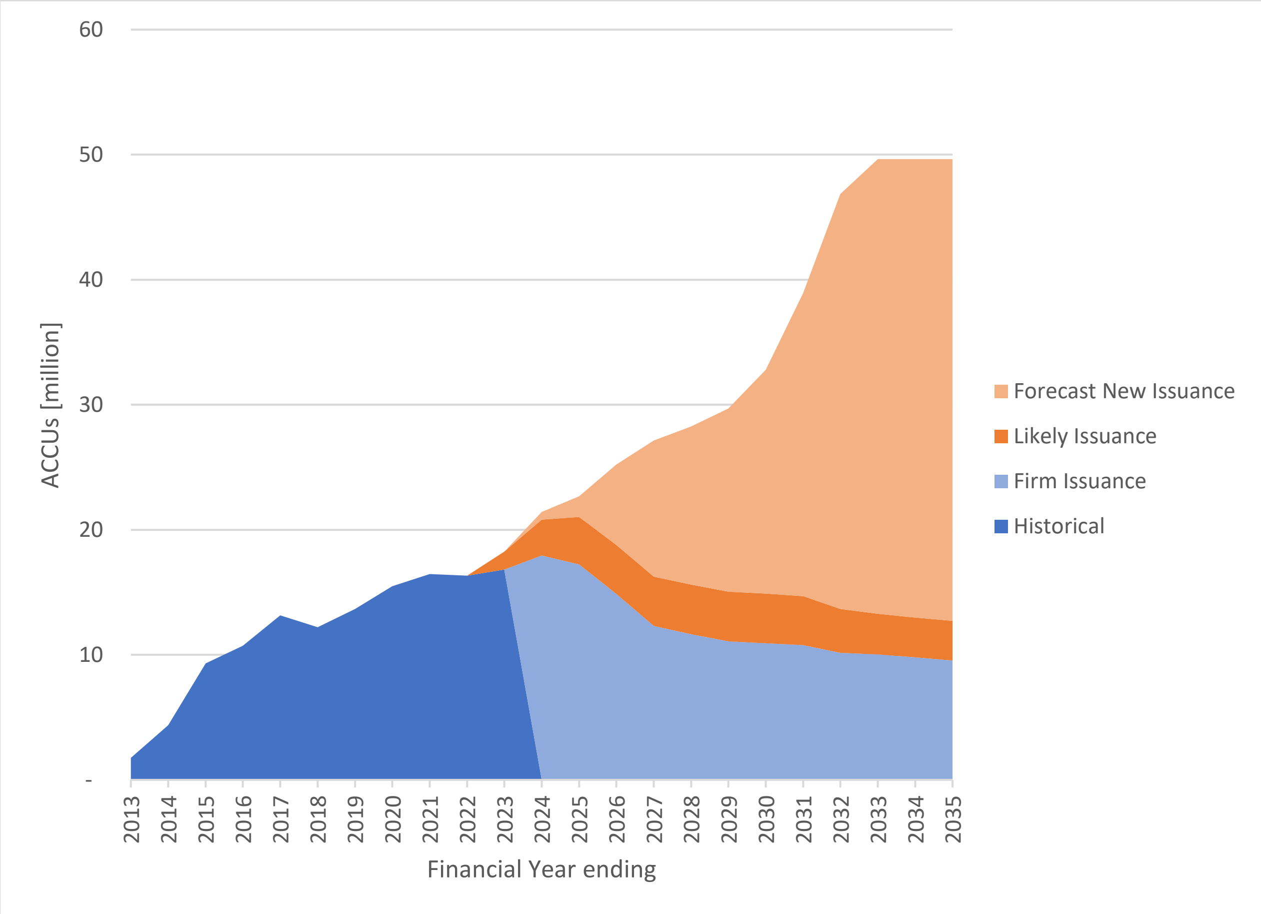
3.5.1 Supply from registered projects

In forecasting future carbon credit supply, we first consider ACCU issuance from projects that are "registered and active" under the ACCU Scheme. We refer this as "firm" issuance, excluding projects that are registered more than two years ago but have not yet been issued credits (e.g., most soil carbon projects).

As shown in Figure 11, available firm supply from existing and active projects (alone) is expected to outpace demand over the next two to three years, growing to 17 million in 2023. This firm issuance is forecast to decline as the crediting period of older projects comes to an end. This could see minimum annual issuance drop below 15 Mtpa, but still be maintained at approximately 10 Mtpa for the foreseeable future.

This pool of supply will be supplemented by first time issuances to projects registered in the last two years, including many soil carbon projects. This "likely" issuance (to projects registered in the last two years but not yet issued credits) is forecast to grow to 3-4 million in the next couple years.

Figure 13: Forecast ACCU issuance to active registered projects (firm issuance) versus new projects.

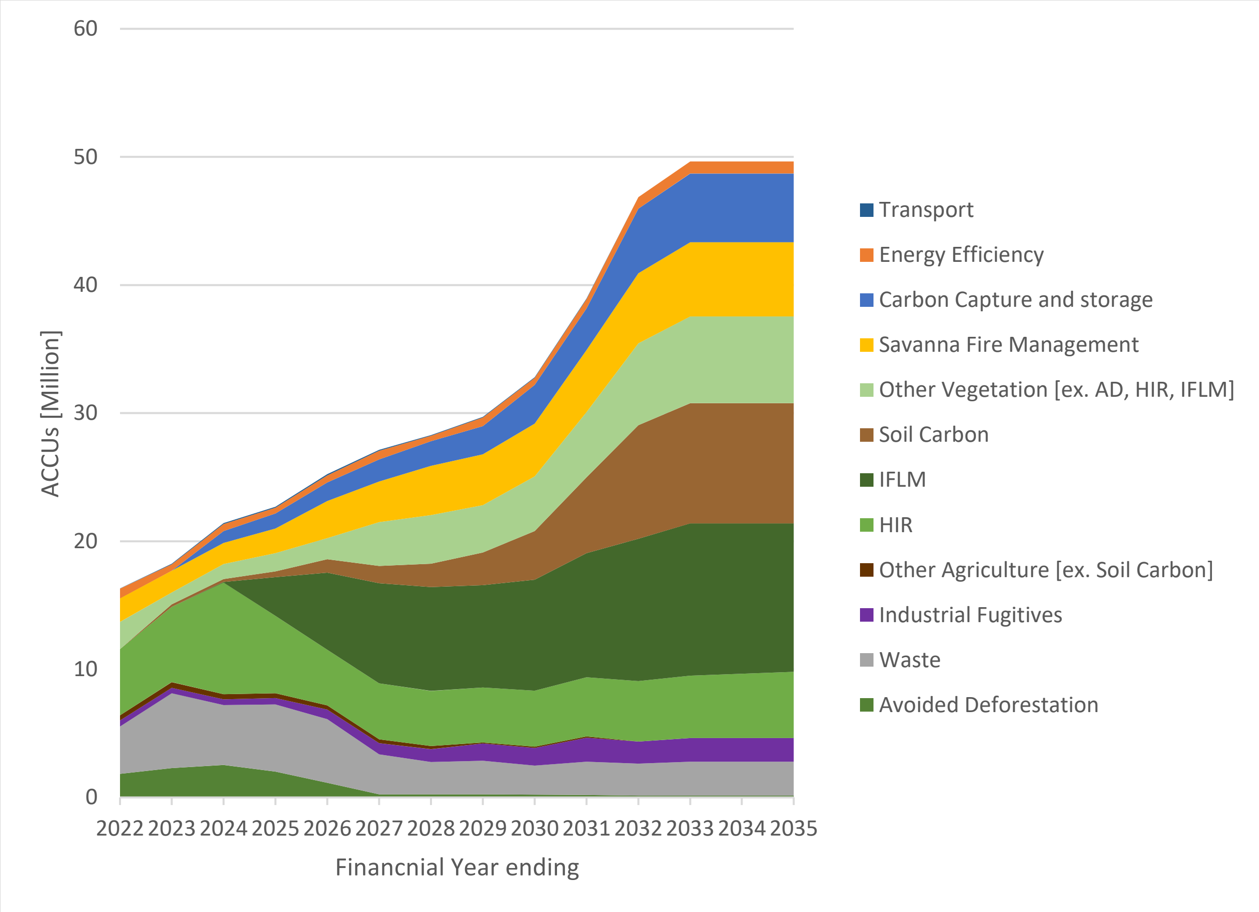


Source: RepuTex Energy, 2023

3.5.2 Supply from new projects

New supply is assumed to be developed in response to increased contracting demand and anticipation of higher prices in the future. For the purposes of this project, modelling assumes that new supply is derived only from newly registered projects under existing methodologies, and priority methods (i.e., Savanna fire management and integrated farm and land management). These sources have potential to contribute large-scale supply, varying in response to contracting demand and market signals.

Figure 14: Moderate Emissions case forecast of annual ACCU issuance by methodology type.



Source: RepuTex Energy, 2023

As shown in the figures above, we expect increasingly strong demand for ACCUs from around 2025 to drive investment in the planning and registration of new abatement projects, with accelerated growth after several years forecast to eventually come largely from soil carbon. As a result, ACCU issuance is likely to grow to nearly 50 million per year by 2035. Initial growth over the next few of years may come from a mix of forestry, savanna fire management, integrated farm and land management, whereas the historically popular HIR and waste methods are modelled to wane over the next several years. Carbon capture and storage is predicted to be associated with the capture of reservoir carbon dioxide during gas processing and geologic storage.[13]

Beyond the two priority ones, new methods were not modelled because of uncertainty in the abatement activities, uptake and ACCU issuance, as well as an assumption about the protracted timeline for issuance to new methods. Specifically, the Emissions Reduction Assurance Committee is not projected to be re-established as the Carbon Abatement Integrity Committee (the CAIC) before 1H 2024, while the first Expression of Interest round should not occur before 2H 2024. New methods would then not be made until 2H 2026, with another one to two years anticipated to lapse before a material number of registrations and another one to two years assumed to pass before material issuance to new methods. Although this would still allow for ACCUs from new method beyond 2030, this was excluded from our modelling.

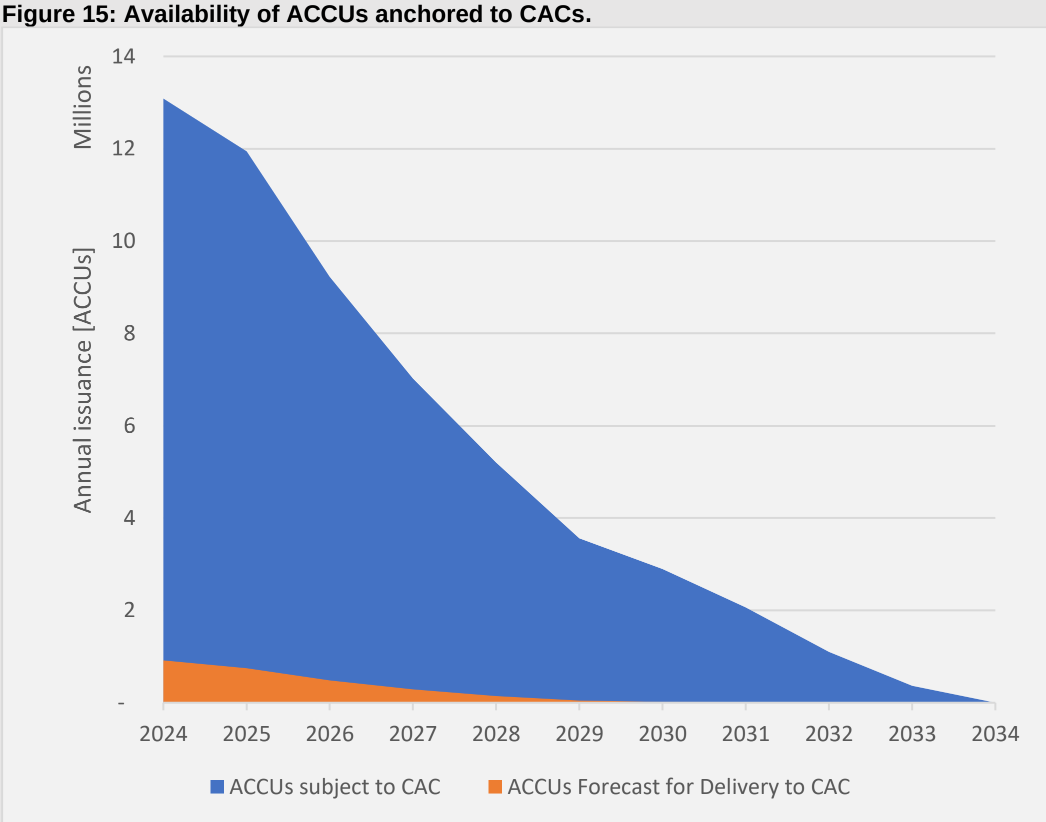
[13] Note that new ACCU Scheme projects registered to the CCS methodology cannot occur at a Safeguard facility.

Assumed availability of ACCUs anchored to CACs

Under the ACCU scheme, proponents with "fixed delivery" CACs were previously required to deliver their ACCUs to the Commonwealth. This future issuance was effectively 'locked away' from the broader market. Following regulatory changes in March 2022, proponents with fixed delivery CACs are now able to pay an exit fee to be released from their delivery obligations to the Commonwealth. We model this pool of firm issuance to be "available" to the market based on the following assumptions:

Fixed delivery CACs	Issuance is made available where the prevailing price is higher than the breakeven price for damages (~$24-29/t) plus an assumed margin. Approximately 10% of fixed delivery CACs are assumed to continue to deliver ACCUs under contract.
Optional delivery CACs	Future issuance to optional CACs is made available to the secondary market where the prevailing price is higher than the contract price at relevant Commonwealth auctions (~ $16-17/t).

Figure 15: Availability of ACCUs anchored to CACs.

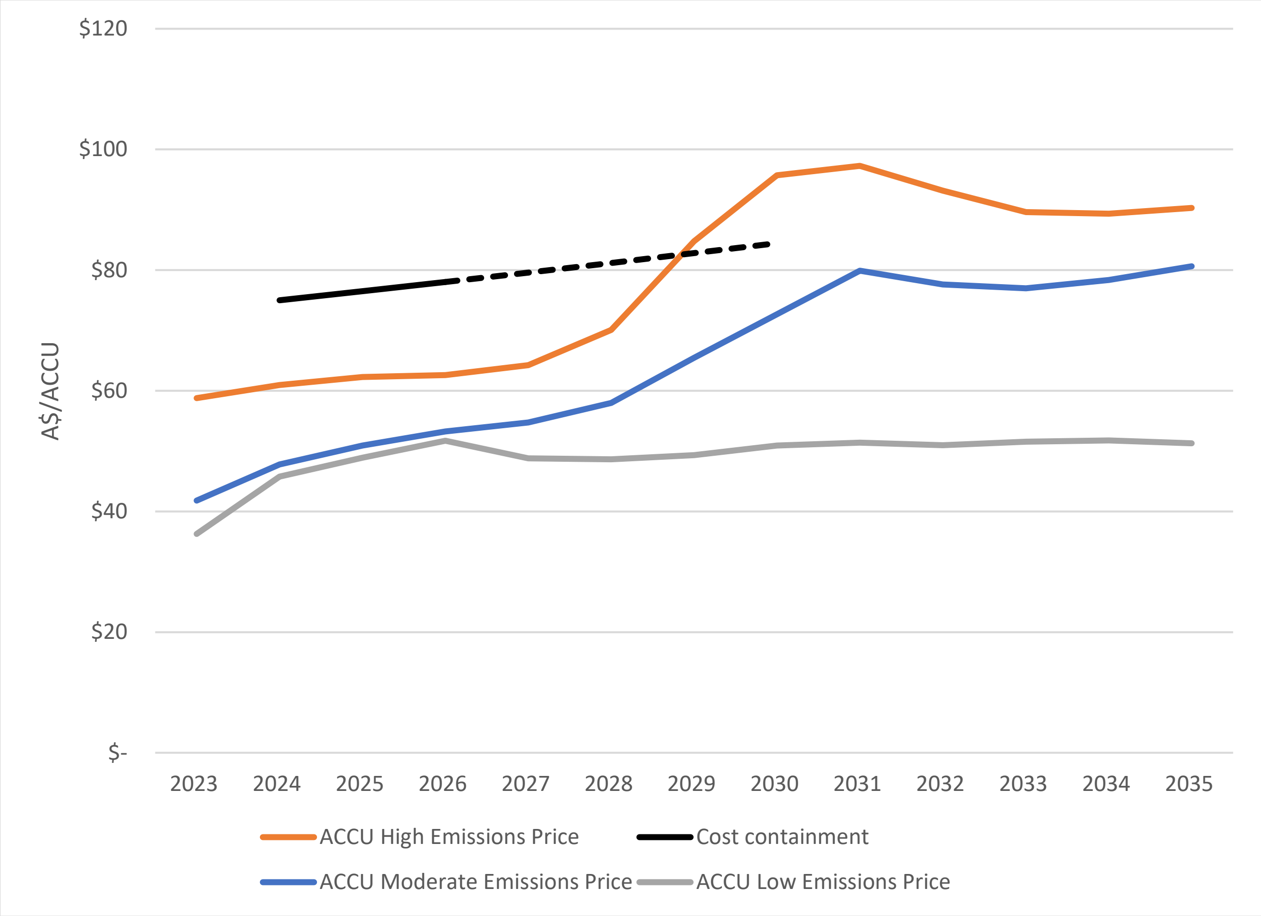


The continued operation of the scheme exit window (or similar[14]) is expected to see around 90 per cent ACCUs anchored to CACs exit their contractual fixed deliveries.

[14] The government continues to refer to the fixed delivery exit arrangement as a "pilot" scheme. While this is intended to imply flexibility to amend the policy, the repeal of the fixed delivery exit arrangement may simply see the market revert to breaking contracts and paying buyers' market damages to make supply available (subject to reputational risks and other limitations on breaking contracts, such as financing arrangements.) The government will review Commonwealth purchasing arrangements in 2H 2023. This could include consideration of a 'minimum delivery' rule for fixed CACs (e.g.10-20% of contracted supply) to support the cost containment measure. Discussion is hypothetical only.

3.6 Forecast ACCU prices by scenario

Figure 16: RepuTex ACCU price forecast – Nature Based 2035.



Note: The cost containment measure allows facilities that have exceeded their baseline to be able to purchase ACCUs form the Government at a fixed price of $75 in 2023-24, increasing with the consumer price index plus 2% each year. A 2026-27 review will consider whether the cost containment measure is sufficient.

Source: RepuTex Energy, 2023.

Table 6: RepuTex ACCU contract price forecast – Generic and Nature Based (NB).

	Moderate Emissions scenario (Generic)	Moderate Emissions scenario (Nature)	High Emissions Case (Generic)	High Emissions Case (Nature)	Low Emissions Case (Generic)	Low Emissions Case (Nature)
2023	$ 41	$ 42	$ 59	$ 59	$ 34	$ 36
2024	$ 48	$ 48	$ 61	$ 61	$ 43	$ 46
2025	$ 51	$ 51	$ 62	$ 62	$ 48	$ 49
2026	$ 53	$ 53	$ 63	$ 63	$ 52	$ 52
2027	$ 55	$ 55	$ 64	$ 64	$ 49	$ 49
2028	$ 58	$ 58	$ 70	$ 70	$ 49	$ 49
2029	$ 65	$ 65	$ 85	$ 85	$ 49	$ 49
2030	$ 73	$ 73	$ 96	$ 96	$ 51	$ 51
2031	$ 80	$ 80	$ 97	$ 97	$ 51	$ 51
2032	$ 78	$ 78	$ 93	$ 93	$ 51	$ 51
2033	$ 77	$ 77	$ 90	$ 90	$ 52	$ 52
2034	$ 78	$ 78	$ 89	$ 89	$ 52	$ 52
2035	$ 81	$ 81	$ 90	$ 90	$ 51	$ 51
Average	**$64**	**$64**	**$78**	**$78**	**$49**	**$49**

Source: RepuTex Energy, 2023.

Increased compliance demand will drive uplift, however surplus issuance will initially constrain prices

The transition from a voluntary- to compliance-led market under the new Safeguard Mechanism framework is modelled to create a supportive environment for Australian carbon prices, underpinned by strong private sector demand for carbon credits.

While we expect positive sentiment and improved policy certainty to drive uplift in prices, short- and medium-term upside is likely to be tempered by the large pipeline of “firm” ACCU supply available to the market, relative to modest initial demand from the corporate sector. In the near term, surplus issuance could see ACCU holdings accumulate to be multiple times the size of annual cancellation demand, constraining growth in prices. This dynamic has become apparent in recent months, with prices for all ACCU products falling since mid April in response to increasing supply (following the resumption of HIR issuances in June) and slow initial buying demand from Safeguard Mechanism compliance entities.

While the market is well priced for new entrants, the first compliance deadline will not fall until end-March 2025 (for FY24 liabilities). As a result, there is not any significant time pressure for compliance entities to enter the market, with most only now beginning to formulate their go-to-market strategies for longer term procurement. This could see prices remain low until the market gains momentum in the latter half of the year, subject to periodic surges in buying demand – currently led by investors and intermediaries.

Timing and scale of industry compliance demand critical to our modelled price pathways

The timing and scale of large compliance buyers entering the market to source ACCUs is the key driver of our modelled price pathways, with the pace of on-site emissions reduction investments directly informing the speed by which the current oversupply is soaked up, and the tightening of the supply-demand balance.

Initial reliance on ACCU offsets is reflected in all our forecast price scenarios, with price trajectories shown to grow, in a narrow range at first, depending on early demand for ACCUs in a market that has built up significant long positions. After several years, however, emissions accountability begins to catch up, while holdings are anticipated to shrink. Our price forecasts then begin to widen depending – critically – on when direct emissions reduction investments begin to scale up over the second half of the decade.

Under our Moderate Emissions scenario, our average ACCU price forecast to 2035 is $65, growing from $41 in 2023[15] to $82/t in 2035[16]. Under this pathway industry is modelled to progressively invest in incremental improvements, such as process and small equipment upgrades, and some transformative projects - including catalytic reduction of nitric oxide, reducing fugitive emissions from gas extraction, and renewable energy and vehicle fuel switching at mining facilities - as carbon prices move from the high $40s toward $70 per tonne of CO_2. Annual buying demand is forecast to continue increasing, and should begin to exceed annual issuance around 2027, triggering a sustained increase in prices through the latter part of the decade.

Comparably, under our High Emissions (slow transition) scenario, covered facilities are modelled to implement emission reduction activities more slowly, with participants instead shown to rely on more external offsets. This brings forward the tightening of the supply-demand balance, with annual buying demand beginning to exceed annual issuance by around 2025-26, driving prices to an average of $79 to 2035, growing from $59 in 2032 to $98 in 2035.

The inverse of this scenario is considered in our Low Emissions case (accelerated industry transition), with the faster uptake of emission reduction measures by industry resulting in the slower increase in compliance demand, particularly after the middle of the decade. This is modelled to see ACCU prices held back by the relatively large, and increasing, availability of firm supply from existing projects, with prices averaging $55 to 2035, growing from $36 in 2023 to $46/t in 2035.

Growing convergence in ACCU prices by method

As compliance buyers become the largest source of demand in the market, we expect increasing convergence between ACCU prices by method, with the spread between Generic and HIR ACCUs (referred to here as nature based)[17] modelled to narrow and remain tight. This reflects the compliance-led nature of the Australian carbon market, with buyers favouring least-cost methods as they come to market.

This is expected to be supported by the development of standardised ACCU compliance products on exchange platforms (such as the eventual Australian Carbon Exchange), with liquidity for these products likely to be initially derived from low-cost avoidance (Generic) methods, before transitioning to nature-based projects as prices rise (incentivising HIR developers to offload larger volumes, more quickly, on exchange traded platforms).

While prices are shown to converge, in practice, we expect a premium for nature based ACCUs to remain, with demand for "higher quality" nature based ACCUs likely to see some nature-based projects marketed and sold as premium units. Examples typically include environmental planting and savanna fire management projects, which some buyers are willing to compensate at up to double the nature based ACCUs. In addition, many compliance buyers will seek to meet all or part of their compliance liabilities with more premium units to mitigate reputation risks, amplified by the recent Chubb Review, and requirements for compliance entities to report the type of offsets surrendered.

While the local market will be compliance-led, we therefore expect local companies to adopt a more "complian-tory" approach (or hybrid compliance-voluntary), with buyers increasing scrutinising the quality and integrity of their purchases, replicating the 'flight to

[15] Delivery in Feb 2024 delivery
[16] Delivery in March 2036
[17] Note that almost all nature based ACCUs currently available are specifically from HIR projects and are typically specifically traded as such. While we continue to see nature based ACCUs as the most liquid and marginal ACCU type going forward, the dominance of the older HIR specific ACCUs is modelled to wane and new methods gain popularity.

quality' seen in the international voluntary market. This should see price stratification remain a key feature of the Australian carbon market, with prices benchmarked against more liquid and highly traded Generic/standardised ACCU contracts.

SMCs may trade with low-cost avoidance ACCUs

Given the fungibility of SMCs and ACCUs for compliance purposes, and the limited availability of SMCs, we currently expect SMCs to trade in line with ACCUs. This is subject to variability in the availability of SMCs, with potential for periodic surges in SMC releases to affect ACCU-SMC price dynamics.

While SMCs represent on-site abatement by industry – which is highly valued by community stakeholders – we do not initially expect a premium to develop for these units, with SMCs more likely trade in line with industrial avoidance ACCUs already transacted (such as landfill gas and coal mine waste gas) currently priced within the 'Generic' (low-cost avoidance) basket.

Over time, this dynamic may shift as new on-site emissions reduction technologies are deployed, such as industrial 'carbon' capture to avoid fugitive and process emissions, similar to atmospheric removal technologies that are highly valued by external stakeholders. Despite this, the low liquidity and limited use of SMCs outside of the Safeguard Mechanism may reduce their attractiveness to external buyers, outside of intermediaries (e.g., liquidity providers) and some investors.

As noted, we therefore expect the larger and more established ACCU market to support carbon credit liquidity in the first several years under the new Safeguard Mechanism framework, and to continue to fulfill the main carbon credit role thereafter, with these units playing a larger role in setting market prices.

Impact of cost containment measure

While we expect prices to rise, we do not model the government's cost containment measure to be triggered under our Moderate Emissions scenario pathway, with potential for our High Emissions scenario (slow industry transition) to interact with the cost containment policy should no changes be made as part of the government's announced review in 2026-27.

Any future price interaction with the ceiling is therefore subject to the outcomes of the review in 2026-27, with strong potential for policy changes to be implemented should the cost containment mechanism be at risk of being triggered, avoiding the cost containment measure from negatively impacting new investment in low emissions technologies, and stifling innovation. By 2026-27, we view this pressure (innovation and investment being stifled) as more pressing than current government sensitivity to high prices and costs-of-living pressures.

4. BUFFER SCENARIO ANALYSIS

To analyse the potential effects of a potential buffer on the ACCU market, analysis below presents scenarios for the mandatory cancellation of a percentage of ACCUs via the implementation of a scheme-level buffer. Analysis applies a discount on issuance (applied at the time of issuance, e.g., the ACCUs are never issued), directly reducing the availability of supply from existing and future abatement projects. As specified by the Authority, the three buffer value scenarios are:

- High buffer scenario – 20% additional discount at the time of ACCU issuance relative to the abatement achieved.
- Medium buffer scenario – 10% additional discount at the time of ACCU issuance relative to the abatement achieved.
- Low buffer scenario – 5% additional discount at the time of ACCU issuance relative to the abatement achieved.

Each buffer scenario is applied to our Moderate Emissions scenario reference, with the effects of reduced issuance on ACCU market balance, and prices, then evaluated. Note that the Moderate Emissions scenario also incorporates buffers that already exist, such as the five per cent risk-of-reversal buffer on sequestration projects and a 20 per cent discount for projects that elect a 25-year permanence period (covering around 70 per cent of projects). Therefore, applying an additional five per cent scheme-level buffer, as in our Low buffer scenario may be equivalent to a 30 per cent buffer for some projects. Similarly, in our High buffer scenario, the additional 20 per cent scheme-level buffer may effectively discount ACCU issuance to some projects by 45 per cent.

4.1 Impact of buffer scenarios on ACCU supply

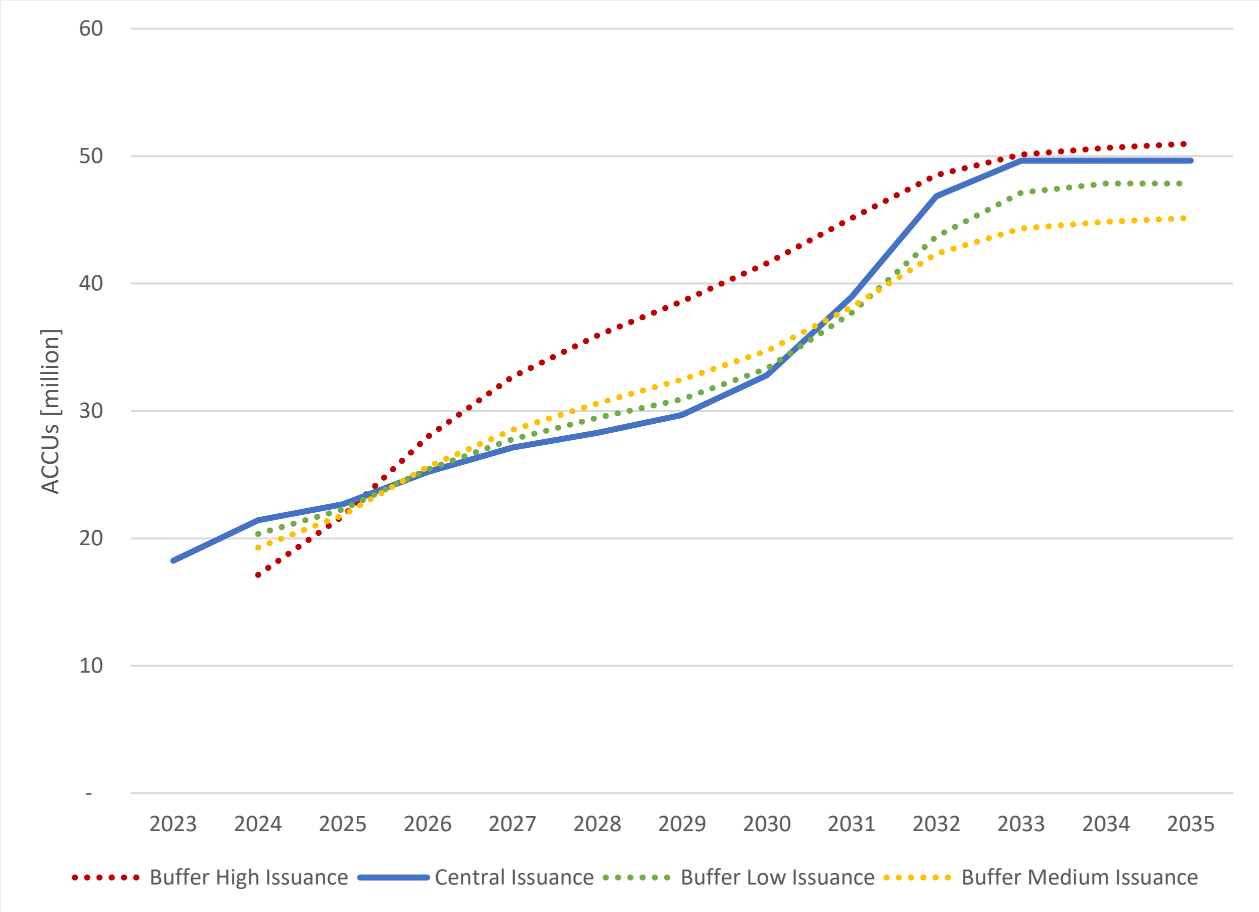
In our presented Moderate Emissions scenario, ACCU issuance is expected to increase from around 18 million in 2023 to 21 million in 2024. If a scheme-level buffer is applied to all current projects, beginning in 2024, we forecast it would reduce ACCU issuance in the first year by between 5-20 per cent, with issuance falling to 17 to 20 Mt in 2024. Despite this, an announced blanket cut to ACCU issuance would be likely to immediately stimulate more ACCU projects, however, because of the typical multi-year lag between project registration and issuance, much of this increased issuance is not likely to occur until 2025 and 2026. After that point, however, ACCU issuance may be higher than it otherwise would have been under the Reference Case.

In the Medium and Low buffer scenarios, ACCU issuance is still modelled to increase in line with the Moderate Emissions scenario, exceeding 30 million by 2029, 40 million by 2032, and reaching about 45 million by 2035. Although the High buffer scenario ultimately reaches a similar level in 2035, interim ACCU issuance is likely to lead the other scenarios by one to two years given earlier price signals (below).

Notably, the High buffer scenario is predicted to trigger slightly different behaviour in 2024. This is because doubling the buffer from 10 to 20 per cent is projected to make the supply-demand balance in 2024 significantly tighter, raising ACCU prices, but also increasing demand from long-positions in the market. As with the lower buffer scenarios, additional ACCU project development should be stimulated, but because the new integrated farm and land management method is not assumed to be available in the first half of 2024, these new projects would come from other existing methods outside of the large aggregators. This suggests that the 20 per cent buffer may have a significantly larger proportional impact than a 10 per cent buffer, and the timing of approving new methods for projects registration may become even more critical.

Although we anticipate the earliest possible approval of the integrated farm and land management method to be November 2023, for this analysis we assume that the method is not available until six months later, in the second quarter of 2024. If the method's approval is further delayed, the tight market could be further exacerbated.[18]

Figure 17: RepuTex ACCU issuance forecast for buffer scenarios.



Source: RepuTex Energy, 2023.

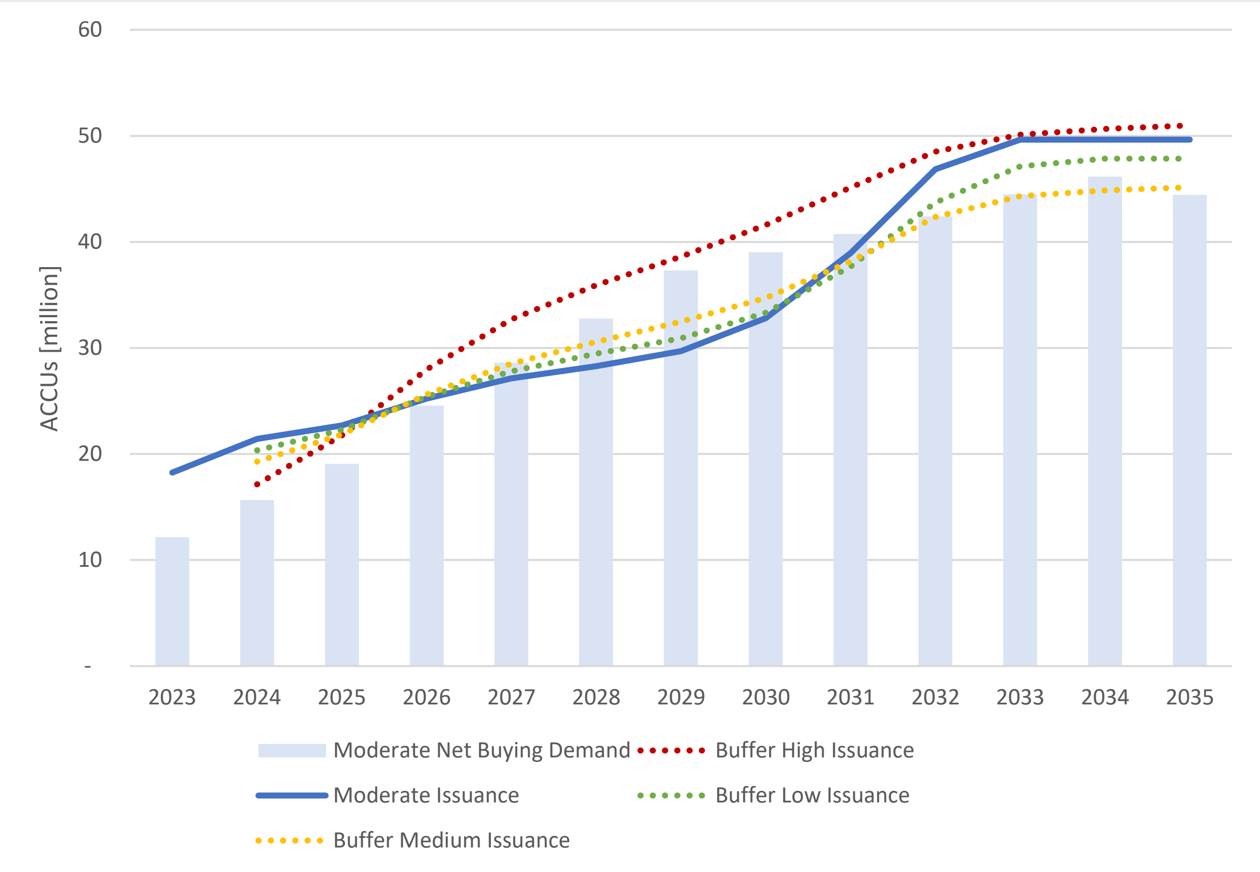
[18] This may be mitigated by allowing new projects to pre-register, or otherwise disclose their interest, before the integrated farm and land management method is officially approved; especially given significant interest is estimated to have built-up after years of method development.

Table 7: Forecast annual ACCU issuance – Moderate Emissions scenario vs buffer scenarios (CY, millions).

	Moderate Emissions scenario	Low scenario	Medium scenario	High Scenario
2023	18			
2024	21	20	19	17
2025	23	22	22	22
2026	25	25	26	28
2027	27	28	29	33
2028	28	29	31	36
2029	30	31	32	39
2030	33	33	35	42
2031	39	38	38	45
2032	47	44	42	49
2033	50	47	44	50
2034	50	48	45	51
2035	50	48	45	51
Total 23-30	**205**	**190**	**193**	**216**
Total 23-35	**440**	**414**	**408**	**461**
Average	34	34	34	38

Source: RepuTex Energy, 2023.

Figure 18: RepuTex ACCU issuance forecast by buffer scenario (relative to Moderate Emissions scenario).



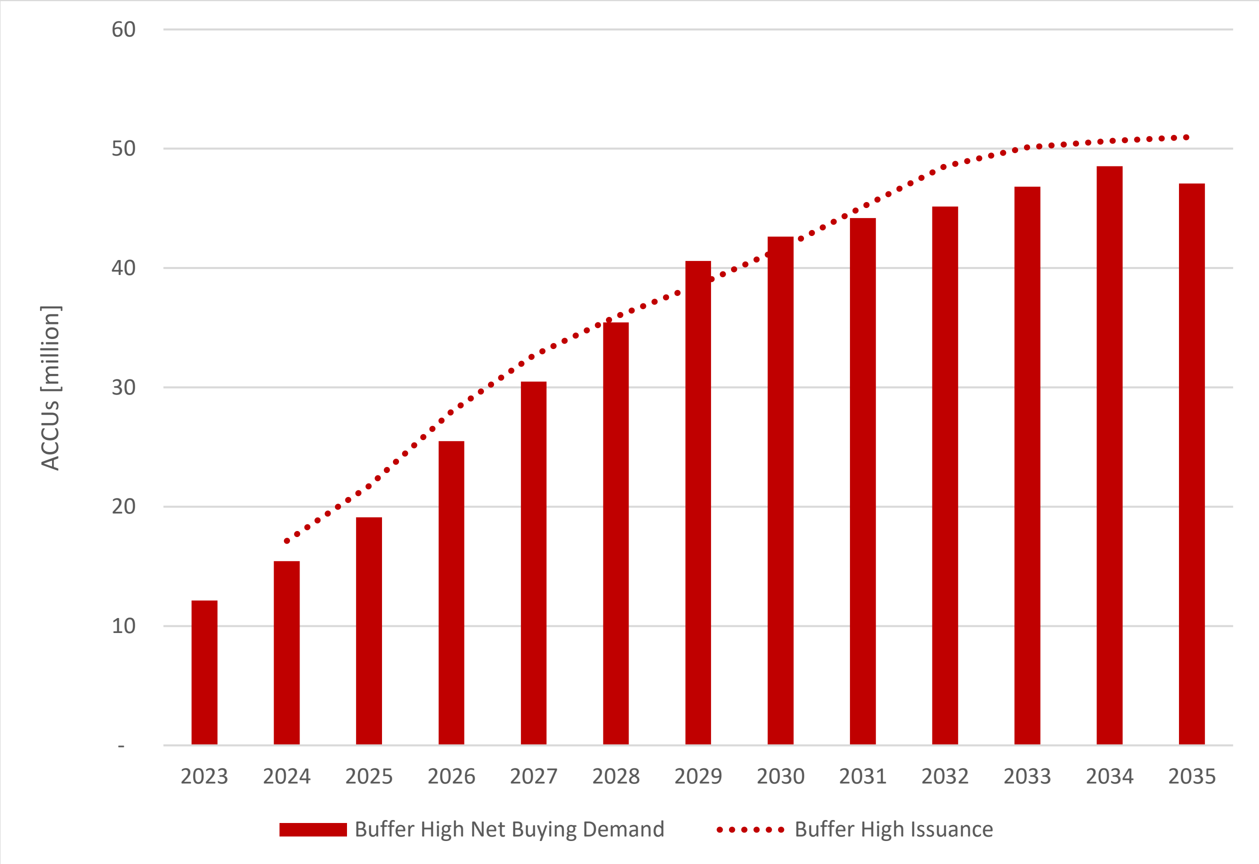
Source: RepuTex Energy, 2023.

Notably, by constraining ACCU issuance, the supply-demand balance is shown to immediately tighten (see figure above), providing a strong market signal to increase

ACCU supply. For example, compliance buyers looking to hedge their growing safeguard liability are increasingly expected to enter long-term ACCU offtake contracts in 2024. By this point, however, ACCU project proponents are assumed to know their future ACCU issuance will be reduced by a scheme level buffer.

This dynamic may lead to increased short-term scarcity given inelastic compliance buyers[19] will have access to less ACCUs to contract over forward horizons. Therefore, in the first couple of years, less supply is estimated to be available to meet annual demand.

Figure 19: RepuTex ACCU issuance projected in the High buffer scenario vs High buffer scenario demand.



Source: RepuTex Energy, 2023.

Modelling assumes that the market does not anticipate the supply restriction before 2024. It therefore takes two to three years for new projects to be developed, resulting in increased ACCU issuance. As this occurs, the least constrained scenarios may ultimately have the lowest annual issuance, while the most constrained scenarios are shown to have the highest issuance, incentivised by higher prices (next section).

In the near-term we expect both ACCU supply and demand to increase, however, because the ACCU market has a lag in supply, the relative rate of the increase becomes important for calculating market balance. As noted, underlying compliance demand is inelastic in the buffer scenarios during the first few years. This continues to drive total buying demand to between 44 and 47 million ACCUs per annum by 2035. ACCU supply

[19] Compliance buying, which makes up the largest portion of all ACCU demand, is based on a facility's estimate of their future liability, usually before any major new emissions reduction projects. Although compliance buying will eventually react to higher ACCU prices, it takes time – modelled as years – to adjust and reconsider direct investment in emission reduction projects in the face of higher offset costs. Thus, the largest source of ACCU contracting demand is effectively inelastic in the short-term. A smaller amount of demand from speculative buyers is much more elastic, but can also add to buying demand in the near-term if the market is fundamentally short of ACCUs.

generally converges to a similar level, although with a tendency to somewhat overshoot as compliance buying levels off.

Thus, in aggregate, the Safeguard Mechanism creates a long-term carbon credit demand signal that starts small but grows steadily into the future. ACCU suppliers – e.g., carbon farmers – are aware of this future growth in demand, however, ACCU generating projects typically involve long-term changes to land management practices and upfront administrative and establishment costs. Therefore, carbon farmers require a high price signal to justify merchant risk and/or build enough certainty they will have a buyer for their ACCUs, typically in the form of an offtake contract.

The higher price dynamic in the more constrained supply scenarios (next section) is therefore shown to incentivise more supply to come to market by providing developers with the necessary certainty and incentive to change land management practices and overcome other financial barriers.

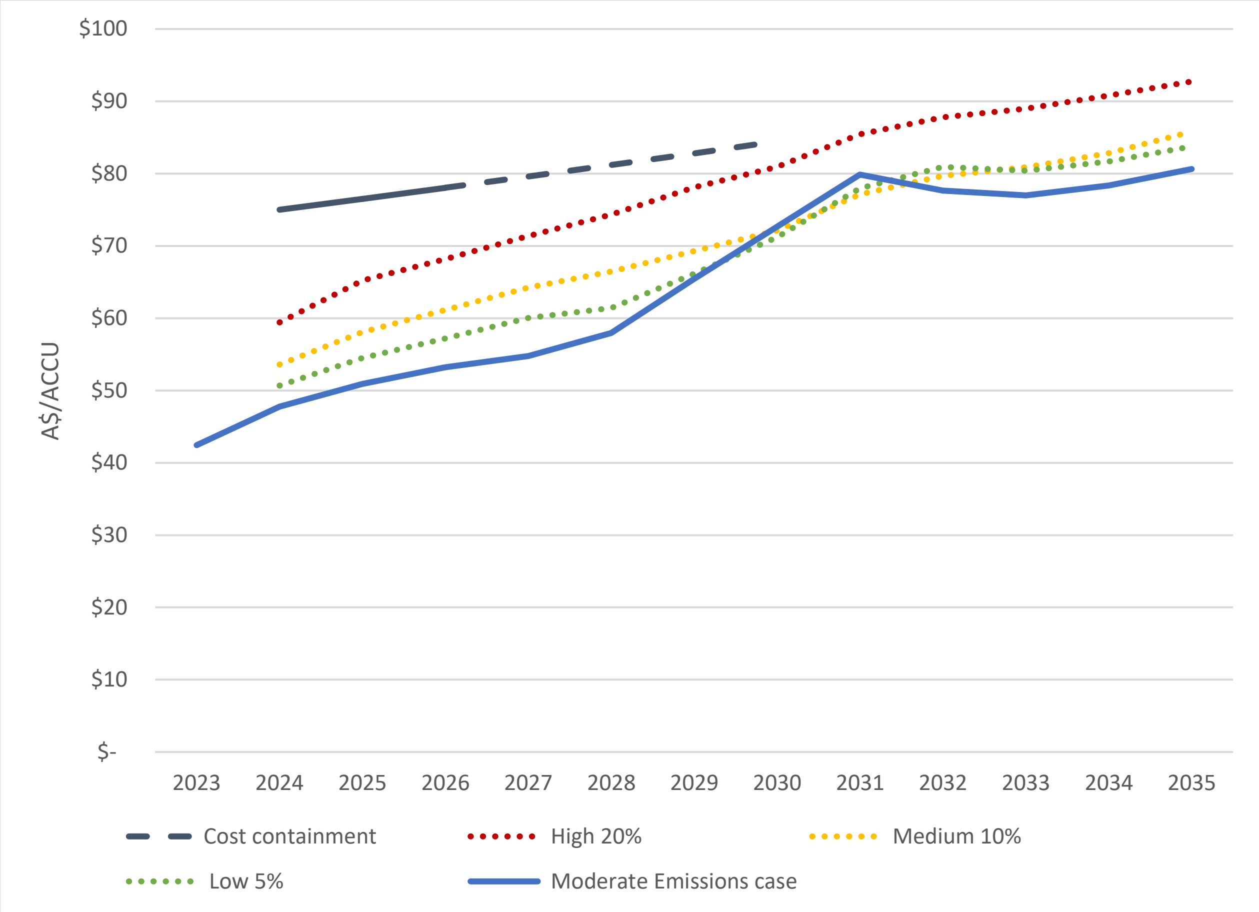
4.2 Impact of buffer scenarios on ACCU prices

As shown in the previous section, reduced ACCU issuance is anticipated to initially tighten market balance and lift prices in each scenario. First year price lifts are forecast to be just six percent in the Low and Medium buffer scenarios, rising to nearly double at 11 per cent in the High buffer scenario. Both ACCU issuance and buying demand could grow for several years, but because of imperfect price signals and supply lags, these are estimated to grow at different rates. Initial price lifts could therefore persist even as annual ACCU issuance continues to exceed annual buying demand. Over the next several years, however, annual buying demand is forecast to grow faster than, and eventually exceed, annual issuance.

From this point, the current net accumulation of ACCUs is expected to slow and reverse, necessitating the drawing down on ACCU holdings of various participants. While this an anticipated and welcome opportunity for those holding long positions, it is also a signal to continue to invest in new projects to generate additional ACCU supply because absolute ACCU demand is still growing. As a result, we forecast that the High buffer scenario, with the lowest initial issuance rate (attributed to the higher buffer) will be the first to see an accelerated lift in prices.[20]

[20] Note that by the time annual buying demand catches up with annual issuance (between 2027 and 2029 across our various scenarios), the relative issuance levels are likely to have reversed. For example, despite having no additional buffer to reduce ACCU issuance, the Moderate Emissions reference case has the lowest absolute annual issuance rate between 2027 and 2029. Similarly, the High buffer scenario now has the highest absolute issuance rate between 2027 and 2029, despite the most severe discount buffer at 20%.

Figure 20: RepuTex ACCU price forecast for buffer scenarios.



Note: The cost containment measure allows facilities that have exceeded their baseline to be able to purchase ACCUs form the Government at a fixed price of $75 in 2023-24, increasing with the consumer price index plus 2% each year. A 2026-27 review will consider whether the cost containment measure is sufficient.

Source: RepuTex Energy, 2023.

Although difficult to model, this effect is likely to carry though down to the project activity level, where the price of scarcer ACCUs is lifted higher (at least in absolute terms) because a uniform cut to their issuance would have a greater proportional impact on their availability. For example, savanna fire management ACCUs are valued more highly than most others, at least in part because of their relative scarcity.[21] A uniform issuance cut of 20 per cent would make these ACCUs even more scarce without the same ability to scale up the development of more projects to compensate for the reduced supply, as would be the case for some other methods.

[21] Not to overlook the more obvious value associated with their co-benefits.

Table 8: RepuTex ACCU price forecast for buffer scenarios.

	Moderate Emissions scenario	Low scenario	Medium scenario	High Scenario
2023	$ 42			
2024	$ 48	$ 51	$ 54	$ 59
2025	$ 51	$ 54	$ 58	$ 65
2026	$ 53	$ 57	$ 61	$ 68
2027	$ 55	$ 60	$ 64	$ 71
2028	$ 58	$ 61	$ 66	$ 74
2029	$ 65	$ 66	$ 69	$ 78
2030	$ 73	$ 71	$ 72	$ 81
2031	$ 80	$ 78	$ 77	$ 85
2032	$ 78	$ 81	$ 80	$ 88
2033	$ 77	$ 80	$ 81	$ 89
2034	$ 78	$ 82	$ 83	$ 91
2035	$ 81	$ 84	$ 86	$ 93
Average	$ 66	$ 69	$ 71	$ 79

Source: RepuTex Energy, 2023.

Because of the higher annual issuance rates, and greater accumulated ACCU holdings in the buffer scenarios, the accelerated issuance and price lift seen in the Moderate Emissions scenario – i.e., after 2028 - may be less pronounced in the Low buffer scenario, but still fundamentally reaches the same annual issuance and price level, at around 50 million and $80 per ACCU – more than double today's issuance and price. Because the Medium buffer scenario is modelled to start at a marginally higher issuance level, the market signal for new supply signal is minimised, resulting in a reduced acceleration of supply growth.

Although we predict this moderated signal and smoother supply growth will result in relatively lower annual issuance, the Medium scenario still falls within the same level of approximately 40 to 50 million ACCUs per year. Despite differing pathways, the Low and Medium buffer scenarios are therefore projected to achieve similar annual issuance levels and should also result in similar ACCU price levels. Such similar price outcomes – e.g., average price of between $65 and $80 - would not significantly impact on abatement strategies of business covered by the Safeguard Mechanism. In our experience, such strategies are much more dependent on the business' economic assumptions about discounting and how any carbon price will evolve, rather than relying of specific price forecasts that that may vary by $15 per tonne of CO2e.

The High buffer scenario is similar; however, the increased buffer triggers some notable differences. In 2024, the High buffer scenario should result in fist year ACCU prices of around $60/t – around double today's market rate ($30-35/t as of 3 August 2023). This reflects the tighter market setting, where annual ACCU issuance is decreasing, while buying demand is increasing. Although compliance demand effectively remains the same, a 'seller's market' is shown to push offers higher, rising quickly to a point where project proponents are willing to take on the merchant risk of establishing new projects without a contacted buyer.

4.3 Market implications

Historically ACCU supply has grown by about 2 million per annum, underpinned initially by the Carbon Pricing Mechanism, and more recently by government offtake contracts under the Emissions Reduction Fund. As a result, Australia's carbon offset market has grown to encompass hundreds of projects, however, the market is now moving away from a government buyer which had previously limited market complexity, long-term growth, liquidity, and prices.

The current transition from public to private purchasing has not been smooth, with Australia's carbon offset market becoming increasingly complex and opaque due to the high stratification of prices by method, and limited transparency around direct contracting (and limited transparency of project activity).

Historically, the biggest source of uncertainty in the ACCU market has been long-term demand growth for ACCUs. New reforms for the Safeguard Mechanism will now see long-term demand growth for ACCUs, however significant uncertainty remains about how much, and when this source of demand will grow. The key challenge for Australia's carbon market has therefore shifted toward bringing on enough ACCU supply to meet this expected demand over the next several years, and longer-term.

While Australia has enormous abatement potential from ACCU methodologies, firm ACCU supply from active projects could fall off a 'supply cliff' in around 2025 due to a confluence of factors that are affecting the most popular methods, including:

- Most HIR projects (c. 2015) are approaching more stringent 10-yr 'gateway checks', where issuance may be discounted if some areas are not regenerating as initially modelled, while no new HIR projects are assumed to be registered after Q3 2023 when the existing HIR method sunsets.
- Most Landfill Gas projects (c. 2013) are approaching the end of their 12-year crediting period and will also see their issuance reduced by new baseline adjustments made in line with the Chubb Review.
- All Avoided Deforestation method issuance will effectively end after 2025 as the crediting period the runs for 15 years from 2010 to 2025.
- ACCU issuance growth from new land sector methods[22] cannot occur until the new methods are finalised and approved. Although scheduled to be approved over the next 9 to 12 months, further delays will restrict new supply in 2024-25.
- New industrial methods involving clean fuels are no longer designated as priority methods and will likely be delayed (or abandoned) due to expected complexity of new proponent-led methodology processes.

To some extent, the forecast mismatch between sharply declining supply from current projects, and strong demand growth from private sector buyers is being masked by the large accumulation of ACCU holdings and the availability of supply under fixed-delivery contract exit arrangements.

Coupled with this, policy reform under the Safeguard Mechanism is new and will not create a liability on entities until first compliance in March 2025 (for FY24). As a result, ACCUs from existing projects currently outweigh demand, while spot prices have softened, with the market losing 25 per cent of its value over the last month.

Growing policy certainty and currently low prices are anticipated to ultimately support a slow build-up of compliance buying demand, and new project development. However, weak market sentiment and poor transparency can risk efficient market development. Although market sentiment is currently weak, this is still more than one and half years before liability from the first year of the reformed Safeguard Mechanism comes due. Unfortunately, this is already within the typical multi-year lag timeframe for ACCUs to be issued to new projects. Therefore, the risk is that buyers take too long to contract for carbon credits they need, leaving project proponents too little time to develop new projects. Although there is assumed to currently be enough ACCUs holdings to cover this relatively small mismatch, the risk will become harder to cover if buying demand ends up being higher than calculated by the project proponents two years ahead or the ratio of

[22] i.e., a new savanna fire management method incorporating sequestration and an Integrated Farm and Land Management (IFLM) method to replace older carbon farming methods, which are sunsetting.

buying demand to available holdings grows. Indeed, this was precisely what happened to the ACCU market in the second half of 2021.

Therefore, without multi-year contracting commitments from larger long-term buyers, or strong enough price signals to incentivise project proponents to take on the merchant risk, many already planned ACCU projects may be slow to register and bring their abatement to market. Again because of multi-year supply lags, if the currently weak market signals persist, there is a growing risk of not bringing on the new ACCU supply that will be needed in around 2025 or later.

In this context, imposing additional buffers on issuance may immediately tighten the ACCU market, increasing ACCU prices, and bringing forward ACCU supply growth beyond what may otherwise occur without the buffers. This may increase prices, which may restrict necessary project development.

Inversely, a High buffer may impose too great a restriction on supply - which the market may struggle to overcome - permanently tightening the market and exacerbating other restrictions on ACCU supply, ultimately resulting in a mismatch that causes market prices to rise well above the modelled reference case.

5. APPENDIX A: APPROACH AND MODELLING ASSUMPTIONS

For the purposes of this analysis, we utilise our Australian Energy and Emissions Market (A-EEM) model, consisting of three modules (demand, supply, and policy), which simulate how changes to overall demand and supply influence price development.

5.1 Industrial demand module and approach

In estimating demand for emissions reductions from Safeguard covered entities (module one), we undertake analysis of facility-level GHG emissions within the industrial sectors based on estimated production and emissions intensities.

In estimating GHG emissions for these industries, our A-EEM framework captures site-specific parameters for each safeguard liable facility, accounting for:

- facility age;
- lifespan of the facility;
- location (e.g. onshore or offshore);
- capacity and output;
- operational efficiency;
- resource intensity (e.g. reservoir CO2 content);
- emissions sources and activities;
- inputs (e.g. processed or unprocessed); and
- expansion plans.

A business-as-usual (BAU) emissions projection is developed for each facility's covered emissions based on site specific parameters, and estimated product demand and production factors (see below), establishing a reference case for emissions prior to the implementation of on-site emissions reduction actions.

5.1.1 Current scheme coverage

The Safeguard Mechanism commenced on 1 July 2016 and applies to facilities that emit more than 100,000 tonnes carbon dioxide equivalent (CO2-e) emissions in a financial year. This extends to businesses across a broad range of industrial sectors, including mining, oil and gas extraction, manufacturing, transport, and waste[23].

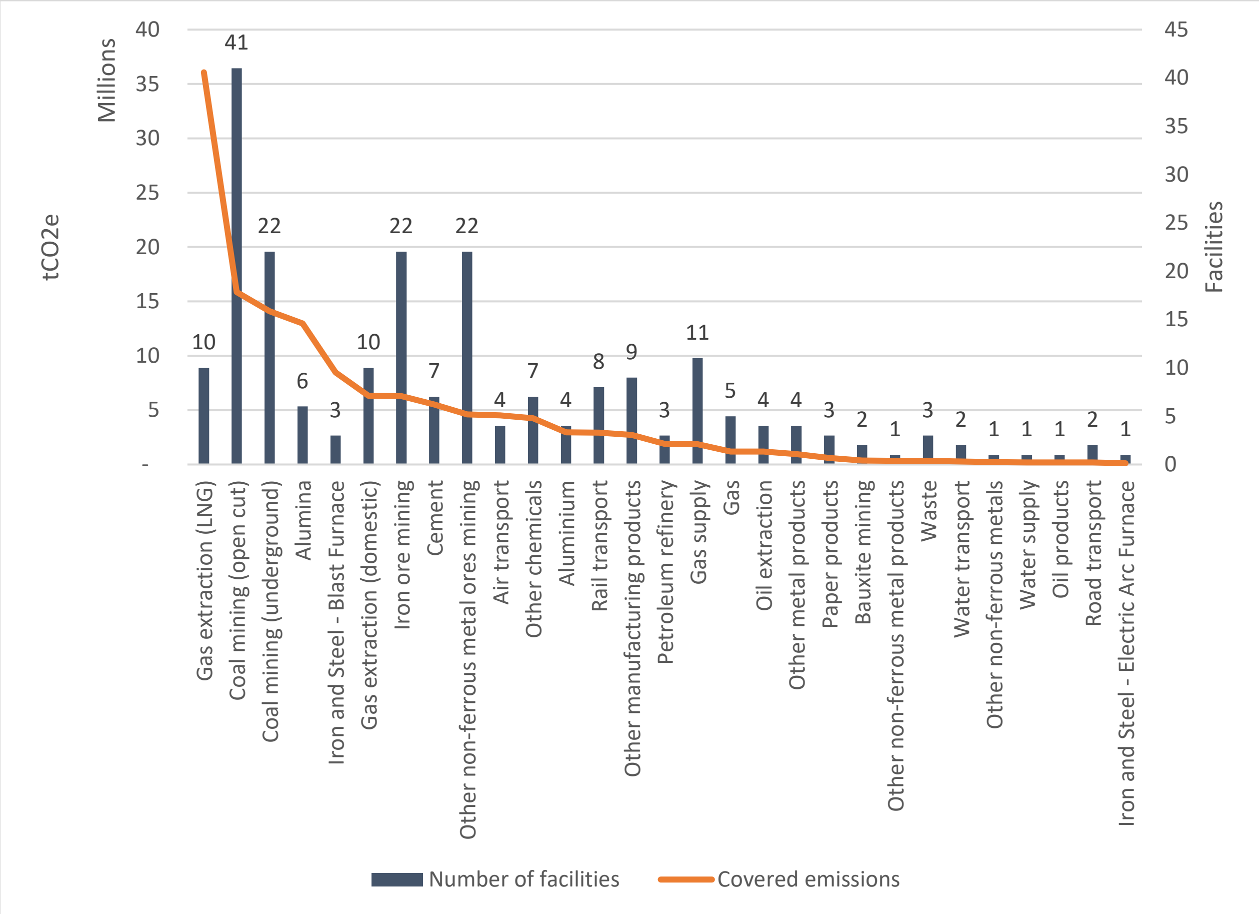
In 2021-22 the Safeguard Mechanism covered more than 215 facilities from the industrial sectors, accounting for 137.5 million tonnes, or more than one quarter (28%) of national emissions. Covered emissions are dominated by extractive industries, with approximately half of all emissions derived from the LNG manufacturing and Coal Mining sectors.

Specifically, more than one quarter (26%) of FY22 emissions are derived from 10 LNG facilities. These emissions relate to fugitive CO2 from gas reservoirs that is vented during extraction and gas combusted for power generation and gas compression processes. A further one-quarter of covered emissions are derived from 63 coal mines. These emissions primarily relate to fugitive emissions from the mine as well as fuel usage in the vehicles operating at the site.

Other highly emitting industries include alumina refining (9%), steel manufacturing (6%), iron ore mining (5%) and cement manufacturing (4%).

[23] While electricity generators are covered under the Safeguard Mechanism, the sector is subject to a separate sectoral baseline. The electricity sector is therefore assumed to be excluded from the operation of the scheme and is instead covered by other policy levers such as the Large-scale Renewable Energy Target.

Appendix Figure 1 (A1): Safeguard Mechanism coverage by number of facilities (right axis) and emissions (left axis).



Source: RepuTex Energy 2023.

5.1.2 New entrants and exits

For the purposes of this modelling, we assume that "financially committed new projects" (above the 100,000 tCO2-e threshold) as published by the Office of the Chief Economist (OCE) are developed, and new projects stated in Australia's Emissions Projections 2022.[24]

Modelling does not consider 'proposed' projects given these are in early planning and have not received regulatory approval or financial commitment. While the project pipeline may be viewed as conservative, analysis instead models the need for new projects to be developed based on higher coal and LNG export demand.

[24] https://www.dcceew.gov.au/sites/default/files/documents/australias-emissions-projections-2022.pdf

Figure A2: Assumed list of new entrants and year of entry to 2030.

Sector	Facility	Projected year of entry
LNG	• Barossa • Browse • Pluto 2/ Scarborough	• 2025 • 2029 • 2026
Domestic Gas	• Narrabri coal seam gas project • Beetaloo basin developments • Waitsia Stage 2	• 2024 • 2025 • 2025
Coal	• Wilkie Creek • Vickery • New Acland • Maxwell • Olive Downs Stage 1 • Hillalong • Wallarah 2	• 2024 • 2025 • 2024 • 2027 • 2024 • 2024 • 2028
Lithium	• Kwinana Lithium Plant (Covalent Lithium)	• 2025
Iron Ore	• Iron Bridge • Rio Tinto/Baowu Joint Venture	• 2024 • 2025

Facilities are modelled to be developed in-line with their announced opening dates. In addition, if needed to meet long-term production assumptions, generic capacity may be added as coming online in the Iron Ore Mining, Coal Mining, and LNG industries, however, for this analysis no generic facilities were needed before 2035.

Facilities are modelled to close in-line with their expiry of permits or announced closure dates, if available. If no closure dates have been publicly announced, facilities in the Iron Ore Mining and Coal Mining sectors are modelled as closing once their marketable reserves are exhausted. Demand reduction does not explicitly close facilities, rather they are modelled to reduce production to meet modelled demand for commodities.

Figure A3: Assumed list of closing facilities and year of exit

Sector	Facility	Projected year of exit
LNG	• Pluto LNG • FLNG • Queensland Curtis LNG Plant • Curtis Island GLNG Plant • APLNG Facility • Wheatstone Operations • Barossa • Darwin LNG	• 2042 • 2044 • 2045 • 2046 • 2046 • 2047 • 2050 • 2050
Coal	• Wambo Coal Mine • North Goonyella Coal Mine • Liddell Coal Mine • Integra Underground Mine • Newlands Coal Complex • Russell Vale Colliery • Moorvale Coal Mine • Dartbrook • Coppabella Coal Mine • Mr Arthur • Mangoola • Carborough Downs Coal Mine • Dendrobium Mine • Clermont Coal Operations • Ashton Coal Mine • Metropolitan Colliery • Moolarben Coal Mine • United Coal Mine • Oaky Creek • Sojitz Gregory Crinum Mine • Poitrel Mine • Grosvenor Mine • Mt Owen Glendell • Rolleston Coal Mine • Ensham Resources Minesite • Capcoal Mine • Bengalla Operations • Mandalong Mine • Hail Creek • Tahmoor Coal Mine • Warkworth Mine • Boggabri Coal Mine • Ravensworth Operations • South Walker Creek • Dawson Mine • Middlemount Coal Mine • Wilpinjong Coal Mine • Daunia Mine • Curragh Mine • New Acland • Jellinbah Mine • Yarrabee Coal Mine • Lake Vermont Mine • Bulga Coal Complex • Collinsville Mine • Mount Pleasant • Batchfire Resources No.1 • Foxleigh Mine	• 2022 • 2022 • 2024 • 2024 • 2024 • 2027 • 2028 • 2028 • 2028 • 2030 • 2030 • 2030 • 2030 • 2031 • 2031 • 2033 • 2034 • 2034 • 2034 • 2034 • 2035 • 2036 • 2037 • 2037 • 2038 • 2038 • 2039 • 2040 • 2040 • 2040 • 2041 • 2041 • 2041 • 2041 • 2042 • 2043 • 2043 • 2043 • 2044 • 2045 • 2045 • 2045 • 2046 • 2046 • 2047 • 2048 • 2048 • 2050

Iron Ore	• Yandi/Marillana Creek • Marandoo Mine • Brockman 4 Mine • Koolyanobbing • Brockman 2/ Nammuldi • Tom Price/ WTS • Hope Downs 4 • Savage River • Newman Operations • Hope Downs 1 Mine • Cloudbreak Mine • Yandicoogina Mine • Mesa A Mine • West Angelas Mine • Paraburdoo Mine	• 2027 • 2030 • 2030 • 2031 • 2032 • 2033 • 2033 • 2035 • 2037 • 2037 • 2039 • 2039 • 2040 • 2045 • 2050

5.1.3 Production and commodity export demand

Given around half of all Safeguard Mechanism emissions are derived from LNG and coal mining facilities, modelling of facility-level emissions is highly reactive to changes in global export market conditions, which drives demand for Australian coal and LNG.

In considering these factors, we apply export values in-line with the OCE's latest Energy and Resources Quarterly and IEA's Announced Pledge Scenario (APS) for longer-term production. These production rates are slightly lower than those published by the Commonwealth in Australia's Emissions Projections 2022.

OCE assumes that Australian coal and LNG production is shaped by projected export demand, based on key regional export partners meeting their announced international commitments to reduce emissions by 2030. For example, forecasts account for longer-term pressure and declines in thermal coal export demand attributed to net-zero emissions targets and tighter emissions policies in Australia's key export markets (China by 2060, the EU by 2050, Japan by 2050, Taiwan by 2050, and South Korea by 2050), along with projected declines in domestic brown coal generation.

Similarly, LNG demand in Japan, South Korea and Taiwan is predicted by OCE to slow as countries pursue net-zero targets, and swing to renewable energy generation. Positive transition impacts are also considered, such as the impact of global electric vehicle policy on demand for lithium production, and opportunities for green steel.

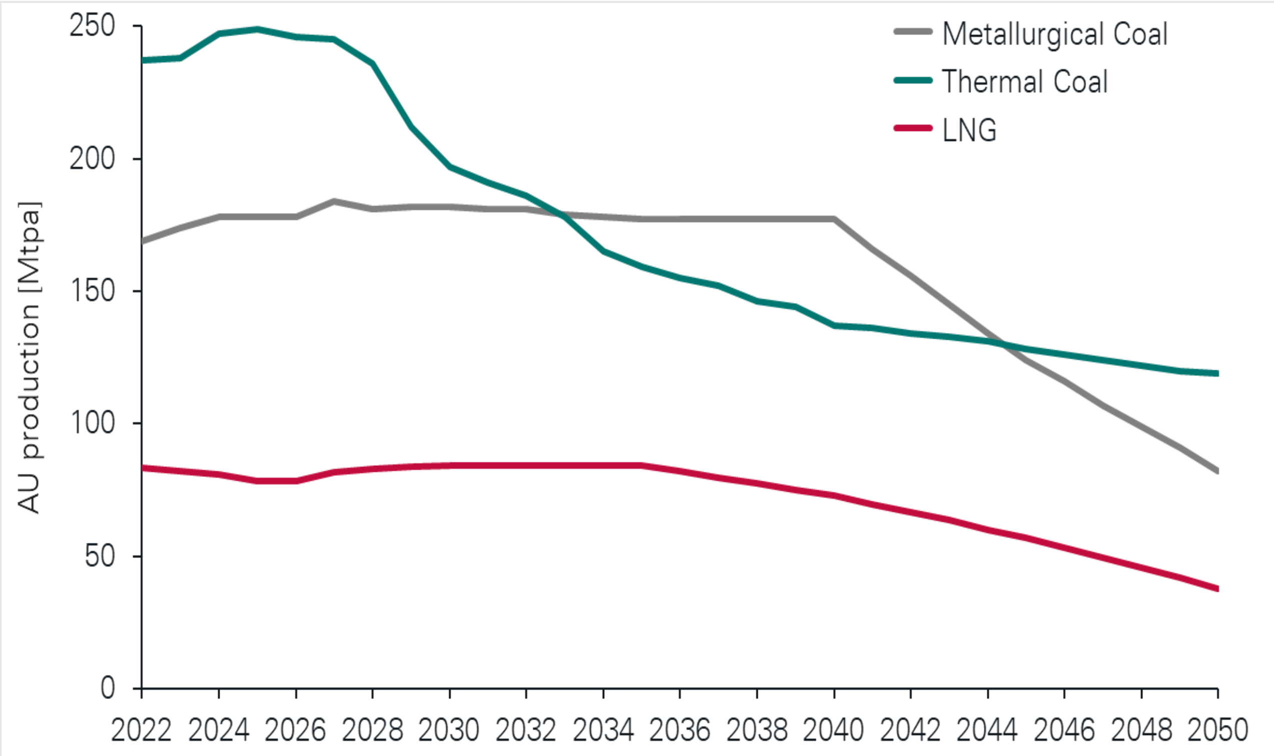
After 2030, we blend production estimates with IEA's Announced Pledges Scenario (APS)[25], which models the impact of announced emissions targets on coal and LNG production. The APS includes all recent major national announcements as of September 2022 for 2030 targets and longer-term net zero and other pledges, regardless of whether these have been anchored in implementing legislation or in updated NDCs.

The IEA publishes total net trade figures for Australian coal, which are assumed to be equal to total exports due to the very low import levels of coal. This is divided into thermal and metallurgical coal exports based on the current ratio of Australian exports, with IEA growth rates for world net trade for thermal and metallurgical coal applied for forward projections. Australian consumption of thermal and metallurgical coal is also projected. For thermal coal, current consumption is projected forward based on demand for coal-based power generation in our Australian electricity sector model. For metallurgical coal, current consumption is projected forward based on the projected growth in Australian steel production.

[25] https://www.iea.org/reports/global-energy-and-climate-model/announced-pledges-scenario-aps

For long-term LNG production, IEA natural gas net export data is assumed to be driven by LNG exports (reflected in the close alignment of production and export data), with trends applied to the OCE trajectory after 2028.

Figure A4: Production assumptions for coal and LNG



Source: RepuTex Energy, Office of the Chief Economist, IEA

For Aluminium, Iron Ore, and Alumina, production assumptions are similarly based on OCE projections to 2030, with long-term growth rates applied to the Safeguard Mechanism share of national production. In the case of critical minerals and other metals, production by Safeguard-covered facilities is kept constant. This is because, while high growth is expected in critical mineral mining, this is assumed to be achieved through an increase in the number of smaller mines, many of which are not emissions-intensive enough to be covered by the Safeguard Mechanism.

5.1.4 Industry abatement and investment decisions

In developing the described emissions scenarios, modelling accounts for the take-up of GHG emissions abatement activities by each facility. In doing so, we utilise marginal abatement cost curves for the industrial (Safeguard Mechanism) sectors, encompassing approximately 80-90 individual emissions reduction actions.[26] For the purposes of this report, individual actions are aggregated to approximately 25 groupings, described below. The costs of individual actions are adjusted over time to reflect the changing profile of developing and emerging technologies, along with exogenous inputs such as electricity and commodity prices.

The marginal abatement cost curves were checked against the industrial opportunities within 140 actions in the SJT data sets. The costs and returns were consistent, providing assurance in the data with two independently developed data sets being aligned.

[26] SJT's industrial emissions reductions data were integrated into RepuTex's energy efficiency activities for each sector before calculating marginal abatement cost curves.

Decision making is informed by behavioural assumptions for the timing and volume of emissions reductions described in each scenario. This is underpinned by a diffusion model approach, with investment decisions informed by facility-level factors such as the suitability of a technology at a particular site, the age and remaining lifespan of the facility, the emissions intensity of the facility, and the relative economics of decision making based on the price of carbon units in each scenario.

For most businesses, investments in new technologies are generally assumed to take place two years after the carbon market price reaches the required level, which approximates the inter-temporal effects of industry investment decisions. Depending on the scenario, a feedback loop is used to estimate the impact of abatement on the price of carbon units, and to forecast future carbon unit prices and abatement levels.

Industry investment in emissions reductions is modelled on a sector-by-sector basis, accounting for changing global demand in both traditional and new export industries. For example, traditional export sectors may utilise opportunities to reduce emissions but may be less likely to invest in abatement projects that have low internal rates of return, negative net-present values, or long-payback times (without public financing support). These sectors may utilise the least-cost combination of internal abatement opportunities and external offsets to meet their annual emissions reduction obligations.

Other sectors of the economy may make more transformational investments in low-emissions technologies as they transition to net-zero emissions, largely via the use of energy efficiency, fuel switching, and industry specific technologies and processes, such as green steelmaking, to eliminate all direct GHG emissions.

For example, most manufacturing industries (such as ammonia & urea, cement, and chemicals) and mining & minerals processing (e.g., iron ore, gold, and alumina) are well positioned to transform their operations via energy efficiency improvements, electrification, low-carbon fuels, and new processes to eliminate direct GHG emissions. Policy measures therefore guide the pace of investment in emissions reduction technologies, either where mature technology exists today, or as demonstrated technologies are more widely utilised.

Figure A5: Adopter category within diffusion model

Adopter Category	Rogers typical diffusion	Definition
Innovators	2-3%	Innovators are willing to take risks, have financial liquidity, have closest contact to scientific sources and interaction with other innovators. Their risk tolerance allows them to adopt technologies that may ultimately fail. Ability to attract external financing help absorb these failures. Aggressive view of carbon pricing priorities all feasible decarbonisation strategies.
Early adopters	13-14%	These businesses have the highest degree of opinion leadership among the adopter categories. Early adopters have a higher financial liquidity and are more socially forward than later adopters but are more decerning in adoption choices than innovators.
Early Majority	~ 33%	Rarely leaders but adopt an innovation after a varying degree of time that is significantly longer than the innovators and early adopters. Typically need to see demonstrated evidence that the innovation works before adopting it.
Late Majority	~ 33%	They adopt an innovation after the average industry participant. These businesses approach an innovation with a high degree of scepticism and after most of the industry has adopted the innovation. Late Majority are typically sceptical about an innovation, with little financial liquidity, and in contact with others in late majority and early majority. Responds to the number of others that have successfully implanted an innovation.
Laggards	~ 17%	They are the last to adopt an innovation. Unlike some of the previous categories, businesses in this category show little to no opinion leadership. These businesses typically have an aversion to change-agents. Laggards typically tend to be focused on tradition and conservatism, have the lowest financial liquidity, and are older. Responds to pressure from financiers and regulation. Carbon pricing assumptions derived from historic averages.

Figure A6: Definition of mature and emerging technology groupings

Abatement measure	Description
Abandoned coal mine methane management	Improved management of abandoned coal mine fugitive methane, through flaring or plugging/flooding.
Biochar	Use of biochar to replace coke as a reductant, most commonly in blast furnaces during steel production.
Biofuel	Use of biofuels (generally biodiesel and Sustainable Aviation Fuel) as drop-in replacements for fossil fuel equivalents.
CCS	Carbon capture and storage (sequestration in underground sites), which may be applied in several different contexts, e.g., reservoir CO_2 capture, post-combustion capture. Note that new CCS activity at covered facilities would reduce that facility's reported emissions, rather than result in being directly issued ACCUs.
Coal mine methane drainage	More thorough drainage and flaring of coal seams (pre- and post-extraction drainage) and management of methane ventilation systems (e.g., seals, leaks), reducing fugitive methane.
Coal to gas switch	Replacement of coal with natural gas for heating or power generation purposes.
Cogeneration	Simultaneous generation of heat and power, allowing reductions in emissions relative to separate generation of each.
Compressor electrification	Replacement of gas turbine compressors with electric compressors, or addition of electric helper motors to reduce gas consumption.
DRI	Direct Reduction of Iron using either natural gas or hydrogen, replacing the blast furnace in steel manufacture. The transition from a

	basic oxygen furnace to an electric arc furnace would be allocated to the DRI technology grouping.
Efficiency	Incremental efficiency improvements through a range of actions such as process optimisation, equipment turnover, and minor process changes.
Electrification – Heat	Use of electricity to generate process heat, replacing fossil fuel combustion. This may include applications such as calcinators, boilers, or low-temperature process heat.
Electrification – Vehicle	Electrification of mining vehicles (e.g., haulage trucks, mining utility vehicles) and machinery.
Flaring reduction	Reduction in routine and non-routine flaring in oil and gas extraction and processing facilities.
General fuel switching and electrification (process heat)	Replacement of fossil fuel combustion for heating with either net-zero or lower-emissions fuels (as a drop-in substitution or a blend) or electricity. Unlike the "Electrification – Heating" or "Hydrogen" technology groups, this group is used for instances where they may be a range of replacement fuels or where the exact replacement fuel is more uncertain at this moment in time. This technology group is comprised of low-, medium-, and high-temperature switching applications as well as steam generation applications. Low-temperature fuel switching is expected to be predominantly accomplished through electrification; medium-temperature using a mix of electrification, hydrogen, and biofuels; high-temperature predominantly using hydrogen and biofuels; and steam generation using a mixture of hydrogen and electrification.
General fuel switching and electrification (vehicle)	Replacement of fossil fuel use in combustion engines with either net-zero or lower-emissions fuels (as a drop-in substitution or a blend), fuel cells, or through electrification. Unlike the "Electrification – Vehicle", "Biofuel", or "Hydrogen" technology groups, this group is used for instances where they may be a range of replacement fuels or where the exact replacement fuel is more uncertain at this moment in time. This technology group is comprised mostly mining haulage trucks, utility vehicles, and mining machinery (e.g., excavators, loaders).
Geopolymer Cement	Use of alternative binders during cement manufacturing, avoiding process emissions from the breakdown of limestone during clinker manufacture.
Hydrogen	Use of blue or green hydrogen to replace grey hydrogen in chemical processes, as well as the use of hydrogen instead of fossil fuels for high-grade heating purposes.
Inert anode	Replacement of carbon anodes in aluminium smelting with inert anodes, which do not degrade and form PFCs and other greenhouse gases.
Leak detection and repair	Detection and repair of leaks in the Oil and Gas Extraction and LNG sectors, reducing fugitive methane leaks.
Mechanical Vapour Recompression	Use of Mechanical Vapour Recompression to capture energy from waste steam and thus generate high-grade heat.
N_2O reduction	Catalytic reduction of N_2O (a high-GWP greenhouse gas), a by-product of nitric acid in the ammonium nitrate production route.
Other	All remaining activities, typically applied at a small number of facilities (e.g., centralised networks in the Gas Supply sector, OneSKY program in Air Transport, Infinity Train in Iron Ore Mining).
Renewable electricity generation	Replacement of on-site fossil fuel power generation (either primary or backup) with renewable power generation.
Ventilation Air Methane Oxidation	Oxidation of Ventilation Air Methane extracted from underground coal mines.
Waste utilisation	Re-use of waste materials (e.g., glass cullet, scrap steel) in industrial processes, enabling reductions in manufacturing emissions intensity.

5.2 Other sources of demand

In addition to compliance demand from industrial facilities described above, analysis also depicts buying demand from other sources, described below.

5.2.1 Demand from the voluntary market (Climate Active)

Voluntary cancellations under the Australian National Registry of Emissions Units (ANREU) continue to grow, with over 17 million units surrendered in the 2022 calendar year, a 35% increase on 2021 levels (12.9 million).

Under the Climate Active scheme, buyers may utilise a wide range of units, including ACCUs and international offsets, with low-cost Certified Emissions Reductions (CERs) making up around 90% of historical cancellations. In 2023 year-to-date, this has softened to 85%, with ACCU cancellations growing to 15% of all activity, reflecting increasing demand for locally sourced projects (particularly high-quality sequestration).

As the market continues to evolve, stakeholder and regulatory pressure may support a continued 'flight to quality', with voluntary buyers (including regulated / statutory authorities) expected to increasingly source ACCUs as they seek to maximise co-benefits and/or respond to increasing regulatory pressure (such as via state-based Environmental Protection Authorities, state-government mandates, etc.). Even before any potential mandates, some industries may increasingly prefer value matching their products with their own offsets to be able to account for market carbon-neutrality before monetising excess offsets.

Potential uplift in voluntary demand for ACCUs remains subject to the increasing spread between ACCU prices and high-quality international offsets. As ACCU prices rise, some voluntary buyers are likely to become increasingly less selective about the origin and type of credit being surrendered, with preferences for quality ultimately less valuable than meeting voluntary commitments at a reasonable price, evidenced by the large historical reliance of voluntary buyers on low-cost renewable energy offsets.

"Other voluntary demand" is assumed to capture businesses under the Climate Active Carbon Neutral Standard, state regulation (such as EPA conditions and make-good requirements), and state-government activities, growing in line with historical trends.

5.2.2 Demand from investors, traders, and intermediaries

As capital markets become more focused on climate risks and opportunities, carbon units (both allowances and offsets) are likely to be increasingly seen as a way for investors to gain exposure to the low-carbon transition via long-term buy and holds. This trend has begun to emerge in the EU ETS, where investment funds (hedge funds, superannuation, and ETFs) and commercial entities (such as physical traders and investment funds) have significantly increased their holdings, underpinning recent growth, and increased volatility in the EU market.

Over the longer-term, we remain of the view that carbon units are increasingly likely to be used by investors as both a low-carbon asset play (long holding) and eventually as a fundamental hedge against climate risks in other asset classes (such as emissions intensive equities, direct investments, or other energy commodities). This suggests carbon units, as a standalone commodity class, may ultimately become part of balanced portfolios, resulting in growth in investor holdings over the decade.

Over the past 24-months ACCU holdings of 'Intermediaries' (brokers, traders, and financial institutions) have grown by more than 4x to 6.5 million at the end of Q1 2023, representing 27% of all holdings. The positive macro environment for low-carbon assets has therefore begun to impact the Australian market, with the number of active funds and institutions growing to their highest-ever, including large local banks which have begun to build liquidity and new product offerings.

Following the change of government, and the alignment of the Safeguard Mechanism with net-zero emissions, continued demand growth from this segment remains likely, with the Australian market becoming more attractive to investor and speculative participants. As this occurs, we estimate investor participation to grow from about 10 per cent of ACCU holdings in 2023 to approximately one-quarter by 2027, growing incrementally to around half of holdings by 2035. This is assumed to be supported by the launch of an exchange by 2024, facilitating liquidity and market access.

5.2.3 Future Commonwealth contracting

The Powering the Regions Fund is assumed to continue to support Commonwealth ACCU purchasing via Carbon Abatement Contracts (CACs) over budgeted years (to 2026-2027). This represents approximately $384 million of the $1.9 billion fund, deducting announced budget measures.

5.3 Supply module and assumptions

5.3.1 Supply from registered projects (firm supply)

In calculating future carbon credit supply (module two of our A-EEM model) we first consider ACCU issuance from projects that are "registered and active" under the ACCU Scheme. Where depicted, we refer this as "firm" issuance, excluding projects that are registered more than two years ago but have not yet been issued credits.

Based on the lag time between registration and first issuance, we also estimate first-time issuance to registered projects that have not yet been issued ACCUs (such as many soil carbon projects). Where depicted, we refer to this as "likely issuance".

5.3.2 Future supply from new projects

New supply is assumed to be developed in response to increased contracting demand and anticipation of higher prices in the future. For the purposes of this project, modelling assumes that new supply is derived only from newly registered projects under existing methodologies (including active methods and those that have not yet had projects registered), and priority methods (such as the integrated farm and land method). These sources have potential to contribute large-scale supply, varying in response to contracting demand and market signals.

In practice, new supply will also be derived from future 'proponent-led' methodologies, including former priority methods such as Carbon Capture Use and Storage (industrial and building materials); Hydrogen (fuel switching); and Transport (renewable diesel and sustainable aviation fuel switching). These activities are not considered here.

In developing new sources of supply, a forward curve is used as a reference relative to the long-run marginal cost of supply for existing and new project methodologies. This informs the potential cost and volume of new supply across the Australian market (in this case limited to existing methodologies). Potential projects across the cost curve are assumed to be registered and issued new ACCUs based on project type, with an issuance lag from registration depending on methodology.

5.3.3 Availability of ACCUs anchored to CACs

Under the ACCU scheme, proponents with "fixed delivery" carbon abatement contracts (CACs) were previously required to deliver their ACCUs to the Commonwealth. This future issuance was effectively 'locked away' from the broader market.

Following regulatory changes in March 2022, proponents with fixed delivery CACs are now able to pay an 'exit fee' to be released from their delivery obligations to the

Commonwealth. This pool of future ACCU issuance (currently contracted to the Commonwealth) is therefore assumed to be made "available" to private buyers.[27].

For the purposes of this analysis, we assume:

- **Treatment of "optional" CAC holders** – Future issuance is made available to the secondary market where the prevailing price is higher than the contract price at relevant Commonwealth auctions (~ $16-17/t).
- **Treatment of "fixed delivery" CAC holders** – Future issuance is made available to the secondary market where the prevailing price is higher than the breakeven price for damages (~$24-29/t) plus a margin. Approximately 10% of fixed delivery CAC holders are assumed to continue to deliver ACCUs under contract.

No change in fixed delivery exit arrangements is assumed, with the exit window assumed to remain open. No future requirement for minimum deliveries is applied.

5.3.4 Availability / banking of SMCs

Where reported emissions are below a facility's baseline (refer to Section 3.4 "policy module"), the facility is modelled to generate below-baseline SMCs that it may trade, or bank for future compliance. Issued SMCs are assumed to be reserved for internal use first. Facilities are assumed to bank sufficient SMCs to meet their forecast liability over a rolling 6-year window, with surplus SMCs made available to the market.

Figure A8: Summary of key supply assumptions

Relevant assumption	Modelled settings
ACCUs issued	127 million
Registered Projects	1,558 projects
Project failure rates	Derived from historic trends at method-type level
CAC fixed delivery exit	Exit window assumed to remain open
% delivered to Cth	10% of fixed delivery CACs assumed to be delivered to the Commonwealth irrespective of market prices.
Optional CAC holders	Made available to the secondary market
Method availability dates	• Savanna Fire Management in January 2024 • IFLM in July 2024
Sequestration growth rates	• Derived from comparable historic ACCU projects. • Varies by climate zone & vegetation type, however, HIR is typically credited about half of its abatement after 10 years.
SMC use and banking	• Issued SMCs are reserved for own use first • Sold into carbon credit market if not needed for SM liability within 6 years
Limit on SMC use	No limit is applied on the use of SMCs. For example, liable entities can utilise SMCs for 100% of a facility's compliance obligations, with no banking restrictions.
Use of international offsets	No use of international offsets
Abatement value of offsets	1 tonne of CO_2-e

[27] The government continues to refer to the fixed delivery exit arrangement as a "pilot" scheme. While this is intended to provide flexibility to amend the policy over time (for example if more ACCUs were sought to fulfil demand under the cost containment measure), we note that any move to walk back the fixed delviery exit arrangement could simply see proponents break their contracts and pay damages to make their supply available to the broader market (subject to reputational risks and other limitations on breaking contracts, such as financing arrangements).

5.4 Policy module and assumptions

The third module of our A-EEM model overlays constraints in line with policy settings described within each scenario. Compliance market participants must bring their net emissions into line with their baselines though the surrender of carbon credits to meet their annual compliance needs by the end of March each year (from FY24). In doing so, modelling simulates the market's reaction to a potential shortage by assuming that some parties take long positions, with the intention of offering supply by selling as prices rise.

In our Central scenario, most compliance entities aim to minimise costs via the least cost combination of internal emissions reductions, below-baseline SMCs or ACCU offsets. These participants are assumed to identify and cover expected shortages by planning to abate emissions 5 years in advance (varying by scenario), either via internal actions or external procurement of eligible carbon credits.

5.4.1 Emissions budget and cap

The government's calculated emissions budget of 1,233 million tonnes CO_2-e emissions between 2021 and 2030 has been built into the Safeguard legislation, creating an emissions limit under the scheme. In aggregate, net emissions from Safeguard facilities must not exceed 100 million tonnes of CO_2-e by 2029-30 and zero by 2050, and 1,233 million tonnes in total over the decade to 2030. Total gross emissions from Safeguard facilities should reduce over time, measured through a rolling 5-year average.

We note potential for the 5-year rolling average to be breached under our High Emissions scenario due to the combined impact of new entrants (Table 3) and higher reliance on carbon offsets. The impact of new entrants on the emissions cap, along with the market's broader reliance on carbon offsets, therefore remains a key watch.

If covered emissions have or will breach the objects of the Safeguard Act (not due to temporary factors such as production variability), the Minister is required to consult and amend the Rules or take other policy actions to ensure the objects are met.

5.4.2 Emissions baselines for existing facilities

Production-adjusted (intensity) baselines for existing facilities are assumed to be set using a "hybrid" model initially weighted towards the use of site-specific emissions intensity values, transitioning to industry average emissions intensity values by 2030 (and beyond) in line with ratios documented within the government's position paper:

2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
10:90	20:80	30:70	40:60	60:40	80:20	100:0

Note: Weighting ratio is Industry Average: Site Specific

Existing facilities' site-specific emissions-intensity values are calculated based on the estimated middle values from up to a five-year period between 2017-18 to 2021-22.

To establish an emissions baseline using an industry average intensity benchmark (before the Department publishes revised intensities), we apply government-determined production variables and emissions intensity values (together called 'default values'). For each facility we multiply estimated individual volume of product by the industry average intensity default value, reflected via the following formula:

Emissions Baseline = Σ (Facility Production x "*Industry Average*" Emissions Intensity).

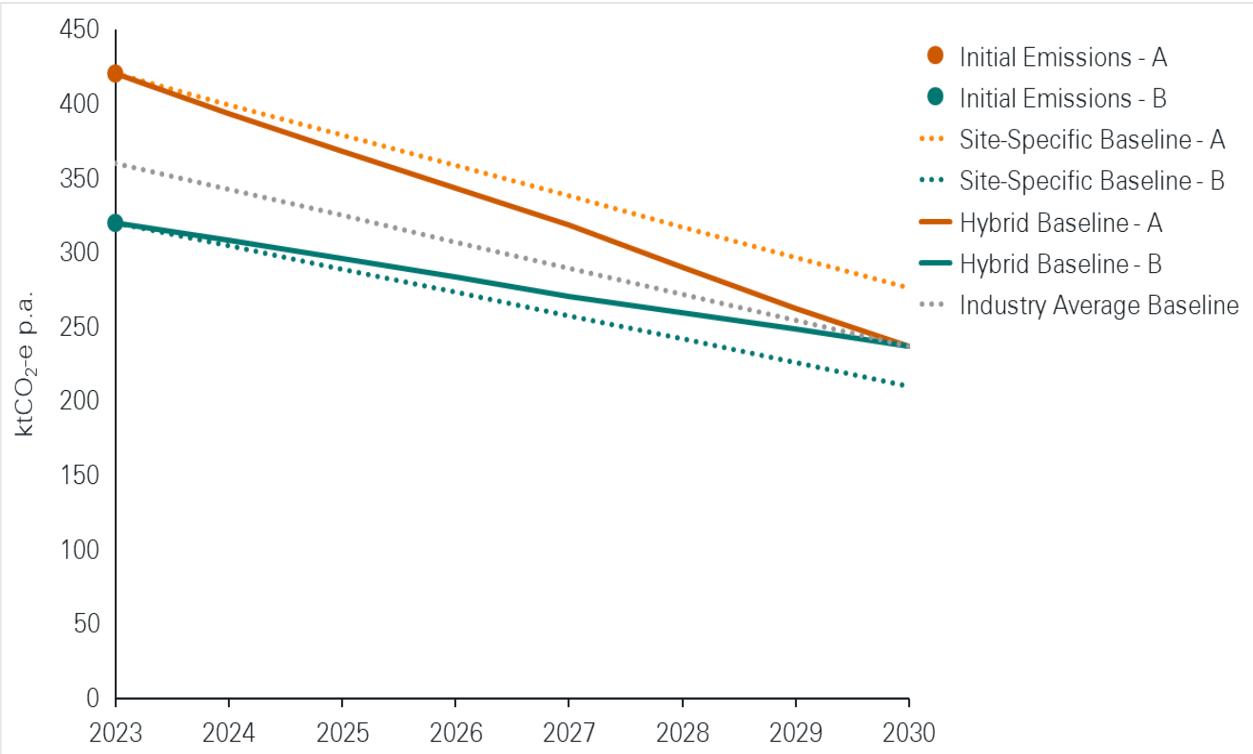
5.4.3 Baseline default decline rate

A uniform 4.9% default decline rate is applied across the Safeguard Mechanism from FY24-30, including a buffer (or emissions reserve[28]) to account for higher-than-expected emissions. After 2030, the default decline rate is assumed to slow to 3.285%, consistent with reaching zero emissions by FY49-50.

In practice, each facility's decline rate is unique. This is because individual facility baselines decline at different rates as the scheme transitions from site-specific to the industry average. For example, in Figure A9, facilities A and B are assumed to have the same outputs. A is more emissions-intensive, B is less emissions-intensive. The more emissions-intensive Facility A is shown to have a steeper decline of 6.2% per annum to 2030, versus just 3.7% for less emissions intensive Facility B.

A facility would only have an exact 4.9% decline rate where their site-specific and industry average benchmarks match.

Figure A9: Example of emissions baseline decline rates



Source: RepuTex Energy, 2023

For each facility we multiply the estimated individual volume of product by their hybrid combination of site specific and industry average intensity benchmarks described above. The baseline and resulting decline rate are then set for each facility through to 2030.

As noted, by 2030, this is calculated to result in more abatement than would be strictly necessary to achieve the Safeguard's portion of the overall 43 per cent reduction target, accounting for higher -than-expected production growth from existing facilities and trade exposed baseline adjustments. A slowdown in the default decline value is therefore adopted beyond 2030 (as legislated) to reach net-zero by 2050.

[28] The default decline rate is calibrated to achieve the target(s) based on assumptions for new entrants and industrial output. The decline rate also accounts for an "emissions reserve", designed to manage upside risk of higher aggregate emissions from Safeguard facilities to help ensure the emissions target is achieved. The default decline rate also reflects assumptions regarding the level of trade-exposed baseline-adjustments that will be made to 2030. An additional buffer of 15 Mt CO2-e of the Safeguard emissions budget is set aside for an emissions reserve.

5.4.4 Baselines for new facilities and closing facilities

New facilities are assumed to be issued a "best practice" emissions intensity baseline set in line with international standards, unless specific treatments are set for some industries. "Best practice" is estimated based on either the top 10% of Australian facilities or secondary research on international best practice. New facility baselines are then modelled to be subject to the default annual baseline decline rate, consistent with baselines for existing facilities – e.g. 4.9% per annum transitioning to 3.285% after 2030,

New LNG backfill projects are assumed to be accountable for all their reservoir CO2 emissions. New projects developed in the Beetaloo are assumed to be required to abate their covered direct emissions, with accountability for larger Scope 2 and 3 emissions referred to the Energy and Climate Change Ministerial Council (ECMC).

No specific treatment is applied for closing facilities, with the phased closure of aging facilities (or depleting resources) assumed to be flexibly accounted for in the setting of production adjusted baselines, reducing the likelihood that a facility would receive windfall carbon credit gains where it records a lower level of production.

5.4.5 Assumed industry assistance measures

Companies that face an elevated risk of carbon leakage are classified as "Trade Exposed Baseline Adjusted facilities" (TEBA), a subset of trade-exposed facilities. These facilities are assumed to apply for a discounted decline rate set based on a scaled scheme impact ratio. For the purposes of this analysis, all TEBA manufacturing facilities are assumed to be assigned a minimum decline rate of 1% each year, with 11 facilities initially assumed to be classified as TEBA facilities (e.g., cement industry).

Facilities may additionally apply for five-year multi-year monitoring periods (MYMP) up to 2030 where a facility has exceeded its baseline but has a committed plan in place to reduce emissions within the MYMP. As an initial simplifying assumption, no allocation of MYMPs is made within this analysis. Although this is assumed to reduce the accuracy of carbon credit demand calculations for individual facilities to 2030, and overall carbon credit demand in any given year, the impact on cumulative carbon credit compliance demand is anticipated to be negligible, relative to the significant uncertainty around individual facility investment behaviour.

5.4.6 Carbon position and crediting of SMCs

To assess each facility's carbon position, the emissions baseline is subtracted from the reported emissions of each facility. If reported emissions exceed the baseline, the facility would be required to reduce its net-emissions. Where reported emissions are below the baseline, the facility is modelled to generate below-baseline credits (SMCs) that it may trade, or bank for a future compliance (refer to supply-side assumptions).

5.4.7 Cost containment and ACCU reserve

A cost containment measure, or price ceiling, will be implemented under the Safeguard Mechanism through the Government sale of ACCUs to Safeguard facilities at a fixed price of $75/t in FY24 increasing with the CPI plus 2% each year.

Where the cost containment mechanism is triggered, the required 'ACCU reserve' is assumed to be supported via a combination of continued ACCU deliveries to the Commonwealth (fixed / optional CACs, deemed surrenders), and new Commonwealth contracting - both within and outside of the PRF.

Where any reserve shortfall is at risk of developing, we assume that the government retains the ability to contract for new ACCU deliveries or change current CAC delivery rules, to build its ACCU reserve.[29]

FY	CPI (%)	CPI + 2%	Price ceiling
2024	4.7	6.7	$75
2025	3.9	5.9	$80
2026	3.0	5.0	$85
2027	2.0	4.0	$89
2028	2.5	4.5	$92
2029	2.5	4.5	$97
2030	2.5	4.5	$101
2031	2.5	4.5	$106
2032	2.5	4.5	$110
2033	2.5	4.5	$115
2034	2.5	4.5	$120
2035	2.5	4.5	$126
2036	2.5	4.5	$132
2037	2.5	4.5	$137
2038	2.5	4.5	$144
2039	2.5	4.5	$150
2040	2.5	4.5	$157
2041	2.5	4.5	$164
2042	2.5	4.5	$171
2043	2.5	4.5	$179
2044	2.5	4.5	$187
2045	2.5	4.5	$195
2046	2.5	4.5	$204
2047	2.5	4.5	$213
2048	2.5	4.5	$223
2049	2.5	4.5	$233
2050	2.5	4.5	$244

[29] For example, the government will consult on future Powering the Regions Fund (PRF) purchasing arrangements, including potential changes to contracting. This could also include changes to the fixed delivery exit arrangement - e.g., to require the minimum delivery of 10-20% of currently contracted supply to provide the government supply for the cost containment measure. This discussion is hypothetical only. This many also be aligned with complimentary policy opportunities, such as underwriting 'carbon abatement + biodiversity' credits via other certificate schemes.

6. APPENDIX B: KEY SENSITIVITIES

Modelling of long-term market dynamics is subject to several influences, including macro-economic factors (e.g., global financial crises, demand for Australian LNG/coal exports), policy intervention (such as a change of government), and unexpected shocks. Below, we summarise the key sensitivities to modelled outcomes.

Change in policy

All carbon markets are political constructs. Policy architecture therefore remains subject to government intervention. This may impact prices to the upside or downside. For example, where prices grow to quickly or too high, policymakers may be pressured to implement countervailing measures (such as the current price ceiling). Measures may also be adopted to support prices where prices fall to low.

While the change of government at the 2022 Federal Election has ushered in a more supportive policy environment for the Australian market, Safeguard Mechanism reforms are not bipartisan. A change of government may therefore represent a structural risk to price development in the Australian carbon market.

Change in assumed emissions targets

The government’s target to reduce GHG emissions by 43% on 2005 levels by 2030, reaching net-zero emissions by 2050, is broadly consistent with a 2°C global warming pathway. Pressure will continue to develop for increased emissions reduction ambition in the setting of Australia’s new interim emissions target for 2035; and/or an earlier timetable for net-zero emissions (such as net-zero emissions by 2040).

Australia is a signatory to the Paris Agreement, which requires countries to increase their emissions reduction ambition over time. The Paris Agreement works on a five- year cycle of increasingly ambitious climate action carried out by countries. Every five years, each country is expected to submit an updated national climate action plan - known as Nationally Determined Contribution (NDC).

Climate Change and Energy Minister, Chris Bowen, has stated that the government will seek to set a higher emissions reduction target for 2035 in the next three years (2025), to be advised by the Climate Change Authority.

According to a recent Carbon Market Institute survey, 52% of respondents now support a 2035 emissions reduction target more than 60%, with an interim target of 70% to 75% on 2005 levels widely regarded as a 1.5 degree aligned target. We believe that this is likely to translate into a strong campaign from green groups for a “75 by 35” target to be adopted by the government, like the “fit for 55” campaign in the EU states.

Any scale up in emissions reduction trajectory is expected to flow through to the Safeguard Mechanism via the design of more ambitious baseline settings. The subsequent increase in the scheme’s abatement task would therefore be supportive for the ACCU market, subject to new regulation - for example possible restrictions on offset use - with the faster decarbonisation trajectory likely to increase initial reliance on offsets as industry becomes accountable for more of their own emissions at a faster pace.

Use of international offsets

International offsets are not part of the Government’s initial reform framework for the Safeguard Mechanism. The Government has stated, however, that it may consider acquiring high integrity international offsets and is likely to consider their use as part of ongoing policy reforms. Should this occur, limits on the direct transfer of international offsets may be implemented to safeguard the ongoing decarbonisation of the domestic economy. Despite this, given the current price spread between international and Australian units, the use of international offsets would be likely to erode ACCU demand.

Material changes in export commodity demand

Given around half of all emissions covered by the Safeguard Mechanism are derived from LNG and coal mining facilities, future emissions outcomes are highly sensitive to changing patterns of external demand for Australia's key export sectors. Should demand for Australian LNG and coal exports be higher/lower, this could translate into material changes in demand for external abatement, and higher/lower prices for ACCU offsets.

Delays or deferral of large new LNG projects

In line with changing export demand for Australian coal and LNG production, potential remains for new LNG backfill projects to be deferred or abandoned, with ongoing questions as to the development of key project such as Barossa, Beetaloo and Browse.

Last September, Santos was ordered to stop drilling at its Barossa gas project following a successful challenge from an indigenous group that was found to not have been properly consulted. In December, Santos' appeal to restart drilling at its Barossa gas development was dismissed adding further uncertainty and delays for the project.

Similarly, the commerciality of projects developed in the Beetaloo basin are highly uncertain, with questions over the viability of these projects as carbon prices rise, and regulatory conditions become tighter – potentially including Scope 3 emissions liabilities.

Woodside's Browse project continues to forge ahead, with the company recently re-stating its support for the project, despite various challenges including the project's location in deep water, remote offshore location, and high CO2 content.

Potential supply side changes (ACCU scheme)

The government continues to refer to the fixed delivery exit arrangement as a "pilot" scheme and will consult on possible changes to Commonwealth purchasing arrangements. This could also include changes to the fixed delivery exit arrangement - e.g., to require the minimum delivery of 10-20% of currently contracted supply, or similar, to provide the government with a source of supply for the cost containment measure.

In addition, following the Chubb Review, the government will consider options and implications for the overlay of a new "buffer" on ACCU issuance, helping to improve the integrity of ACCUs issued under the ACCU scheme framework. This has potential to materially limit ACCU issuance subject to its implementation.

Availability of low-emissions technology

Analysis in this report accounts for the take-up of GHG emissions abatement activities drawing on marginal abatement cost curves for the industrial (Safeguard Mechanism) sectors, encompassing approximately 80-90 individual developing and emerging technologies. As with any long-term analysis, the cost and availability of low emissions technologies is highly uncertain, with potential for large breakthroughs or delays in the availability and cost of technology to materially impact modelled outcomes.

7. APPENDIX C: ECONOMIC ANALYSIS (SJT)

7.1 Purpose of the economic analysis

The economic model serves to offer additional, broad information regarding the effects of ACCU price increases and changes to ACCU supply on the economy, encompassing impacts on Gross Domestic Product (GDP), employment, and tax revenue.

Modelling within Section 4 provides insights into the likely impacts on ACCU price and supply which is already useful in determining the impact of buffers on businesses within Australia, both producers of ACCUs and purchasers of ACCUs. However, where one business may benefit from price increases another may lose and it can be difficult to understand the likely net impact without a broader economic analysis.

Figure 20 in Section 4.2 shows the modelled price of ACCUs under the three different buffer scenarios and the extent to which the price increases. Buffers increase ACCU prices, which combined with changes in supply, can both increase and decrease total revenue for businesses that generate ACCUs.

For example, combining Table 7 and Table 8, under the high buffer scenario, revenue for ACCU generators are increased by $693 million in 2035 compared to a no buffer scenario. However, in 2035, under the low buffer scenario, revenues are decreased by $162 million.

The decrease in revenue leaves ACCU generating businesses worse off, whereas an increase in revenue, assuming no escalation in ACCU production costs, translates to a favourable outcome for these entities. It's important to note that while revenue may rise for ACCU producers, the corresponding increase in revenue equates to an equivalent cost escalation for ACCU purchasers. This naturally prompts the question: What is the net economic impact of these buffers?

The economic analysis aims to answer this question in broad terms. As with all modelling, there are limitations and assumptions. A notable limitation is that implementing a buffer is to guard against the risk that there is over-crediting, and it cannot be known the extent to which over crediting exists. Implementing a buffer that over represents the amount of over-crediting could be economically detrimental, however under a no buffer scenario, the economy could be paying for emissions reductions that are not occurring which is also economically detrimental.

The results of the analysis cannot be taken as the exact increase or decrease in Gross Domestic Product (GDP), tax revenue or employment down to the dollar value or person employed. However, the analysis can be used to understand the general trend and orders of magnitude.

7.2 Productivity and wealth transfers

The rationale for implementing an ACCU buffer would be to guard against the risk that there is over-crediting of ACCUs - that the amount of ACCUs being credited represents a larger amount of emissions reduction than is being achieved. This risk arises in part because it is impossible to know with full certainty the counter-factual situation - that is, what would have happened in the absence of the ACCU scheme.

Productivity refers to the output that can be generated with a given amounts of inputs[30]. From the perspective of a business that generates ACCUs with zero overclaiming; under the different buffer scenarios, generators of ACCUs are undertaking the same process and consuming the same quantity of inputs, however the output, measured as ACCUs, are reduced by the buffer.

However, from the perspective of the wider economy where actual emissions reduction could be viewed as the output and ACCU purchasing as an input, and considering the businesses that may be overclaiming ACCUs, a buffer will increase overall productivity.

$$Productivity \ = \frac{ACCUs\ Index}{Combined\ Inputs\ Index}$$

With ACCUs Index being a change in ACCUs compared to an arbitrary baseline.

If the ACCU index is reduced by 20%, 10% or 5% and the inputs remains the same, the productivity of ACCU creation reduces by 20%, 10% or 5% respectively.

An alternative measure of productivity is where the output is not measured as an ACCU index but Gross Value Added (GVA).

For example, under the high buffer scenario, producers of ACCUs see an increase in price of 15% by 2035 per ACCU (Table 8). If we assume no change in the cost per input even with an increase in demand for ACCUs, we still have a reduction in ACCU generation per project of 20%, for the same inputs. This results in a productivity equation:

$$Productivity \ = \frac{GVA\ Index\ \times 1.15\ \times 0.8}{Combined\ Inputs\ Index}$$

Which results in a reduction in productivity per project of 8%, even with a price increase of 15%.

However, from the perspective of the wider economy where actual emissions reduction could be viewed as the output and ACCU purchasing as an input, and considering the businesses that may be overclaiming ACCUs, a buffer will increase overall productivity.

$$Productivity \ = \frac{Tonnes\ of\ CO_2\ \times (1 + Buffer)}{Combined\ inputs\ including\ ACCUs\ Purchased}$$

These two productivity mechanisms work against each other. A buffer will increase productivity if the businesses generating ACCUs are over claiming, however a buffer will decrease productivity if businesses generating ACCUs are not over claiming. Ideally, a buffer would accurately represent the amount of overclaimed ACCUs, which would likely represent the optimum buffer that best balances both productivity mechanisms, however this cannot be known.

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[30] Productivity (rba.gov.au)

Given the uncertainty around a buffer's effect on net productivity, and the limitations of the economic model (see next section), productivity effects will be excluded from the analysis.

Wealth transfer effects can be modelled. Under the high buffer scenario, the sector that produces ACCUs (modelled as the agriculture sector in the economic model) will see an increase in GDP, tax revenue and jobs. However, this increase in economic metrics may not out weight the decrease in GVA and corresponding national GDP from the sectors required to purchase the ACCUs.

Increasing the cost of emissions reduction on the sectors purchasing ACCUs such as manufacturing, mining and oil and gas, increases the input costs for those businesses without delivering an increase in GVA. These businesses are required to deliver a set amount of emissions reduction and if the price goes up, it is a simple increase in cost.

Therefore, the buffers which have the potential to both increase and decrease GVA in the sectors that generate ACCUs will reduce GVA in the sectors that purchase them. Additionally, since the effects that both places upwards and downwards pressure on GVA for the sector that generates ACCUs all results in a corresponding reduction in GVA for purchasing sectors, therefore the net effect for buffers can only be negative to the overall economy, assuming all sectors generate similar returns on investment.

However, not all sectors deliver the same returns. Mining projects for example, typically result in a 15% to 30%+ internal rate of return[31]. Farming however can have a return on capital as low as 3.3% on average with a range between 6.2% and -0.4%[32]. These may be the most extreme examples in the data, with other sectors impacted by ACCU prices, such as metals manufacturing not delivering the returns of mining. If the overall wealth transfer is from more productive sectors of the economy to less productive sectors of the economy the impact on GDP, particularly as it relates to future investment and growth over multiple years will be decreased. With a decrease in GDP comes decreases in tax revenue and jobs.

7.3 Economic model limitations and assumptions

It is important to understand there are limitations to how the theory can be applied in the economic model. The model is a simplified economic model, designed to be used for energy and emissions modelling purposes only. It was built by simulating multiple energy and emissions reduction scenarios in a national Computerized General Equilibrium (CGE) model to generate a data set and it uses that data to extrapolate results from new inputs. It provides a good indication of the direction (positive or negative impact on the economy) and orders of magnitude. Additionally, the simplified economic model can be used to run broad questions that allow the user to identify further, detailed questions that can be explored with a more complex economic model, if required.

The specific numbers produced cannot be taken as an exact representation of the future outcomes.

Some specific points to note include:

- The impact of internal investments in projects were included as a cost to the business which is equivalent to the marginal cost of purchasing ACCUs at the buffer price compared to the ACCU prices with no buffers. The rationale was, it was assumed that the marginal cost increase required to unlock these projects would be equivalent to the marginal cost increase of purchasing ACCUs, otherwise a rational business would have already undertaken the project prior to an increase in ACCU prices. This is a simple modelling method that is justifiable,

[31] Australian Critical Minerals Prospectus 2022 (globalaustralia.gov.au)
[32] Financial performance of cropping farms - DAFF (agriculture.gov.au)

however, there is a limitation. When a business examines the costs and benefits associated with the decision to undertake an internal project or simply purchase ACCUs, a rational business will invest internally if the internal project has a lower cost on an NPV basis, including risk factors compared to purchasing ACCUs. Therefore, the marginal cost of the internal projects under a buffer scenario will in fact, be slightly less than the cost of simply purchasing ACCUs at the buffer price. The economic modelling has been undertaken assuming the costs are equal. This limitation has an effect of slightly overestimating the negative impact of buffers on the economy.

- The economic model simulates costs and benefits at the sector level not at a facility level. The main error this introduces is large and small businesses are impacted in the economic model where in reality only large emissions producing businesses within a sector will be affected. For example, the investment strategy is typically different for a large mining company compared to a smaller operator. Large mining companies will typically invest more capital in a site initially, compared to a smaller operator that is capitally constrained and uses the first stage to finance following stages of expansion. This limitation will not change the overall finding of the economic modelling, however a refined model which only simulates the impact on effected sites would provide more granular information. There may be value in investigating the economic impact of buffers on specific facilities, focusing on specific impacts such as closures, reductions in expansion projects, etc. however the current economic analysis is not granular enough to provide this information.
- The model has been set up so that costs are allocated proportionally to the sectors in line with their need to purchase ACCUs. The simplified economic model sectors are not granular enough to capture all economic sectors affected by ACCU buffers in high detail. This has meant that costs and benefits have been allocated to the most appropriate, similar sector. For example, the simplified economic model has an agriculture sector but not other sectors that generate ACCUs, such as a sector relating to savanna burning. In this case all benefits associated with additional revenue from ACCUs have been allocated to the agriculture sector.
- The model is not capable of simulating the reduction in productivity resulting from buffers, for sectors that generate ACCUs, modelled as the agriculture sector. This means the reductions in GDP, tax and employment in the results represent the impact of a wealth transfer between the sectors that buy ACCUs to the sectors that generate ACCUs. This limitation is therefore likely resulting in an underestimation of the negative impact on economy.
- The benefits of higher prices have been allocated to the agriculture sector. So, while there are costs to other sectors, those costs are paid to the ag sector in the model. This results in a net impact to the economy being calculated. There are sectors other than ag that generate ACCUs, however all benefits have been allocated to the agriculture sector as it is the most appropriate sector available in the model.

7.4 Results from the economic model

Table 9 illustrates the economic impact of each buffer scenario. By 2035, the cost to the economy exceeds $1 billion across all scenarios, with a tax revenue reduction of over $100 million per year by 2033. It is estimated that there will be more than 1,000 job losses under all three scenarios by 2030.

Table 9 - Economic Impacts of Different Buffer Scenarios

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Buffer Scenario	**5%**											
GDP (% of 2022 GDP)	-0.001%	-0.003%	-0.005%	-0.009%	-0.012%	-0.017%	-0.023%	-0.030%	-0.039%	-0.047%	-0.056%	-0.064%
Tax (% of 2022 tax)	0.000%	-0.001%	-0.002%	-0.003%	-0.004%	-0.006%	-0.008%	-0.011%	-0.014%	-0.017%	-0.019%	-0.022%
FTE (% of 2023 National FTE)	0.000%	-0.001%	-0.002%	-0.004%	-0.005%	-0.007%	-0.009%	-0.011%	-0.013%	-0.012%	-0.009%	-0.005%
Buffer Scenario	**10%**											
GDP (% of 2022 GDP)	-0.002%	-0.004%	-0.008%	-0.013%	-0.018%	-0.024%	-0.030%	-0.037%	-0.045%	-0.053%	-0.062%	-0.070%
Tax (% of 2022 tax)	-0.001%	-0.002%	-0.003%	-0.004%	-0.006%	-0.008%	-0.011%	-0.013%	-0.016%	-0.019%	-0.022%	-0.025%
FTE (% of 2023 National FTE)	-0.001%	-0.002%	-0.004%	-0.005%	-0.007%	-0.010%	-0.012%	-0.014%	-0.015%	-0.014%	-0.010%	-0.006%
Buffer Scenario	**20%**											
GDP (% of 2022 GDP)	-0.003%	-0.008%	-0.014%	-0.020%	-0.027%	-0.035%	-0.044%	-0.054%	-0.064%	-0.073%	-0.082%	-0.091%
Tax (% of 2022 tax)	-0.001%	-0.003%	-0.005%	-0.007%	-0.010%	-0.012%	-0.016%	-0.019%	-0.022%	-0.026%	-0.029%	-0.032%
FTE (% of 2023 National FTE)	-0.001%	-0.004%	-0.006%	-0.009%	-0.011%	-0.014%	-0.017%	-0.020%	-0.021%	-0.018%	-0.013%	-0.007%

Under a buffering scenario, the economic cost per ACCU that is removed from the system, or not allowed to be generated, is higher than the price of an ACCU beyond 2027. This is largely because as money is taken away from investment opportunities and operational budgets, the impact compounds over time.

Buffered ACCUs incurs a significantly higher economic cost compared to the cost of an ACCU alone. In practical terms, buffering 5% of ACCUs only leads to a slight increase in the cost of ACCUs, but the total cost increase divided by the number of buffered ACCUs becomes disproportionately high (see Table 10). Moreover, the economic cost is not constrained by price caps, resulting in a wide range of costs per buffered ACCU, ranging from $13 to over $431.

Table 10 - Economic Cost per ACCU Buffered

Economic Cost per ACCU Buffered ($)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
reduction (5%)	-13	-39	-69	-106	-148	-195	-236	-262	-277	-318	-376	-431
reduction (10%)	-13	-33	-54	-77	-104	-133	-153	-161	-162	-180	-208	-238
reduction (20%)	-13	-29	-45	-62	-80	-99	-112	-116	-114	-123	-138	-153

The reduction in tax revenue experienced by the government surpasses the historical price the government has paid for emissions reduction. Under all buffer scenarios, the loss in tax revenue per buffered ACCU exceeds $15 per tonne after 2030.

It should be noted however, that the analysis provides the total tax loss to the economy associated with a buffer. This is not directly comparable to the government using tax revenue to purchase ACCUs because the price government pays for emissions reduction is not the total net cost to government. An economic analysis of the cost when government purchases emissions reduction would include the opportunity cost (what else could government spend that money on and would it deliver more or less economic growth), the borrowing costs and the impact on other industries when government creates competing demand for goods and services. It may be that the total cost to government of purchasing ACCUs, when broader economic impacts are considered, are similar to the tax costs associated with buffers.

Table 11 - Tax Cost per ACCU Buffered

Tax Cost per ACCU Buffered ($)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
reduction (5%)	-2	-6	-10	-15	-21	-28	-34	-38	-40	-46	-54	-62
reduction (10%)	-2	-5	-8	-11	-15	-19	-22	-23	-23	-26	-30	-34
reduction (20%)	-2	-4	-6	-9	-12	-14	-16	-17	-16	-18	-20	-22

As noted above, a limitation to the analysis is it reports the economic and tax costs of buffered ACCU, however this is not directly comparable to price of ACCUs. There is a significant difference between financial costs and economic costs. Economic costs consider broader impacts in an economy, financial only considers the direct costs and benefits of the transaction. Therefore, where the analysis suggests the economic cost of buffering ACCUs is in the range of $150 to $430 per ACCU buffered by 2035, compared to the price generating and selling an ACCU in 2035, which ranges from $84 to $93 per ACCU, it is important to note that the former is an economic cost and the latter is a financial cost. It may be that if an economic analysis was undertaken for generating and selling ACCUs, the total economic cost per ACCU would be much greater. The analysis cannot say if the economic cost of generating and selling ACCUs would be more or less than the economic cost per buffered ACCUs as this was not considered in the analysis.

Further analysis could be undertaken to examine the economic cost of generating and selling ACCUs to compare to the economic cost of buffering ACCUs, which may be useful in understanding the relative merits associated with different policy approaches.

Refer to Section 6 for a summary of the modelling approach.

7.5 How the simplified economic model works

The economic model used to derive these economic, tax and employment costs is a simplified economic model, derived from a broader Computerized General Equilibrium (CGE) model. The simplified model is designed to simulate energy and emissions policies only, based on changes to capital, administrative and energy costs. The model works by interpolating between existing pre-ran scenarios, where a range of energy and emissions policies have been run using the Centre of International Economics (CIE) CGE model. The model was developed by the former Department of Industry to model energy and climate policies simply and cost effectively. The model has been used for the Low Emissions Technology Strategy (LETS) and the Low Energy Buildings Trajectory.

The model is a reduced form of the more complicated and detailed CGE model – CIE-REGIONS. Simulations using the CIE-REGIONS serves the purpose to understand the relationship of energy saving (and associated costs) and the interest variables, and to provide data for the development of the model. More information on the model can be found in the CIE Report, 2017 – supplied separately.

How the modelled ACCU supply and prices input into the economic model

The economic model simulates the impact of the changes in ACCU price under the three buffer scenarios. The total cost of purchasing ACCUs is not considered, only the additional, marginal cost associated with buffers.

The marginal price increase from Tables 8 combined with the demand for emissions reduction by sector are feed into the economic model as an economic shock. The shock is modelled as a cost to all sectors other than the agriculture sector, where the value of costs to all other sectors combined are modelled as a benefit.

Long run vs short run

The difference between a short run and a long run is how employment is treated. Under a short run scenario it is assumed that a change in demand for employment will result in a change employment numbers, however in the long run there will be a change in wages, with employment eventually normalising. The analysis has been run as a mixed case, with early years being short run, moving into long run, however given the timeframes, the short run scenario is more relevant.

Sectors

The results of the ACCU price modelling have been input into the economic model in sectors. The sectors available in the economic model are;

- Wood, paper and printing
- Chemical products
- Non-metallic minerals
- Iron and steel
- Nonferrous metals
- Other manufacturing
- Commercial
- Mining
- Agriculture

The ACCU purchasing has been allocated to these sectors based on the output of the RepuTex model.

8. APPENDIX D: ACCU METHODS

Active methods: ACCU Scheme methods currently available to register new projects.[33]

Opportunities for industry:

Carbon capture and storage

- Carbon capture and storage method

Energy efficiency

- Aggregated small energy users
- Commercial buildings
- High efficiency commercial appliances
- Industrial and commercial emissions reduction
- Industrial equipment upgrade
- Refrigeration and ventilation fans

Landfill and alternative waste treatment

- Alternative waste treatment
- Facilities method
- Landfill gas
- Landfill gas (generation)
- Source separated organic waste
- Wastewater treatment method

Mining, oil and gas

- Coal mine waste gas
- Oil and gas fugitives

Transport

- Aviation transport
- Land and sea transport

Opportunities for the land sector:

Avoided Deforestation

- Avoided clearing of native regrowth

HIR

- Human-Induced regeneration of a permanent even-aged native forest V1.1

Other Agricultural [ex. Soil Carbon]

- Animal effluent management method
- Beef cattle herd management
- Reducing greenhouse gas emissions by feeding dietary additives to milking cows
- Reducing greenhouse gas emissions by feeding nitrates to beef cattle

[33] Source: Accessed 25 July 2023 [ACCU Scheme methods] Australian Government: Clean Energy Regulator, Emissions Reduction Fund - https://www.cleanenergyregulator.gov.au/ERF/Pages/Method-development.aspx

- Reducing greenhouse gas emissions from fertiliser in irrigated cotton

Other Vegetation [ex. AD, HIR, IFLM]

- Measurement based methods for new farm forestry plantations
- Native forest from managed regrowth
- Plantation forestry
- Reforestation and afforestation V2.0
- Reforestation by Environmental or Mallee Plantings – FullCAM
- Tidal restoration of blue carbon ecosystems method
- Verified carbon standard project

Savanna fire management

- Savanna fire management 2018—emissions avoidance
- Savanna fire management 2018—sequestration and emissions avoidance

Soil Carbon

- Estimation of soil organic carbon sequestration using measurement and models method
- Estimating sequestration of carbon in soil using default values (model-based soil carbon)

New methods: ACCU Scheme methods assumed to available to register new projects:

- Integrated farm and land management [IFLM]
- Savanna fire management - sequestration and emissions avoidance

9. APPENDIX E: ABATEMENT ACTIVITIES BY INDUSTRY

Figure A11: Take-up of abatement activities by industry

	Geopolymer Cement	Other	CCS	Gen. Fuel Switching and Elec. (heat)	Efficiency	Inert Anode	Renewable Electricity Generation	Gen. Fuel Switching and Elec. (vehicle)	Cogeneration	Hydrogen	N_2O Reduction	Electrification – Heat	Waste Utilisation	Biochar	Biofuel	Electrification – Vehicle	DRI	Leak Detection and Repair	Compressor Electrification	Flaring Reduction	Coal Mine Methane Drainage	VAM Oxidation	Abandoned Coal Mine Methane Management	Coal to Gas Switch	Mechanical Vapour Recompression
Fossil Fuel Electricity Generation					x		x																		
Rail Freight Transport		x			x					x					x	x									
Rail Passenger Transport					x					x					x	x									
Air and Space Transport		x			x			x							x										
Water Freight Transport					x			x																	
Water Passenger Transport					x			x																	
Alumina Production					x		x			x		x												x	x
Aluminium Smelting					x	x																			
Basic Ferrous Metal Manufacturing (Iron Smelting and Steel Manufacturing)			x	x	x							x	x	x			x								
Basic Ferrous Metal Product Manufacturing				x																					
Coal Mining		x			x		x	x													x	x	x		
Oil and Gas Extraction		x			x													x							
Gas Supply		x			x													x	x						
LNG			x		x		x											x	x	x					
Glass and Glass Product Manufacturing				x	x					x		x	x												
Other Non-Metallic Mineral Manufacturing				x	x									x											
Bauxite Mining					x		x	x																	

Mining of Copper ore, Gold ore, Mineral Sand, Nickel ore, Silver-Lead-Zinc ore, Other metal ore					x		x	x																	
Iron Ore Mining			x		x		x	x																	
Other Basic Chemical Manufacturing				x	x																				
Pulp, Paper and Converted Paper Product Manufacturing				x	x																				
Grain Mill and Cereal Product Manufacturing				x	x				x																
Basic Polymer Manufacturing				x	x																				
Fertiliser and Pesticide Manufacturing				x	x					x	x														
Copper, Silver, Lead and Zinc Smelting and Refining				x	x																				
Other Basic Non-Ferrous Metal Manufacturing			x	x	x																				
Petroleum and Coal Product Manufacturing			x		x																				
Water Supply, Sewerage and Drainage Services				x	x																				
Waste Collection, Treatment and Disposal Services				x	x																				
Cement, Lime, Plaster and Concrete Product Manufacturing	x		x	x	x																				
Road Freight Transport					x			x																	

Source: RepuTex Energy, 2023

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ABOUT REPUTEX

Established in 1999, RepuTex is a leading provider of modelling services for the Australian electricity, renewable energy, and emissions markets. Our forecasts and analysis have been at the forefront of energy and climate thinking for over two decades. We have worked with over 150 customers across Asia-Pacific, including government policymakers, regulators, large energy users and large emitters, project developers and investors.

RepuTex has offices in Melbourne and Hong Kong, with a team of analysts with backgrounds in energy commodities, policy, meteorology, and advanced mathematics. The company is a winner of the China Light and Power-Australia China Business Award for energy and climate research across Asia-Pacific.

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