Institute for Energy Economics and Financial Analysis

Briefing Note

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Not so hard to abate

Unlocking Australia's cost-effective path to industrial decarbonisation

- *Many opportunities to reduce industrial emissions while delivering cost savings remain untapped, including: energy efficiency, low grade heat and underground mine electrification, renewables in remote sites, clinker substitution in cement, and capturing fugitive methane emissions.*
- *Many of those opportunities can deliver material benefits to industry beyond cost savings, including improved productivity, better working conditions for employees and enhanced energy security.*
- *Australia lags other industrialised countries on their uptake due to a range of barriers and lack of effective policy incentives. Reforming the Safeguard Mechanism and introducing complementary policies in line with what has worked overseas could put Australia back on track.*

Introduction

As the federal government reviews the Safeguard Mechanism — Australia's primary policy to reduce industrial emissions — public debate on what is actually achievable in industrial decarbonisation has intensified. BHP's Australian president Geraldine Slattery declared in March that, "decarbonising large industrial sectors depends on technologies that are not yet commercially viable at scale, rely on immature supply chains, or lack established markets". Meanwhile, the federal government argues that the transition is in Australia's economic interests and vital to ensure its industry remains competitive.

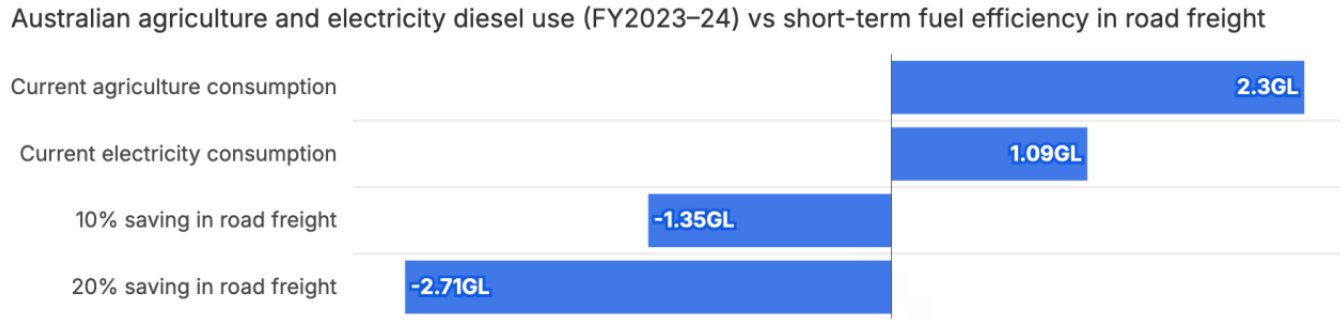
While some technologies required to decarbonise industry are still emerging and costly, this briefing note identifies several opportunities — "low-hanging fruit" — that could deliver immediate emissions reductions, cost savings and a range of other benefits. It reviews these benefits, the barriers to their implementation, and what Australia can learn from other countries.

Energy efficiency

There is ample evidence that energy efficiency can deliver significant benefits to Australian industry. Sustainability Victoria found that food and beverage manufacturers can achieve substantial energy savings through measures that pay for themselves in less than two years — for example, through heat recovery or metering high-energy equipment. The New South Wales (NSW) Gas Efficiency Improvement Program, which began in 2015, supported 51 businesses to cut gas use by roughly 300,000 gigajoules (GJ) a year, triple its target. A NSW study found that 80–90% of the energy going into compressed air systems was wasted, with leaks alone accounting for 30–65% of air produced. Across 49 sites, six-month payback measures more than halved energy costs. Anecdotal case studies show energy savings exceeding 90% can be achieved from simple upgrades — such as fixing missing pipework and rightsizing equipment.

Material energy efficiency improvements can often be delivered in a short time frame. For example, IEEFA recently found that short-term behaviour, process and technology improvements could reduce diesel use by 10–20% in road freight. Similar savings are available in the mining sector. This could materially contribute to alleviating cost and supply pressures in the context of the Iran crisis.

Figure 1: Short-term efficiency gains in road freight can deliver big diesel savings



Source: IEEFA, Efficiency first: How Australia's freight industry can lead on cutting diesel risk

Improving energy efficiency in industrial facilities can deliver other benefits, including:

- Improved process stability and reduced downtime.
- Reduced material and resource inputs as well as waste volumes.
- Reduced maintenance costs.
- Improved process control.
- Enhanced output consistency and quality.
- Improved indoor conditions, resulting in better worker health and wellbeing.

For every dollar saved on energy, these benefits can add up to more than one additional dollar in value for the business.

The International Energy Agency (IEA) identified process optimisation and energy management as the most promising measure to accelerate efficiency progress in the industrial sector for advanced economies. However, Australia had the lowest number of companies with ISO 50001 energy management certification, according to an American Council for an Energy-Efficient Economy (ACEEE) review of the 25 highest energy-consuming countries. Only 29 Australian companies or 0.02% have ISO 50001 certification, the international standard for industrial

energy management. This compares to more than 24,000 companies certified in Germany, with an 11% participation rate. IEA analysis of more than 200 companies that implemented the standard found they achieved 11% energy savings on average in years one to three, rising to 25% in years seven to nine, with many of the measures low or no cost.

ACEEE rated Australia 0/8 on energy management policy criteria. These include establishing voluntary agreements with manufacturers, providing financial incentives for energy efficiency, requiring industrial facilities over a certain size to employ energy managers and conduct regular energy audits, providing access to energy management expertise to smaller companies, and encouraging the adoption of energy management standards.

Many jurisdictions have implemented energy management regulations for high-consuming companies, including China, the European Union, Indonesia and Mexico. Other countries, such as the US, Canada and Saudi Arabia, rely on voluntary schemes.

Australia's former Energy Efficiency Opportunities (EEO) program showed what could be achieved with government support. The rate of energy efficiency improvement in industrial sectors increased from a historic average of 0.4% to 1.3% during the first three years of the program, in line with international best practice. A study found that the activity correlating with the highest increase in energy savings was regular analysis of energy data. However, the program finished in 2014, and nothing has filled the gap since then.

Overall, ACEEE ranked Australia 18th for industrial energy efficiency with a score of 8.5/25. The only countries ranking below Australia were: Saudi Arabia, Brazil, Mexico, South Africa, Russia, UAE and Egypt, while 6 European and Asian countries scored over 20/25.

Electrification

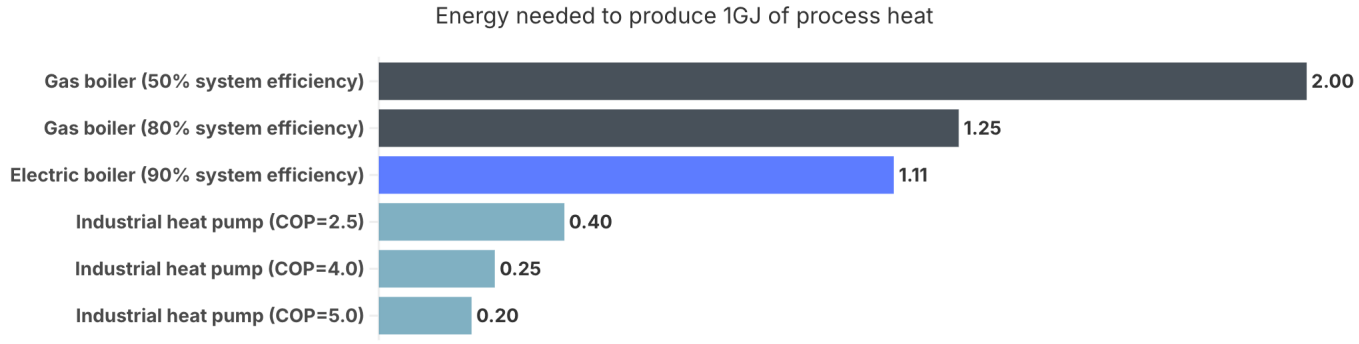
Low-grade heat electrification

IEEFA previously identified that commercially available industrial heat pumps (IHPs) could cut energy use by 80–90% in the food and beverage sector, and be highly profitable. About half of the opportunity is in Victoria, potentially cutting industrial gas use by 36% in 10 years in a state that is facing the possibility of gas shortages. The government's industry sector plan also identifies that IHPs are an immediate decarbonisation opportunity for low grade heat.

IHPs are attractive because they are highly efficient. For each unit of electricity they use, they can typically produce 2.5-5 units of heat. In contrast, traditional gas boilers typically consume more gas than heat produced (Figure 2). In the food and beverage sector, 45% efficiency is common due to losses through steam distribution systems, or because higher heat is generated than required. IHPs can slash those losses through decentralised systems closer to the point of use.

In Australia's food and beverage sector, case studies found that the implementation of heat pumps delivered financial savings, as well as significant other benefits, such as reduced water and chemical use, improved automation and throughput, reduced refrigerant risk, increased redundancy, increased comfort and marketing and brand benefits.

Figure 2: Gas boilers vs industrial heat pumps by efficiency of delivered heat



Source: IEEFA, Industrial heat pumps key to addressing excess gas demand

Despite these benefits, the implementation of IHPs is still emerging in Australia. A few small-scale programs are trying to accelerate their uptake through financial support for feasibility studies or deployment. IHPs are also eligible for deployment co-funding through ARENA's Industrial Transformation Stream and the NSW Low Emissions Industry Program.

But large-scale IHP deployment faces a range of challenges, including: long paybacks (5–10 years in the case studies mentioned above), lack of decarbonisation plans for industrial facilities, supply and skills gaps, lack of metering and monitoring to support effective design, access to capital and cost, and timelines for grid augmentations.

In contrast, the New Zealand government estimated a quarter of the country's potential for IHPs had already been captured by early 2025, leading to a material shift from gas and coal to electricity in the food and beverage sector. This success was achieved through a comprehensive government program, which included financial support (for decarbonisation plans, technology demonstration and technology deployment), information and capability building, industry engagement and the development of comprehensive datasets.

Similar assistance is needed to unlock the opportunity in Australia, including financial support that not only targets IHPs but also enablers such as:

- The development of comprehensive decarbonisation plans.
- The implementation of metering and monitoring equipment.
- Measures to reduce the cost of electricity for industrial consumers, including cost-effective grid connection processes.

Mining electrification

Full electrification of underground mines is a promising short-term opportunity. In underground mines, a large share of the fixed equipment is already electrified, but most mobile equipment runs on diesel. The Electric Mine Consortium, a large, industry-led collaboration with a strong focus on Australian mining, found that battery electric vehicles (BEVs) for underground mines were commercially available in Australia for most classes. They have been trialled domestically, for example, at South32's Cannington mine and at AngloGold Ashanti's Sunrise Dam mine.

The consortium highlighted multiple benefits, including that BEVs "are quieter, generate less dust, and generate less heat than their diesel-powered equivalents". This can generate major

electricity consumption savings from reduced ventilation requirements. A 2024 feasibility study at the Cosmos mine in Western Australia (WA) showed the mine's electricity consumption with a fully electrified fleet would be lower than with a diesel fleet due to the cooling and ventilation savings. A shift to BEVs also significantly improves working conditions, which could be valuable for employee retention in a tight workforce environment.

Haul truck electrification is also emerging in open-cut mines. While several large mining companies have delayed their electrification plans, recent analysis suggests electrification could be highly attractive financially.

Despite these benefits, Australia lags Canada, where 15–30% of new haul trucks were BEVs in 2024. Their deployment is supported by tax incentives to help overcome the capital cost barrier for BEVs, which are typically more expensive upfront while delivering operating cost reductions. Other challenges include sourcing sufficient affordable electricity and charging infrastructure, undifferentiated underground mine ventilation regulations, and fragmented and misaligned government incentives.

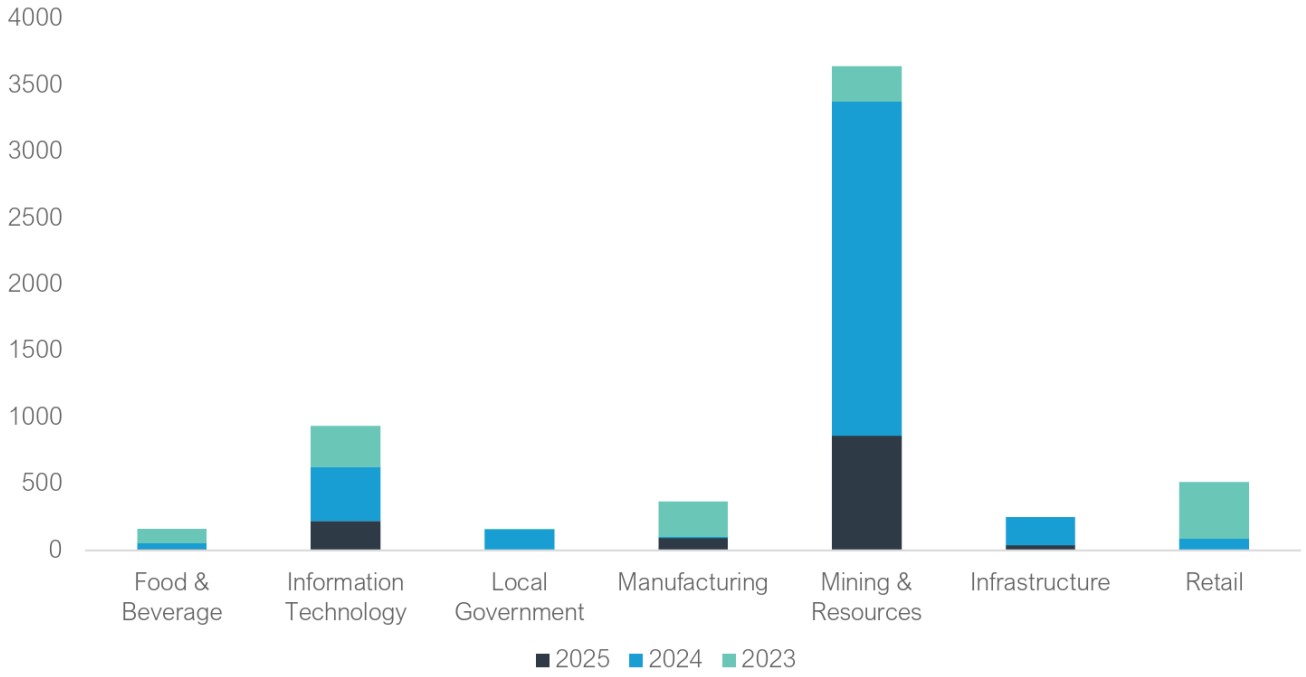
Changing a mine's design to support electrification can also deliver significant financial benefits. BHP's Prominent Hill underground copper mine reported double-digit reductions in operation costs and emissions, and similar increases in productivity, by replacing diesel trucks with an electric hoist lifting rock up a shaft. The investment was critical to the long-term future of the mine, boosting output by 30% by opening up new reserves inaccessible to the diesel truck fleet. In Tasmania, Grange Resources is delivering significant financial and environmental benefits by shifting from open-cut to underground operations. The shift will enable the electrification of operations, with an electric crushing system, electric conveyors and electric loaders, which will reduce long-term unit operating costs by 30% and emissions by 80%.

Finally, for machines that only work within a limited radius at open-cut mines (such as electric drills, draglines and shovels), tethered electric equipment has been in use for decades. The availability of electricity supply, the geography of the pits and the relative price of electricity compared to diesel are key factors deciding whether electric or diesel equipment is more advantageous. The Climate Change Authority (CCA) identified battery or tethered ancillary fleet as an immediate opportunity to increase mining electrification. Iron ore miner Fortescue already operates 15 electric excavators, and ordered more than 50 electric drill rigs in April 2025 in its journey to full electrification.

Off-grid renewables

Since 2023, mining and resources companies have been the largest buyers of corporate renewable power purchase agreements (PPAs) by far (Figure 3). In mining, renewable powered facilities are increasingly common, particularly in off-grid locations where expensive diesel generation has traditionally been favoured.

Figure 3: Corporate PPAs by sector, 2023–2025, megawatts (MW)



Source: Business Renewables Centre Australia, Corporate Renewable Power Purchase Agreements in Australia

Several projects, such as the Bellevue Gold mine and the Kathleen Valley lithium mine, now average above 80% renewables generation through a combination of wind, solar and batteries. BHP Mitsubishi Alliance (BMA) recently committed to sourcing 100% of its forecast electricity demand from renewables through CleanCo, Queensland's publicly owned energy generator and retailer. While projects required government support in the past, large projects are now going ahead through private build-own-operate arrangements, which mean the miners do not need to cover the upfront capital costs.

According to remote power specialist Zenith Energy, miners are shifting to renewables to "reduce exposure to diesel costs and logistics, improve energy security and support emissions reduction targets". Bellevue Gold has cut its diesel exposure, with the fuel comprising just 1.3% of its total project costs, among the lowest in the sector. This has protected it from diesel supply issues affecting other mining operations during the Iran conflict. Diesel users are particularly exposed to oil shocks given that Australia is the world's largest importer of diesel, representing 10% of global net seaborne trade, and that diesel prices have experienced significantly larger spikes than crude oil and petrol during the crisis.

A lot more can be done to accelerate the shift to renewables at remote mines. In WA's Pilbara region, the source of about 40% of the state's greenhouse gas generation, renewables account for just 2% of electricity generation. Meanwhile, some companies have retreated from renewables, including BHP abandoning a 500MW wind, solar and battery plan in 2025.

The WA and federal governments are working with industry on co-ordination of infrastructure provision to avoid the expensive replication of islanded fossil fuel grids in the Pilbara. The Pilbara Energy Transition (PET) plan identified four priority transmission projects to facilitate the connection of renewable resources to industrial sites, with those projects then allocated concessional financing. The Clean Energy Finance Corporation assessed that a common user infrastructure approach to the Pilbara's renewable electrification journey could save AUD31 billion in electricity system costs over 25 years.

However, this initiative only lowers the barriers to connecting renewables. There are no renewable targets for the Pilbara, no mandates for renewable procurement or comprehensive penalties for fossil fuel generation. The only constraint is through the Safeguard Mechanism when off-grid generation is integrated into covered facilities.

In contrast, Chile implemented a 2050 National Mining Policy in 2022, with the objective that 90% of electricity contracts in the mining sector would come from renewable sources by 2030 and 100% by 2050. The target has been embraced by many mining companies: Compromiso Minero, a coalition of mining companies including BHP, Rio Tinto and South32, has committed to achieving 90% renewable electricity by 2030. BHP achieved 100% renewables at its Chilean operations in 2022, and continues investing in matching renewable generation to its growing electricity needs there.

Clinker substitution in cement

When producing cement, up to 90% of emissions come from the intermediate product, clinker, of which about 60% are an unavoidable byproduct of raw materials transformation. Yet clinker content can be reduced by blending it with supplementary cementitious materials (SCMs), including in downstream concrete. SCMs can be recycled materials such as slag and fly ash (byproducts of coal power generation and steel production), natural products such as limestone or lower-emissions alternatives such as calcinated clays (15–20% of the emissions of clinker), all available in Australia. Some products cost more than clinker, but others such as limestone do not.

Australia produces about 5 million tonnes a year (MTPA) of clinker, and imports an additional 3–4MTPA. The national average ratio of 84% clinker to cement could be significantly reduced closer to the 71% global average. Novel cements have achieved much lower ratios, such as limestone calcined clay cement (LC3) at 50%.

The main barriers to reducing the clinker-to-cement ratio are product standards that prescribe the composition of building materials. The EU reformed its cement standard in 2021 to allow significant reductions in clinker content. The average clinker content in cement in Germany, for example, dropped from 83% in 1990 to 69% in 2023.

Using performance-based specifications would provide more flexibility on the clinker ratio without compromising safety, and could enable improvements in material efficiency and circularity more broadly.

Methane

Fugitive methane emissions capture is another example of a low-cost or even cost-beneficial opportunity not being taken up by industry. Large volumes of methane (the main ingredient in fossil gas) escape into the atmosphere during the extraction of coal and gas, and through gas pipeline and storage leaks. These fugitive emissions have an outsized effect on global warming, with methane responsible for nearly 30% of the rise in global average temperatures even though it represents a much smaller fraction of global emissions, due to its high warming potential.

IEEFA previously found that existing technologies could reduce Australia's fugitive methane emissions by about two-thirds. Those technologies are particularly low cost in the oil and gas sector, where the opportunity mostly consists in deploying best practice equipment and processes to reduce leaks. One example is shifting from gas-driven compressor stations to more modern electric-driven stations. Santos and Beach Energy recently reached final investment decision on such a project in the Cooper Basin, with a forecast internal rate of return of more than 15%. It will also debottleneck production and reduce emissions by about 40 kilotonnes of CO_2e a year.

The IEA estimates more than half of oil and gas methane emissions could be cut at a net financial benefit due to the fact the recovered gas can be used or sold. In total, 97% of methane emissions could be cut at a cost below USD20/t of carbon dioxide equivalent (CO_2e) (~AUD28/tCO_2e), well below the cost of Australian Carbon Credit Units (ACCU), which was AUD38/tCO_2e on average in Q2 2026.

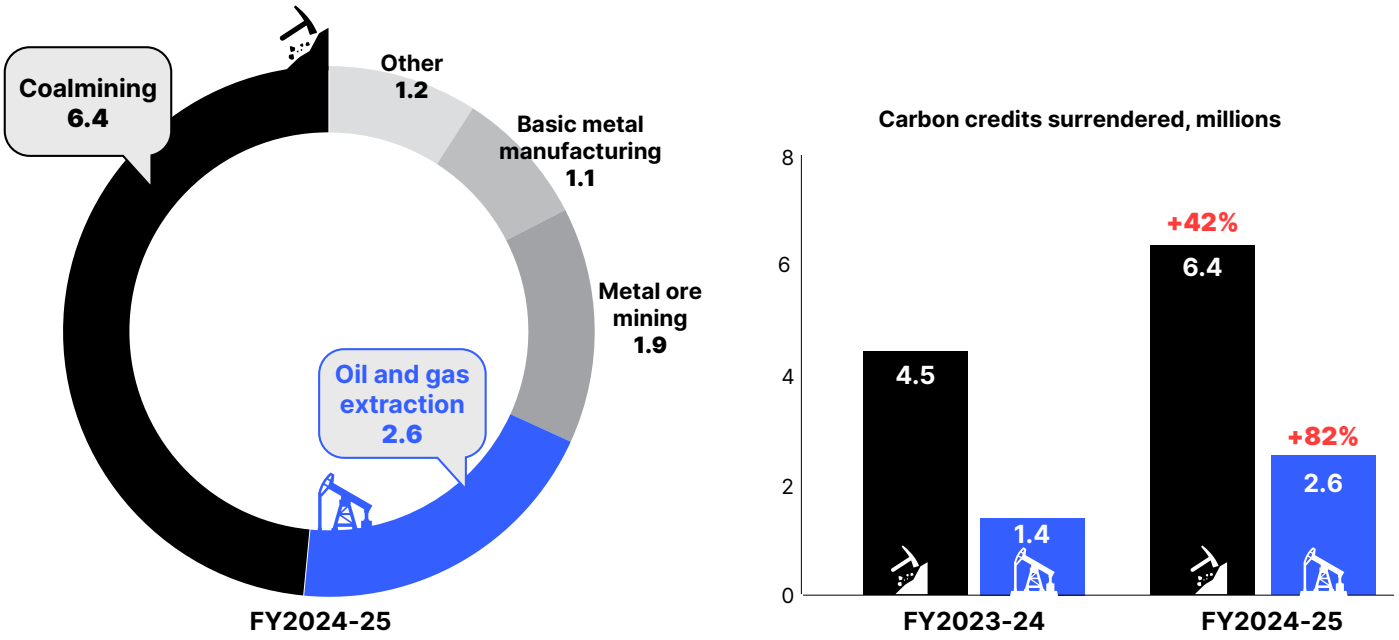
When it comes to coalmining, the technology varies depending on the type of mine. For underground mines, the main opportunities lie in abating ventilation air methane (VAM), detecting and repairing leaks, and enhancing methane drainage. For open-cut mines, the main opportunities are methane pre-draining, and reducing production at methane-intensive mines. Rystad found that most fugitive methane emissions could be abated at a cost below AUD30/tCO_2e, with a net cost of about AUD1/t of coal or about 0.5% of revenue levels. CSIRO found that 6MtCO_2e a year could be abated at a cost of less than AUD11/tCO_2e.

The costs could be even lower should suspicions of systemic underreporting prove correct. Indeed, the cost of the equipment would stay the same while the value of the methane recovered would increase.

Captured methane has a material value. IEEFA estimated that about 76 petajoules (PJ) of methane was recoverable annually, more than the total volume of gas used for electricity generation in FY2025–26 in the National Electricity Market (NEM). This had a value of about AUD950 million based on 2024 prices. Several coalmines have started to use captured methane to displace onsite diesel use or to generate electricity to power their operations.

Despite this potential, most companies are not taking action to increase their methane capture. Instead, coal, oil and gas producers are largely relying on carbon credits to meet their requirements under the Safeguard Mechanism. Recent IEEFA analysis found that the two sectors combined represented more than two-thirds of carbon credits surrendered in FY2024–25 (Figure 4). The use of carbon credits grew strongly year on year; coalmining by 42% and oil and gas extraction by 82%.

Figure 4: Coal, oil and gas producers are the largest, and fast growing, users of carbon credits



Source: IEEFA, The coal-fired carbon credit market

Stronger government intervention is required to unlock this opportunity, including by urgently fixing methane measurement and Safeguard Mechanism issues, and reforming or introducing regulation and price signals to drive action. NSW is leading on introducing VAM restrictions but the long phase-in period means it may have a limited impact on emissions.

In comparison, China recently tightened its regulation of underground coalmining methane emissions, which represent about 80% of its fugitive coal methane emissions. It mandated methane capture above certain concentrations from 2025 for new mines and from 2027 for existing mines. The government also created a pathway for mines not covered by regulation to earn carbon credits for methane reduction.

Conclusion

This report highlights many untapped opportunities to reduce industrial emissions in Australia. Several of these "low-hanging fruit" would deliver cost savings to businesses, and others would come at a lower cost than carbon offsets to meet Safeguard Mechanism requirements. These opportunities would also bring significant additional benefits, such as productivity improvements, better working conditions for workers, and improved energy security. Despite these factors, those opportunities are not being taken up because of a range of barriers, including tight competition for allocation of capital, electricity supply challenges and low business priority.

The Safeguard Mechanism has not been effective at driving uptake of these opportunities, with recent analysis showing that covered industrial facilities only reduced their emissions by 0.4%, while fossil fuel facilities increased their emissions by 0.2%, relying instead on carbon credits to meet their requirements. Reforming the Safeguard Mechanism to constrain the use of offsets, especially when companies have access to emissions reduction opportunities at a lower cost, will be an important first step in accelerating industrial decarbonisation.

However, complementary policies are likely to be required, for sectors and facilities not covered by the Safeguard Mechanism, as well as to help overcome other barriers. This note identifies policies that have been implemented successfully by other countries, including:

- Energy management policies
- Financial incentives for IHPs, mining BEVs and decarbonisation plans
- Cement standards update
- Mining renewable electricity targets
- Methane capture requirements.

Material reductions in industrial emissions could be achieved by 2035 and make Australia's industry stronger and more competitive internationally. But it requires stronger and broader policy intervention than the existing framework provides.

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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