LETA

Low Emission Technology Australia

Upstream Clean Coal Technologies

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OVERVIEW

1. Setting the context
2. Why methane matters
3. LETA's investments in methane abatement technologies
4. Why this is important for APEC economies
5. Policy and market drivers

AUSTRALIA'S ENERGY RELATIONSHIP WITH ASIA-PACIFIC

- Australia has been a major supplier of high-quality black coal to Japan, Korea, China, and other economies in the region.
- Australian coal has supported industrial development, electricity generation, and economic growth across the Asia-Pacific.
- These trade relationships = long-standing, stable, and underpinned by mutual trust and investment.
- APEC economies are committed to net zero or carbon-neutrality targets in the coming decades.
- Shared challenge: maintain affordable and reliable energy and materials + rapidly reducing emissions across supply chains.

WHY METHANE MATTERS

Methane is naturally present in some coal seams and the surrounding rock strata in underground coal deposits.

When coal is mined, any remaining methane is released into the mine workings and into ventilation air streams.

For safety reasons most of the methane is pre-drained. Mines then use ventilation systems to dilute and vent methane from underground workings to the atmosphere.

These releases are known as fugitive emissions because the gas escapes during production rather than being deliberately combusted.

Fugitive methane emissions from coal mining are a significant component of the overall climate footprint of coal mining.

UPSTREAM CLEAN COAL TECHNOLOGIES

Ventilation Air Methane (VAM)

- VAM = methane present in ventilation air of underground coal mines.
- Typically contains low methane concentrations (0.1–1%).
- Because of large volume of ventilation air in coal mines VAM is a significant source of emissions in coal mining.
- Different abatement technologies are used to capture or utilise VAM.

LETA'S METHANE ABATEMENT FOCUS

Two Key Abatement Methods:

Thermal Oxidation:

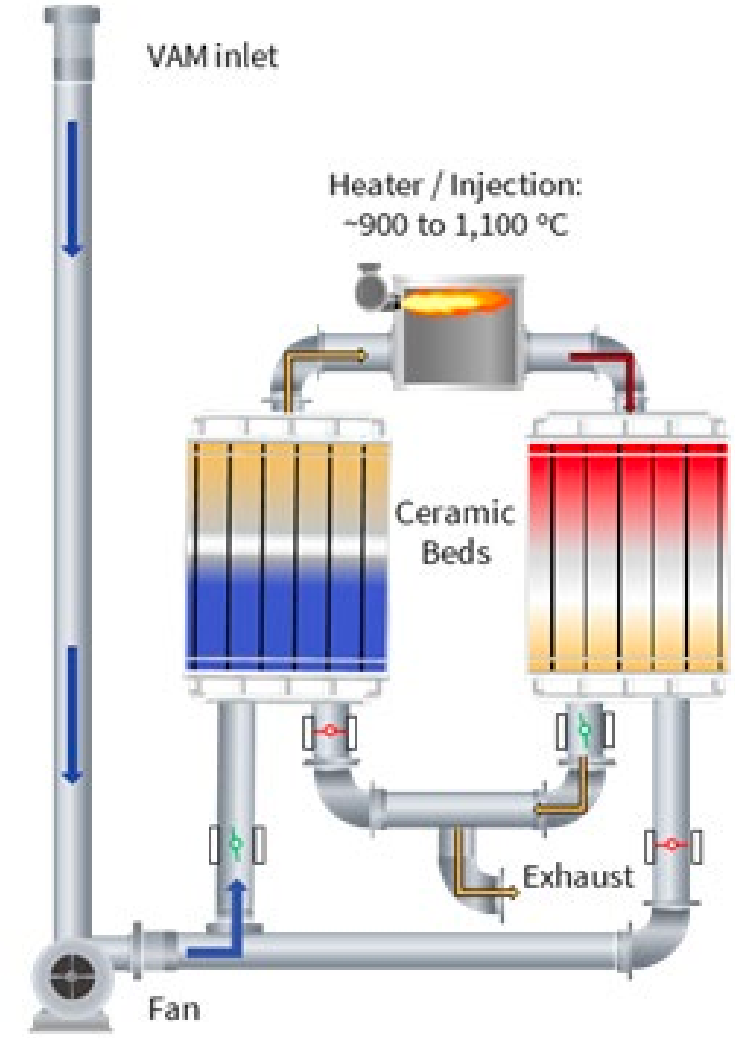
Regenerative Thermal Oxidisers (RTO):
These systems oxidise VAM at temperatures above 850°C, converting methane into CO_2 and water vapour. RTOs are highly effective in reducing methane emissions at higher concentrations but can require extra energy to sustain combustion at very low concentrations.

Catalytic Oxidation:

This process involves using a **catalyst which** lowers the temperature at which methane can be converted.

However, this is not yet a commercial technology.

REGENERATIVE THERMAL OXIDISERS (RTOs)



- Regenerative Thermal Oxidisers utilise a ceramic bed to oxidize VAM.
- Capable of operating on methane concentrations **down to 0.4%.**
- LETA is working with Anglo American on deploying an RTO at a Queensland mine site.
- Project goals:

  1. Equip the industry with a technology to safely and effectively reduce methane emissions from gaseous coal mines in line with the safeguard mechanism.

  2. Provide a project implementation methodology for other mines to follow when developing their own VAM abatement projects.

RTO: TECHNICAL AND SAFETY CHALLENGES

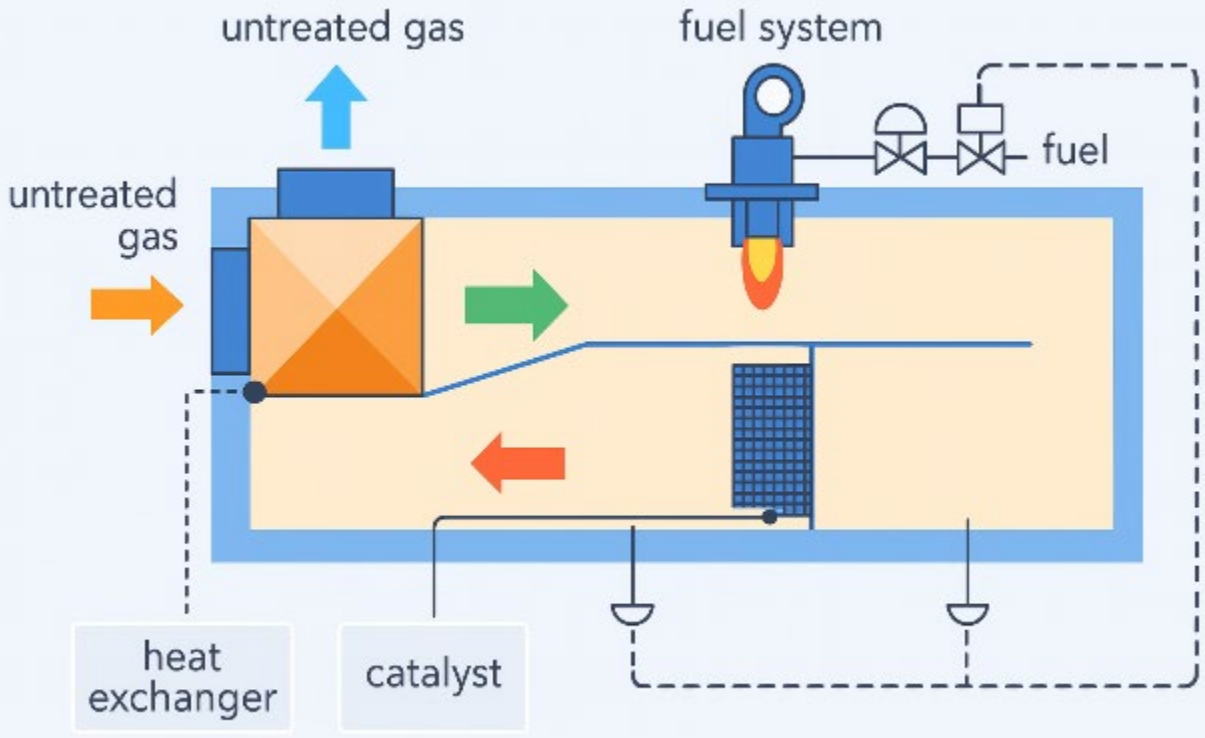
1. **Methane concentration:**
   RTOs require methane concentrations in the ventilation air to fall within a certain operating window to sustain efficient and stable combustion.

2. **Low methane levels:**
   If methane concentrations are too low, *as is often the case in Australia, where some mines have less than 0.3–0.4% methane in VAM,* the RTO may require supplementary fuel to maintain the temperatures needed for oxidation.

3. **High methane levels:**
   If methane levels are unexpectedly high, the system must safely divert or dilute the gas to prevent overheating.

4. **Fluctuating gas levels:**
   Coal mines experience fluctuating gas levels over time due to changing geology, production rates and operating conditions.

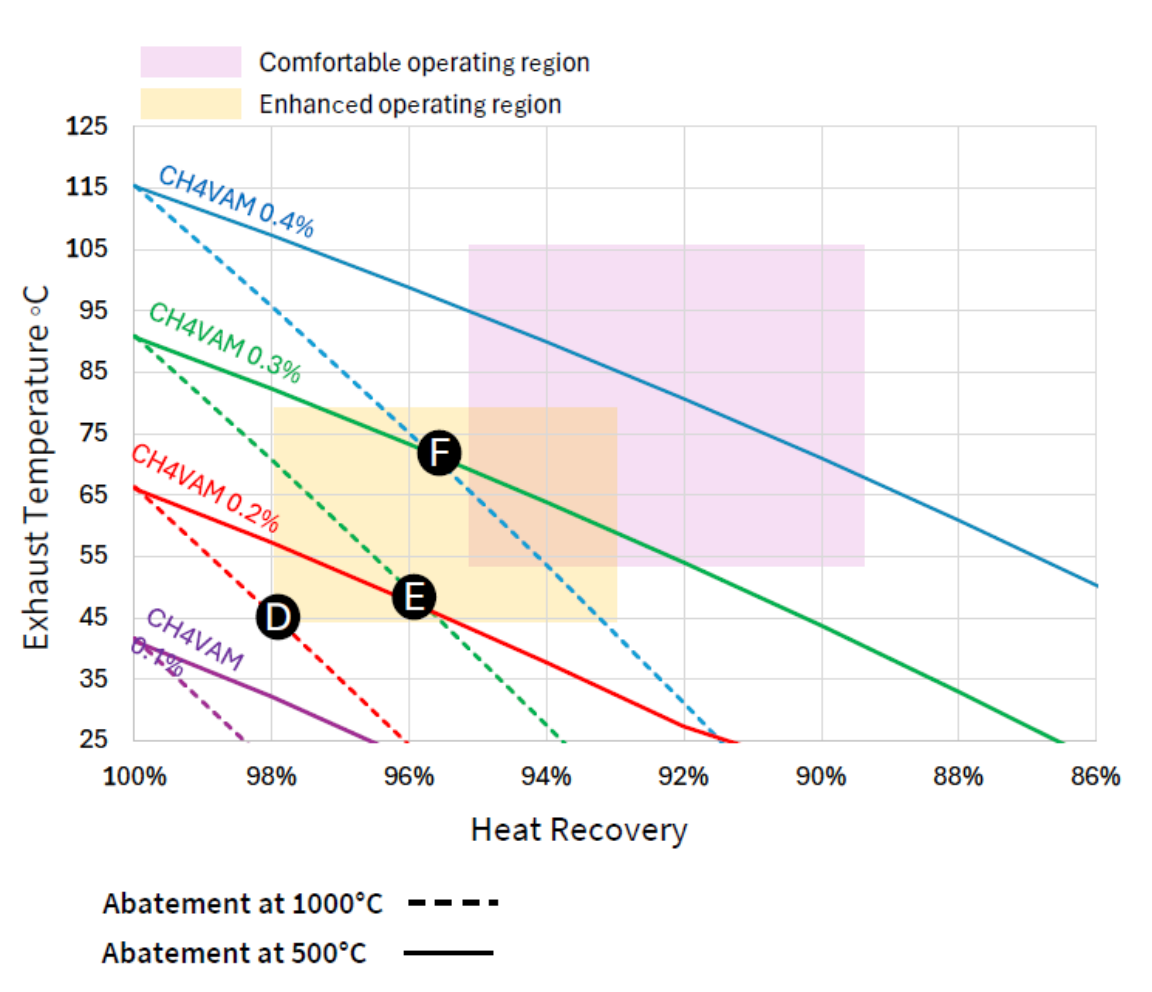
CATALYTIC VAM ABATEMENT



- Catalytic technology for VAM abatement operates in a similar manner to RTOs but employs catalysts to trigger the conversion reaction.
- This enables the system to operate at lower temperatures and lower methane concentrations.
- The catalysts are placed with the heat exchange media in the bed increasing the total column of material.
- Catalytic reactors operate at lower temperatures, ranging between 300℃ to 500℃, below the auto ignition point of methane.
- Working with Mining3, LETA is assessing the suitability of the technology for safe deployment at scale in Australia.

CATALYTIC VAM ABATEMENT

- This chart illustrates why catalytic abatement technologies will play an important role.
- The purple box represents the practical operating range of current RTO technology.
- RTOs would need greater than 98 per cent heat recovery efficiency to operate at 0.2 per cent methane concentration levels.
- This level of heat recover would be extraordinarily hard (if not impossible to achieve).



- LETA and industry partners have invested in a multi-phase program called **CATCH4 (Catalytic Oxidation of Methane)** led by the Australian company Mining3.
- The goal is to develop, test, and commercialise a catalytic oxidiser specifically designed for mine ventilation air methane.
- The program is structured in four phases, moving from laboratory research through to full-scale mine deployment.
- Phase 1, which has now been completed, involved:
  - Laboratory testing of multiple catalyst formulations under VAM like conditions.
  - Identification of catalyst materials that can consistently oxidise methane at temperatures below about 550℃.
  - Development of an initial pilot unit design and preparation of capital and operating cost estimates.

- Phase 2 of CATCH4 is now underway and is focused on field testing catalytic oxidisers at an operating underground coal mine.
- A pilot unit is being installed to treat around one cubic metre per second of ventilation air drawn from a mine duct or shaft.
- The trial will examine how the catalyst performs with real mine air that contains dust, humidity, and fluctuations in methane concentration and airflow.
- Data will be collected on methane destruction efficiency, pressure drop, maintenance requirements, and operating costs.
- If the results are positive, Phase 3 and Phase 4 will scale up to larger demonstration units capable of treating the airflow from a typical ventilation shaft.

METHANE'S CLIMATE IMPACT AND NEAR-TERM OPPORTUNITY

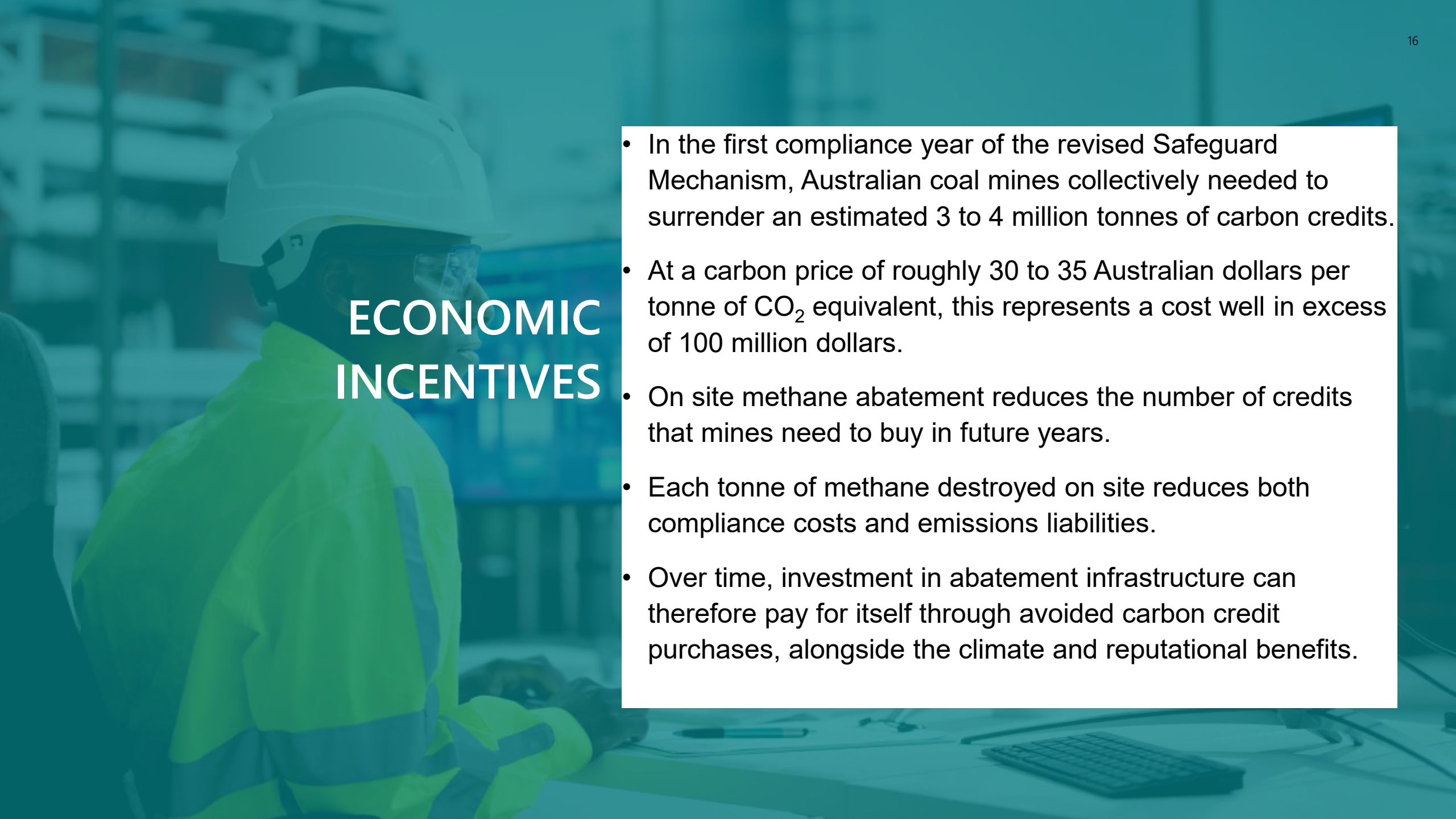
- Methane (CH_4) is a potent greenhouse gas with a much higher warming effect than carbon dioxide (CO_2) on a tonne-for-tonne basis.
- Over a 100-year time horizon, one tonne of methane has a warming impact roughly 28 times that of one tonne of CO_2.
- Methane has a relatively short atmospheric lifetime of around 10 to 12 years, compared with CO_2, which persists for centuries.
- This combination of high short-term potency and short lifetime means that cutting methane now can have a rapid and noticeable effect on global temperature trends.

BENEFITS FOR AUSTRALIAN TRADING PARTNERS

- Upstream methane abatement reduces the emissions associated with coal exported from Australia.
- Power generators and steelmakers in Japan, Korea and China can report lower scope 3 emissions when they purchase coal with a reduced upstream footprint.
- This supports their own national climate commitments and corporate net zero strategies.
- It demonstrates that traditional energy and industrial supply chains can be made cleaner through technology rather than being shut down.

POLICY AND MARKET DRIVERS IN AUSTRALIA

- Australia has strengthened its Safeguard Mechanism, which now sets declining emissions baselines for large industrial facilities, including coal mines.
- Facilities that emit less than their baseline can generate Australian carbon credit units, while those that exceed their baseline must purchase credits.
- This embeds a cost for unabated methane emissions and a value for emissions reductions achieved on site.
- Federal and state governments are also providing targeted funding and grants for innovation in methane abatement from coal mining.
- Policy signals are therefore aligned with LETA's work by encouraging investment in VAM abatement technologies and projects.



ECONOMIC INCENTIVES

- In the first compliance year of the revised Safeguard Mechanism, Australian coal mines collectively needed to surrender an estimated 3 to 4 million tonnes of carbon credits.
- At a carbon price of roughly 30 to 35 Australian dollars per tonne of CO_2 equivalent, this represents a cost well in excess of 100 million dollars.
- On site methane abatement reduces the number of credits that mines need to buy in future years.
- Each tonne of methane destroyed on site reduces both compliance costs and emissions liabilities.
- Over time, investment in abatement infrastructure can therefore pay for itself through avoided carbon credit purchases, alongside the climate and reputational benefits.

KEY MESSAGES

- Methane from coal mines is a significant but also an actionable source of greenhouse gas emissions.
- Upstream clean coal technologies, such as RTOs and catalytic oxidisers, can reduce fugitive methane emissions without compromising on safety.
- RTOs are ready for deployment in mines with suitable methane concentrations, and catalytic systems are being developed to cover low methane conditions.
- Policy frameworks and carbon markets in Australia are sending clear signals that methane emissions carry a cost and that abatement has value.
- Technologies being proven in Australian mines can be adapted and applied in other APEC economies to clean up existing coal supply chains.

CONCLUSION

- Reducing fugitive methane from coal mining is a critical and achievable step toward cleaner fossil energy operations.
- Through organisations like LETA and with support from government and industry, Australia is piloting and proving technologies that can be shared globally.
- Ventilation air methane abatement cuts emissions and strengthens the long-term sustainability of coal supply chains.
- APEC economies have an opportunity to lead on methane mitigation by collaborating on technology, standards and finance.
- Thank you for your attention. I look forward to discussing these ideas further and exploring potential partnerships.

Arigatou gozaimasu!

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