Future Proofing NSW Small to Medium Sized Industry: A Decarbonisation Roadmap

Nature Conservation Council of NSW

Final Report: Prepared by DETA Consulting

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Contents

List of Acronyms

Acronym	Full Term
AES	Australian Energy Statistics
ACCU	Australian Carbon Credit Unit
ANZSIC	Australian and New Zealand Standard Industrial Classification
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
BEAP	Bioenergy Association of Australia Programs
CEFC	Clean Energy Finance Corporation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DNSP	Distribution Network Service Provider
ESS	Energy Savings Scheme
GIDI	Green Industry Development Initiative
MVR	Mechanical Vapor Recompression
NGERS	National Greenhouse and Energy Reporting Scheme
NSW	New South Wales
SME	Small and Medium Enterprises
NCC	Nature Conservation Council of NSW
TRL	Technology Readiness Level

Executive Summary

Background and Opportunity

The Nature Conservation Council of NSW (NCC) engaged DETA Consulting to assess natural gas use for small to medium industrial enterprises (SMEs) within New South Wales, identify policy gaps, and recommend measures to support their transition to renewable energy. The findings will inform NCC's submission to the forthcoming NSW Gas Decarbonisation Roadmap highlighting opportunities to accelerate emissions reduction across SME manufacturing industries.

NSW consumes approximately 118 PJ of natural gas annually, accounting for 7.7% of Australia's total gas use. Approximately 47 PJ is used in manufacturing, with 14.5 PJ consumed by non-major gas users such as Food and Beverage, Wood and Wood Products, Textiles and Leather, and Pulp, Paper and Printing. **These businesses represent 12% of total NSW gas use and around 771 kt CO_2-e per year, yet remain outside the Safeguard Mechanisms,** leaving a critical policy and support gap in current decarbonisation frameworks.

Policy Gaps and Decarbonisation Barriers

DETA consulted with representatives across the food and beverage, forestry, energy supply and distribution sectors, as well as independent industry advisors. These consultations revealed common barriers to decarbonisation across New South Wales's SME manufacturing base.

Rising energy costs leading to a declining international investment appetite have made it increasingly difficult for renewable and electrification technologies to compete on capital cost and payback terms. Existing federal and state policies largely prioritise emissions reduction from large emitters and grid-scale projects, leaving SMEs with fragmented policy settings, limited access to capital and technical guidance, and low workforce readiness.

Without coordinated policy intervention, there is a risk that accelerating legislative requirements for decarbonisation may drive multinational SMEs offshore to more cost-effective jurisdictions with negative impacts on regional employment and NSW industrial productivity.

Modelling Insights

DETA modelled sector-level technology adoption pathways, matching process heating needs to commercially available low-emissions alternatives.

Under the business as usual (BAU) scenario, which assumes continuation of current policies and market conditions, **70% of SME natural gas demand will remain in 2050. Current NSW policy however targets a 70% emissions reduction by 2035, and net zero by 2050** – leaving a large gap between target and forecast SME gas demand reductions. This reflects that neither NSW nor the Commonwealth currently anticipate a significant decline in industrial gas use, with emissions reductions instead expected to be achieved through sequestration and offsets.

Policy gaps and existing drivers for SME behaviour were identified through a review of current NSW and Federal energy policies. Several gaps were identified, with a number of policy areas recommended for development, with modelling then undertaken to assess gas demand impacts if these gaps were addressed.

Modelling Results

The analysis identifies seven key policy levers that together enable SME decarbonisation:

- **Electricity Network Readiness** – Provide targeted information to DNSPs (Ausgrid, Endeavour Energy, Essential Energy) on expected increases in SME electricity demand from electrification projects. This enables proactive grid planning, avoids bottlenecks, and ensures SMEs can access sufficient capacity when transitioning from gas.
- **Policy Alignment** – Streamline government programs and incentives across federal and state levels to reduce fragmentation. Assign SMEs dedicated account managers to help identify relevant programs and navigate eligibility requirements, reducing administrative burden and encouraging uptake.
- **Funding Opportunity Identification** – Conduct on-site energy audits and process-level assessments for SMEs, identifying high-impact efficiency and fuel-switching opportunities. This approach increases the likelihood of early adoption by providing clear investment cases for individual businesses.
- **Demand Flexibility** – Support SMEs in implementing operational measures and technologies that shift energy use to periods of low-cost, low-emission electricity. This includes grid-responsive scheduling, thermal storage, and process timing adjustments, reducing operational costs and improving renewable integration.
- **Job Growth Incentives** – Provide targeted support to expand skilled labour availability, including apprenticeship schemes for renewable processes installers, and grants for hiring local engineers and technicians. This strengthens capacity to implement decarbonisation projects and builds long-term regional technical capability.
- **Capital Support** – Offer targeted capital investment for proven renewable process heat technologies. This incentivises investment in SMEs, leverages additional private capital, and accelerates adoption in sectors with long payback periods.
- **Knowledge Sharing** – Develop collaborative forums to share best practices on renewable technologies, process heat decarbonisation and project implementation. This builds confidence, reduces perceived technical risk, and accelerates sector-wide adoption.

Modelling revealed SME decarbonisation rates are highly sensitive to grid electricity prices. Facilities with access to lower cost electricity (e.g. demand flexibility or behind the meter solar) could experience more rapid cost reductions for electrification than the modelled timeline which represents national grid prices.

Compared to the BAU scenario, modelling indicates a coordinated implementation of all recommended policies **could reduce gas use by up to an additional 7.5 PJ (i.e. 360 kt CO_2-e additional reduction), cutting total SME consumption from 14.5 PJ to 3.1 PJ by 2050**. Capital specific policies would require approximately $70 million in targeted capital, which could then unlock over $200 million in private investment, delivering long-term economic and employment benefits for regional NSW.

Recommended Natural Gas Reduction Targets

Together, these policies create a supportive ecosystem that shifts the economic needle for industrial energy use away from gas and toward renewable process heat: electrification, biomass, and biogas.

To support monitoring and accountability, this report recommends that NSW establish explicit natural gas reduction targets for SME manufacturing, based on the readily achievable outcomes relating to the proposed policy interventions:

Year	2030	2035	2040	2045	2050
Recommended reduction from 2025 levels	16%	37%	50%	64%	78%

These targets are ambitious yet feasible if recommended policies are enacted. They also highlight a critical gap in short-term reductions: while long-term decarbonisation is achievable, immediate emissions reductions remain limited because electricity emissions currently constrain the benefits of fuel switching. Accelerating early action, particularly through electrification where grid carbon intensity allows, is therefore essential to improve NSW's trajectory toward 2035 and 2050 climate goals.

Broader Implications

Beyond emissions reductions, coordinated implementation of these policies supports local job creation, strengthens SME competitiveness, and mitigates the risk of industrial relocation due to rising energy costs. By sequencing interventions—combining network readiness, capital support, workforce enablement, and knowledge sharing—NSW can drive a sustained decline in natural gas use while positioning SME manufacturers to make meaningful contributions toward state-level climate targets.

1. Introduction

1.1 Background

DETA Consulting was engaged by the Nature Conservation Council of NSW (NCC) to model natural gas demand across small to medium businesses (SMEs) in NSW, identify policy gaps, and make recommendations to inform the NSW Government's forthcoming Gas Decarbonisation Roadmap. SMEs play a critical role in NSW's manufacturing sector, contributing significantly to economic activity and employment. However, many rely on natural gas for process heat, a major source of industrial greenhouse gas emissions.

NSW's net zero commitments set ambitious decarbonisation targets, 50% reduction of 2005 emissions by 2030, 70% by 2035 and net zero by 2050. However, current policies primarily focus on large emitters, leaving SMEs with limited guidance and support. Addressing these gaps is essential to unlock sector-wide emissions reductions and facilitate the transition to renewable energy.

1.2 Purpose

This report aims to identify practical, high-impact policy interventions to accelerate the decarbonisation of natural gas use in SME manufacturing. By quantifying energy demand, mapping process heat applications, and modelling technology adoption scenarios, the report provides actionable insights for government and industry stakeholders to prioritise investments, policy levers, and complimentary initiatives that can drive structural shifts toward low-carbon industrial heat.

1.3 Scope

This report focuses on small to medium enterprises (SMEs) within NSW's manufacturing sector, which includes Food and Beverage, Textiles and Leather, Wood and Wood Products, and Pulp, Paper and Printing sectors. The analysis covers:

- Assessment of current natural gas demand and its distribution across processes and subsectors.
- Identification of decarbonisation opportunities for process heat, including renewable technologies and efficiency improvements.
- Evaluation of existing policy frameworks and identification of gaps that constrain SME uptake of low-carbon solutions.
- Development of practical, actionable policy recommendations to accelerate the transition away from natural gas, including capital support, workforce development, and knowledge-sharing initiatives.

The scope excludes large-scale industrial emitters and sectors dominated by single facilities, as these are already addressed under the Commonwealth Safeguard Mechanism and other regulatory and funding schemes. These industries are generally well understood and subject to significant decarbonisation focus. The remaining sectors, primarily SME-dominated manufacturing, represent a material share of NSW's gas consumption but receive comparatively limited policy attention. This report therefore models the broad impacts of policy interventions on natural gas reduction and emissions within these sectors and provides guidance for NCC in shaping targeted policy advocacy. It is not intended to provide prescriptive operational guidance to individual businesses.

1.4 References/Informative studies

Several reports and studies were used to develop this report, including:

- Northmore Gordan – NSW Gas Demand Analysis Report (Northmore Gordan, 2021)
- ITP – The Australian Industrial Process Heat Market (ITP, 2025)
- Climate Change Commission - Net Zero Sector Pathways Review (CCA, 2025)

1.5 Methodology

The report presents each industry in order of its ANZSIC code to maintain consistency with national classification and data sources. A bottom-up approach was used to quantify natural gas use and decarbonisation opportunities across NSW SME manufacturing, focusing on ANZSEC categories sectors dominated by SMEs:

- Food and Beverage (ANZSEC Code 11-12)
- Textiles and Leather (ANZSEC Code 13)
- Wood and Wood products (ANZSEC Code 14)
- Pulp, Paper and Printing (ANZSEC Code 15-16)

Natural gas consumption was mapped using publicly available data from AEMO and NSW distributors, supplemented by sector-specific sources to estimate sub-sectoral demand where official data are limited. Energy use was disaggregated by industrial process, accounting for variations in temperature, process medium, and thermal efficiency.
Potential renewable process heat solutions were identified for each process, including:

- Energy Efficiency opportunities
- Heat pumps (air- and water-sourced)
- Electric boilers
- Electric air heaters (electric resistance, infrared)
- Mechanical vapor recompression (MVR)
- Biomass and biogas systems

Technology efficiency, capital costs, and adoption constraints informed realistic uptake projections. The model applied technology adoption curve theory to project the rate of uptake for renewable heating solutions, based on financial payback thresholds and expected investment behaviour. Three different scenarios were explored:

- Slow uptake
- Expected uptake
- Rapid uptake

Policy interventions based on a gap analysis of policy in NSW were then added to the model to explore possible outcomes of any policy changes in the state. Interventions include:

- Funding for opportunity identification

- Demand flexibility measures
- Job growth incentives
- Capital support
- Knowledge-sharing mechanisms

Further technical detail on data sources, process-level assumptions, technology mapping, and scenario modelling is provided in Appendix A – Methodology.

2. NSW Industrial Gas Context

NSW consumes **118 PJ of natural gas annually**, with manufacturing as the largest end-use sector. Major industrial emitters such as Ammonia, Iron and Steel, and Cement are regulated under the Safeguard Mechanism, **while SME-dominated sectors—including Food and Beverage, Textiles and Leather, Wood, and Pulp, Paper and Printing—consume 14.5 PJ, generating 771 kt CO_2-e and remaining largely outside federal reporting.** Limited visibility of regional gas use makes it difficult to target decarbonisation support, highlighting the need for **improved data transparency** to enable coordinated renewable and electrification strategies.

2.1 Natural Gas Consumption by Sector

In 2024, Australia emitted 520 Mt CO_2-e and absorbed 74 Mt CO_2-e, resulting in net emissions of 446 Mt CO_2-e. 75% of emissions were from the energy sector (394.4 Mt CO_2-e), with natural gas combustion contributing 20% of that (78 Mt CO_2-e) nationwide.

AES Data publicised in 2024 showed NSW consumed 118 PJ of natural gas, or 7.7% of Australia's total, generating approximately 6.3 Mt CO_2-e (AES, 2024) of energy. Figure 1 shows gas consumption by sector, with manufacturing as the largest end use. Within manufacturing, most natural gas consumption came from high-emission industries including Ammonia and Hydrogen Production (12.2 PJ[1]), Iron and Steel manufacturing (9 PJ), and Lime and Cement processing (10 PJ). These large entities report their emissions under the National Greenhouse and Energy Reporting Scheme (NGERS) and are regulated under the Safeguard Mechanism, which mandates annual emissions reductions.

In contrast, Food and Beverage manufacturing (9.2 PJ), Pulp, Paper and Printing (4 PJ), Textiles and Leather (0.74 PJ), and Wood and Wood products (0.59 PJ) together consume 14.5 PJ of gas, producing approximately 771 kt CO_2-e. These sectors are composed largely of small and medium enterprises (SMEs) that fall below federal reporting thresholds. Despite their lower individual emissions, these businesses represent the majority of industrial business entities in NSW.

[1] It was assumed most natural gas consumed in ANZSEC 18-19 Basic Chemical, Chemical, Polymer and Rubber Manufacturing is from ammonia and hydrogen production

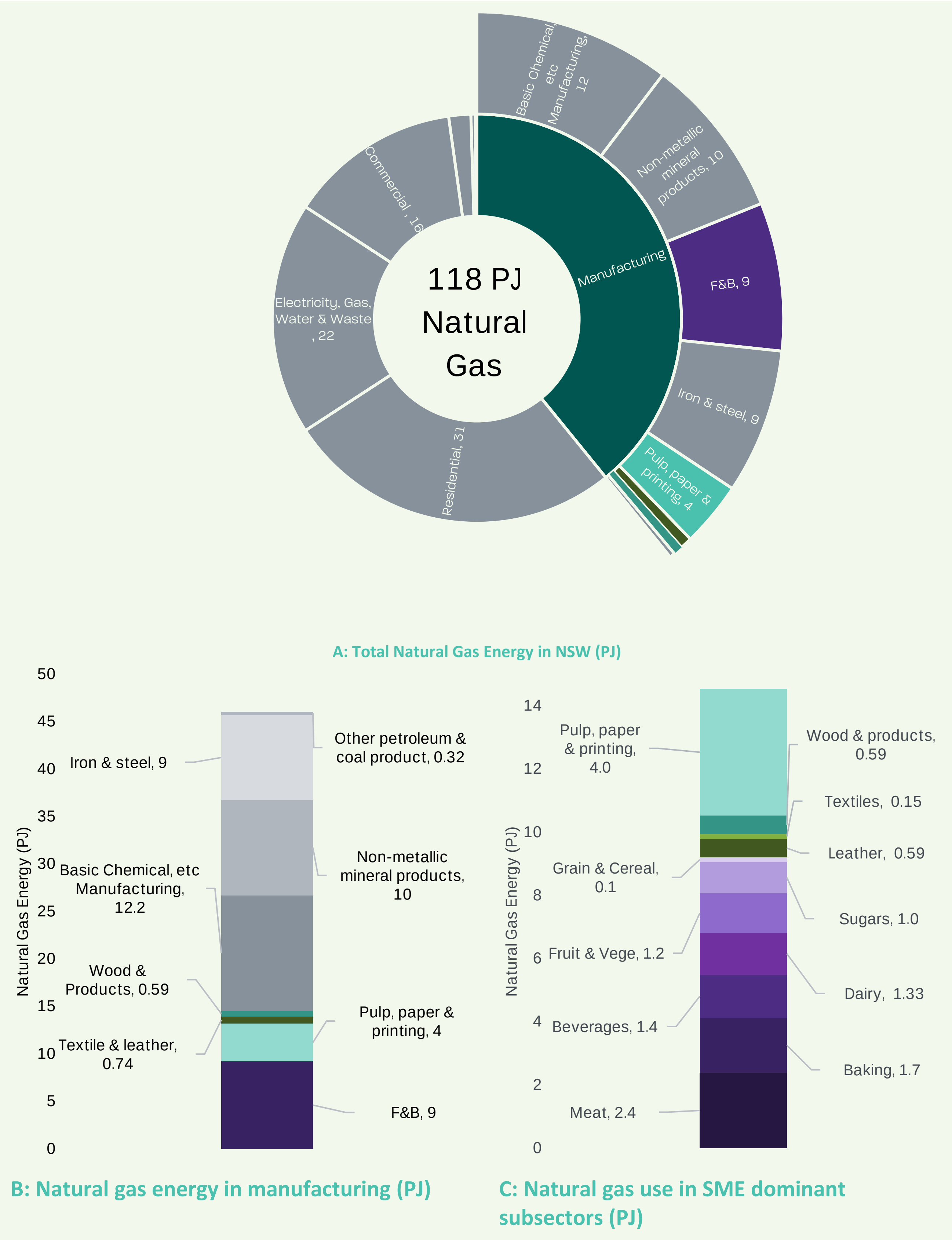

Figure 1: Infographic displaying breakdown of natural gas demand in NSW:
A: Total natural gas use in NSW (PJ),
B: Natural gas use in manufacturing (PJ),
C: Natural gas use in SME dominant subsectors.

2.2 Natural Gas Mapping

State-level data identifies total gas consumption but does not show where gas is used across NSW. Figure 2 maps the state's gas distribution network, showing how natural gas flows through major pipelines under the National Gas Rules. This data illustrates transmission routes but exclude withdrawals at distribution stations and end-use sites.

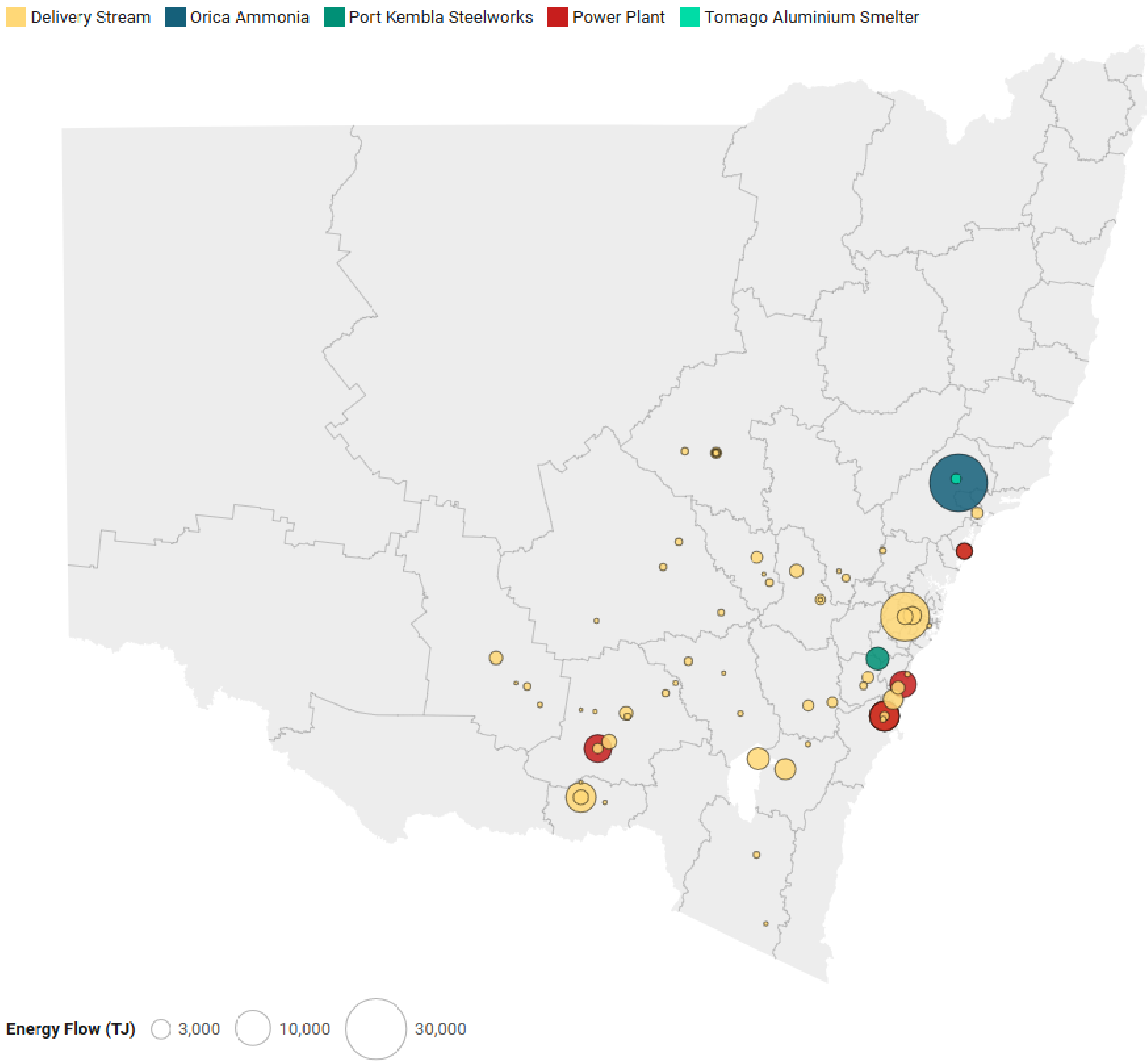

Figure 2: Natural Gas flow in NSW showing south and east regions are where natural gas is distributed.

Gas distributors such as Jemena and Australian Gas Networks collect detailed metering and flow information that captures consumption by location and volume; however, this data is not publicly available. Limited visibility of regional gas demand makes it more challenging to identify industrial clusters and plan targeted decarbonisation support. Improved transparency would allow government and industry to better coordinate infrastructure upgrades, renewable fuel deployment, and decarbonisation programs tailored to the specific technical and operational needs of each subsector.

3. Key Industry Processes

SME-dominated industries face shared barriers to decarbonisation, **including high capital costs, technical complexity, and limited access to tailored funding or guidance.** Process heating requirements differ across sectors, with low-to-medium temperature operations more easily electrified, while high-temperature processes are likely to rely on biomass or biogas under specific conditions. Accelerating adoption of renewable and electrification technologies in these sectors provides a meaningful opportunity to reduce emissions and support the broader transition to a renewable energy grid.

This section outlines the major SME-dominated industrial subsectors that rely on natural gas in NSW and examines their specific process heating requirements and decarbonisation pathways. It provides a detailed overview of the processes and energy demands within each sector to inform later discussion of feasible technology options and transition strategies. Accelerating these transitions will also support the broader renewable grid integration and preserve limited gas supply for processes without technically feasible alternatives.

3.1 Process Overview

The NSW Manufacturing sector consumes over 46 PJ of natural gas across its 29,000 businesses (Investment NSW, 2025), the majority of which are small to medium enterprises (SMEs) in Food and Beverage, Textiles and Leather, Wood and Wood Products, and Pulp, Paper and Printing processing. Approximately 20% of natural gas use across these sectors are covered under Safeguard and are subject to emissions reductions requirements. The remaining 80% of industries and emissions have limited policies to disincentivise high emissions processes or incentivise decarbonisation opportunities.

Consultations with representatives across the food and beverage, forestry, energy supply and distribution sectors, as well as independent industry advisors revealed consistent barriers to decarbonisation across New South Wales's SME manufacturing base. A consistent challenge across SMEs is the combination of competing internal investment priorities, limited organisational engagement with decarbonisation initiatives, and the technical complexity of implementing electrification or renewable fuel solutions. Technical complexity includes difficulties integrating new systems with existing process equipment, adapting operations to alternative heat sources, and ensuring reliable performance. Existing funding programs and incentives often prioritise larger or more energy-intensive sites. **As a result, SMEs face high relative costs, limited access to support schemes, and long payback periods that are difficult to justify.**

Detailed quantitative analysis of natural gas use and abatement potential by sector is provided in Appendix B. The following sections provide a breakdown of gas consumption and decarbonisation opportunities by industry, highlighting process characteristics, energy intensity, and potential pathways for transition.

3.2 Food and Beverages

Gas consumption is concentrated in meat, dairy, fruit and vegetable processing, baking, breweries, and sugar refining:

- **Meat processing** – gas-derived process heat primarily used for rendering, cooking, drying, and sterilisation; there are efficiency opportunities across the various processes, and hot water demand for sterilisation can electrify, however steam demand is harder to decarbonise.
- **Dairy facilities** – steam and hot water for pasteurisation, evaporation, and spray drying. Large-scale milk-powder production is harder to decarbonise, while smaller facilities producing drinking milk, yoghurt, or cheese are more feasible to electrify.
- **Fruit and vegetable processors** – gas-derived process heat used for blanching, peeling, frying, and drying; opportunities to improve energy efficiency through emerging technologies such as Pulse Electric Fields.
- **Bakeries** – dependent on high temperature gas fired ovens; electrification technically feasible but require complex transition opportunities.
- **Beverages** – gas-derived process heat used for boiling, and pasteurisation, which can transition to heat pumps or electric systems.
- **Sugar refineries** – distinctive because many refineries generate their own electricity and use bagasse for cogeneration; natural gas is used primarily at the start and end of the season; electrification can reduce overall demand, however external biomass supply is most viable.

3.3 Textiles and Leather

Processing is characterised by dispersed SME-dominated operations with lower aggregate gas consumption. Gas is primarily used for heating air and water in dyeing, drying, and tanning processes, operating between 30–70°C. Leather processing is concentrated in larger facilities with continuous hot water requirements, while textile operations are smaller and more fragmented. Decarbonisation pathways include small-scale electric dryers or heat pumps for low-temperature processes and chemical or mechanical process adjustments in larger operations. Access to biomass and biogas is limited, particularly for tanneries, highlighting the importance of policy support tailored to SMEs.

3.4 Wood and Wood Products, and Pulp, Paper and Printing

These sectors rely heavily on kiln drying with natural gas supplying ~25% of energy demand, supplemented by biomass in the form of onsite processing waste streams, such as saw dust. Decarbonisation potential depends on biomass availability and the integration of high-temperature heat pumps or efficiency measures, though capital costs and complexity remain significant barriers. In Pulp, Paper and Printing, natural gas provides roughly half of thermal energy, with biomass and black liquor covering the remainder. Energy-intensive processes such as pulping, bleaching, drying, and evaporation operate between 120–180°C, and more than 50% of emissions in this sector fall under the Safeguard Mechanism. While heat pumps, electric boilers, MVR, and biogas could theoretically replace gas-fired steam, retrofitting integrated mills is constrained by capital costs, operational continuity, and thermodynamic limits. Near-term decarbonisation focuses on expanding biomass use and integrating purchased biofuels.

4. Key Process Transition Options

NSW SMEs can fully decarbonise natural gas use with existing technologies, including electrification, bioenergy, and efficiency measures. Adoption is constrained by shared **challenges such as capital cost, integration complexity, and limited access to support.** High-temperature processes require bioenergy or biogas under defined conditions, while lower-temperature applications are readily electrifiable. Coordinated policy support, targeted funding, and knowledge sharing are critical to accelerate adoption and realise the full technical potential across sectors.

This section outlines the primary process heating pathways and the range of renewable technologies available to decarbonise NSW's SME manufacturing sectors. It emphasises the diversity of solutions, noting that no single technology can address all applications, and highlights the importance of context-specific choices, particularly for bioenergy, which is only considered under defined conditions (Appendix C).

4.1 Heat Delivery Mediums

Natural gas end-use in NSW manufacturing can be grouped by the end process heat medium: hot air, hot water, or steam, to reflect the type of thermal energy delivered and the temperature requirements of each process. This structure highlights where gas is used, the renewable or electrification alternatives, and the relative feasibility of deployment based on process type and facility scale. For more detailed information on hot air, hot water, and steam applications, including process-specific users, energy demand, and temperature ranges, refer to Appendix D.

Hot Air	Used for direct heating or drying applications such as kilns, ovens, and batch dryers. Gas allows small-scale systems to operate efficiently without the need for thermal distribution networks, resulting in minimal storage losses and low maintenance. Renewable or electric alternatives include heat pumps, biogas, biomass, electric resistance or ETES systems, depending on temperature and scale. Hot air is used in grain, bakery, textile and wood processing.
Hot Water	Typically generated using hot water generators or indirectly using steam, it is used for cleaning, preheating, pasteurisation, and low temperature cooking. Hot water can be stored to manage peak loads, while steam may be used where cogeneration or historical infrastructure dictates. Key decarbonisation options include heat pumps, electric boilers, and MVR, with MVR suited to higher temperature drying processes in industries like sugar, or pulp and paper.
Steam	Energy intensive operations such as cooking, drying, evaporation, and steam-injection processes primarily utilise steam to provide heat. While efficient for heat transfer, it incurs higher distribution losses, and maintenance requirements, and cannot be stored (note: small capacity buffering is possible). Renewable and electrification pathways include electric boilers or ETES, MVR, heat pumps, biomass, and biogas, with adoption feasibility dependent on process integration, facility size, and capital availability. High-temperature steam is used in meat, dairy, sugar, and pulp and paper operations, where temperatures range from 100°C to 300°C.

4.2 Decarbonisation Technologies

Across all sectors, the primary technologies available for decarbonisation include

- process efficiency improvements,
- heat pumps,
- electric boilers,
- electric air heaters,
- mechanical vapour recompression (MVR), and
- biomass and biogas boilers.

Low-to-medium temperature processes such as cleaning, sterilisation, and pasteurisation are most amenable to electrification, while high-temperature continuous processes have other options to electrification like biomass or biogas. The feasibility of each renewable heating option is dependent on a multitude of factors such as the temperature and intensity of the heat requirement, size of the facility/load, site location (i.e., proximity to fuel sources, weather conditions etc.), relative fuel costs, access to capital, and financial hurdle rates.

The pathways for renewable fuel transition in NSW manufacturing are diverse and unique to each sector, shaped by process type, temperature requirements, and facility scale. Each industry was assessed based on its specific end-use process heating requirements, temperature demand, and the appropriateness of available renewable alternative. DETA have evaluated the individual process heating duties within the key industries and evaluated the likely alternatives to these. Figure 3 summarises the technical potential of seven decarbonisation technologies—heat pumps, electric boilers, electric air heating, mechanical vapor recompression (MVR), biomass and biogas boilers, and process efficiency measures—across key subsectors, showing feasible gas abatement (GJ) at a NSW-wide level. Further technical detail and cost assumptions for these technologies are provided in Appendix E.

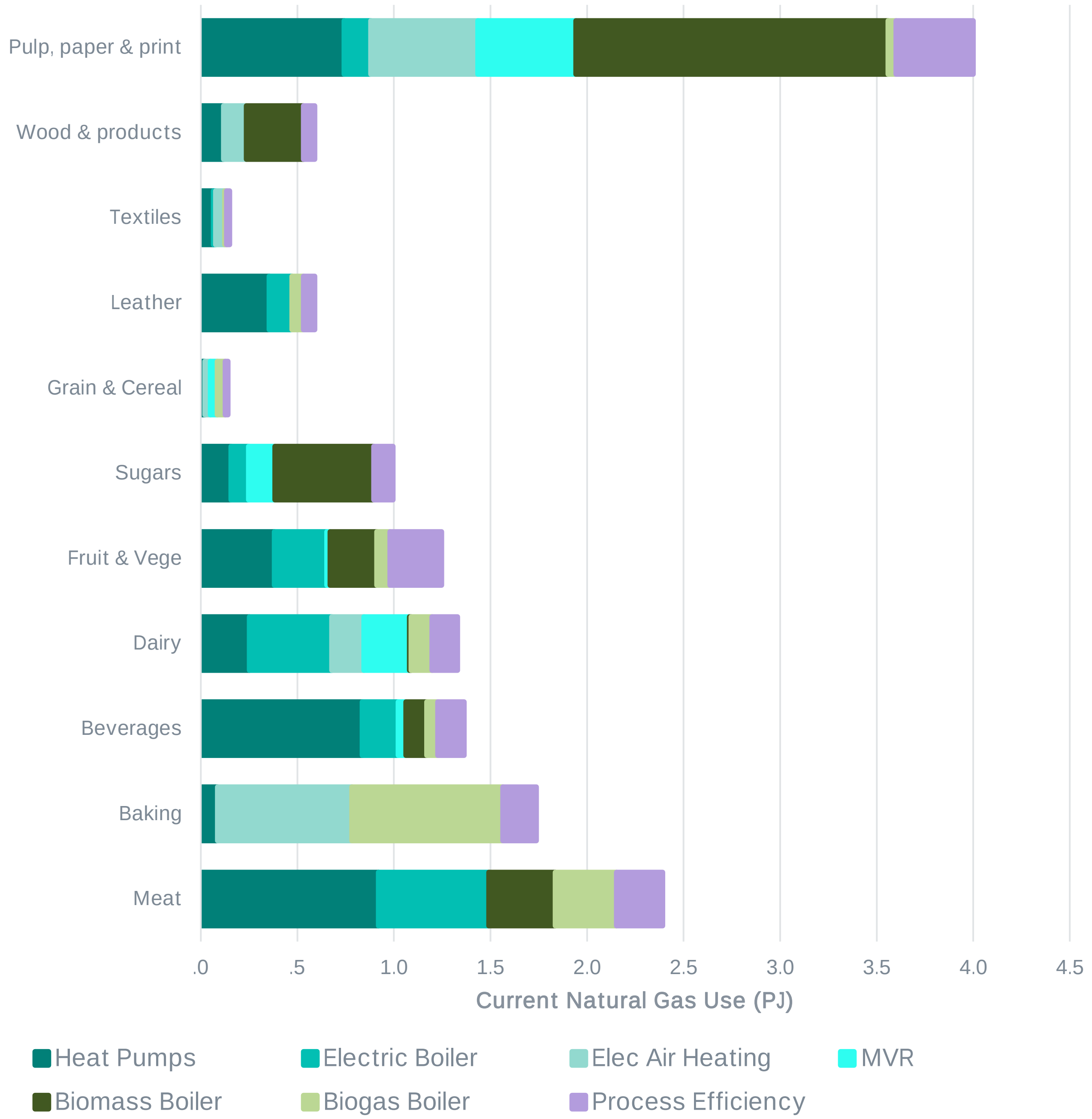

Figure 3: Breakdown of all-natural gas consumption across the subsectors, showing renewable technology potential.

Electrification technologies represent the majority of natural gas reductions across NSW SMEs. However, biomass also plays a prominent role, particularly in sectors with higher temperature processes, while biogas contributes a smaller proportion of abatement within these subsectors. It is important to note that Figure 3 reflects the technical potential for SMEs to decarbonise. The broader strategic role of biogas in decarbonising hard-to-abate industrial processes, such as large-scale chemical processing or steel production is not captured. Biogas should continue to be prioritised for applications where electrification is less feasible, consistent with NCC's position on biofuels, as outlined in Appendix C.

5. Current Decarbonisation Pathways

Minimal emissions reductions from NSW's SME manufacturing sector are expected, due to high reliance on natural gas and limited electrification. **Modelling of three scenarios – Slow, Expected, and Rapid – shows that SMEs could reduce natural gas demand between 8–65% by 2050**. Food and Beverage manufacturing offers the largest abatement opportunity, with electrification and efficiency measures delivering most reductions, while other sectors rely on biomass and incremental electrification. **Barriers including technology readiness, integration complexity, and capital costs constrain the uptake of existing technologies**.

This section explores decarbonisation pathways for NSW SMEs, using scenario modelling to quantify potential natural gas reductions across sectors. It highlights how technologies such as heat pumps, MVR, electric boilers, and biomass can be deployed depending on process requirements and operational constraints. Readers are guided through sector-specific opportunities and limitations, showing where policy or investment support could accelerate transitions.

The current Australian Net Zero Report indicates that emissions reductions from the manufacturing sector are projected to be modest under current policies, reflecting the sector's high reliance on thermal energy and limited electrification to date (DISR, 2025). Figure 4shows manufacturing emissions are expected to remain a significant contributor to Australia's overall industrial emissions through to 2050.

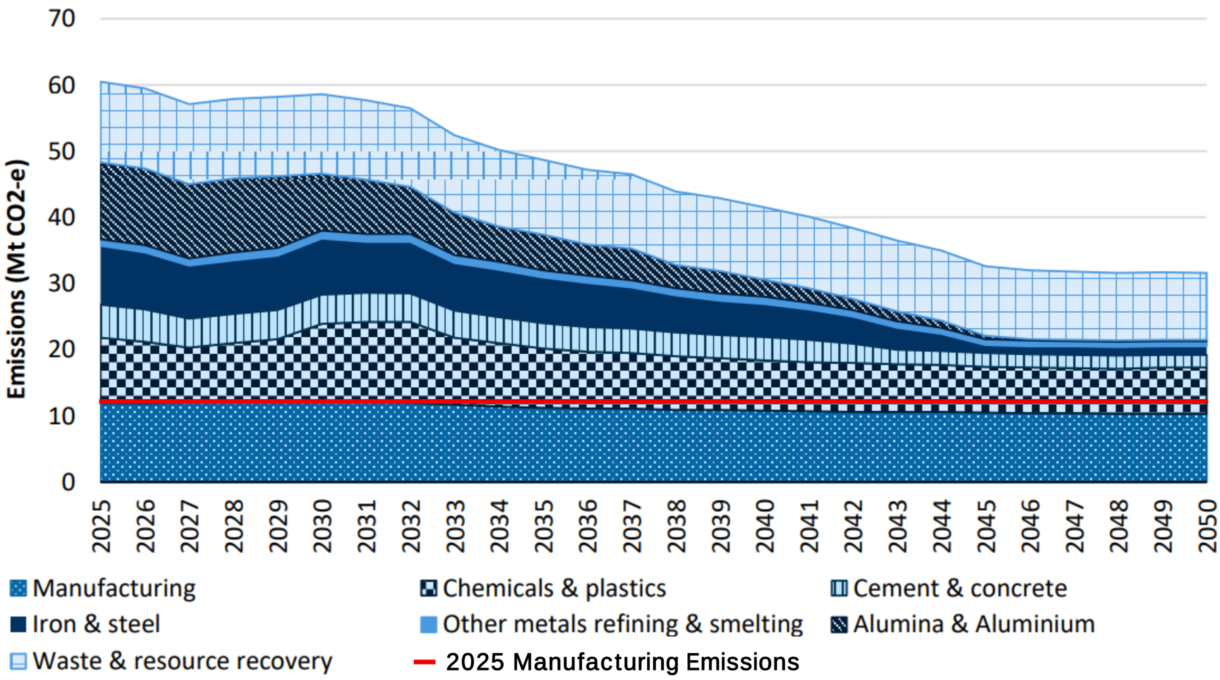

Figure 4: Projected Scope 1 emissions from DISR Industry Sector Plan. Natural gas emissions from industries considered in this report are under Manufacturing (DISR, 2025).

To explore potential decarbonisation pathways, three scenarios – Slow, Expected, and Rapid – have been modelled. These scenarios differ in their assumptions regarding technology deployment, fuel switching, emissions costs, and energy price trajectories, which collectively shape the pace and extent of decarbonisation. Further information on assumptions made for the various scenarios and mathematical modelling of uptake can be found in Appendix A.

Figure 5 shows the projected decline in emissions from natural gas consumption across the SMEs based on the different explored scenarios. It shows that as natural gas processes transition to renewable technologies, those renewable technologies will still produce emissions, but at a significantly lower rate compared to natural gas, Appendix A.5 presents the emissions intensities of renewable energies. This graph also presents the range of potential decarbonisation when comparing the expected scenario to slow and rapid scenarios.

Slow Scenario

Assumes minimal policy intervention, gradual uptake of renewable technologies, and conservative declines in fossil fuel use. Natural gas consumption declines slowly, with technologies such as biomass boilers, biogas boilers, and heat pumps deployed at modest rates. The result is a steady but limited reduction in emissions, with total natural gas consumption falling from 14.5 PJ in 2025 to 13.6 PJ by 2050, and emissions decreasing by less than 10% from 750 ktCO_2 to 703 ktCO_2.

Expected Scenario

Represents the central case, reflecting anticipated policy developments and market driven adoption of decarbonisation technologies. Emissions are disaggregated by natural gas and renewables to show that renewable technologies are not zero emissions and will contribute to overall emissions. The declining cost of electricity in comparison to the declining cost of natural gas, grid decarbonisation, and effect of ACCUs in the forced and voluntary market driving deployment of electrification and biofuel technologies. Natural gas use declines more than the slow scenario, from 14.5 PJ to 10.6 PJ, with net emissions falling 26% from 750 ktCO_2 to 550 ktCO_2.

Rapid Scenario

Assumes accelerated technology adoption, higher ACCU prices, and more aggressive grid decarbonisation. The scenario sees faster uptake of heat pumps, MVR, and biomass boilers, combined with declining fossil fuel emissions factors from electricity and natural gas through the implementation of biogas in the gas network. As a result, natural gas demand decreases from 14.5 PJ to 5.3 PJ, with increasing network costs causing cascading effect to incentivise industry transition. The result is a 65% decline in emissions across these sectors from 750 ktCO_2 to 260 ktCO_2.

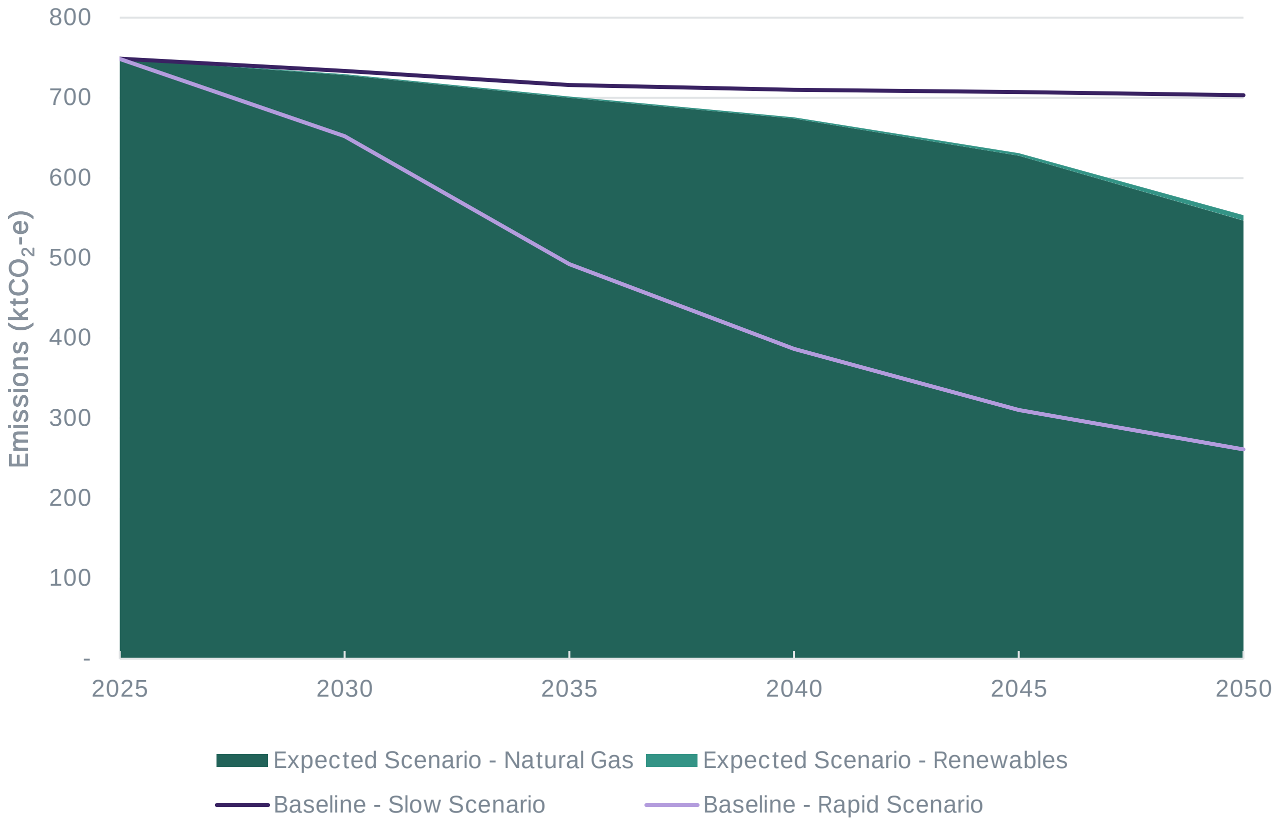

Figure 5: Net Emissions from natural gas and renewables over time following expected scenario, with slow and rapid scenario overlayed to show variation.

5.1 Sectoral Observations

Figure 6 shows that decarbonisation progress differs across industries depending on process heat requirements, technology suitability, and opportunity for electrification. The modelling results highlight clear differences in both the pace and pathway of emissions reduction.

Food and Beverages

Manufacturing in this sector represents the largest opportunity for emissions reduction under the scenarios. Electrification through heat pumps, MVR, and process efficiency, delivers substantial abatement, while electric boilers, and electric air heater implementation is marginal due to the relative cost of electricity to natural gas. Biogas and biomass boilers are limited to industries that are already capable of utilising those resources, or when electrification is not financially viable.

Textiles and Leather

These industries primarily operate at low to medium temperatures, enabling early electrification through heat pumps for hot water generation, however natural gas used in dryers are unlikely to transition to electric alternatives due to the emissions intensity and efficiency disparity of natural gas generated electricity vs direct natural gas supply.

Wood, and Wood Products

Wood processing already relies heavily on biomass boilers, as such a continuation is expected, with hybrid energy supply from electric air heating when onsite biomass cannot be utilised. Heat pumps and efficiency upgrades provide incremental abatement, yet full decarbonisation will depend on technology readiness for high temperature drying systems and availability of low-cost renewable electricity.

Pulp, Paper, and Printing

This sector has one of the highest absolute energy demands, which is expected to be primarily supplied by biomass in the future, as there is pre-existing infrastructure. While the industry is capable of utilising its own waste residues, it still requires significant additional natural gas for processing. Heat pumps, and MVR may reduce the demand on existing biomass boilers, allowing onsite residues to take up a larger proportion of existing natural gas demand.

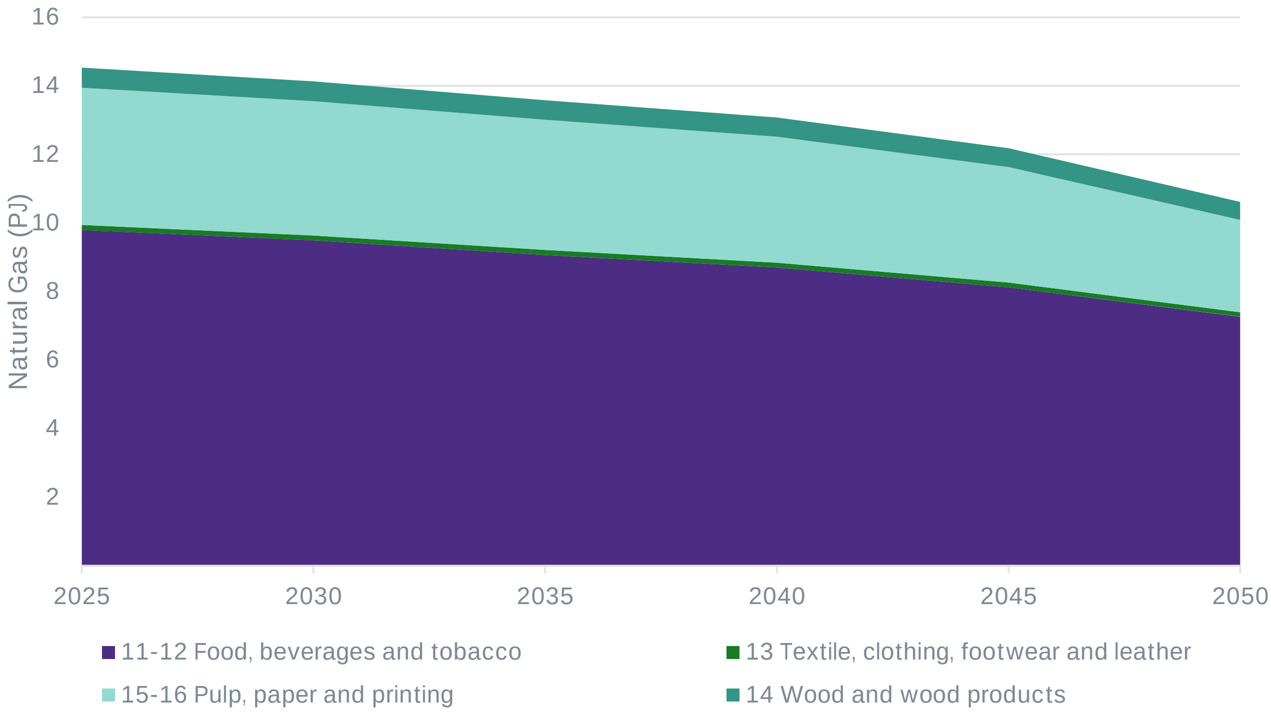

Figure 6: Natural gas decline by sector between 2025 to 2050 following expected scenario.

6. Energy Transition Challenges

SMEs face a combination of cost and non-cost barriers that limit their ability to transition from natural gas to low-carbon process heat. **High upfront capital, long payback periods, limited access to funding, and electricity price volatility constrain adoption**, while **technology supply constraints, long delivery times, and grid infrastructure limitations further delay projects**. Workforce capability and internal expertise gaps, particularly in regional areas, amplify these challenges, highlighting that effective decarbonisation requires both financial and technical support.

This section examines the practical challenges SMEs encounter in adopting renewable and electrified process heat technologies, including cost, technology availability, infrastructure readiness, and workforce capability. It outlines where interventions—policy, financial, and technical—are most needed to accelerate adoption, providing a framework for the following section on actionable policy levers.

6.1 Cost barriers

Cost influences both the feasibility and timing of technology adoption because it affects upfront capital requirements and ongoing operational expenses. For SMEs, significant cost barriers include:

- High Capital Outlay: Electric boilers, heat pumps, and MVR systems require significant upfront investment compared to gas, especially if a network upgrade is required to unlock supply of electricity from the transmission or distribution networks.
- Long Payback Periods: SMEs face difficulty justifying projects without strong financial incentives or concessional finance.
- Limited Access to Funding: Existing programs (CEFC, ARENA) often target large emitters or early-stage innovation; expired NSW incentives (e.g., Solar & Battery) left gaps for <$1m projects.
- Price Volatility: Uncertainty in electricity tariffs and network charges undermines confidence in long-term cost savings.
- Investment competition: Internal and multi-national investment competition drives investment into production or low payback opportunities instead of decarbonisation.

6.2 Technology availability

Technology availability determines whether SMEs can access proven, reliable solutions at scale. Limited supply or integration complexity can delay projects and increase costs. Key barriers include:

- Supply Constraints: While Industrial-scale heat pumps and MVR units have limited local availability; reliance on readily available imports increases lead times, costs, and risk.
- Longer project timelines: Transformers and high-capacity electric boilers often have 6–12-month delivery windows, slowing project timelines.

6.3 Infrastructure barriers

Infrastructure readiness is critical for electrification because grid capacity and connection processes dictate whether new loads can be supported. Common barriers include:

- Grid Capacity Limitations: Distribution network service providers (DNSPs) face challenges accommodating high-load electrification without major upgrades.
- Slow Upgrade Processes: Network augmentation approvals and design processes are lengthy and opaque to network users; SMEs lack leverage to expedite these workstreams.
- Mismatch between Network & Industry Project Timelines: There is a mismatch between the length of time for delivery of an industrial electrification project (2-3 years), and a network upgrade project (5 years or more). This requires networks to commit to infrastructure upgrades with uncertainty and volatility around the future electrification loads, which poses challenges due to the regulated nature of network charges and investment, and how costs are passed on to network users.
- Lack of Shared Infrastructure: No district heating or renewable hubs tailored for SME clusters.

6.4 People and Expertise

Human capability and technical expertise underpin successful project delivery. Without skilled labour and internal champions, SMEs struggle to scope and implement solutions. Barriers include:

- Skills Shortage: Limited workforce trained in industrial electrification and biomass systems.
- Regional Labour Gaps: Rural sites struggle to attract qualified engineers and contractors. Or face increased workforce costs.
- Internal Capability: SMEs often lack designated technical champions to take project responsibility or resources to scope and manage projects.
- Scarcity of Sectoral Expertise: Australia is still in the early stages of developing companies and expertise in implementing onsite and infrastructure projects necessary for decarbonisation.

7. Existing Energy Policy

Current federal and state policies primarily target large industrial emitters, leaving SMEs with limited practical support for decarbonisation. **Strategic plans provide long-term signals, but incentives are fragmented, administratively complex, and often financially inaccessible for small-scale projects.** Regulatory mechanisms largely exclude SMEs, infrastructure planning benefits are indirect, and workforce initiatives have had minimal impact on building sector-specific capacity. **Targeted, SME-focused capital and operational support, streamlined programs, and light-touch regulatory engagement are essential to enable meaningful** decarbonisation in NSW's manufacturing sector.

For example, some of New Zealand's plans and policies have been more straightforward in **mechanism, as well as more widely applicable and accessible, with an intent to be long-term in effect, and provide an indication of what could be implemented in NSW.**

This section examines the policy environment shaping industrial decarbonisation in NSW. Section 7.1 provides an overview of existing federal and state policies, and their relevance to SMEs, broken down by policy levers. Figure 7 presents a policy landscape map showing strengths and gaps of policies, and a detailed breakdown is provided in Appendix F. Section 7.2 presents policy opportunities and how they can shape the decarbonisation pathways.

7.1 Existing Policy

Australia's industrial decarbonisation framework relies on a complex mix of Commonwealth and State-level policies and market mechanisms. Figure 7 summarises the key initiatives influencing the energy transition in NSW, with emphasis on their relevance to SMEs. A detailed breakdown of policies and relevance to SMEs can be found in Appendix F. A clear distinction between Australian and New Zealand Policies is the simplicity, broad reaching and long-term effectiveness of New Zealand policies, while Australian policies are targeted, short term, and numerous resulting in a complex and confusing policy landscape. Federal instruments primarily target large industrial emitters and national-scale transition mechanisms, providing overarching direction rather than practical or accessible support for SMEs. Examples include:

- Long term strategies
  - *Net Zero Plan* (NSW Govt., 2020)
  - *Future Made in Australia*
- Emissions compliance schemes
  - *Safeguard Mechanism* (DCCEEW, 2025)
  - *National Greenhouse and Energy Reporting Scheme (NGER)* (CER, 2025)

NSW has several state-based programs providing voluntary incentives that are relevant to smaller businesses but their historic impact on driving decarbonisation projects is limited due to modest financial returns on opportunities and complex application requirements. Such programs include:

- *Energy Savings Scheme*
- *Peak Demand Reduction Scheme*
- *Renewable Fuel Scheme*

Across both levels of government, existing frameworks favour organisations with the resources to manage complex applications and compliance. SMEs are less inclined to invest in projects with financial payback beyond 4 years, particularly in sectors with multinational businesses facing relatively high operating costs compared to other international jurisdictions.

Businesses are further constrained by incentives that focus on prescriptive technology substitution (e.g., heat pump programs) rather than broad funding that allows identification of site-specific energy efficiency and fuel switching opportunities. Without incentives supporting early-stage energy audits or feasibility studies, it's likely that up to 10% of potential energy savings remain unrealised before capital upgrades occur.

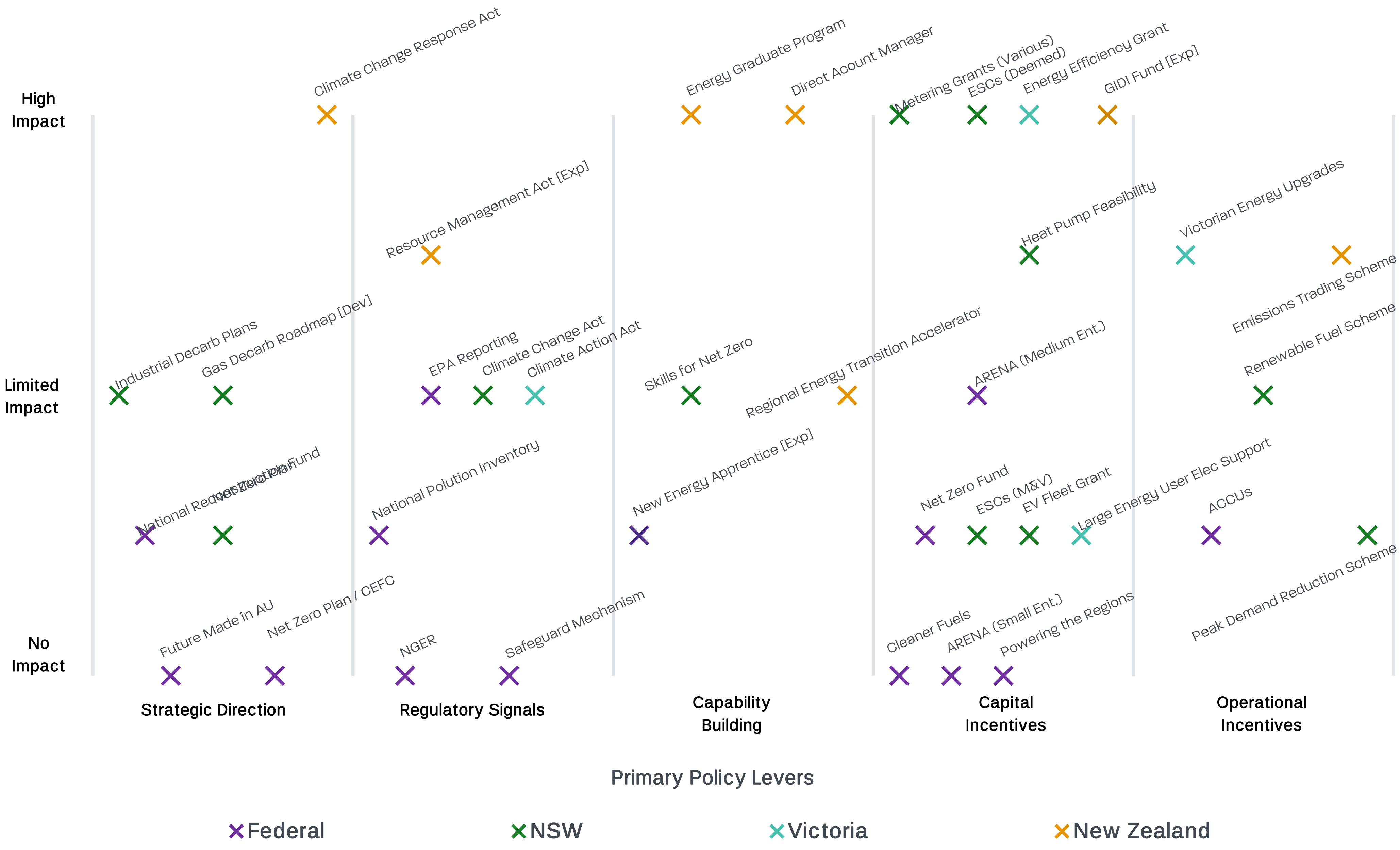

Figure 7: Policy Gap analysis presenting impact of current policies on supporting decarbonisation of SME. Detailed breakdown in Appendix F.

7.2 Primary Levers

The following subsections group these initiatives by their primary policy leavers. This structure highlights how current mechanisms function in practice, identifies where support is strongest, and clarifies where additional interventions are required to improve SME accessibility and effectiveness.

Strategic Direction

Overarching plans including the Federal and State Net Zero Plans, the Future Gas Strategy, and upcoming NSW Gas Decarbonisation Roadmap provide long-term policy clarity but do not provide immediate support for SMEs. These documents establish decarbonisation intent but lack sector-specific implementation frameworks or measurable SME engagement pathways, with no unified program linking high-level targets to individual business decisions. NSW Gas Decarbonisation Roadmap has the potential to embed measurable SME milestones within future roadmap updates, which would help align these plans with practical industry outcomes.

Regulatory Signals

The Safeguard Mechanism, NGER Scheme, and NSW Climate Change Act collectively create the regulatory scaffolding that enforces emissions transparency and reduction among large emitters. For SMEs, however, these instruments do not offer meaningful engagement or enforcement. Most business in Food & Beverage, Textiles, and Wood sectors fall below current compliance thresholds, meaning no mandatory pressure exists to reduce gas use or report emissions. The absence of regulatory drivers for SMEs weakens business case development for transition especially when considering investment trade-offs without policy certainty. Expanding light-touch regulatory frameworks such as voluntary emissions reporting, sectoral benchmarks, or recognition programs could help SMEs align with state targets and anticipate future compliance requirements.

Infrastructure Enablement

Market-level initiatives such as AEMO integrated System Plan, Gas Market Code, and National Gas Infrastructure Plan shape the broader energy landscape by ensuring reliability and planning for the gas-to-electric transition. These policies provide the structural foundation that supports long-term electrification readiness but have limited near-term relevance to SMEs. Their indirect benefits include improved grid planning, renewable integration, and avoided gas price volatility. Despite this, there is currently a disconnect between infrastructure planning outcomes and the SME decarbonisation needs, such as identifying priority industrial zones for electrification support or grid reinforcement. This reduces the trickle-down benefit of system planning to SME decision making.

Capability Building

Workforce and training programs such as the New Energy Apprenticeships initiative (expired in July 2025) and the NSW Smart and Skilled subsidies aimed to expand the clean energy workforce and address skill shortages in trades relevant to decarbonisation. While the New Energy

Apprenticeships initiative was highly relevant for SMEs, the program had minimal success in achieving material growth in capacity within the renewable energy industries in NSW. Trends tend to focus on generic renewable energy skills rather than industrial process applications. Directed funding for industries to hire graduates or apprentices in renewable energy professions would see the broader skill sets honing development in critical areas. New Zealand's GIDI Graduate program is a successful case study which provided a 50% investment and helped each graduate to identify and decarbonise 2 GWh/y of energy (EECA, 2025).

Capital Incentives

Capital funding mechanisms such as the CEFC Programs, ARENA grants, the now expired NSW Solar and Battery Incentive, and the High Emitting Industries Grant provide varying levels of financial support for clean energy projects. However, most funding is skewed toward large emitters or early-stage innovation, leaving SMEs with limited access to practical capital assistance for decarbonisation projects.

SMEs typically require modest but fast-tracked support with limited application complexity and administration burden. While finance or co-investment frameworks exist, there remain a clear gap for simple templated finance products tailored to <$1m projects.

Operational Incentives

Operational Incentives primarily include the NSW Energy Savings Scheme (ESS), Peak Demand Reduction Scheme, Renewable Fuel Scheme, and Renewable Energy Target (RET). These indirectly improve the business case for decarbonisation by lowering the cost of electricity upgrades or encouraging renewable fuel generation. These schemes are intended to drive adoption of efficient electrical equipment and flexible load technologies. However, participation rates among SMEs remain low due to limited awareness, complex compliance documentation, and a focus on electricity generation over process heat. The ESS, in particular, could play a pivotal role if pre-approved pathways for industrial electrification technologies were developed to simplify eligibility and accelerate uptake.

8. Policy Recommendations

SME decarbonisation in NSW is constrained by economic, technical, and institutional barriers, including high upfront costs, limited access to funding, workforce shortages, fragmented policy, and weak coordination between energy networks and industry. **Targeted policy interventions** across eight areas—**network planning, streamlined policy guidance, technical advisory support, demand flexibility, workforce development, capital co-funding, knowledge sharing, and localised coordination**—can address these barriers. Implementing these measures in parallel could **reduce total natural gas use by 11.4 PJ and cut emissions by approximately 560 kt CO_2-e by 2050**, representing a 75% reduction relative to 2025 levels, far exceeding business-as-usual outcomes.

The following policy gaps have been identified through sectoral analysis and stakeholder engagement. These gaps reflect consistent themes across the manufacturing subsectors, where process heat decarbonisation remains constrained by a mix of economic, technical, and institutional factors.

Each gap presents an opportunity for targeted policy interventions to assist small and medium enterprises (SMEs) make the transition toward low-emissions technologies.

8.1 Electricity Network Readiness and Gas Outflow Planning

Gas networks are capable of providing data on gas consumption and expected change in gas consumption by area, but are not required to publicly disclose this information. By contrast, electricity distributors are required to publicise past and forecast energy volumes and peak demands at a substation level in the form of asset management plans. Currently electricity distribution networks lack visibility of the potential increase in electrical demand due to the electrification of fossil fuel heating loads. This constrains forward planning for critical network upgrades and leads to uncertainty around connection approvals, delays, and potential local grid constraints.

Policy Opportunity

Develop a Gas Outflow Mapping Framework that mandates coordination between gas and electricity distributors. Mapping forecast gas demand at a regional and sectoral level would allow proactive grid reinforcement and investment planning for future electrical loads.

The NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW), in coordination with electricity and gas distributors, should lead the development and mandatory reporting of the Gas Outflow Mapping Framework. Distributors are accountable for providing accurate consumption and forecast data to support proactive network upgrades.

Improved coordination with electricity distribution companies enables more confident planning of upgrades, supports future electrical demand, accelerates project delivery, and helps prevent grid capacity bottlenecks.

This would enable smoother more predictable decarbonisation pathways, aligning with NSW's strategy for managing cross-sectoral energy transitions and maintaining system reliability through electrification.

8.2 Fragmented Policy and Regulatory Landscape

SMEs face overlapping or inconsistent federal, state, and local policies, particularly regarding grants, emissions reporting, and energy standards. The resulting administrative burden discourages participation and limits uptake of available programs.

Policy Opportunity

Implement a streamlined "one-window" Energy Transition Portal that consolidates information on funding, regulatory requirements, and technical support. The policy could include using the gas mapping (Policy 8.1) to identify SMEs with heavy gas usage and an outreach program with dedicated account managers or case officers to assist businesses in identifying suitable funding opportunities, navigating application processes, and connecting with technical service providers. This would significantly reduce transaction costs and improve program accessibility for smaller businesses.

NSW DCCEEW should establish and manage the Energy Transition Portal, working with federal and state agencies to consolidate programs and designate account managers for SME support.

A single coordinated system would reduce administrative friction, accelerate project initiation, and improve uptake of available incentives. This would directly increase the pace of gas-to-electricity conversions across SME manufacturing, ensuring more projects commence within the 2030-2050 timeframe and supporting NSW's interim decarbonisation targets.

8.3 Fund Opportunity Identification

Many SMEs lack the in-house expertise to identify viable decarbonisation opportunities or assess feasibility. Existing advisory programs are limited in reach and often not aligned to process heat applications.

Policy Opportunity

Establish programs that provide subsidised energy audits, and decarbonisation roadmaps tailored to the individual SMEs. Support should include sector-specific technical guidance on process heat technologies, emissions accounting, and business case development.

Enabling SMEs to upgrade or install metering systems would improve visibility of gas use, particularly time-of-use and process heat loads. Despite NSW's ongoing efforts to promote energy metering, awareness and utilisation remain low. Without accurate load data, renewable systems risk being oversized, compounding the capital cost barriers.

NSW DCCEEW with technical input from ARENA and CEFC, should deliver subsidised energy audits and decarbonisation roadmaps for SMEs, ensuring sector-specific guidance is accessible and actionable.

Providing access to technical support would build SME readiness and convert awareness into implementable projects, ensuring gas users transition earlier and more efficiently. This would improve credibility of decarbonisation pathways within NSW's manufacturing base and contribute measurable reductions to the state's industrial emissions inventory.

8.4 Support Demand Flexibility and Smart Controls

Current tariff and STC structures offer limited incentive for SMEs to operate flexibly or align energy use with renewable generation. This limits potential system-wide benefits from electrification.

Policy Opportunity

Introduce or accelerate new tariff structures that reward localised renewable generation and flexible consumption, complemented by funding for smart control systems and load management technologies. These measures would allow SMEs to optimise process scheduling, integrate with renewable supply, and utilise Electric Thermal Energy Storage (ETES) systems to store heat during low-cost, low-emission periods.

Electricity distributors and the NSW DCCEEW should jointly implement flexible tariff structures, incentivising smart control adoption and ensuring alignment with renewable generation availability.

Flexible demand incentives would enable cost-effective integration of electrified process heat technologies, especially where operating costs currently rival those of gas systems. By improving the economic performance of ETES and other flexible electrification systems, SMEs could maintain competitiveness while reducing emissions intensity. This policy would also ease pressure on the electricity grid, allowing NSW to expand electrification without compromising reliability—advancing both decarbonisation and system stability objectives.

8.5 Incentivise Job Growth

Business case development, design, installation and maintenance of electrified process heat systems require specialised skills that are currently limited, especially in regional areas. Existing federal trade certificate schemes designed to increase the numbers of technical workers in the clean energy sectors have not addressed the projected workforce shortfalls. This scarcity drives up costs and delays project timelines.

Policy Opportunity

Co-develop regional training partnerships with TAFEs, industrial associations, equipment manufacturers and installers, and SME businesses that require decarbonisation, to build workforce capacity in industrial decarbonisation across the supply chain.

NSW DCCEEW and NSW Department of Education should correspond to identify relevant qualifications and industries that could benefit from them, then provide co-funding graduate programs, and targeted apprenticeships. Developing a skilled workforce would increase installation capacity, reduce project costs, and minimise downtime, accelerating large-scale conversion from gas to electric systems. This strengthens NSW's ability to meet mid-term decarbonisation milestones and supports local employment in clean energy projects.

8.6 Provide Capital Support for Decarbonisation Projects

Australia's historical appeal to multinational corporations was built on a foundation of affordable energy and high product quality, which helped offset its relatively high labour costs. Today, that balance has shifted: energy and labour costs have both risen, and Australia's quality advantage has narrowed, making it a less compelling destination for investment. This shift is felt acutely by SMEs, who face prohibitive capital costs even when viable electrification options are identified — particularly for bespoke process retrofits and electrical upgrades. Private finance remains limited, and while public funding mechanisms exist, they often introduce significant administrative burdens. Financing through the Clean Energy Finance Corporation (CEFC) can be complex, and ARENA grant programs require extensive upfront effort without guaranteed outcomes, further discouraging investment in energy transition initiatives.

Policy Opportunity

Introduce or expand direct grant or co-funding schemes that cover up to 50% of eligible project costs, reduce administrative burden in funding applications and streamline confirmation of eligibility through an account manager (Policy 8.2).

CEFC and NSW Treasury could oversee grant and co-funding schemes, while the NSW DCCEEW coordinates eligibility, account management, and streamlined application processes for SMEs. Funding opportunities should prioritise government cost of carbon abatement of projects less than existing ACCU prices, ensuring financial viability and early mover confidence in low emissions technologies.

By offsetting upfront costs, capital co-finding would incentivise multinational industries to invest in Australia, accelerate technology adoption and enable SMEs to act before 2035 rather than deferring investment to end of existing asset life. This would drive down natural gas consumption at scale, supporting NSW's targeted emissions reductions in the industrial sector and stimulating local clean-tech markets.

8.7 Facilitate Knowledge Sharing

SMEs are risk-adverse and hesitant to invest in technologies that lack proven case studies or operational benchmarks in comparable facilities. Technology suppliers are unaware of industries looking to transition, and energy distributors are unaware of potential future energy demands in local regions.

Policy Opportunity

NSW DCCEEW, supported by industry associations and renewable technology suppliers, should organise localised workshops and roundtables to connect SMEs with suppliers and peers for knowledge transfer and coordinated planning. Using insights gathered through energy mapping (Policy 8.1) and directed industry correspondence (Policy 8.2) develop a bottom up analysis of industry expectations of decarbonisation. They could then provide localised and targeted in-person round tables or workshop sessions between the renewable energy supply chain to allow process industries to talk with each other, with renewable energy suppliers, and renewable technology suppliers so that everyone in the supply chain can be aware of and prepare for organisational plans and capacities.

This would improve cross-sector awareness and coordination, reduce uncertainty and accelerate adoption of proven decarbonisation technologies. By enabling early planning between industries and suppliers, it would shorten deployment timelines and reduce duplication effort. The result would be a more synchronised and predictable reduction in natural gas demand, improving alignment with NSW's industrial decarbonisation milestones and supporting equitable access to renewable infrastructure for smaller emitters.

8.8 Effect of Policy Recommendations

Figure 8 shows the combined policy suite could reduce natural gas use by an additional 7.5 PJ by 2050, on top of the expected 4 PJ following the business-as-usual scenario, with corresponding emissions reductions of approximately 360 kt CO_2-e (Figure 9). This is equivalent to planting approximately 280,000 ha of native forest[2] and would result in a 75% reduction in emissions from 2025 compared to the 26% reduction without implementing policies. This represents a significant shift in the natural gas trajectory for NSW's SME manufacturing sector when compared with the business-as-usual outlook.

The analysis was based on assumed impacts for each policy lever, reflecting their expected influence on technology adoption and project feasibility across SMEs. Further detail on these assumptions and the resulting technology adoption rates is provided in Appendix A.

The introduction of up to $70 million in targeted capital support, alongside increased labour participation in the region, could catalyse more than $200 million in private investment through a marginal increase in project numbers and overall project value. These measures are expected to reduce natural gas consumption by up to 2.7 PJ and deliver annual emissions savings of approximately 140 kt CO_2-e by 2050.

Based on the projected gas decline under the policy intervention scenario, the following natural gas reduction targets presented in Table 1 are recommended for NSW's SME manufacturing sector.

Table 1: Recommended gas reduction targets.

Year	2030	2035	2040	2045	2050
Recommended reduction from 2025 levels	16%	37%	50%	64%	78%

These targets provide **clear, measurable benchmarks** to guide policy implementation and track progress. They are ambitious yet realistic, reflecting the combined impact of coordinated policy interventions including network readiness, capital support, flexible demand measures, and workforce development. By achieving these targets, NSW can accelerate decarbonisation in SME manufacturing, reduce reliance on natural gas, and meaningfully contribute to the state's 2035 and 2050 climate objectives.

[2] Long term average carbon stock of 750,000 ha of managed private native forest regrowth can sequester an additional 97.2 M tCO2-e over 100 years (Venn, 2024).

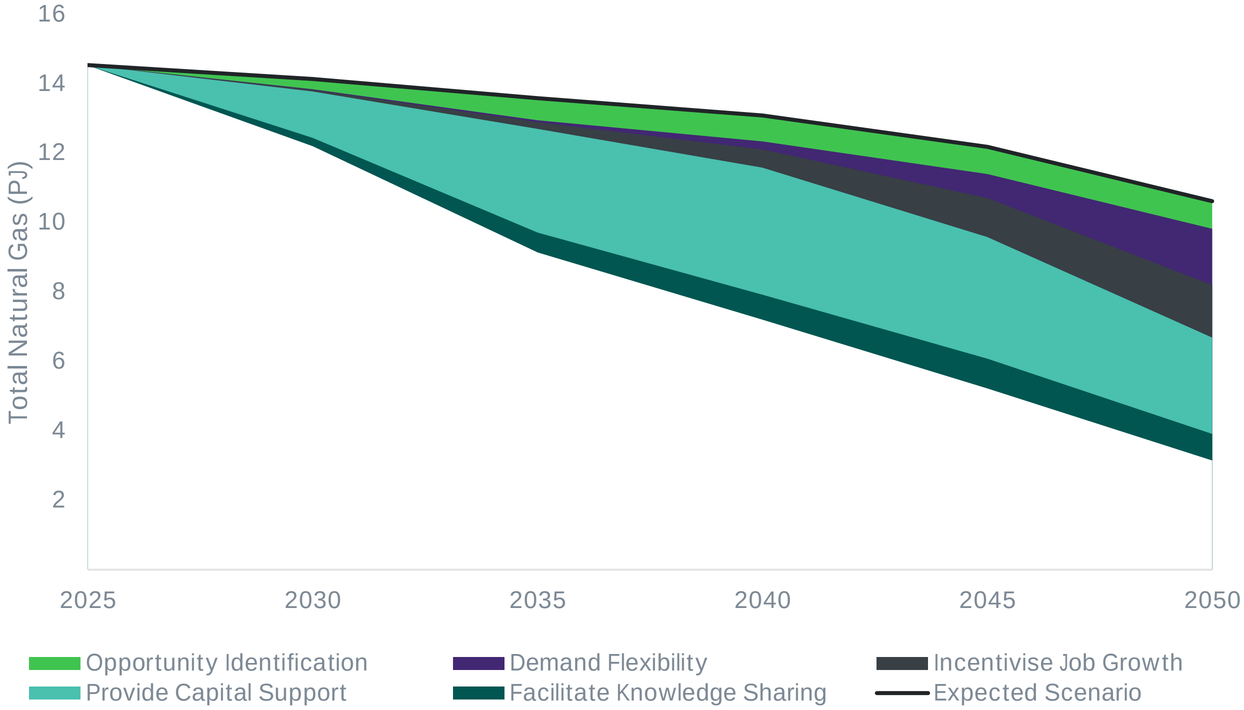

Figure 8: Natural gas decline over time showing effect of recommended policies.

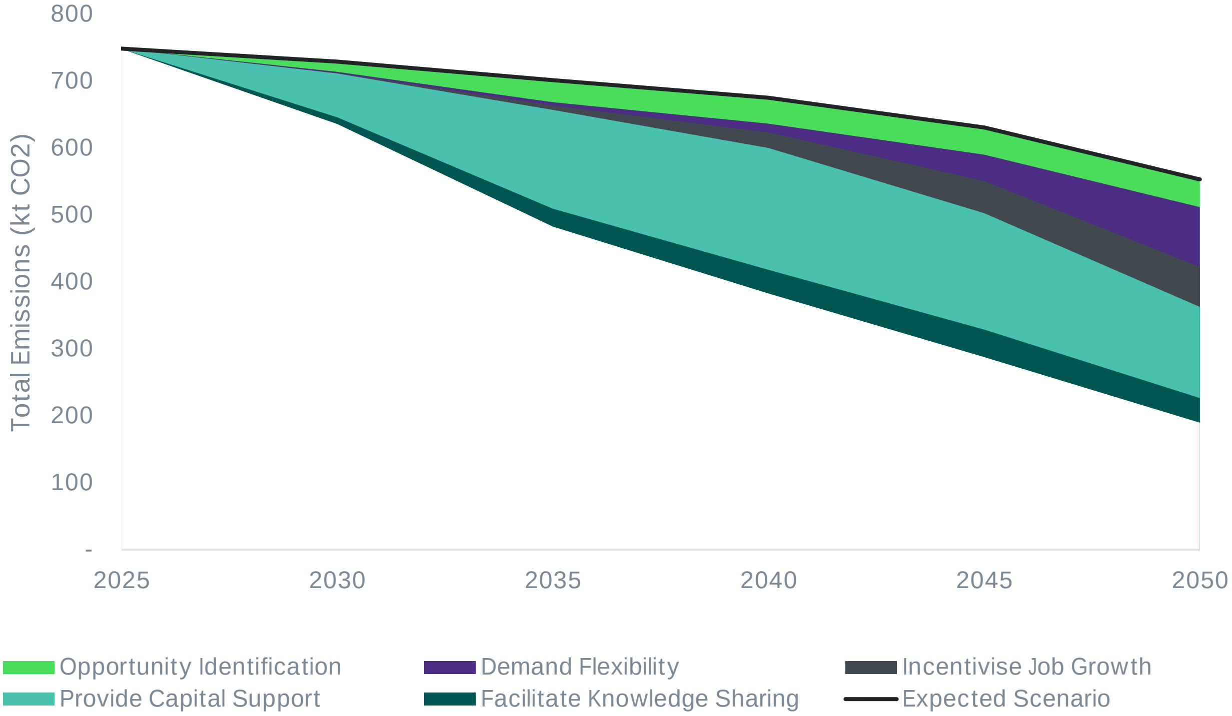

Figure 9: Natural gas emissions decline over time showing effect of recommended policies.

The results illustrate the compounding benefits of implementing multiple policy levers in parallel. Network readiness and coordinated planning enable efficient uptake of renewable process heat, while capital funding and flexible demand measures accelerate the transition at the business level. When sequenced correctly, these mechanisms collectively drive a sustained decline in gas demand and emissions across the sector.

9. Outlook & Broader Implications

Under business-as-usual or the "expected" scenario, emissions reductions from SME manufacturing remain minimal. Current federal net zero plans anticipate only limited abatement from these industries, largely because existing measures do not directly address on-site fuel use or electrification barriers. This underscores the importance of state-level intervention to stimulate practical change.

NSW has ambitious climate targets: a 70% reduction in emissions relative to 2005 levels by 2035, and net zero by 2050. SME manufacturing, particularly in sectors such as Food and Beverage, Textiles and Leather, Pulp, Paper and Printing, and Wood and Wood products, play a critical role in achieving these goals. While each sector individually represents a modest share of total state emissions, collectively they contribute significant cumulative reductions if supported by effective policy.

Australia's rising energy and labour costs, combined with diminishing quality advantages, have reduced its appeal to multinational investors. It is unlikely that all industrial users will electrify or transition to waste related biofuels by 2050 and some industries may succumb to cost pressures and close or relocate permanently. A multi-pronged approach which supports industry with the energy transition is therefore essential. Policies that simultaneously increase the share of renewable gas in the grid and reduce total gas demand compound the rate of decarbonisation, driving both fuel substitution and energy efficiency gains across the system. This presents a key future pathway which should be investigated further.

It is critical that bioenergy development should prioritise applications where electrification is technically or economically unviable. This would include applications requiring continuous high temperature demands, sites experiencing grid supply constraints, or low margin businesses that would prioritise investments with higher returns. Prioritising state funding towards these end uses ensures limited renewable feedstocks are directed where they deliver the greatest decarbonisation and strategic value.

Together, these measures demonstrate that coordinated, well-sequenced policy action can transform incremental improvements into a lasting structural shift away from fossil gas dependence. Reducing natural gas use in NSW's SME manufacturing sectors directly lowers Scope 1 emissions and strengthens the state's ability to meet its legislated targets. The projected gas reductions with these policies—up to 11.4 PJ by 2050, corresponding to approximately 560 kt CO_2-e—improve the likelihood that NSW can achieve its 70% emissions reduction by 2035 and net zero by 2050. By proactively addressing on-site fuel use, accelerating electrification, and directing renewable fuel deployment where it is most needed, these interventions ensure that SME contributions are maximised, closing a key gap in the state's overall decarbonisation pathway.

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Appendix A: Methodology Breakdown

This appendix outlines the methodology used to quantify natural gas consumption, process-level energy demand, and renewable technology adoption within NSW SME manufacturing. It supports the analysis of policy opportunities presented in the main report and provides a transparent framework for the projections of emissions reductions and natural gas decline.

The focus is on SMEs in industries where decarbonisation opportunities are most relevant: Food and Beverage, Textiles and Leather, Pulp, Paper and Printing, and Wood and Wood products.

A.1 Natural Gas Mapping

Under Australia's Natural Gas Rules, network operators are required to publish monthly flow data. Key sources used for this analysis include:

- AEMO: major pipeline and transfer station flows (AEMO, 2025).
- NSW distributors: Jemena (Jemena, 2025) and Australian Gas Networks (AGN, 2024) for smaller streams

These data sets were compiled and mapped to estimated meter locations to develop the NSW natural gas consumption map. This mapping enables assessment of sectoral demand patterns and identification of opportunities for decarbonisation.

A.2 Energy Use Breakdown

A.2.1 Data Sources

- Australian Energy Statistics (AES, 2024): provided state-level annual fuel consumption by ANZSIC category.
- AES totals were supplemented using sector-specific studies (Northmore Gordan, 2021) to disaggregate sub-sectoral gas use where AES data were limited (e.g., Pulp Paper and Printing manufacturing dominated by a few large groups).

A.2.2 Focus on SME-Dominated Sectors

Analysis focused on ANZSIC categorised subsectors primarily composed of SMEs:

- Food and Beverage manufacturing (ANZSIC 11–12)
- Textiles and Leather (ANZSIC 13)
- Wood and wood products (ANZSIC 14)
- Pulp, Paper and Printing (ANZSIC 15-16)

A bottom-up approach was applied and generated indicative estimates of process-level energy demand:

1. Identify total production volumes for relevant industries in NSW.
2. Apply process-level natural gas energy intensities from published sources.
3. Scale energy use according to production volumes and process requirements.

A.3 Technology Breakdown

Natural gas demand was further disaggregated by process to identify opportunities for renewable alternatives. Processes were classified as:

- Kiln drying / processing
- Drying
- Evaporating
- Boiling
- Cleaning / sterilising
- Process washing
- Baking / cooking
- General steam – indirect heating
- General steam – direct injection

Each process was characterised by:

- Process medium: hot water, steam, hot air
- Process temperature: 40°C–300°C
- Thermal efficiency: fuel to useful energy conversion

A.3.1 Renewable Technology Mapping

Renewable heating technologies were mapped to each process:

- Air-sourced heat pump
- Water-sourced heat pump
- Mechanical Vapour Recompression (MVR)
- Electric or electrode boiler
- Electric air heating (resistance or infrared)
- Biomass boiler
- Biogas boiler
- Process efficiency improvements

Efficiency factors were applied to account for performance differences relative to natural gas systems (e.g., heat pumps often achieve >300% thermal efficiency relative to electrical input). This enabled estimation of renewable energy demand required to fully substitute existing natural gas consumption by process.

A.4 Technology Adoption Rates

Technology adoption was forecast under three scenarios:

- Slow: conservative adoption with minimal policy support.
- Expected: adoption based on current government and industry trends.
- Rapid: accelerated adoption assuming supportive policies and incentives.

The list of assumptions made at each scenario and each year can be seen in Table 2. A base case assumes existing policies are reflected in current pricing and emissions forecasts.

Policy interventions were modelled to evaluate their effect on adoption:

- Funding opportunity identification increases likelihood of completing efficiency projects by 50%.
- Demand flexibility reduces net electricity costs of thermal storage by up to 50%.
- Capital support: reduces project capital costs by 25%, provided payback Is greater than 7 years.
- Job growth incentives: reduce inflationary impacts on capital projects by 0.5%.
- Knowledge sharing programs: increase acceptable payback periods for successful business cases from 6 years to 7 years.

A.5 Adoption Curve

Market penetration of technologies over time was modelled using a logistic adoption curve:

$$A(t) = \frac{K}{1 + e^{-r(t-t_0)}}$$

Where:

- A(t) is the market penetration at a specific year.
- t is the specific year chosen.
- t_0 is the year 50% of adoption is likely to occur.
- K is the maximum penetration that it could reach in that year.
- r is the growth rate or steepness of the curve.

The anchor year (t_0) was selected as the year when payback for each technology falls below six years. Figure 10 illustrates a representative adoption curve.

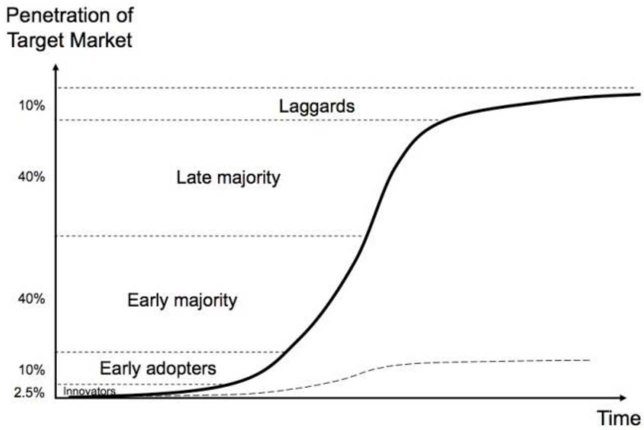


Figure 10: Adoption curve representing rate of adoption of a product.

A.6 Key Energy Transition Parameters

Transition modelling considered multiple factors affecting cost and emissions:

- **Natural gas cost**: retail and distribution costs based on AEMO and Jemena forecasts (Jemena, 2025), (AEMO, 2025).
- **Electricity cost**: projected to decline by 0.5–2.5% annually, consistent with AEMC expectations (AEMO, 2024).

- **Biomass and biogas cost**: estimated using current prices and long-term supply considerations (DPI, 2023); (AEMO, 2024)
- **Capital Cost: S**ynthesised from historical business cases for Australian projects and expressed as $/MW installed (Table 2).
- **Grid emissions factor:** based on historical performance and projected DCCEEW scenarios, including behind-the-meter solar (33% of electricity demand) (DCCEEW, 2024).
- **Natural gas emissions factor**: assumed constant, with potential reduction from renewable gas injection (Jemena, 2024).
- **ACCU value:** derived from projected carbon credit cost increases (DCCEEW, 2024)

These parameters are presented in Table 2 inform the energy cost, emissions, and technology adoption scenarios presented in the main report.

Table 2: All assumed forecasted values made in modelling decarbonisation pathway.

Product	**Scenario**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**Units**
ACCU Value	Slow	$0.036	$0.043	$0.051	$0.060	$0.072	$0.085	$/kgCO2
ACCU Value	Expected	$0.036	$0.054	$0.080	$0.119	$0.177	$0.264	$/kgCO2
ACCU Value	Rapid	$0.036	$0.058	$0.094	$0.152	$0.247	$0.399	$/kgCO2
Grid Emission (GE)	Slow	152.78	130.56	19.44	8.33	8.33	8.33	kgCO2/GJ
Grid Emission (GE)	Expected	141.67	41.67	19.44	8.33	8.33	8.33	kgCO2/GJ
Grid Emission (GE)	Rapid	85.00	25.00	11.67	5.00	5.00	5.00	kgCO2/GJ
Natural Gas Emissions (NGE)	Slow	51.53	51.53	51.53	51.53	51.53	51.53	kgCO2/GJ
Natural Gas Emissions (NGE)	Expected	51.53	51.53	51.53	51.53	51.53	51.53	kgCO2/GJ
Natural Gas Emissions (NGE)	Rapid	51.53	51.53	49.5	48.5	47.6	46.6	kgCO2/GJ
Biomass Emissions Factor (BEF)	Slow	1.8	1.8	1.8	1.8	1.8	1.8	kgCO2/GJ
Biomass Emissions Factor (BEF)	Expected	1.8	1.8	1.8	1.8	1.8	1.8	kgCO2/GJ
Biomass Emissions Factor (BEF)	Rapid	1.8	1.8	1.8	1.8	1.8	1.8	kgCO2/GJ
Biogas Emissions Factor (BGF)	Slow	6.43	6.43	6.43	6.43	6.43	6.43	kgCO2/GJ
Biogas Emissions Factor (BGF)	Expected	6.43	6.43	6.43	6.43	6.43	6.43	kgCO2/GJ
Biogas Emissions Factor (BGF)	Rapid	6.43	6.43	6.43	6.43	6.43	6.43	kgCO2/GJ
Electricity Emissions Cost (EEC)	Slow	$5.50	$5.58	$0.99	$0.50	$0.60	$0.71	$/GJ
Electricity Emissions Cost (EEC)	Expected	$5.10	$2.23	$1.55	$0.99	$1.48	$2.20	$/GJ
Electricity Emissions Cost (EEC)	Rapid	$3.06	$1.46	$1.10	$0.76	$1.23	$2.00	$/GJ
Gas Emissions Cost (GEC)	Slow	$1.86	$2.20	$2.62	$3.11	$3.69	$4.38	$/GJ
Gas Emissions Cost (GEC)	Expected	$1.86	$2.76	$4.12	$6.13	$9.14	$13.62	$/GJ
Gas Emissions Cost (GEC)	Rapid	$1.86	$3.00	$4.66	$7.40	$11.73	$18.60	$/GJ
Biomass Cost + Emissions (BCE)	Slow	0.1	0.1	0.1	0.1	0.1	0.2	kgCO2/GJ
Biomass Cost + Emissions (BCE)	Expected	0.1	0.1	0.1	0.2	0.3	0.5	kgCO2/GJ
Biomass Cost + Emissions (BCE)	Rapid	0.1	0.1	0.2	0.3	0.4	0.7	kgCO2/GJ
Biogas Cost + Emissions (BGE)	Slow	0.23	0.27	0.33	0.39	0.46	0.55	kgCO2/GJ
Biogas Cost + Emissions (BGE)	Expected	0.23	0.34	0.51	0.77	1.14	1.70	kgCO2/GJ
Biogas Cost + Emissions (BGE)	Rapid	0.23	0.37	0.61	0.98	1.59	2.57	kgCO2/GJ
Electricity Cost (EC)	Slow	**83.3**	81.3	79.3	77.3	75.4	73.5	$/GJ
Electricity Cost (EC)	Expected	69.4	64.4	59.7	55.4	51.3	47.6	$/GJ
Electricity Cost (EC)	Rapid	55.6	48.9	43.1	38.0	33.5	29.5	$/GJ
Gas Cost (GC)	Slow	18.9	17.5	18.1	19.3	20.6	21.5	$/GJ
Gas Cost (GC)	Expected	21.6	20.2	19.7	21.2	22.3	23.2	$/GJ
Gas Cost (GC)	Rapid	22.7	21.4	20.7	21.9	23.2	24.3	$/GJ
Biomass Cost (BC)	Slow	7.5	8.5	9.6	10.8	12.2	13.8	$/GJ
Biomass Cost (BC)	Expected	7.0	7.5	8.1	8.7	9.4	10.1	$/GJ
Biomass Cost (BC)	Rapid	5.9	6.0	6.2	6.3	6.5	6.6	$/GJ
Biogas Cost (BGC)	Slow	27.0	27.0	27.0	27.0	27.0	27.0	$/GJ
Biogas Cost (BGC)	Expected	12.0	12.0	12.0	12.0	12.0	12.0	$/GJ
Biogas Cost (BGC)	Rapid	10.0	10.0	10.0	10.0	10.0	10.0	$/GJ
Air Sourced Heat Pumps	Slow	1.2	1.2	1.2	1.2	1.2	1.2	$m/MW
Air Sourced Heat Pumps	Expected	1.0	1.0	1.0	1.0	1.0	1.0	$m/MW

Air Sourced Heat Pumps	Rapid	0.8		0.8	0.8	0.8	0.8	0.8	$m/MW
Water Sourced Heat Pumps	Slow	1.6		1.6	1.6	1.6	1.6	1.6	$m/MW
Water Sourced Heat Pumps	Expected	1.5		1.5	1.5	1.5	1.5	1.5	$m/MW
Water Sourced Heat Pumps	Rapid	1.4		1.4	1.4	1.4	1.4	1.4	$m/MW
MVR	Slow	4.0		4.0	4.0	4.0	4.0	4.0	$m/MW
MVR	Expected	3.0		3.0	3.0	3.0	3.0	3.0	$m/MW
MVR	Rapid	2.0		2.0	2.0	2.0	2.0	2.0	$m/MW
Electric Boiler	Slow	1.2		1.2	1.2	1.2	1.2	1.2	$m/MW
Electric Boiler	Expected	1.0		1.0	1.0	1.0	1.0	1.0	$m/MW
Electric Boiler	Rapid	0.8		0.8	0.8	0.8	0.8	0.8	$m/MW
Electric Air Heating	Slow	1.0		1.0	1.0	1.0	1.0	1.0	$m/MW
Electric Air Heating	Expected	0.8		0.8	0.8	0.8	0.8	0.8	$m/MW
Electric Air Heating	Rapid	0.6		0.6	0.6	0.6	0.6	0.6	$m/MW
Biomass Boiler	Slow	3.0		3.0	3.0	3.0	3.0	3.0	$m/MW
Biomass Boiler	Expected	2.0		2.0	2.0	2.0	2.0	2.0	$m/MW
Biomass Boiler	Rapid	1.5		1.5	1.5	1.5	1.5	1.5	$m/MW
Biogas Boiler	Slow	3.5		3.5	3.5	3.5	3.5	3.5	$m/MW
Biogas Boiler	Expected	2.5		2.5	2.5	2.5	2.5	2.5	$m/MW
Biogas Boiler	Rapid	2.0		2.0	2.0	2.0	2.0	2.0	$m/MW
Process Efficiency Increase	Slow	1.5		1.5	1.5	1.5	1.5	1.5	$m/MW
Process Efficiency Increase	Expected	1.0		1.0	1.0	1.0	1.0	1.0	$m/MW
Process Efficiency Increase	Rapid	0.5		0.5	0.5	0.5	0.5	0.5	$m/MW
Market Penetration (K)	Slow	1%		75%	100%	100%	100%	100%	
Market Penetration (K)	Expected	1%		75%	100%	100%	100%	100%	
Market Penetration (K)	Rapid	1%		75%	100%	100%	100%	100%	

Appendix B: Industry Breakdown

B.7 Food, Beverage and Tobacco (11-12)

The Food, Beverage, and Tobacco subsector consumed 9.2 PJ of natural gas in 2023 (AES, 2024), making it the largest gas user among SME-dominated industries. This sector is also the largest employers, with over 70,000 people across over 3,600 businesses in NSW (NSW Government, 2025). Gas use in this subsector is highly diverse, reflecting the variety of thermal processes. Around 9% of the subsector's emissions are captured under the Safeguard Mechanism, meaning most sites fall within the SME range and operate without mandatory emissions constraints.

Access to capital and network capacity are recurring barriers to decarbonisation. Many SMEs have feasible business cases for electrification or biogas adoption but face long paybacks, high upfront costs and limited incentives. Multi-site processors and long-lived assets make retrofits expensive, while tight margins and regional labour shortages add further challenges. Site-specific network upgrades resulting in first-mover costs can deter electrical investment, and reliable electricity supply in regional areas remain a concern for firming loads. Stakeholders emphasised that technology-agnostic funding and clear policy signals are critical to reduce risk and enable action.

B.7.1 Meat Processing

Meat processing is one of the most gas intensive components of the food subsector, consuming approximately 2.4 PJ of natural gas. The subsector comprises of approximately 30 small to large red meat abattoirs, and 31 poultry abattoirs, which together account for a substantial share of the sector's total gas demand (MLA, 2025). Natural gas is primarily used for steam or hot water in either rendering cooking and drying, (115-145°) or for washing and sterilising (65-100°C).

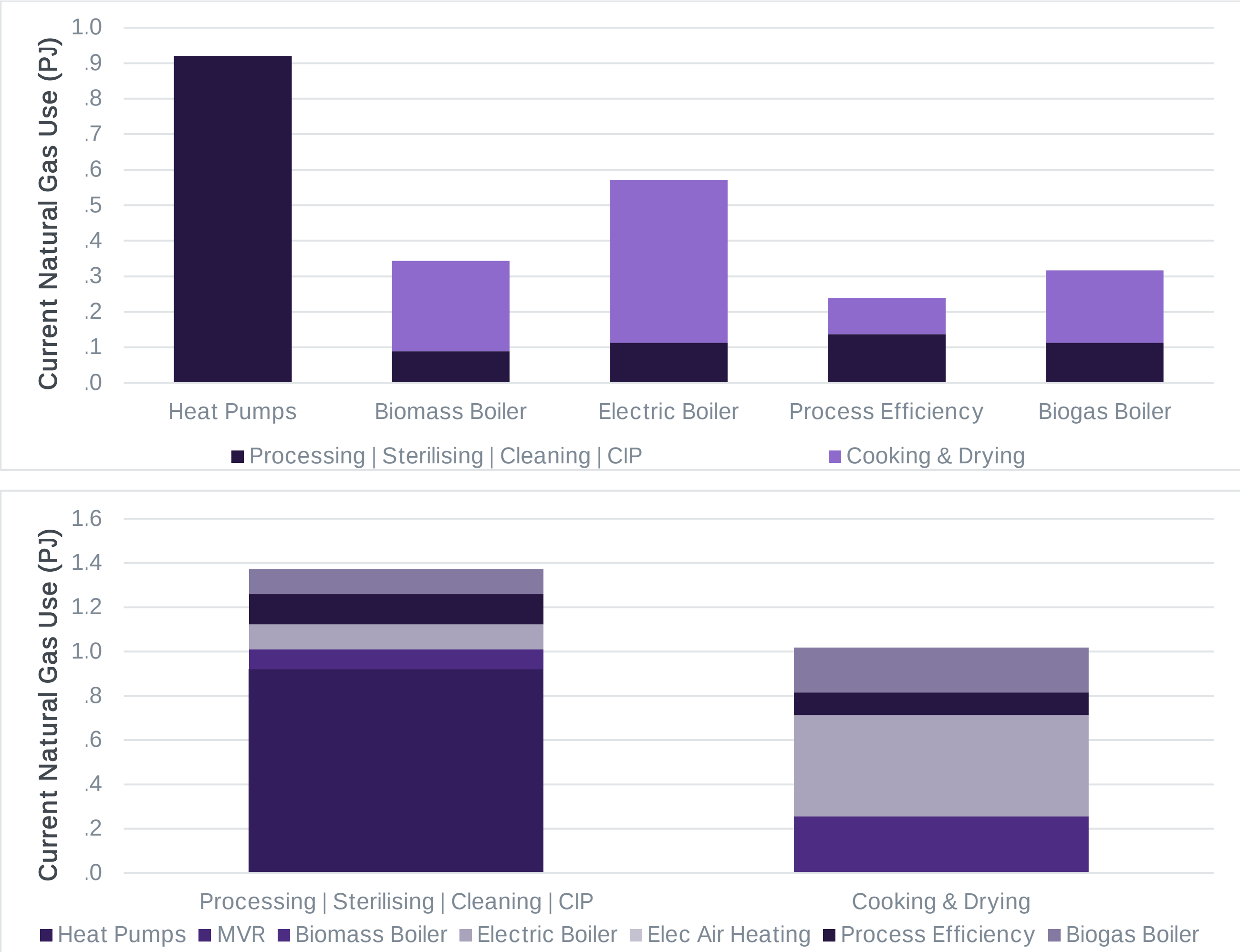
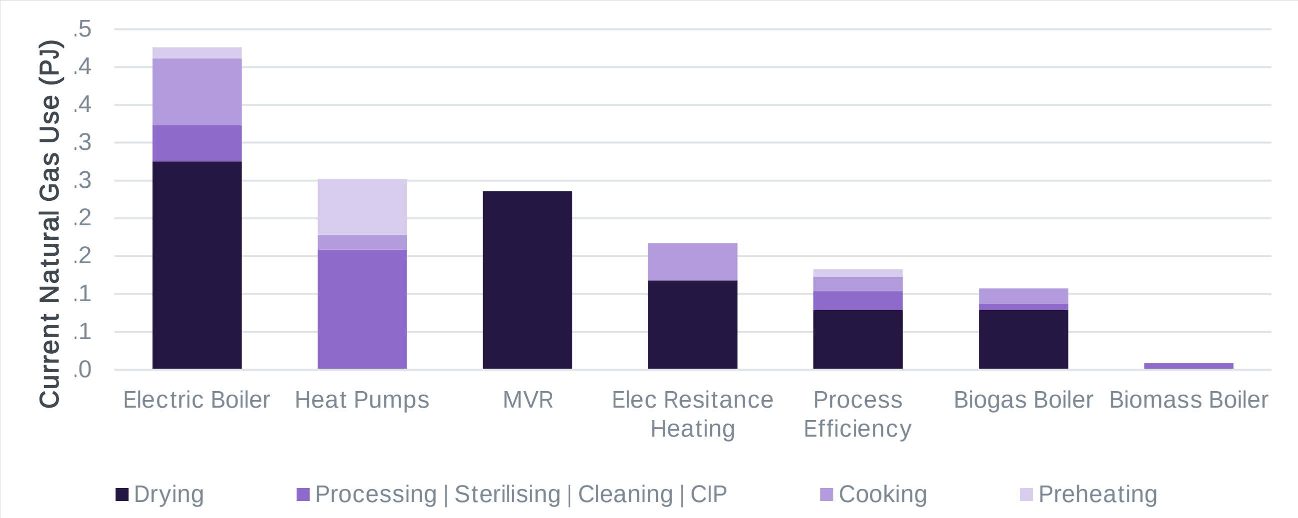


Figure 11: Decarbonisation technologies suited to meat processing based on ability of technology to abate natural gas in PJ and broken down by technology and process.

B.7.2 Dairy Processing

Dairy processing has a lower overall gas consumption compared to other industries, but gas intensity per plant is relatively high. The subsector comprises approximately 18 main dairy processing facilities, employing over 1,400 people (NSW Government, 2025). Figure 12 summarises electrification and decarbonisation technologies available in dairy processing, broken down by process and potential natural gas abatement. Key process includes drying, pasteurisation, spray drying, cooking, cleaning in place (CIP), and preheating, with steam and hot water requirements ranging from 60°C to 200°C.

Spray drying is a major thermal energy consumer, representing one of the most challenging processes to decarbonise due to high temperature requirements (NSW Government, 2025). Larger SMEs with multi-national owners that typically produce, and export milk powder are typically harder to electrify due to their scale, high temperature demands, and competition with international facilities for investment. Smaller processes producing drinking milk, yogurt, or cheese generally have lower-temperature processes and are more amenable to electrification or heat pump solutions.



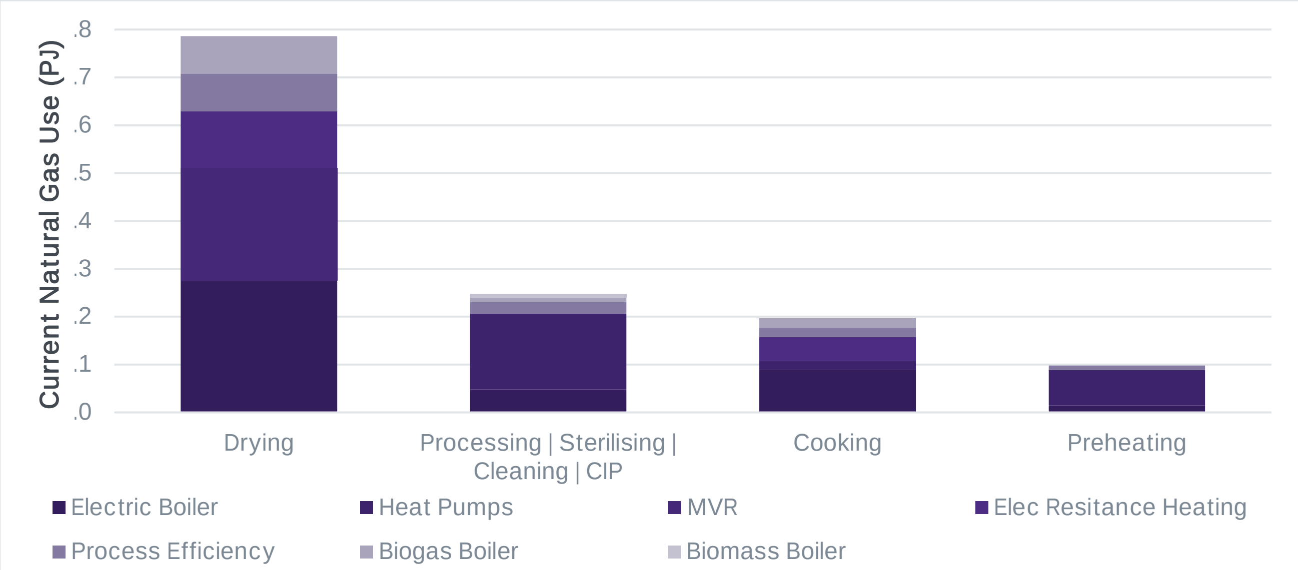


Figure 12: Decarbonisation technologies suited to dairy processing based on ability of technology to abate natural gas in PJ and broken down by technology and process.

B.7.3 Fruit and Vegetable Processing

Fruit and vegetable processing is one of the larger natural gas consuming subsectors, estimated at approximately 1.2 PJ annually. Potatoes represent the largest volume processed, with over 175,800 of the 414,660 tonnes of vegetables processed in NSW. There are around 20 potato processing facilities, ranging from frozen fries to potato chips (IBIS World, 2023). Lamb Weston, a single large facility, likely accounts for the majority of natural gas demand in NSW (Lamb Weston, 2025).

Figure 13 summarises electrification and decarbonisation technologies by process and their potential to abate natural gas use. Key processes include cooking, blanching, sterilising/cleaning (CIP), drying, preheating, and frying, with steam and hot water temperatures ranging from 50°C to 200°C depending on the operation.

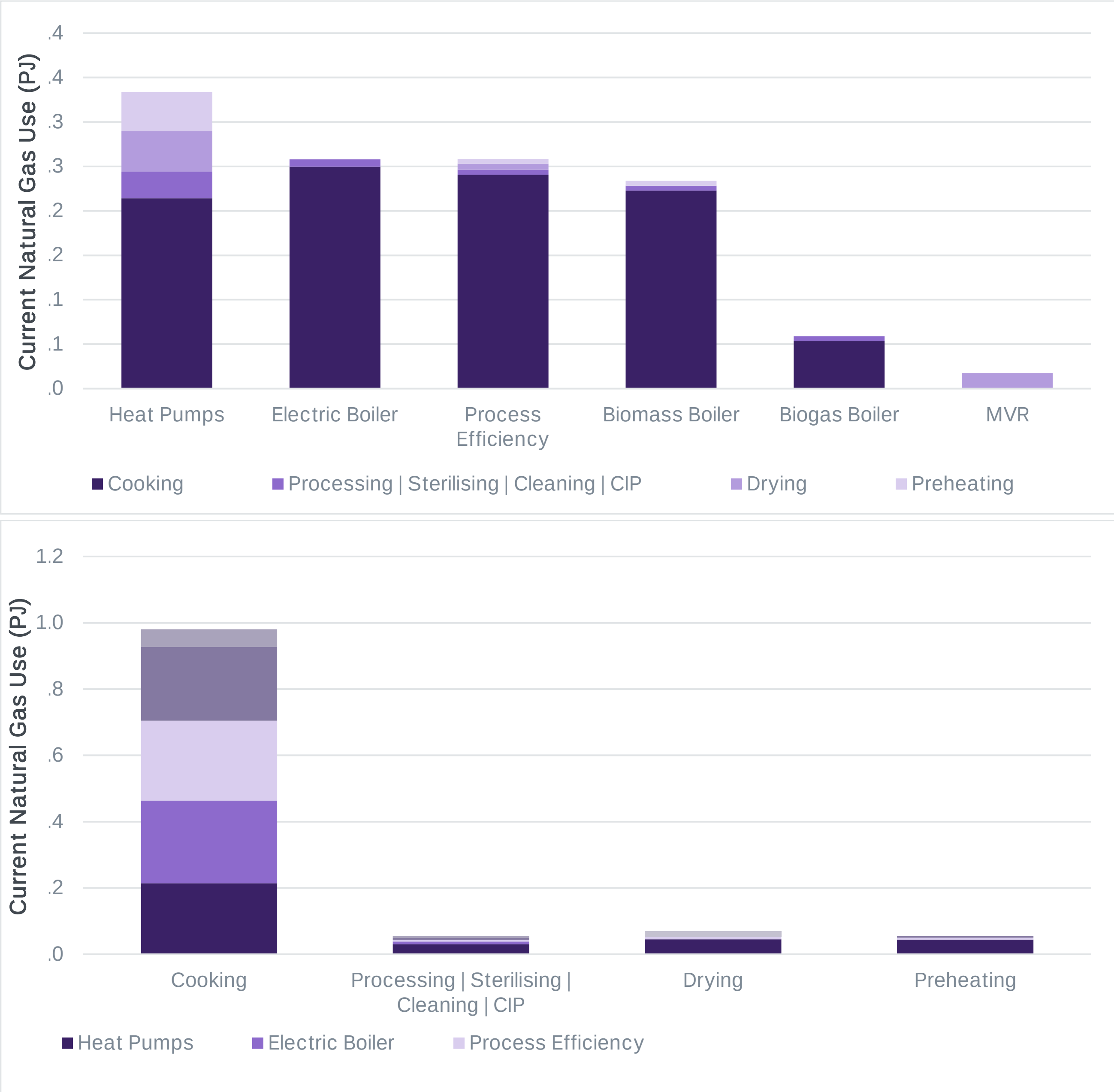


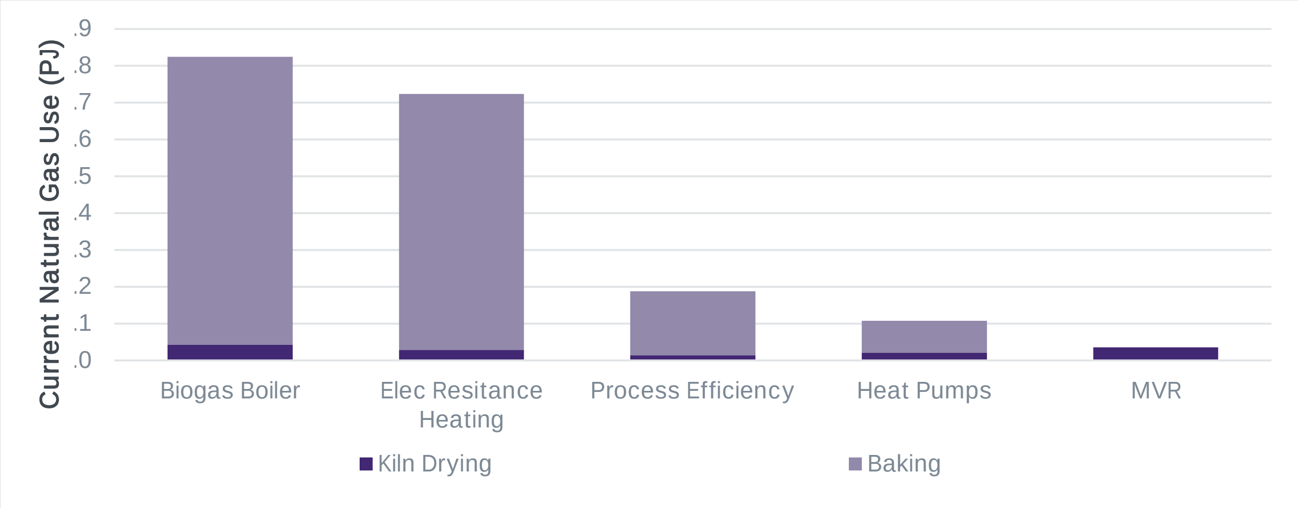
Figure 13: Decarbonisation technologies suited to fruit and vegetable processing based on ability of technology to abate natural gas in PJ and broken down by technology and process.

Steam is heavily used for blanching (60–100°C) and sterilising or sanitising (65–100°C), particularly during canning and CIP operations. Potato processing also includes peeling (150–200°C), preheating, frying (65–200°C), and drying (<50°C). Figure 6 shows the primary decarbonisation technologies for the sector, including heat pumps, electric boilers, biomass boilers, electric air heating, process efficiency measures, biogas systems, and mechanical vapor recompression (MVR).

Additional process efficiency opportunities exist. For example, blanching is among the highest energy consumers, and emerging technologies such as Pulse Electric Fields (PEF) could achieve up to 40% energy reduction and 80% water reduction (EECA, 2021).

B.7.4 Grains and Baking

Facilities in the Grains, Cereal, and Bakery subsectors tend to be smaller than meat or dairy plants, resulting in a large number of SME sites across NSW. Aggregate natural gas demand across these subsectors is estimated at 1.9 PJ (Industry Sources, 2002). Figure 14 summarises natural gas use and potential abatement by process and technology. Key processes include kiln drying (40–90°C) for grains, and baking (160–220°C) for pastries and bread. The primary decarbonisation options include biogas boilers, electric air heating, process efficiency measures, heat pumps, electric boilers, and MVR.



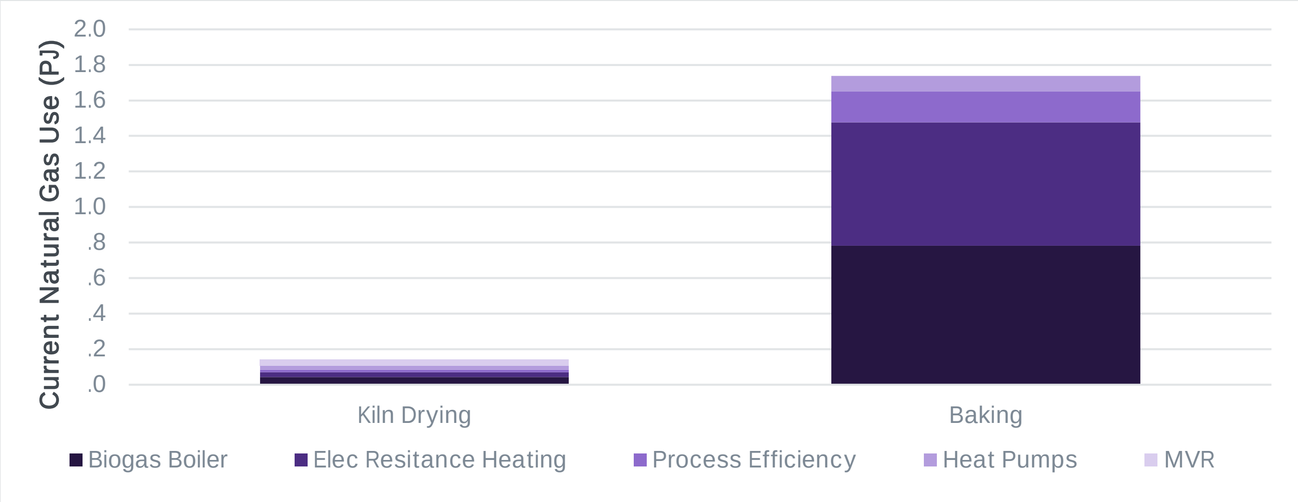


Figure 14: Decarbonisation technologies suited to the grains and cereal, and baking sectors based on ability of technology to abate natural gas in PJ and broken down by technology and process.

Small-scale electric air heating systems could replace gas in some operations. However, their efficiency remains marginal compared to existing gas systems. Regional facilities face additional challenges due to limited network capacity and potential infrastructure upgrades required for electrification. Medium sized businesses particularly those owned by multinationals, often prioritise investments with paybacks under four years, meaning higher cost electrification projects are generally not considered.

Near term biogas or on-site renewable gas production presents more feasible decarbonisation opportunities, particularly where natural gas is cheaper than electricity and grid emissions remain high. Over the long term, electric resistance heating may become viable for small businesses as the grid decarbonises or onsite solar is utilised.

B.7.5 Breweries and Beverages

Breweries and beverage manufacturers and dairy processers in NSW consume similar volumes of natural gas. Breweries and beverage manufacturers are less energy intensive, however there are significantly more breweries (137 in NSW), resulting in a net energy demand of 1.4 PJ (Brew News, 2022). Figure 15 summarises where natural gas is used within the industry and the potential abatement from renewable technologies. Gas-fired steam and hot water are primarily used for wort boiling (100°C), mashing (75°C), sterilisation (90°C), and pasteurising or bottling (70°C).

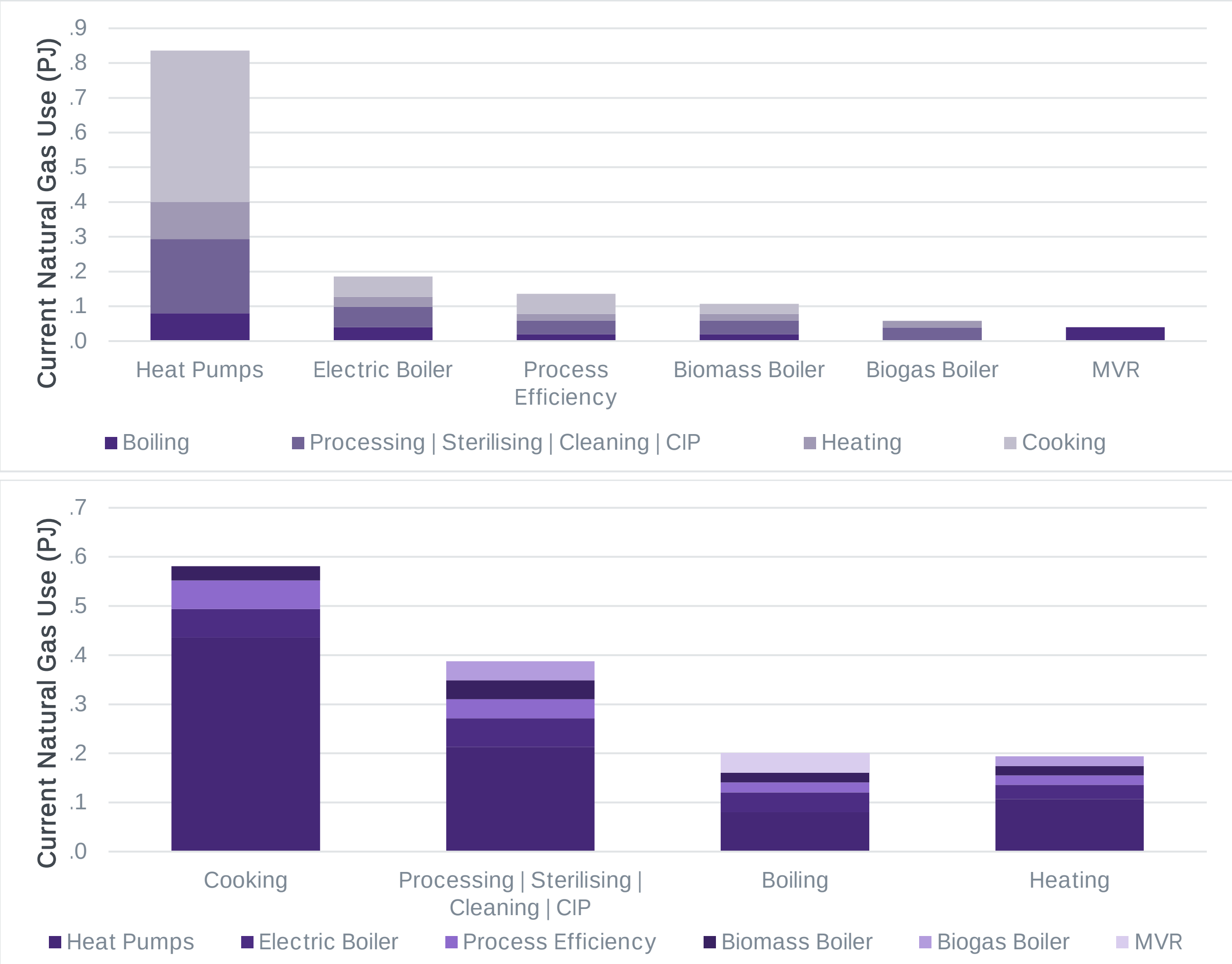


Figure 15: Decarbonisation technologies suited to breweries and beverages based on ability of technologies to abate natural gas in PJ and broken down by technology and process.

There is significant technical potential for heat pumps to provide low temperature heat at high efficiencies (up to 400-500%) because of the heating and cooling requirements in breweries. MVR is also able to supplement high temperature heating requirements at very high efficiencies (over

600%). However, retrofitting existing breweries can be expensive, and natural gas processes require less capital in greenfield sites.

B.7.6 Sugar & Confectionary

The sugar and confectionery subsector differ from most Food and Beverage industries in that the majority of its natural gas demand lies in sugar refining, which is capable of generating its own electricity. The subsector consumes approximately 1 PJ of natural gas annually. Figure 16 outlines where natural gas is used in sugar refining and the potential abatement from renewable technologies. Refineries primarily rely on bagasse, a by-product of sugarcane processing, for cogeneration of heat and electricity. However, natural gas is required to support plant operations at the start and end of the crushing season. These facilities supply electricity both for onsite use and to nearby communities, with waste heat efficiently utilised within the process (Canegrowers, 2024).

Figure 16: Decarbonisation technologies suited to Sugar refining based on ability of technologies to abate natural gas in PJ and broken down by technology and process.

Cane trach or bagasse could be sold at higher values for sustainable aviation fuel production instead of inhouse utilisation, however increased electrical or alternative renewable fuel costs would add risk and uncertainty. As a result, fully replacing cogeneration is not an effective strategy. Instead, offsetting natural gas use with drop-in biofuels such as biogas or biomass, and deploying solar PV to reduce auxiliary electricity demand, would support a transition toward 100% renewable cogeneration while maintaining system efficiency.

B.8 Textiles, Clothing, and Leather (13)

The textiles, clothing, and leather subsector consumed approximately 2.1 PJ of natural gas in 2023, making it a smaller, but still relevant consumer among SME-dominated industries in NSW (AES, 2024). Employment is fragmented across approximately 4,000 businesses, and over 13,000 employees (AISC, 2022), however medium businesses in leather such as Casino Hides make up the majority of natural gas consumption (Leather Naturally, 2023).

Figure 17 shows where natural gas is used in the subsector and the potential abatement from renewable technologies. Gas is primarily used for heating air directly or heating water and air via steam boilers. The dominant processes include clothing dyeing and drying, and leather tanning, typically operating between 30–70°C.

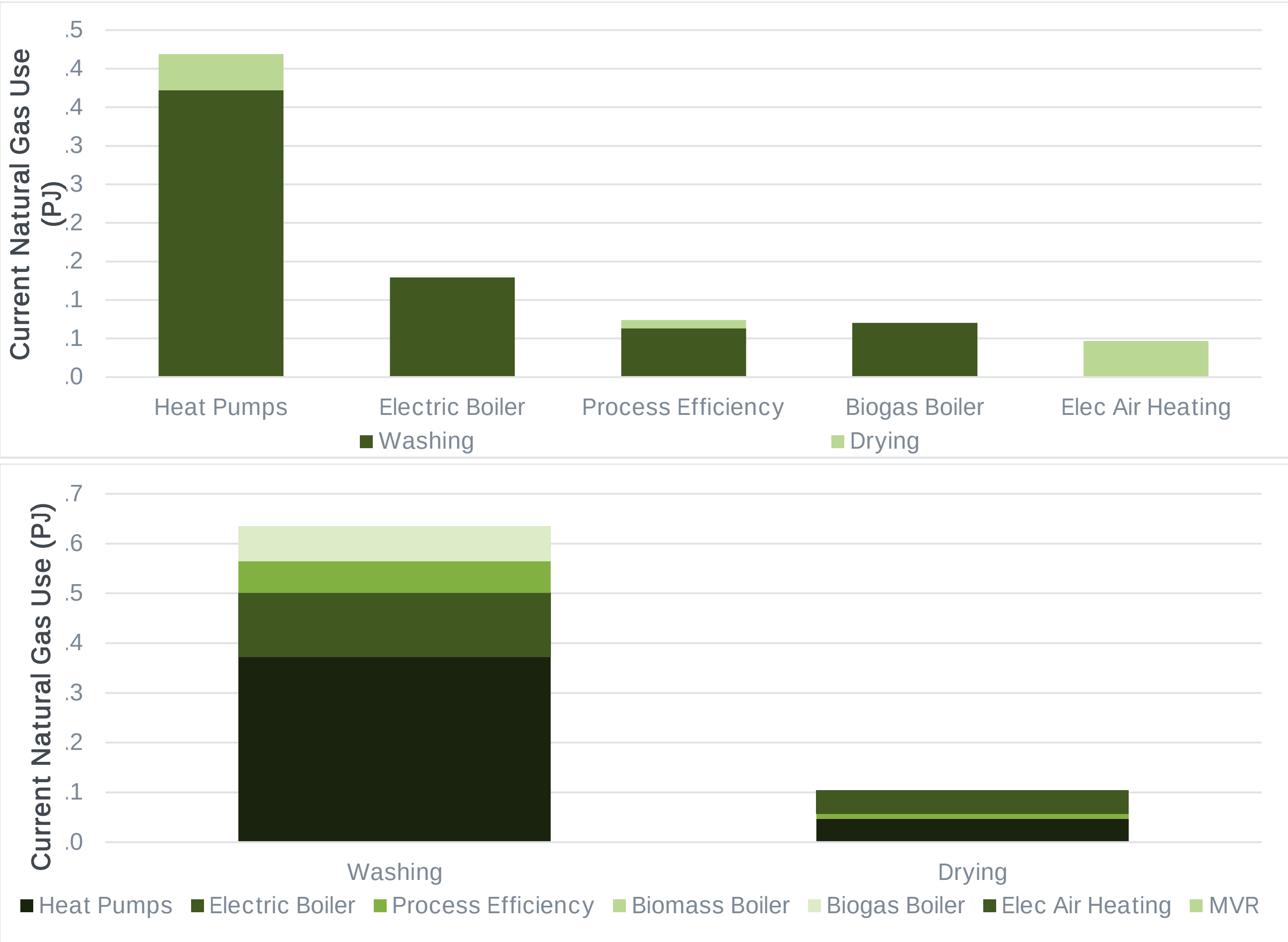


Figure 17: Decarbonisation technologies suited to Textiles and Leather Processing based on ability of technology to abate natural gas in PJ and broken down by technology and process.

Energy use across textiles and apparel manufacturing is typically dispersed, and many sites operate below thresholds where energy is a primary cost driver, as a result investment is typically focused on short payback production opportunities. Leather processing facilities are fewer but more energy-intensive, with continuous hot water demand driving higher absolute gas use. Gas remains the dominant fuel source for these processes, as biomass or biogas is rarely available where tanneries are located.

Decarbonisation opportunities differ by segment. In textiles, smaller gas-fired dryers can transition to electric resistance or heat pump dryers, while larger dryers may shift to electric steam systems. In leather, hot water and steam generation can feasibly electrify, and chemical or mechanical process substitutions may further reduce heat demand. Larger facilities may be able to trial these transitions, while smaller operators face higher relative capital costs and administrative barriers, underscoring the need for SME-focused policy support to enable adoption.

B.9 Wood and Wood Products (14)

The Wood and Wood Products subsector in NSW consumes approximately 0.59 PJ of natural gas annually, with demand primarily driven by kiln drying, which heats air to 100–160°C. Employment across forestry and wood product operations totals roughly 18,950 people (NSW Government, 2016), with over 76 sawmills distributed across NSW (Timber NSW, 2025).

Figure 18 shows the renewable technologies suited to this industry. Gas demand is largely site-dependent, with over 85% of energy supplied from onsite biomass (wood waste) and the remaining ~25% from natural gas (AES, 2024). Full substitution with biomass is limited by security and availability of feedstock beyond internal resources.

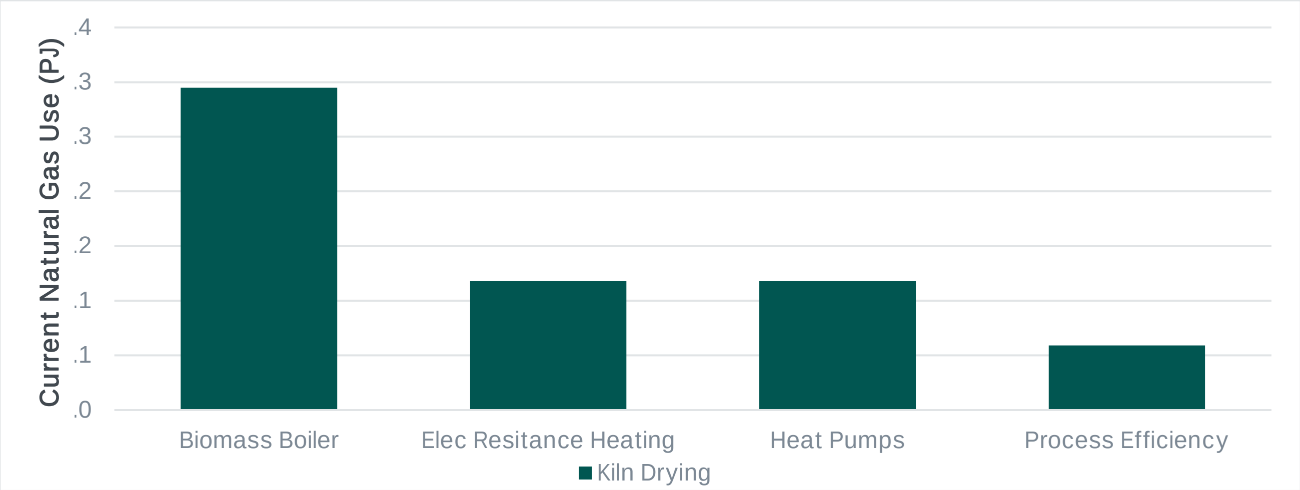


Figure 18: Decarbonisation technologies suited to Kiln drying in Wood and Wood Product Processing based on ability of technology to abate natural gas in PJ.

Decarbonisation potential is closely tied to biomass supply and logistics. Where resources are abundant, biomass substitution is feasible and cost-effective in the near term, but long-term purchased biomass is expected to exceed gas costs. High-temperature heat pumps and energy efficiency measures could reduce overall energy demand and enable complete abatement of natural gas, though capital costs and integration complexity remain significant barriers.

The subsector's dispersed SME profile means smaller operators may face higher relative costs and administrative burdens in accessing support schemes. Larger engineered wood facilities, by contrast, have greater capacity to trial advanced technologies and secure long-term biomass supply contracts from third-party vendors.

B.10 Pulp, Paper, and Printing (15-16)

The Pulp, Paper, and Printing subsector in NSW is highly energy-intensive, consuming over 4 PJ of natural gas annually. Gas provides approximately 47% of thermal energy for on-site boilers and cogeneration systems, supplemented by biomass (40%) and black liquor (2.5%) (AES, 2024). Figure 19 shows the primary processes and renewable technologies suited for decarbonisation.

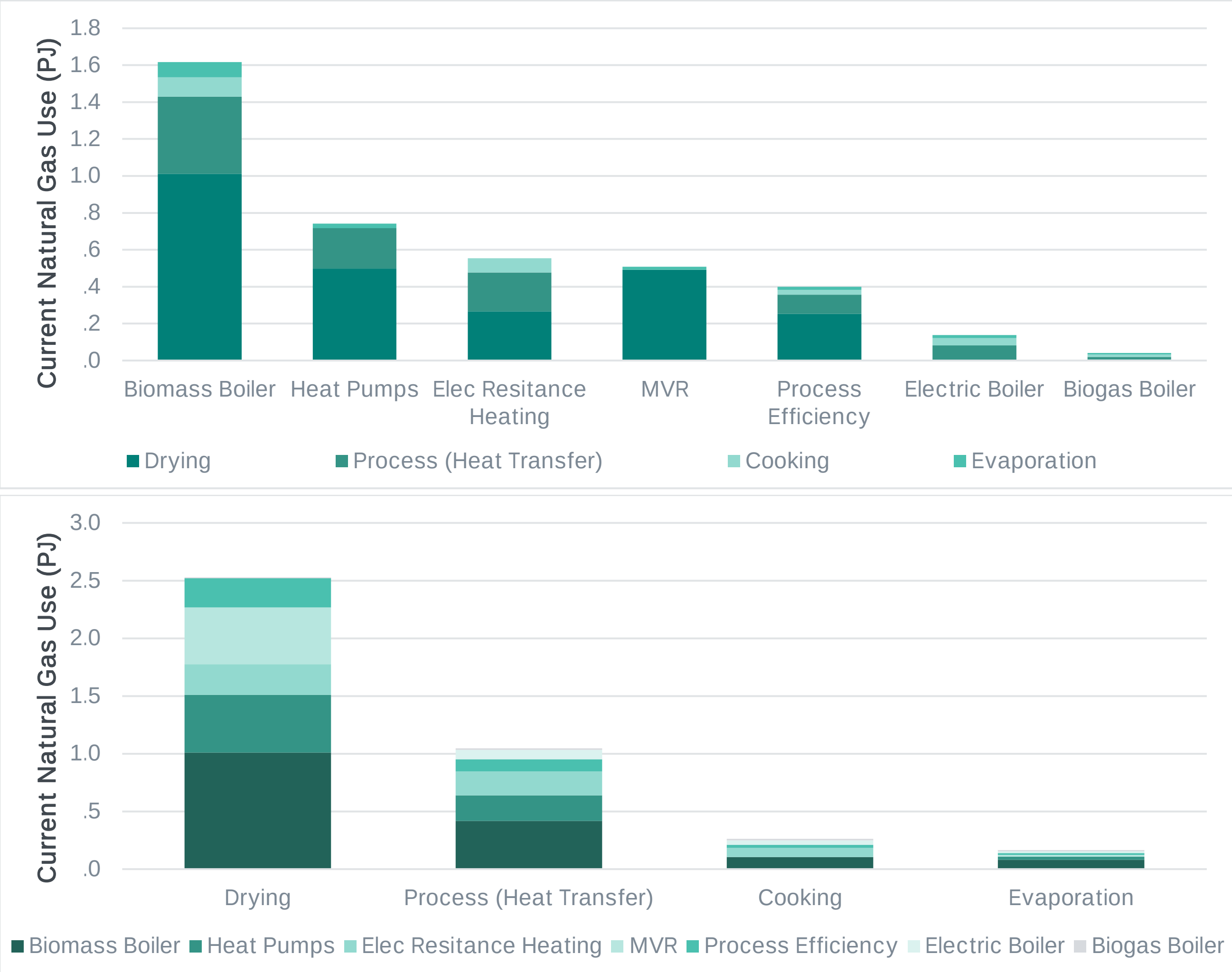


Figure 19: Decarbonisation technologies suited to Pulp and Paper Processing based on ability of technology to abate natural gas in PJ and broken down by technology and process.

Low-temperature steam (120°-180°C) is required for pulping, bleaching, evaporating moisture, pulp drying, paper pressing, and paper drying. Energy demand is concentrated in a small number of large facilities, which also account for over 50% of subsector emissions being covered under the Safeguard Mechanism.

Larger mills generally have the technical capacity to assess advanced decarbonisation options, but full transition is constrained by complex energy profiles, high retrofit costs, long equipment lifetimes, and the need for continuous steam supply (Zhou, 2025). Incremental efficiency upgrades are limited by technical challenges and the lack of targeted policy support.

Electrification pathways such as high-temperature heat pumps and MVR could reduce steam demand by providing low-temperature heating or direct drying. However, retrofitting these into integrated mill systems faces thermodynamic and economic bottlenecks. Full substitution of gas-fired steam would require deployment of electric boilers, ETES, or biofuel boilers (Del Rio, 2022).

In practice, the most pragmatic near-term approach is scaling up existing biomass use: most mills already operate solid or liquid biofuel boilers using on-site waste streams. Expanding this model with purchased biofuels could substantially reduce natural gas dependence while allowing facilities to retain existing infrastructure.

Appendix C: NCC Bioenergy Position 2025

Principles:

1. Electrification should be encouraged for all viable solutions.
2. Bioenergy should be prioritised for use in hard to abate sectors where electrification is not deemed viable.
3. Bioenergy should be generated from waste or residual materials, not for-purpose feedstock that negatively impacts animal habitat or displaces food production.
4. Potential growth in biogas production should not be used to justify delayed electrification.
5. Native forest residues or land clearing residues should not be used as biomass for energy because they provide income streams to the native forest logging industry and the agricultural sector in a way that can prop up unsustainable practices. NCC are opposed to native forestry logging and believe it should be phased out for sustainable plantation industry. NCC have concerns with land clearing laws that permit clearing of native vegetation. Additional income streams for by-products provides support for these practices, possibly providing the marginal benefit that sees these ventures undertaken.

Appendix D: Existing Applications and Processes

This appendix outlines the current applications of natural gas in NSW manufacturing, broken down by the type of thermal energy delivered: hot air, hot water or low-temperature steam, and steam. The section is structured to help readers understand:

- Process type and typical temperature range – low and high temperatures relevant to each application.
- Sector and scale – which industries and processes predominantly use each technology.
- Energy consumption and emissions – natural gas use in GJ and associated CO_2 emissions.
- System size and renewable alternatives – indicative total system size in MW and potential technologies for decarbonisation.

Tables following each subsection provide a detailed breakdown of representative applications, including the primary renewable technologies that could replace natural gas.

D.11 Hot Air

Hot air systems are used where direct surface heating or drying is required. Applications include kilns and ovens, as well as small batch dryers in textiles or food processing. Gas combustion allows these systems to operate independently of a central heat distribution network, avoiding storage and distribution losses. The relatively low operating temperature also reduces corrosion and maintenance costs.

Table 3 provides examples of hot air applications across NSW manufacturing, showing typical temperature ranges, natural gas consumption, CO_2 emissions, and the primary renewable technologies suitable for transition. Biofuels (biogas or biomass) are typically the first-choice renewable replacement, while electric alternatives such as electric resistance or ETES may also be feasible.

Table 3: Processes that use hot air directly.

Application	Subsector	Temp Low °C	Temp High °C	Natural Gas GJ	tCO2	Total System Size (MW)	Primary Renewable Technologies
Kiln	Grain Mill & Cereal	40	90	141,000	7,260	10	Biogas, Electric Resistance,
Oven	Bakery Product	160	220	1,737,000	89,500	123	Biogas, Electric Resistance
Drying	Textiles	30	60	104,000	5,400	7	Heat Pumps, Electric Resistance
Kiln	Wood and wood products	100	160	590,000	30,400	33	Biomass, Electric Resistance

D.12 Hot Water (Generated or Indirect Steam)

Hot water can be produced directly in heaters, or via steam through heat exchangers. In larger plants, a single steam boiler may supply both hot water and process steam. While steam is historically less efficient for low-temperature applications due to higher operating temperatures, it has been favoured for economic reasons and, in some cases, as a byproduct of cogeneration (e.g., sugar processing). Hot water has the additional benefit of storage, enabling peak load management. Table 4 summarises typical hot water and low-temperature steam applications, their energy use, and suitable renewable or electric alternatives. Heat pumps and electric boilers are generally the preferred electrification technologies for these applications.

Table 4: Processes that use hot water at point of use.

Application	Subsector	Temp Low °C	Temp High °C	Natural Gas GJ	ktCO2	Total System Size (MW)	Primary Renewable Options
Processing | Sterilising | Cleaning | CIP	Meat, Dairy, Fruit & Vege, Beverages	65	100	1,894,123	97,604	108	Heat Pumps, Electric Boilers
Preheating	Dairy, Fruit & Vege	55	75	153,659	7,918	9	Heat Pumps
Drying	Fruit & Vege, Sugars, Pulp, Paper & Printing	40	90	2,986,168	153,877	186	Heat Pumps, MVR, Electric Resistance
Low Temperature Cooking, Heating	Beverages, Pulp, Paper & Printing	30	90	1,821,805	65,771	80	Heat Pumps, Electric Boilers
Washing	Textiles, Leather	30	70	634,700	32,706	40	Heat Pumps

D.13 Steam (Exclusively)

Steam underpins most energy-intensive industrial processes, valued for its high latent heat, uniform energy transfer, and versatility across 60–300°C. It is primarily used in cooking, drying, and evaporating processes, such as meat rendering, milk drying, or sugar concentration. High-temperature steam systems incur distribution losses and higher maintenance costs due to potential leaks or failed traps. Unlike hot water, steam cannot be stored, requiring boilers to ramp up or down to meet demand. Steam is critical in processes where hot air is insufficient for heat transfer. Table 5 summarises processes where high-temperature steam is necessary, their natural gas consumption, and potential renewable or electric alternatives. Electric boilers, biomass, heat pumps, and MVR are all applicable technologies depending on process temperature and integration feasibility.

Table 5: Processes that directly use steam.

Application	Subsector	Temp Low °C	Temp High °C	Natural Gas GJ	ktCO2	Total System Size (MW)	Primary Renewable Technologies
Cooking, Boiling	Meat, Dairy, Fruit & Vege, Beverage, Pulp, Paper & Printing	100	200	2,654,546	136,789	141	Electric Boiler, Biomass
Drying, Evaporating	Meat, Dairy, Sugars, Pulp, Paper & Printing	100	300	1,474,602	75,986	63	Biogas, MVR, Heat Pumps
Processing (Steam injection, heat exchanger)	Dairy, Fruit & Vege, Sugars, Pulp, Paper & Printing	70	200	342,672	17,658	18	Biomass, Heat Pumps

Appendix E: Decarbonisation Technologies

This section summarises the principal electrification and renewable technologies available to replace natural gas in NSW manufacturing. It presents high-level capital investment (CapEx), operational savings, payback periods, and key feasibility considerations. The technologies presented in order of typical deployment, with commentary on industrial applicability and constraints. The tables provide NSW wide estimates for costs, gas savings, and operational savings over time.

Energy Efficiency

Energy efficiency measures reduce natural gas demand by lowering heat requirements before new technologies are applied. This reduces the scale and cost of renewable technology deployment. Common strategies include waste heat recovery and process design modifications such as low temperature rendering in meat or pulse electric fields in blanching. Across sectors, audits indicate at least 10% energy reduction is achievable at low cost, though technical complexity or limited knowledge often hinders adoption. Payback periods are consistently short, typically 2–3 years, making energy efficiency a foundational step for decarbonisation (Table 6).

Table 6: Feasibility of implementing efficiency projects across industry at a given year.

Process Efficiency Increase	2025	2030	2035	2040	2045	2050
CapEx ($m)	$92	$92	$92	$92	$92	$92
Gas Savings ($m)	$35	$32	$32	$35	$37	$40
Renewable Cost ($m)	-	-	-	-	-	-
Operational Savings ($m)	$35	$32	$32	$35	$37	$40
Payback	3	3	3	3	2	2

Heat Pumps

Heat pumps deliver process heat as air (up to 140°C) or water (up to 95°C). Air-sourced heat pumps have lower capital costs but efficiencies of 200–300%, while water-sourced heat pumps can exceed 500% efficiency when integrated with waste streams, however, typically have higher capital costs and complexity. They are best suited for low-to-medium temperature processes, with emerging technology capable of low-temperature steam production, though higher temperature processes often transition to mechanical vapor recompression (MVR) instead. Average payback periods improve over time from 27 years in 2025 to 6 years by 2050 as costs decline and savings accumulate (Table 7).

Table 7: Feasibility of installing heat pumps across industry at a given year.

Air Sourced Heat Pumps	2025	2030	2035	2040	2045	2050
CapEx ($m)	$115	$115	$115	$115	$115	$115
Gas Savings ($m)	$41	$38	$38	$42	$45	$48
Renewable Cost ($m)	$48	$45	$41	$38	$36	$33
Operational Savings ($m)	-$7	-$6	-$3	$3	$9	$15
Payback	-	-	-	36.0	12.5	7.6

Water Sourced Heat Pumps	2025	2030	2035	2040	2045	2050
CapEx ($m)	$178	$178	$178	$178	$178	$178
Gas Savings ($m)	$44	$41	$41	$44	$47	$49
Renewable Cost ($m)	$26	$24	$23	$21	$19	$18
Operational Savings ($m)	$18	$17	$18	$23	$27	$31
Payback	10	11	10	8	7	6
Heat Pumps (Total)	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
CapEx ($m)	$293	$293	$293	$293	$293	$293
Gas Savings ($m)	$85	$80	$79	$85	$92	$97
Renewable Cost ($m)	$74	$69	$64	$59	$55	$51
Operational Savings ($m)	$11	$11	$15	$26	$36	$46
Payback	27.5	27.4	20.1	11.2	8.1	6.3

Electric Boilers and Electric Air Heating

Electric boilers convert electricity to thermal energy at nearly 100% efficiency, and electric air heating systems provide similar efficiency for direct heat. These technologies are most applicable in high-temperature steam or air processes but can be less cost-effective and more emissions intensive if electricity is generated from fossil fuels, due to lower net efficiency. Electro-thermal energy storage (ETES) can supplement these systems to manage peak loads but is not yet financially incentivised. Capital costs are moderate, but operational costs are high in the early period, resulting in a negative net present value under current grid costs and tariff structures (Tables Table 8-Table 9).

Table 8: Feasibility of installing electric boilers across industry at a given year.

Electric Boiler	2025	2030	2035	2040	2045	2050
CapEx ($m)	$93	$93	$93	$93	$93	$93
Gas Savings ($m)	$39	$37	$36	$39	$42	$44
Renewable Cost ($m)	$96	$89	$83	$77	$71	$66
Operational Savings ($m)	-$57	-$53	-$47	-$38	-$30	-$22
Payback	-	-	-	-	-	-

Table 9: Feasibility of installing electric air heating across industry at a given year.

Electric Air Heating	2025	2030	2035	2040	2045	2050
CapEx ($m)	$81	$81	$81	$81	$81	$81
Gas Savings ($m)	$35	$33	$32	$35	$38	$41
Renewable Cost ($m)	$90	$83	$77	$72	$67	$62
Operational Savings ($m)	-$55	-$51	-$45	-$36	-$28	-$21
Payback	-	-	-	-	-	-

MVR

MVR upgrades energy within the process itself, achieving efficiencies of 600–2000%, particularly suited for evaporation, drying, or distillation. High capital costs make retrofits costly for brownfield sites, but greenfield installations can integrate efficiently. Operational savings and payback periods improve over time, typically 8–12 years by 2050, depending on process integration (Table 10).

Table 10: Feasibility of installing MVR across industry at a given year.

MVR	2025	2030	2035	2040	2045	2050

CapEx ($m)	$157	$157	$157	$157	$157	$157
Gas Savings ($m)	$21	$20	$20	$22	$24	$26
Renewable Cost ($m)	$8	$8	$7	$7	$6	$6
Operational Savings ($m)	$13	$12	$13	$15	$17	$20
Payback	12	13	12	10	9	8

Biomass Boilers

Biomass boilers use solid biofuels sourced primarily from onsite waste material or plantation forests. Biomass derived from native forest residues or land clearing activities is excluded from consideration due to its negative impacts on biodiversity and carbon accounting (DCCEEW, 2022). In Australia, biomass is only considered sustainable where it utilises true waste or residual material, such as sawmill offcuts, agricultural by-products, or plantation residues within viable supply radius (typically within ~150 km of the facility).

However, biomass is not expected to play a large-scale role in industrial decarbonisation, given its limited availability, land-use implications, and the governments priority on wide-scale electrification powered by renewable sources. Biomass consumption is not considered carbon neutral (1.8 $kgCO_2$/GJ) because of the emissions from combustion, transport, and land-use change, and this is reflected in the assumptions for transition.

Industry groups recognise that biomass in Australia remain viable only in niche, hard-to-abate sectors where high-temperature processes or on-site waste streams make electrification impractical, such as sugar refining, wood, paper or printing processes, or processes in rural regions where firm electrical supply is unreliable, and biomass is available. Competition for wood residues from these sectors as well as emerging capabilities to produce sustainable aviation fuel (SAF), biodiesel, and biomethane is expected to increase significantly, driving up costs for smaller industrial users in Food and Beverage processing.

Table 11 shows operational costs increasing as biomass is expected to become less abundant over time, except where facilities have secure, on-site residuals. In most other industrial settings, electrification will likely remain the preferred long-term solution.

Table 11: Feasibility of installing biomass boilers across industry at a given year.

Biomass Boiler	2025	2030	2035	2040	2045	2050
CapEx ($m)	$401	$401	$401	$401	$401	$401
Gas Savings ($m)	$74	$70	$69	$76	$82	$89
Renewable Cost ($m)	$20	$22	$23	$25	$27	$29
Operational Savings ($m) ($m)	$54	$48	$46	$51	$55	$60
Payback	7	8	9	8	7	7

Biogas Boilers

Biogas boilers offer combustion-based replacement for fossil gas and can be fuelled by either on-site biogas from anaerobic digestion of organic waste, or network-supplied biomethane. On-site biogas systems are capital intensive due to waste processing and gas conditioning equipment but can deliver strong operations savings where organic feedstock is continuously available (e.g., abattoirs, dairies, and food processors). Table 12 shows paybacks are typically 8-10 years, depending on waste stream characteristics.

It is estimated that NSW is capable of producing 3.7 PJ of biogas through landfill as low as $10 /GJ, and 30 PJ of biogas from current waste sources as high as $27 /GJ (Energy Networks Australia, 2025), without considering utilisation of crop residues. It is estimated that SMEs, which currently make up 12% of NSW natural gas demand in will likely require 1.5 PJ or 4% of low-cost biogas availability for long-term or permanent solutions. However, biogas is not carbon neutral (6.43 $kgCO_2$/GJ), as a result national policy directions now prioritise renewable electrification as the primary decarbonisation pathway, reserving bioenergy for niche or on-site waste recovery systems.

Table 12: Feasibility of installing biogas boilers across industry at a given year.

Biogas Boiler	2025	2030	2035	2040	2045	2050
Onsite Biogas Production CapEx ($m)	$230	$230	$230	$230	$230	$230
Gas Savings ($m)	$26	$24	$23	$25	$27	$28
Onsite Biogas Payback	8.8	9.58	10	9.2	8.5	8.2
Renewable Network Gas Cost ($m)	$55	$52	$48	$45	$42	$39
Operational Network Savings ($m)	-$30	-$28	-$25	-$20	-$15	-$11

Appendix F: Detailed Breakdown of Policies

This table proved a breakdown of all policies analysed in Figure 7. Some policies shown in Figure 7 were condensed, for visual clarity and have been disaggregated here into their constituent programs. For example, ARENA-related policies are presented as individual streams that than single entries.

Table 13: Detailed breakdown of policies impacting SMEs

No Impact	Minimal Impact	Limited Impact	Some Impact	High Impact

Primary Policy Leaver	Jurisdiction	Scheme Name	Description & Justification
Strategic Direction	Federal	Battery Breakthrough Initiative - ARENA	$523m grant for battery manufacturing capability development. Targets battery sector, not directly relevant to food/beverage, textiles, or wood manufacturing decarbonisation.
		Future Made in Australia	$22.7b for renewable energy and critical minerals value chains. Limited direct relevance to SME process heat needs; may support upstream technology development.
		National Reconstruction Fund	$15b for industry transformation including clean energy manufacturing. May indirectly benefit SMEs through improved heat pump/biomethane supply chains and technology costs.
		Solar Sunshot - ARENA	$1b grant for solar manufacturing infrastructure. Targets solar sector, not directly relevant to SME manufacturing decarbonisation.
	NSW	Industrial Decarbonisation Plans	Regional transition support for Hunter and Illawarra. Benefits only SMEs in these regions, excludes operations in Sydney, Western NSW, and coastal areas.
		Net Zero Industry and Innovation Program	$360m for high-emitting and low-carbon industries. Strategic direction unclear for SMEs but may support biomethane infrastructure and low-carbon materials development.
	Victoria	Victoria's Climate Change Strategy	$8.5b investment toward net zero by 2045. Provides policy certainty but lacks SME-specific implementation pathways or direct business support mechanisms.
	New Zealand	Climate Change Response Act	Legislated net zero by 2050 with interim budgets. Prioritised process heat as key sector, creating framework for GIDI and ETS reforms. Demonstrates need for strategy plus implementation programs to drive SME action.
Regulatory Signals	Federal	Capacity Investment Scheme	$72b for large-scale renewable energy and battery storage. Infrastructure program for grid decarbonisation; no direct SME relevance but supports long-term electricity transition.

		Climate-Related Financial Disclosure	Large companies must disclose climate risks (phased 2025-2027). Not applicable to most SMEs but may create supply chain pressure as large customers request emissions data from suppliers.
		NGER (National Greenhouse & Energy Reporting)	Mandatory reporting for facilities >25ktCO2 or corporates >50ktCO2. Most SMEs below thresholds; only captures largest processors and mills. No support mechanism.
		Safeguard Mechanism	Facilities >100ktCO2 must reduce 4.9%/year or purchase credits. Most SMEs well below threshold; only largest pulp/paper and meat/dairy facilities captured. No pressure on typical SMEs.
		EPA Reporting	Environmental Protection Licenses are required for scheduled activities. Includes emissions monitoring, pollution limits, and annual reporting requirements. Emitters >25 ktCO2 now subject to greenhouse gas mitigation requirements and Climate Change Mitigation and Aciton Plans.
		National Polluting Inventory	Mandatory reporting for facilities exceeding substance thresholds (e.g. Category 1: >10t/y of listed substances, Category 2a: >400t/y tonnes of fuel consumption). Covers 93 substances emitted to air, water, land. Most SMEs fall below reporting thresholds; however it tracks pollutants and is used to provide transparency.
	Victoria	Climate Action Act 2017	5-yearly sector pledges across economy. Voluntary for businesses with no SME enforcement mechanism. May influence future programs but no current direct engagement.
	New Zealand	Resource Management Act	Requires emissions reduction plans for new fossil fuel equipment consents. Provides friction to long-term lock-in at capital investment decisions. Complements funding and pricing but only applies to new equipment, not existing.
Capability Building	Federal	New Energy Apprentice Program [Exp.]	Up to $10k apprentice support payments. Targeted clean energy occupations. Minimal impact shown as it provided less than a 1% increase in apprentices.
	NSW	Skills for Net Zero	100 paid internships (200hrs min) providing $2,500 subsidy plus recruitment support. Provides affordable technical expertise for SMEs lacking internal sustainability capacity to scope electrification projects.
	New Zealand	Energy Graduate Programme	50% graduate salary co-funding (Up to $70,000). Embeds energy expertise within businesses; graduates averaged 2 GWh/year savings. Proven success in food processing (dairy, meat). Accessible for SMEs.

		Direct Account Manager	40% co-funding (up to $35k) for comprehensive pathway development with dedicated Account Managers. Overcomes information barriers, provides personalized guidance, connects to funding, and ensures SMEs don't fall through gaps. Critical to GIDI uptake.
		Regional Energy Transition Accelerator (RETA)	Regional assessment of decarbonisation opportunities, biomass supply, and infrastructure needs. Publicly available data reduces individual assessment costs and enables regional coordination for biomass and grid solutions.
Capital Incentives	Federal	Advancing Renewables Program (ARP) - ARENA	$100k-$50m grants (50% co-funding) for renewable tech projects. Minimum accessible for SME pilots (heat pumps, biomethane). Competitive merit-based process.
		Cleaner Fuels Program	$1.1b for low-carbon liquid fuel production. Benefits fuel producers, not users. Tangential to process heat needs; may reduce future sustainable fuel costs.
		Driving the Nation Program - ARENA	~$500m for EV uptake and charging. Transport-focused; minimal manufacturing relevance (Scope 3 only).
		Future Made in Australia Innovation Fund - ARENA	$1.5b for clean tech manufacturing and supply chains (green metals, renewables, low-carbon fuels). May support heat pump/biomethane development but direct SME access uncertain.
		Hydrogen Headstart Round 2 - ARENA	$2b for large-scale (>100MW) hydrogen production. Not accessible to SMEs; current focus on production infrastructure rather than end-use supply.
		Net Zero Fund	$5b for industrial retrofits and electrification. Large facility focus; SME access pathways unclear, likely favours larger operations and novel technologies.
		Powering the Regions Fund	$1.9b ($600m for trade-exposed facilities). Tied to Safeguard compliance; excludes SMEs below 100kt threshold.
		Regions Industrial Transformation Stream - ARENA	$180m pool, grants up to $500k for regional industrial decarbonisation requiring material emissions reduction. Accessible scale for SME process heat electrification projects.
		Ultra Low-Cost Solar PV R&D Funding Round - ARENA	$60m for solar PV R&D. Research-focused; no direct SME relevance but may reduce future solar costs.
	NSW	Energy Metering and Monitoring Planning Grants	$15k for energy metering planning. Entry-level funding accessible for fragmented operations and smaller processors with limited technical resources.

		Energy Performance Services Grant	$50k (50% co-funding) for submetering data insights ($1.5m total). Supports process optimisation in complex operations (rendering, evaporation, dyeing cycles).
		EV Fleet Kickstart Grant	$50k per vehicle (up to 15 vehicles/chargers) for electric trucks. Transport focus; minimal relevance to thermal process emissions (Scope 3 only).
		Heat Pump Feasibility Studies Grant	$30k (75% co-funding) for heat pump feasibility studies. Directly supports process heat transition assessment for pasteurisation, drying, and kiln operations. De-risks capital decisions.
		High Emitting Industries Fund (HEI)	$305m for facilities >90ktCO2. Threshold excludes most SMEs; only captures largest processors and mills.
		Net Zero Planning Grant	$30k (75% co-funding) for transition planning. Accessible scale for SME pathway development. Program closure creates strategic planning gap.
		Submetering Grant	$20k (50% co-funding) for permanent submetering. Essential for establishing baselines in multi-process facilities before targeted decarbonisation.
	Victoria	Business Acceleration Fund	$40m for regulatory reform and business innovation. General program not decarbonisation-focused; tangential to thermal transition needs.
		Energy Efficiency Grants (EEG) for SMEs	$10k-$25k (100% funding) for equipment upgrades. SME-targeted with accessible process. High relevance for meat, bakery, and textile equipment upgrades.
		Energy Innovation Fund (Round 3)	$10m for food/beverage electrification (heat pumps, electric processing). Sector-targeted; closure creates innovation funding gap.
		Large Energy User Electrification Support Program	$14k-$60k for facilities using 10-100 GWh/year. Threshold too high; typical SMEs use 5-20 GWh (food) or <10 GWh (textiles).
		Solar for Business Program	$3,500 rebates for commercial solar. Reduces electricity costs but doesn't address thermal gas replacement.
	New Zealand	Government Investment in Decarbonising Industry (GIDI) Fund	Up to 50% co-funding (min $300k projects). Directly targets industrial process heat (coal/gas to biomass/electricity). 81 projects delivered 6.6Mt lifetime reductions. Accessible scale for medium-large SMEs; strong uptake in food (dairy, meat) and textiles (wool). Additionality requirements ensured funding supported projects that otherwise wouldn't proceed.
Operational Incentives	Federal	ACCUs (Emissions Reduction Fund)	Tradable credits (~$30-40/tCO2) for emissions avoidance/storage. Requires approved methodology; most SME equipment upgrades don't qualify. More relevant to land sector.
	NSW	Energy Savings Scheme (ESS)	Certificate trading for electricity efficiency. 13% savings target by 2030. Limited process heat pathways; mainly supports electrical equipment not gas-to-electric thermal solutions.

		Peak Demand Reduction Scheme (PDRS)	Certificate trading for peak demand reduction. Limited relevance to gas-dependent thermal processes; may support refrigeration demand response.
		Renewable Fuel Scheme (RFS)	Certificates for renewable fuel production (hydrogen 2026, biomethane 2028). Biomethane relevant for organic waste sectors but favours producers over users; SME benefit depends on supply development.
	Victoria	Victorian Energy Upgrades (VEU) Program	Certificate trading for energy efficiency. Largest state program, strong SME uptake. Limited industrial heat pathways; supports electrical equipment (lighting, HVAC, motors) not thermal processes.
	New Zealand	New Zealand Emissions Trading Scheme (NZ ETS)	Carbon price on coal/gas (NZD $64 floor). Upstream obligation passes cost to all fossil fuel users. Combined with GIDI co-funding, created strong business case. Agricultural emissions excluded; some EITE free allocation remains, inconsistent pricing and long-term price decreases have reduced long-term impact