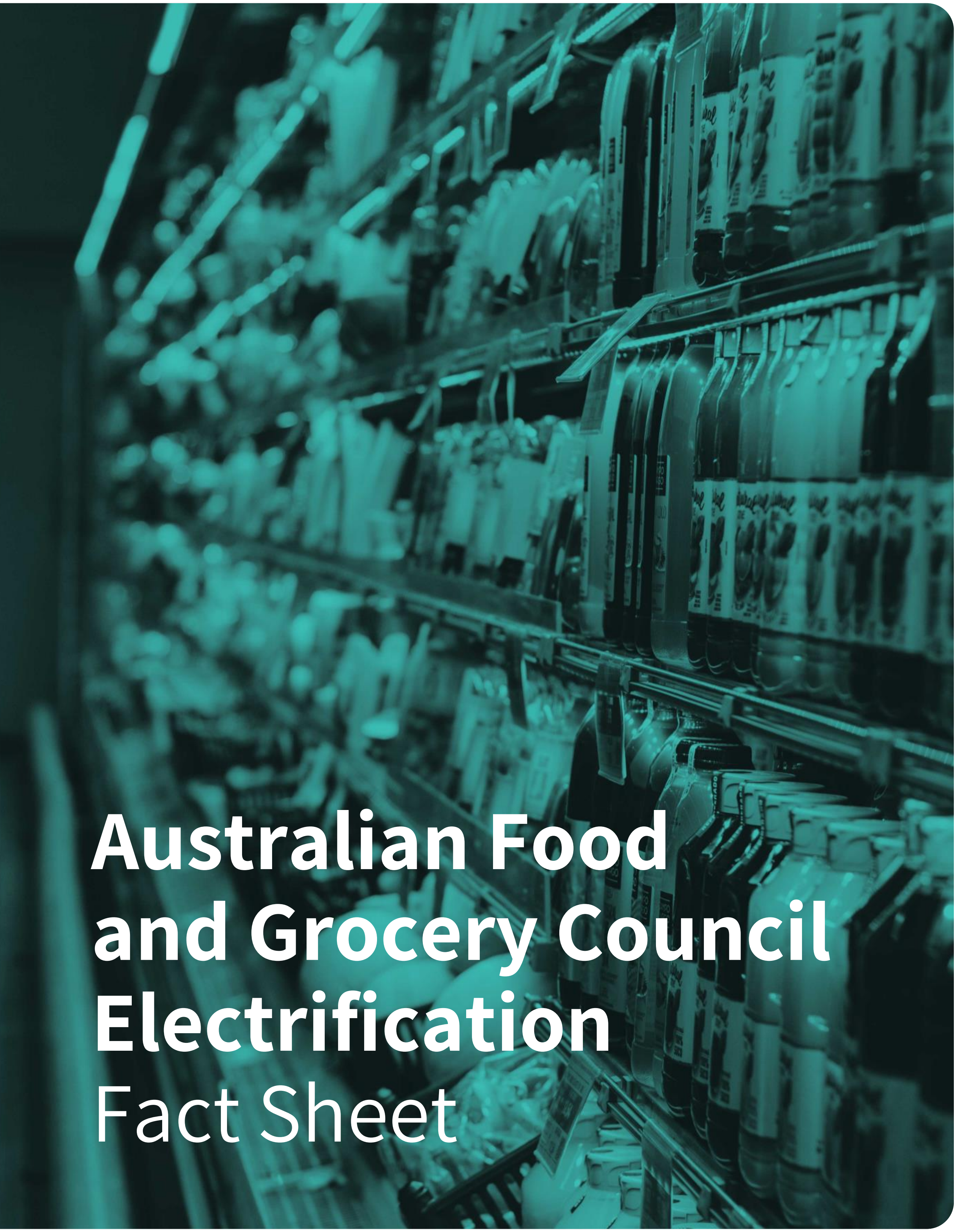
energylink SERVICES

AUSTRALIAN FOOD & GROCERY COUNCIL
CELEBRATING 30 YEARS 1995-2025



Australian Food and Grocery Council Electrification

Fact Sheet

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State of the Industry

The food and grocery manufacturing sector makes up 32% of Australia's total manufacturing output and has strong growth ambitions. With this growth will come an increase in energy consumption.

Energy demand is expected to **exceed 220 PJ** annually by FY30, with natural gas accounting for **40%** of use

Oxford Economics Australia, 2025

This reliance is significant, as many core processes, such as steam generation, drying, pasteurisation, and process heating, are built around fossil fuels.

As the energy landscape shifts, the sector faces pressure to cut emissions, manage rising energy costs, and meet stricter regulatory and customer expectations. At the same time, advances in high-temperature electrification, improved grid stability, and greater access to low-emissions electricity are creating new opportunities.

This fact sheet focuses on electrification and efficiency measures that are technically and commercially viable today, based on existing technologies, operational practices, and proven deployments, not future projections.

To reduce exposure to volatile fossil fuel markets, enhance energy productivity, and meet net-zero targets, the industry should prioritise process optimisation, fuel switching, and electrification where feasible. Strategic electrification, backed by energy management, heat recovery, and targeted capital upgrades, can improve productivity, lower long-term costs, and position the sector as a leader in clean, cost-competitive manufacturing.

This resource outlines key drivers and barriers to electrification, how to build a business case, available financial enablers, and proven electric technologies. It also identifies energy-efficiency options and includes a checklist to guide detailed design.

Industry Electrification Drivers

Several forces are accelerating the shift toward electrification in food and grocery manufacturing, reshaping how facilities produce, process, and distribute goods. The following drivers highlight why the transition is gaining momentum across the industry.

DECARBONISATION COMMITMENTS
Net-zero goals drive emissions cuts, with electrification as a direct pathway

HIGH AND VOLATILE COST OF GAS
Rising costs can improve electric technology viability

MOMENTUM
Early adopters help to reduce perceived risk and grow industry experience

LEADERSHIP
Leadership with visible commitments accelerates decision making and unlocks organisational resources

GOVERNMENT INCENTIVES
Incentives and support reduce electrification costs and improve investment payback

MAINTENANCE AND OPERATIONAL SIMPLICITY
Electric equipment offers higher efficiency, less maintenance, and simpler, more reliable operation.

REPUTATION AND MARKET ADVANTAGE
Emissions cuts boost brand value and meet rising customer sustainability expectations

Industry Electrification Barriers

Despite growing momentum, food and grocery manufacturers face several challenges that can slow or complicate the shift to electrification. The barriers below highlight the key constraints shaping adoption and solutions to overcome them.

DATA AVAILABILITY

Incomplete or poor-quality operational data restricts the ability to model thermal loads, assess electrification potential, and build bankable business cases.

Solutions:

Complete an energy and mass balance for your facility to understand where the major energy consuming loads are and to define a targeted sub-metering strategy. Sub-metering should focus on:

- Major thermal end use flows, temperature and pressures (e.g. hot water to process heating, natural gas to ovens, etc.).
- Loads with high variability, peak demand, or electrification potential.
- Waste heat stream flows and temperatures.
- Meters should be able to calculate energy consumption i.e., temperature and pressure compensated mass flow meters for gas.

Targeted sub-metering enables the development of clear heat and energy maps and provides the data needed to characterise when, where, and how heat is used.

What this enables:

- Accurate modelling of thermal loads, including peak demand and variability.
- Appropriate sizing of technology and storage.
- Identification of low-risk, no-regrets electrification opportunities.
- Stronger, evidence-based business cases and reduced risk of mis-sized equipment.

TEAM KNOWLEDGE

Limited understanding of electrification technologies, energy management, or change processes slows adoption.

Solutions:

- Build internal capability by assigning energy champions and embedding basic energy literacy in onboarding and skills development.
- Invest in targeted training for engineering, maintenance, procurement, and operations teams on electric systems.
- Use peer learning and organise site visits to facilities that have already electrified similar processes.
- Engage vendors for demonstrations, pilots, and trials so staff can see technologies in operation and build confidence.
- Encourage cross-industry knowledge sharing through networks, industry bodies, and case-study exchanges.

What this enables:

- Greater organisational confidence to evaluate, trial, and implement electrification solutions.
- More informed decision-making, reducing perceived risks and misconceptions.
- Faster internal alignment and improved change management.
- A stronger, capability-led pathway for ongoing optimisation and long-term energy transition planning.

Industry Electrification Barriers (cont'd)

CAPITAL REQUIREMENTS

Electric technologies, such as MVR systems, heat pumps or high-capacity IR ovens, often require significant upfront investment that can be hard to overcome, even if operational costs can be lowered.

Solutions:

- Leverage government grants and incentives that reduce upfront capital requirements for electrification and process efficiency. Having a feasibility study conducted can often help to unlock grant funding.
- Access green finance options (sustainability-linked loans, concessional finance, CEFC products) to lower the cost of capital.
- Use alternative commercial structures, such as power purchase agreements (PPAs) or heat-as-a-service (HaaS) models, to shift expenditure from CAPEX to OPEX.
- Adopt a staged investment approach – electrify priority loads first, align upgrades with asset replacement cycles or other electrical infrastructure upgrades, and spread capital over time by having an electrification roadmap.
- Conduct full total-cost-of-ownership (TCO) and lifetime abatement cost analyses to demonstrate long-term value and risk reduction.

What this enables:

- Reduced upfront capital hurdles and improved feasibility of early electrification projects.
- Stronger, investment-grade business cases that reflect whole-of-life economics, not just CAPEX.
- Better alignment of electrification with asset renewal, grid upgrades, or process changes.
- Increased access to external funding sources and faster progression from feasibility to deployment.

SCALE

Large thermal loads are difficult to electrify because they require substantial electrical supply upgrades, high-capacity equipment, and often technologies that are still maturing at this scale.

Solutions:

- Break large loads into modular electrification stages, tackling the most compatible or flexible processes first rather than attempting full conversion in one step.
- Integrate aggressive heat recovery and efficiency improvements (e.g., waste-heat capture, heat cascading, process optimisation) to reduce the required electrical and thermal capacity before sizing new equipment.
- Plan phased electrical infrastructure upgrades, aligned with asset replacement cycles and grid connection timelines.
- Collaborate early with networks, OEMs, and technology providers to identify scalable technology pathways, hybrid solutions, and roadmap options as higher-capacity systems mature.
- Use thermal storage to smooth peak loads and reduce instantaneous electrical demand.

What this enables:

- Reduced size and cost of new electrical and thermal equipment, improving technical and financial feasibility.
- A staged, lower-risk transition pathway that matches technology readiness and grid availability.
- Greater operational resilience by avoiding oversized or premature investments.
- Future-ready solutions that can scale up as technologies advance and site needs evolve.

Industry Electrification Barriers (cont'd)

ELECTRICAL CAPACITY

Existing infrastructure may not support the high power demand of electric heating, MVR compressors, or other large-scale electric equipment without costly grid upgrades.

Solutions:

- Engage your DNSP (network operator) early to understand connection limits, upgrade pathways, costs, and lead times.
- Conduct detailed onsite electrical capacity assessments to identify bottlenecks in transformers, switchboards, and distribution circuits.
- Implement load-management strategies (e.g., staggering equipment, demand control systems, thermal storage) to reduce instantaneous peak demand.
- Prioritise energy efficiency and heat-recovery measures to lower required electrical input for the same thermal output.
- Leverage behind-the-meter generation and storage – such as rooftop PV, batteries, or thermal storage – to offset peak loads and reduce required network capacity increases.
- Stage electrification rollout to align with planned infrastructure upgrades and asset replacement cycles.

What this enables:

- Reduced or deferred network upgrade costs, improving project feasibility.
- Smoother grid connection processes with greater certainty around timelines and requirements.
- Lower peak demand, enabling appropriately sized electrification equipment and infrastructure.
- A more resilient and future-ready electrical system that supports ongoing electrification and decarbonisation efforts.

PROCESS COMPLEXITIES

Food and grocery manufacturing involves tightly controlled thermal, hygiene, and timing requirements that complicate equipment changes.

Solutions:

- Undertake detailed process mapping to understand temperature requirements, cycle durations, cleaning processes, and dependencies across the production line.
- Explore partial or hybrid electrification options (e.g., electrifying pre-heating, pasteurisation stages, or low/medium-temperature loads first) to reduce risk and build familiarity.
- Engage engineering specialists and food-process experts early to ensure alternatives meet hygiene standards, validation requirements, and product-quality specifications.
- Use pilot trials or technology demonstrations to validate performance under real operating conditions before full rollout.
- Integrate heat-recovery and process-efficiency improvements to streamline operations and reduce the thermal load needing electrification.

What this enables:

- Confidence that electrification will maintain or enhance product quality, food safety, and production throughput.
- Lower-risk implementation pathways that respect operational constraints and regulatory requirements.
- Identification of the most suitable processes for early electrification.
- A smoother transition to low-carbon thermal technologies with minimal disruption to manufacturing operations.

Industry Electrification Barriers (cont'd)

INERTIA

Changing long-standing operational habits is difficult, and many electric technologies demand different approaches and skills.

Solutions:

- Develop clear, compelling business cases that details operational, financial, and risk-reduction benefits—not just emissions reductions.
- Use incremental upgrades (partial electrification, pilot installations, low-risk trials) to allow teams to adapt gradually and build confidence.
- Secure visible executive sponsorship so that electrification becomes a recognised organisational priority with clear expectations and leadership support.
- Assign energy reduction targets to internal resources and build into KPIs.
- Integrate electrification goals into operational planning and asset-renewal cycles to normalise change.
- Celebrate early wins and share internal success stories to build momentum and shift cultural norms.

What this enables:

- Stronger organisational alignment and reduced resistance to new technologies.
- A smoother transition as teams gain hands-on experience and confidence with electrified systems.
- Faster progression from feasibility through to implementation.
- A culture that supports and values continuous improvement and ongoing decarbonisation efforts.

GOVERNMENT/POLICY CHANGE

Shifting energy policy and regulatory settings create uncertainty around long-term investments.

Solutions:

- Monitor policy trends and regulatory updates to stay informed on future directions, emerging compliance requirements, and upcoming funding opportunities.
- Policy uncertainty can be mitigated by adopting flexible, modular, or hybrid technologies that are able to adapt to changes in grid pricing, carbon policy, or operational requirements, reducing exposure to future policy shifts.
- Use available incentives early – grants, concessional finance, and energy-efficiency programs – to reduce exposure to policy shifts and accelerate payback.
- Develop long-term energy and electrification strategies that are resilient to policy change and built around scenarios rather than single-point forecasts.
- Engage with industry bodies and government consultations to shape policy settings and ensure industrial needs are understood.

What this enables:

- Reduced investment uncertainty and stronger confidence in the long-term financial viability of electrification.
- More resilient projects that remain viable across a range of policy or price scenarios.
- Ability to act proactively and capture funding or regulatory advantages rather than reacting to changes.
- Clearer strategic planning, helping businesses move from short-term caution to long-term investment readiness.

Industry Electrification Barriers (cont'd)

TECHNOLOGY

Certain high-temperature or specialised processes cannot yet be electrified because commercial solutions are still emerging.

Solutions:

- Consider hybrid systems that combine electrification with existing thermal equipment to manage peak loads, maintain reliability, or bridge current technology gaps.
- Run pilot trials or on-site demonstrations to validate performance, operating costs, and integration risks before committing to full-scale deployment.
- Develop technology roadmaps that sequence adoption over time as solutions mature, grid capacity improves, or suppliers expand offerings.
- Collaborate with vendors, research institutions, and industry bodies to stay informed on upcoming releases, participate in demonstration programs, and co-develop solutions tailored to specific temperature or process needs.
- Monitor international case studies to learn from early adopters and shorten learning curves.

What this enables:

- Reduced technical and operational risk when adopting next-generation electrification technologies.
- Clearer investment timing based on technology readiness, helping avoid premature or misaligned purchases.
- Increased confidence in long-term performance and maintainability.
- Access to emerging solutions earlier, enabling competitive advantage and faster decarbonisation as technologies mature.

FEAR

Unfamiliar technology can create hesitation and perceived risks (equipment downtime, technological uncertainty, or impact on product quality) which can stall decisions.

Solutions:

- Pilot at small scale to test equipment in real operating conditions, gather performance data, and build internal familiarity.
- Reference successful case studies, both locally and internationally, to demonstrate proven performance and de-risk the perception of being early adopters.
- Use hybrid configurations or maintain redundant gas systems during the transition so operations can fall back to known technologies if required.
- Conduct structured risk assessments covering operational, safety, and quality dimensions to clarify real risks versus perceived ones.
- Seek vendor guarantees and strong service agreements to provide confidence on uptime, product quality, and maintenance support.
- Facilitate internal communication and change-management sessions to address concerns directly and build organisational confidence.

What this enables:

- Reduced perceived risk and increased willingness to trial and adopt new technologies.
- Smoother transition periods with minimal disruption to operations.
- More confident and evidence-based decision-making.
- Faster progress from feasibility to implementation as fear-based barriers diminish.

Introduction to Building the Electrification Business Case

Building a robust electrification business case is critical for demonstrating the economic, operational, and environmental benefits of switching from fossil fuels to electric technologies. It helps decision-makers understand potential savings, optimise technology selection, and de-risk investments while unlocking incentives and long-term cost reductions. Below are some key considerations for your business to develop a robust business case, that are further explored within this section.

ENERGY MARKET TRENDS
Consider current and future energy costs and how variations can affect your business case

QUANTIFIED BENEFITS OF ELECTRIC TECHNOLOGIES
Understand how electric technology savings vary by application and operating conditions.

UNIVERSAL VARIABLES
Variables exist that universally benefit electrification business cases

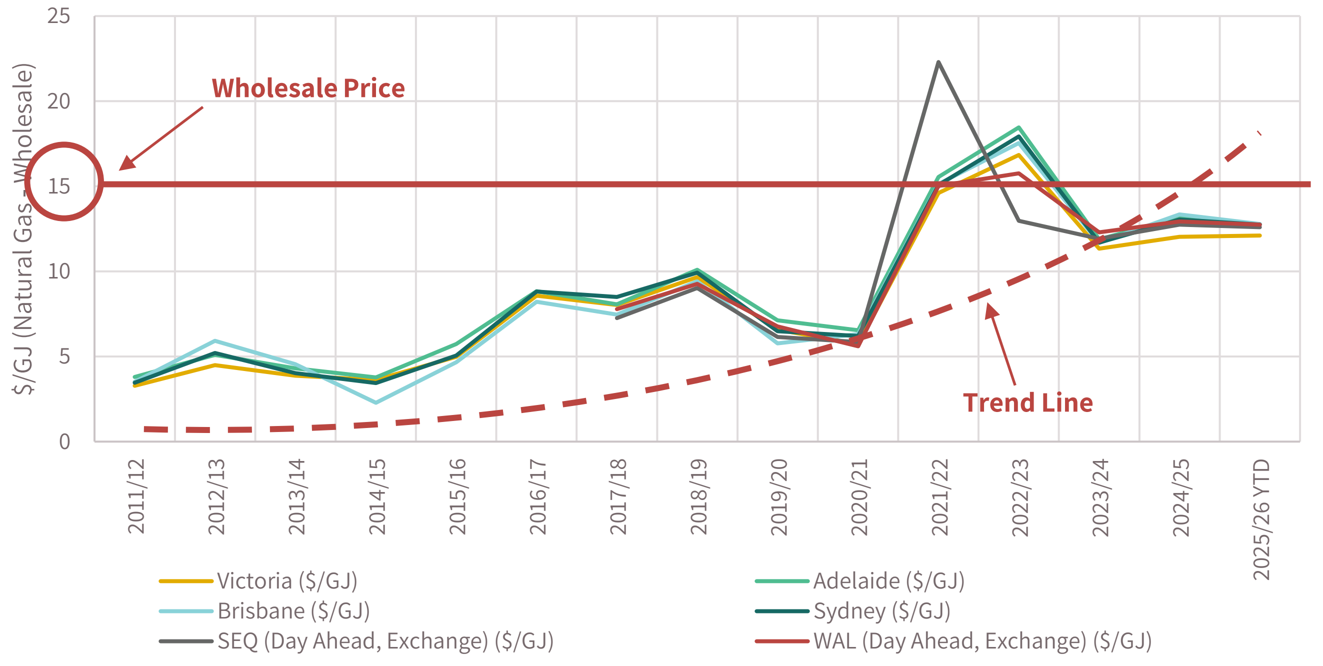
ADDITIONAL FINANCIAL TOOLS
Alternative funding opportunities exist that can assist electrification projects to overcome financial barriers

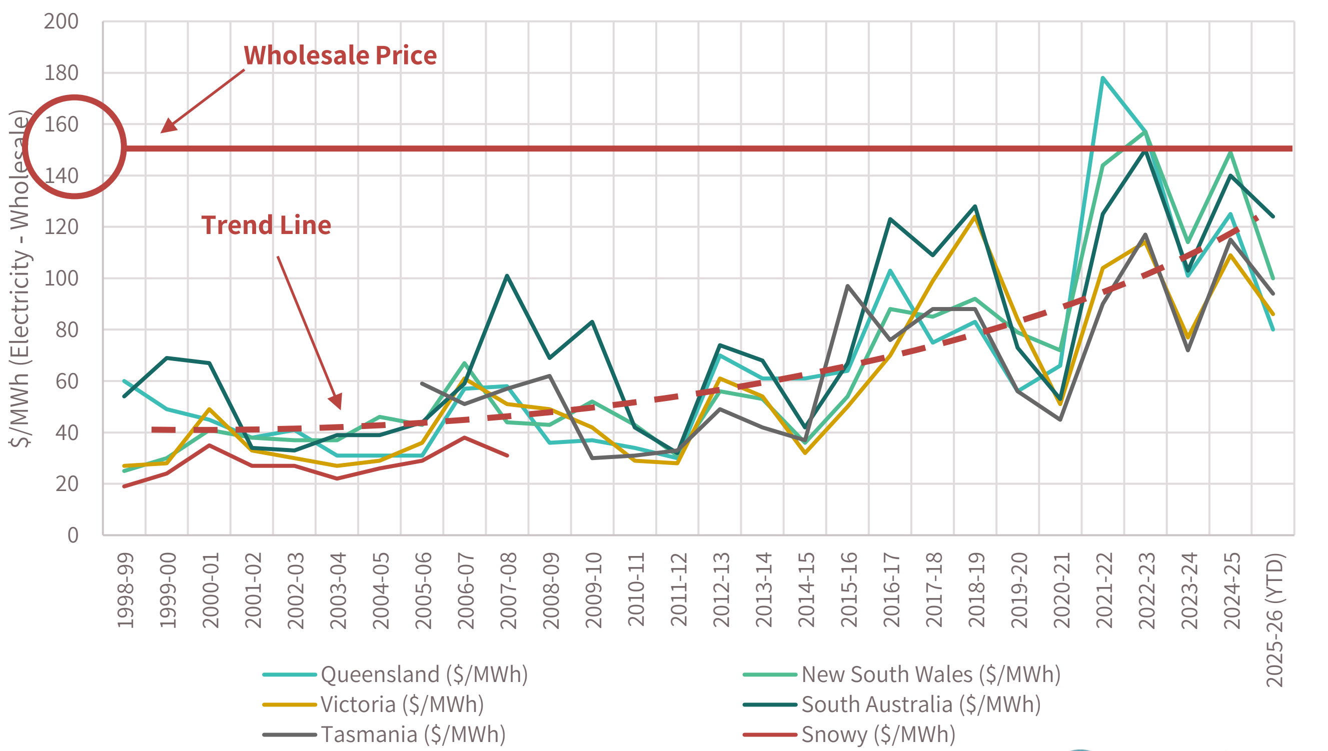
BUSINESS CASE GUIDE
A step-by-step guide on how to build an electrification business case

FINANCIAL BARRIERS and SOLUTIONS
Typical financial barriers to successful electrification projects and how to overcome them

Energy Market Trends

Energy prices across Australia are expected to rise, with natural gas and electricity increasing at similar rates. Current indicative* wholesale prices are approximately $150/MWh for electricity and $15/GJ for natural gas. Businesses need to understand how these trends impact decision making.





*Numbers for comparison only

Heat Pump and MVR Energy Savings

As gas and electricity prices increase, efficient electric technologies like heat pumps and mechanical vapour recompression (MVR) deliver larger savings due to their lower overall energy consumption.

Technologies such as heat pumps and MVR systems typically have high Coefficients of Performance (COPs) because they don't create heat from electricity – they move existing heat from one place to another. Because these systems recycle or upgrade existing heat, they typically deliver 3+ units of heat for every 1 unit of electricity, giving them COPs of 3+ (essentially 300% efficient).

The COP is therefore an expression of the efficiency of the unit.

Businesses should consider the break-even COP. This is the minimum COP a heat pump or MVR system must achieve for it to be cost-competitive with another heating technology – usually a gas boiler – and depends on relative energy prices and boiler efficiency:

$$Break\ Even\ COP = \frac{Power\ Cost\ (\$\ per\ MWh)}{\left(\frac{Gas\ Cost\ (\$\ per\ GJ)}{0.2778 \times Boiler\ Efficiency}\right)}$$

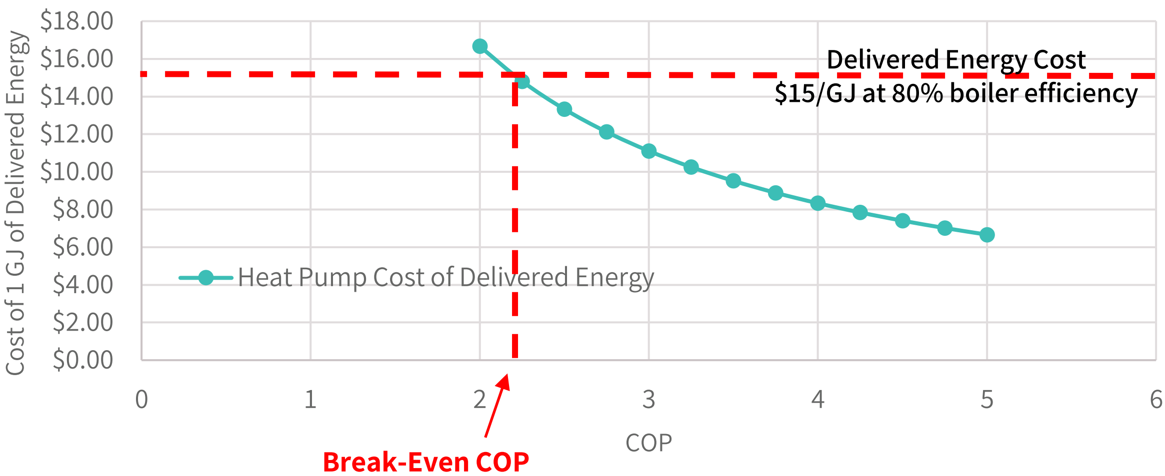
$15/GJ
Current average wholesale natural gas price

~80% Boiler efficiency

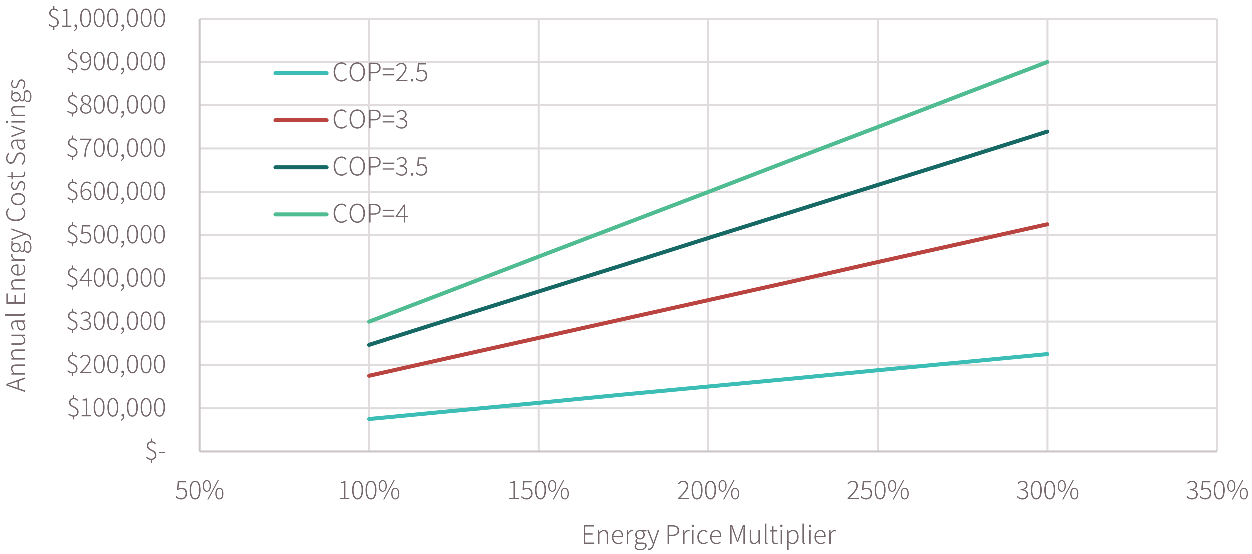
$150/MWh
Current average wholesale electricity price

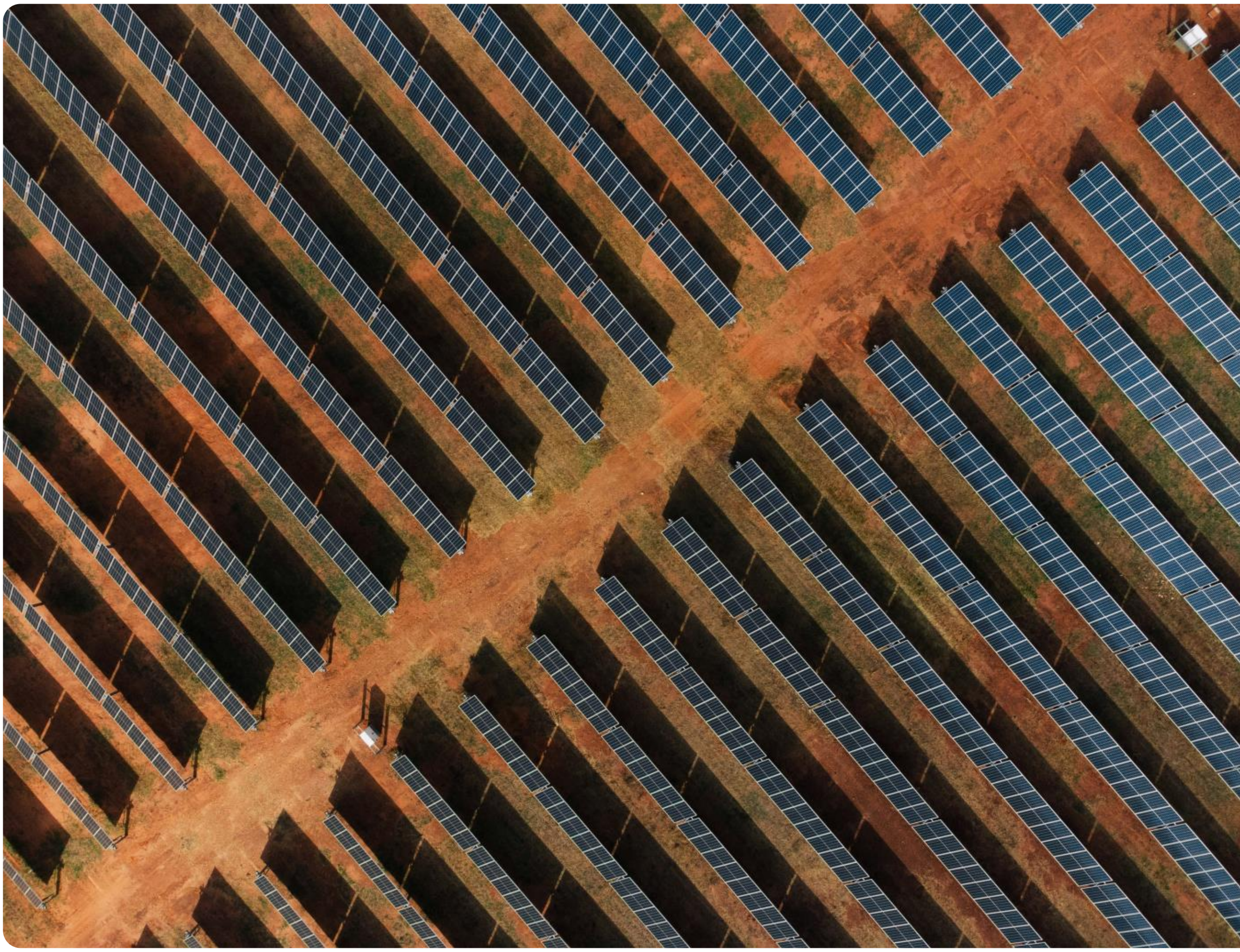
Break-Even COP = 2.22

The cost of delivered energy to processes reduces as COP increases. Anything above a COP of 2.22 in this scenario presents a saving over an 80% efficient gas-fired boiler at current average wholesale prices.



As energy prices increase (at assumably equivalent rates) in systems with better than break-even COP, the value of savings increase. Below are example saving for a site using 10,000 MWh (36,000 GJ) of natural gas per annum, comparing different COPs and energy price multipliers.





Direct Electric Heating Energy Savings

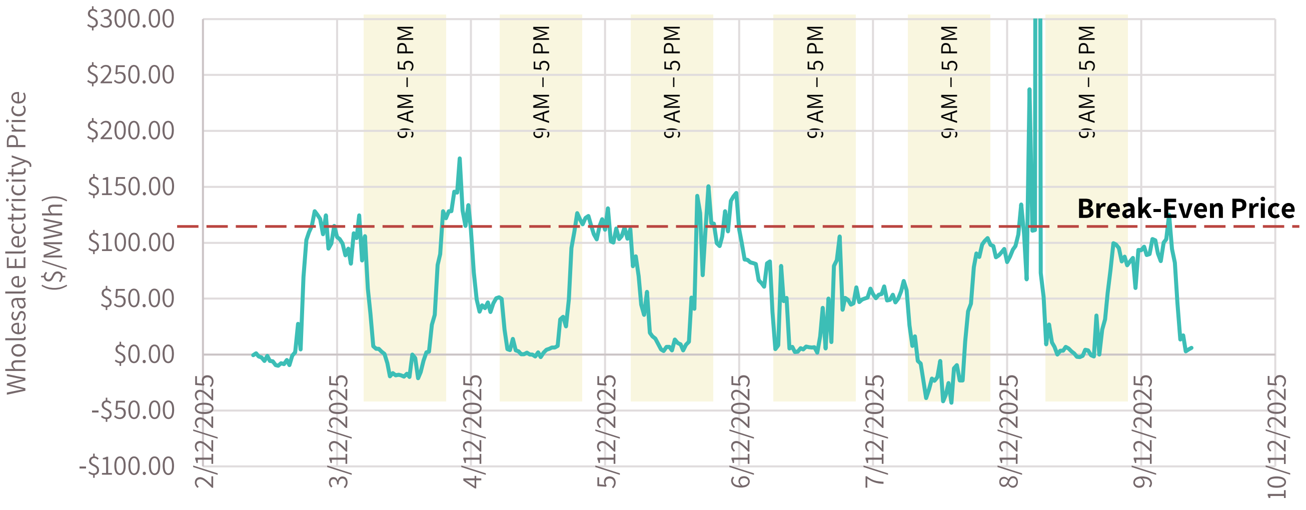
At current energy prices, direct electric heating technologies, powered by grid electricity, with around 100% efficiency (e.g., electrode boilers) are usually more expensive to operate than gas-fired assets and become even less cost-competitive as electricity and gas prices rise. Direct electric heating becomes more economic than gas boilers when electricity is below the break-even price.

The break-even price is approximately $67.5/MWh when assuming a gas price of ~$15/GJ and typical boiler efficiency of 80% (see formula below).

How to Improve Direct Heating Business Cases:

- Access to wholesale electricity markets or time-of-use tariffs: Wholesale electricity prices regularly fall below the break-even price during the day. Setting your wholesale strike price below the break-even price will enable a site to realise the benefits of being wholesale exposed. Time of use tariffs may also offer cheaper pricing during the day, with some network operators offering "Solar Soaker" tariffs.
- On-site solar: On-site solar can provide low-cost energy during the day below break-even prices.
- Load Shifting: Strategies such as battery storage or eTES could shift consumption into lower-price periods. A full analysis of your load profile and electricity pricing would be needed to determine viability.

$$Break\text{–}Even\ Price\ (\$\ per\ MWh) = \frac{Gas\ Cost\ (\$\ per\ GJ) \times 3.6}{Boiler\ Efficiency}$$



NEM spot prices tend to be higher during the morning and evening peaks when demand increases and solar generation reduces.

Lower-priced periods typically fall in the midday to early afternoon, particularly when solar generation is strongest.

State-specific market behaviour varies, so a detailed assessment is required, and engaging a specialist consultant is recommended to determine the optimal control and operating strategy.

Universal Variables that Make a Business Case

Each site is unique, with differing strengths, constraints, process conditions, and budgets. However, variables exist that universally benefit electrification business cases:

Strong differential between fossil fuel and electricity prices: Higher gas vs lower electricity prices accelerate payback. Often assisted if there is existing excess solar generated on-site.

Operational Savings Beyond Energy: Electrification frequently reduces maintenance costs and downtime and equipment failure.

Available Electrical Capacity: A site with sufficient electrical capacity can support new electrification loads without costly grid or infrastructure upgrades, improving project feasibility and payback.

Compare your current electricity and gas prices by first normalising the units. Convert the electricity price shown on your power bill using the equation below and compare it with the gas price on your gas bill.

$$Electricity\ Price\ (\$\ per\ GJ) = \frac{Electricity\ Price\ (\$\ per\ MWh)}{3.6}$$

Additional Financial Tools

Decarbonisation or electrification projects can often benefit from alternative funding opportunities aimed to assist projects overcoming financial barriers.

Certificates and Environmental Markets:
These schemes are often overlooked or misunderstood by business; however, they represent a real and present opportunity to assist with an electrification business case.
There are state and federal schemes that award certificates when completing applicable emissions or energy reducing projects. These include Energy Savings Certificates (ESCs) in NSW, Victorian Energy Efficiency Certificates (VEECs) in VIC, Retailer Energy Productivity Scheme (REPS) in SA, Australian Carbon Credit Units (ACCUs) available nation-wide. These certificates provide additional sources of revenue which can improve project returns or leveraged to unlock project finance.

CASE STUDY
Heat Pump replacing gas boiler

A beef and lamb processor in northern New South Wales replaced a 3 MW gas boiler with a high-lift ammonia heat pump as part of a site decarbonisation upgrade. The switch is expected to reduce emissions by approximately 2,500 tCO_2-e per year.

Without certificates the project has a 7 year simple payback based on improving system efficiency and reducing fuel costs. The payback was reduced to 4.5 years by utilising NSW ESCs.

The table below shows the certificate revenue from ESCs. It also illustrates the potential revenue if the project were undertaken in South Australia or Victoria. In Victoria, the table compares the outcomes under the traditional Project-Based Activities (PBA) Method and the new simplified heat pump method.

Incentive Type	VEEC (VIC) Simplified PBA Method	VEEC (VIC) Traditional Method	ESC (NSW)	REPS (SA)
Natural Gas Reduction	100,000 GJ			
Electricity Increase	7,407 MWh			
Certificates Generated	17,630 VEECs (lump sum)	24,812 VEECs (lump sum)	49,435 ESCs (lump sum)	74,226 REPS (lump sum)
Gross Value*	$1,674,000	$2,157,000	$937,000	$514,000
Payback with Certificates	2.5 Years	1.2 Years	4.5 Years	5.6 Years

Below are some very high-level calculations you can use to estimate potential opportunity from these schemes. The actual volumes require detailed engineering and various scheme rules to be applied. Additionally, each scheme has its own eligibility criteria. So reach out to an energy consultant who will be able to assist. Hence, these calculations are here only to enable an internal "go/no-go" on further exploration of participating.

$$VEEC\ Value(\$) = (Natural\ Gas\ (GJ) \times 0.05523\ (tCO_2 - e/GJ) - Electricity\ (MWh) \times 0.393(tCO_2 - e/MWh)) \times \text{~9 (years)} \times \text{VEEC Spot Price}$$

$$ESC\ Value(\$) = Natural\ Gas\ (MWh) \times 0.47\ (natural\ gas\ conversion\ factor) - Electricity\ (MWh) \times 1.06\ (electricity\ conversion\ factor) \times \text{~9 (years)} \times \text{ESC Spot Price}$$

$$ACCU\ Value(\$\ per\ annum\ for\ 7\ years) = (Natural\ Gas\ (GJ) \times 0.05153\ (tCO_2 - e/GJ) - Electricity\ (MWh) \times 0.64\ (tCO_2 - e/MWh)) \times \text{ACCU Spot Price}$$

Certificate Financing: Upfront capital secured against future certificate generation, can be repaid through certificate sales.

Sustainability-Linked Loans (SLLs): Loans where interest rates are linked to achieving sustainability targets (e.g., energy reduction, emissions reduction, electrification milestones). This is typically applied at a corporate level.

Asset Finance: Loans secured against equipment value which can significantly reduce the upfront capital required. Specialised institutions offer better terms such as lower interest for green investments.

Energy as a Service (EaaS): A model where a third-party provider owns, operates, and maintains energy technologies - like electrification or efficiency upgrades – while the customer pays for energy use or performance, shifting costs from upfront investment to predictable service payments. These contracts can have minimum performance guarantees to provide additional security.

Power Purchase Agreements (PPAs) and On-Site Renewable PPAs: Long-term contracts to purchase electricity, sometimes bundled with on-site solar or battery infrastructure funded by a third party. These can provide the required lower electricity prices with pricing certainty over a longer period.

*Based on late-2025 certificate spot prices

How to Put Together an Electrification Business Case?

Key steps to be taken to present a compelling business case for electrification at your site.

1

Define the Need Driving the Project

Anchor the business case in an operational or strategic goal, e.g.:

- Reduce bottlenecks or downtime
- Replace aging gas assets
- Improve temperature control, hygiene, or product consistency
- Reduce emissions or OPEX

Output: Clear 'Why?'

2

Quantify the Baseline in Operational Terms

Estimate current 'Business As Usual' costs:

- Fuel use and cost, boiler/system efficiency
- Electricity use and cost for pumps/fans
- Maintenance, labor, downtime, compliance costs

Output: Annual baseline cost (OPEX + maintenance + labor)

3

Estimate Annual Operating Costs of the Electric Option

Project future costs after electrification:

- Electricity consumption and demand charges
- Additional components (thermal storage, controls, heat recovery)
- Maintenance and labor savings

Output: Projected annual OPEX for electric solution.

4

Convert Both Systems to Cost per Unit of Useful Output

Use common metrics such as:

- $/GJ of useful heat delivered
- $/kg of product output
- $/CIP cycle

This makes the comparison production-relevant and easier for decision makers.

Output: Apples-to-apples cost benchmark.

5

Calculate the Total Required Capital Cost (CAPEX)

Include (as required):

- Equipment purchase and installation
- Electrical upgrades and building works
- Engineering, commissioning, and downtime costs
- Contingency

Output: Total upfront investment required

6

Apply Incentives, Rebates, Financing Options

Reduce capital costs by identifying:

- Certificates, government grants, utility rebates
- Tax incentives, accelerated depreciation
- Manufacturer rebates, low-interest or green loans
- On-bill financing options

Output: Net CAPEX after incentives

7

Model Cash Flows Over the Asset Life

Build an asset-life cash flow model including:

- Annual OPEX, maintenance, and labor savings
- Avoided replacement costs (e.g., no new gas boiler)
- Residual value and carbon cost savings
- Fuel and electricity price escalation (seasonal peaks, volatility)

Output: Annual net cash flow profile

8

Calculate Financial Metrics

Use standard financial indicators:

- Payback period
- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Levelized Cost of Energy (LCOE)

Compare against internal thresholds or hurdle rates

Output: Clear financial attractiveness indicators

C

The Biggest Financial Barriers to Electrification – and How to Overcome Them

1

HIGH UPFRONT CAPITAL COSTS

Barrier:

Electric technologies often cost more upfront than fossil replacements. Manufacturing sites also face added integration costs: electrical upgrades, process redesign, and downtime during installation.

What to do:

- Use grants, certificates, utility rebates, and low-interest green financing to reduce initial CAPEX so projects become financially feasible and less risky.
- Stage investments (e.g., electrify hot-water loads first, then steam) to spread costs over time, target higher returns and reduce operational disruption.
- Combine projects (e.g., refrigeration upgrade + heat recovery) to improve ROI by maximising energy savings and overall project efficiency, and link in with other planned upgrades/shutdown periods.
- Use leasing or energy-as-a-service models where available to access modern technologies without heavy upfront investment.

2

HIGHER OPERATING COSTS

(typical when using resistive electric heating)

Barrier:

In many regions, electricity price per MWh is higher than the equivalent gas or diesel per MWh of useful heat, especially for resistive systems. Demand charges can also penalise large instantaneous loads.

What to do:

- Prioritise high-efficiency electrification (e.g. heat pumps or MVR instead of resistive heating) technology, improving OPEX and ROI.
- Add thermal storage to flatten peaks and shift loads to avoid demand charges so you can better manage load and reduce peak costs.
- Shift thermal loads to off-peak periods where possible (CIP, water heating, storage) to lower demand charges and take advantage of lower cost electricity.
- Generate electricity onsite through the likes of solar PV to improve energy independence and reduce grid reliance.
- Optimise tariffs or negotiate with the utility for a suitable rate to minimise operating costs and avoid peak penalties. Increasing electrical load may move you into a more favourable tariff bracket.
- Focus electrification efforts on the loads where the economics are favourable to ensure positive financial returns and phased adoption.

3

UNCERTAINTY ABOUT FUTURE ENERGY PRICES

Barrier:

Manufacturers may fear committing to a solution that might become more expensive if electricity rates rise or incentives disappear.

What to do:

- Run sensitivity analysis in the business case (best, worst, likely scenarios) to understand financial risks and support informed decision-making.
- Lock in tariffs, hedges, or long-term contracts where possible to provide price stability and reduce exposure to energy market volatility.
- Highlight volatility risks with continued gas/diesel/LPG reliance to demonstrate the potential cost uncertainties of sticking with fossil fuels.
- Show how heat pumps or MVR reduce exposure by using less total energy, to illustrate how efficient electrification mitigates future energy price risks.

4

GRID INFRASTRUCTURE UPGRADE COSTS

(typical when using resistive electric heating)

Barrier:

Some sites need significant upgrades to transformers, switchboards, or wiring to support new electric loads. These upgrades can be costly and have long lead times.

What to do:

- Conduct an early electrical capacity assessment to plan upgrades and avoid surprises.
- Implement load management or staged electrification to defer costly infrastructure upgrades to align with other expansion plans.
- Explore using storage systems to reduce capacity upgrade requirements.
- Use heat recovery to reduce net electric load, minimizing required grid capacity.
- Consider hybrid configurations temporarily (partial electrification) to start electrification sooner while limiting upgrade needs.

D

Food and Grocery Thermal Requirements: What's Needed

All food and grocery subsectors rely on some type of thermal energy for critical functions such as heating, cooking, drying, sanitation, and sterilisation, creating consistent demand for hot water, steam, direct heating or high-temperature process heat across production lines. Based on these thermal needs, each subsector presents a range of viable electrification opportunities, with emerging success stories providing strong proof of concept.

BREAD, CEREALS AND RELATED PRODUCTS

Breads, cakes, biscuits, etc.

Baking typically requires medium-temperature hot water for ingredient conditioning and mixing, low-pressure steam for dough proofing/fermentation, and high direct heat for oven/baking steps.

A significant energy-consuming step is the baking/oven process, which typically relies on gas-fired heat for precise temperature control, affecting crust, texture, and moisture. Post-bake cooling uses refrigerated or controlled airflow systems but usually consumes comparatively less energy.

Breakfast cereals, other cereal products

Cereal production requires medium-temperature hot water and low-pressure steam for grain conditioning and cooking, high-temperature hot air or steam for drying, toasting, and extrusion/puffing, and heated vessels for coating applications. Significant energy use occurs during drying, toasting, and extrusion, where precise temperature and airflow control are critical for product texture and expansion. Cooling steps consume comparatively less energy.

Electrification-Relevant Notes

- Many low-temperature processes (mixing, proofing, hot water at 80–90°C) are highly compatible with heat pumps.
- Ovens and dryers (180–260 °C) can be electrified using electric ovens, infrared systems, or electric air heaters, though cost/feasibility varies and proof of concepts are required to ensure product quality is maintained.
- Steam requirements (1–2 bar) for grains can be met by electrode boilers, MVR, or eTES where technically feasible.
- Refrigerated spiral cooling is already electrified but offers opportunities for heat recovery.

Success Stories

Bread crumb manufacturer (Spain) – reduced gas consumption by ~30% by capturing heat from oven flues for reuse. This cut emissions by ~250 tCO_2-e per year. More information can be found here.

MEAT AND SEAFOODS

Beef and Veal, pork, lamb and goat, poultry, other meats, fish and other seafood

Meat and seafood processing typically requires medium-temperature hot water and low- to medium-pressure steam for scalding, defeathering, sterilisation, sanitation, and cooking/blanching. The highest energy-consuming steps are baking, roasting, frying, rendering and smoking/cook-smoking processes, typically using direct gas or electric heat for ovens, fryers, and smokehouses. Steam-jacketed kettles and water baths are also used extensively, while cooling steps consume comparatively less energy.

Electrification-Relevant Notes

- Hot water generation (60–90°C) is highly compatible with industrial heat pumps, reducing steam demand.
- Low-pressure steam (1–5 bar) for rendering, sanitation and some cooking can be supplied by electrode boilers or eTES.
- Ovens, smokers, and fryers can be electrified but require careful peak-load and cost management.
- Large refrigeration loads already run on electricity and provide a major heat-recovery opportunity for hot water preheating.
- Electrifying scalding and high-flow hot-water systems often requires thermal buffers or storage tanks to manage peak demand.

Success Stories

Hardwick Processors (Kyneton, VIC) – Hardwick installed a 1 MW-th heat pump and upgraded its electrical supply system at the cost of $2.58m (with $838,000 funded by ARENA). This is projected to reduce the site's reliance on natural gas by over 75% and annual energy costs by over $500,000. More information can be found here.

Kilcoy Global Foods (QLD) – installed three heat pumps to provide a renewable source for their entire site's hot water demand, alongside broader decarbonisation measures. More information can be found here.

Silver Fern Farms (Pareora, NZ) – replaced coal-fired boilers with a system using surplus refrigeration heat plus a heat pump to generate hot water (50–75 °C) for sanitation, washdowns, and process-water needs. More information can be found here.

Alliance Group (Nelson, NZ) – Installed a high-temperature heat pump in 2019. In the first year of operation diesel use dropped by 44%, and on-site electrical energy efficiency improved significantly. More information can be found here.

DAIRY AND RELATED PRODUCTS

Milk, cheese, ice cream and other dairy products

Dairy processing typically relies on medium- to high-temperature hot water and steam for pasteurisation, sterilisation, curd cooking, evaporation, drying, and CIP sanitation. High-temperature steps include UHT/sterilisation, multi-effect evaporation, and spray drying, while cooking, blanching, and process heating for value-added dairy (cheese, yogurt, ice cream) use moderate temperatures. Hot water and steam are typically supplied via boilers or direct steam systems, and material handling is increasingly electrified.

Electrification-Relevant Notes

- Many dairy hot-water and low-to-medium temperature loads (40–90°C) are excellent candidates for industrial heat pumps, replacing steam.
- CIP water heating is often a high-impact electrification opportunity, especially when paired with thermal storage.
- Steam-intensive processes (evaporation, UHT) may require electrode boilers, MVR, or eTES depending on temperature thresholds.
- Spray dryers and large evaporators have very large, constant thermal loads – partial electrification or hybrid systems involving MVR, electrode boilers, or eTES may be most realistic.
- Refrigeration systems provide significant heat-recovery potential for preheating water or integrating with a heat pump.

Success Stories

Fonterra (Edendale, NZ) – installed a 30 MW electrode steam boiler and has reduced site emissions by ~20%. More information can be found here.

Arla Foods (Svenstrup, Denmark) – installed a high-temperature heat pump to replace natural gas consumption for their spray drying activities, reportedly cutting ~1,500 tonnes of CO_2 emissions per year at that site. More information can be found here.

FRUIT AND VEGETABLES

Fruit and vegetable processing typically uses low- to medium-temperature hot water and steam for greenhouse heating, washing, and blanching, and higher-temperature steam or hot air for cooking, value-added preparation, and drying/dehydration. Significant energy use occurs during blanching, cooking, and drying, while greenhouse and washing steps have moderate, continuous thermal demand. Electrification opportunities exist for low-temperature heating, batch cooking, and air-heated drying systems.

Electrification-Relevant Notes

- Low-temperature hot-water systems for blanching, cleaning, and greenhouse heating are prime candidates for industrial heat pumps.
- Steam-based blanching or cooking can be replaced with electrode boilers or heat pumps (where hot water is used), particularly for batch or small-scale operations.
- Drying and dehydration can be electrified, but careful load management and peak power consideration are needed due to high thermal demand. MVR presents a potential opportunity here.
- Refrigeration systems can provide opportunities for heat recovery to preheat water, maintain process temperatures or matched with a heat pump.

Success Stories

Queensland Plants & Flowers (Brisbane, QLD) – installed twelve air-to-water heat pumps totaling 1,680 kW in installed capacity for greenhouse heating and cooling. More information can be found here.

McCain Foods (Ballarat, VIC) – installing two interconnected heat recovery systems aiming to reduce site natural gas consumption by ~22%. The project will design, install and commission a high-pressure condensate recovery system and a fryer exhaust heat recovery system with mechanical vapour recompression (MVR), costing $16.3m with $7.38m funded by ARENA. More information can be found here.

McCain Foods (Timaru, NZ) – Installed a mixture of pulse electric field technology (pre-cooking), MVR (fryer heat recovery), and a 14 MW biomass wood chip boiler (converted from coal) to reduce site emissions by 93%. More information can be found here.

FOOD PRODUCTS

Eggs, jams, honey and spreads, food additives and condiments, oils and fats, snacks and confectionery, other food products

Food product manufacturing processes typically vary greatly but often use medium- to high-temperature hot water and steam for cooking, pasteurisation, sterilisation, and cleaning across eggs, jams, spreads, condiments, oils, snacks, confectionery, and other processed foods. High-temperature steps include baking, frying, roasting, and high-temperature refining, while low- to medium-temperature processes (pasteurisation, coagulation, chocolate tempering, low-temp cooking) are well-suited to electrification via heat pumps or electrode boilers.

Electrification-Relevant Notes

- Low- to medium-temperature processes (30–90°C): Very suitable for industrial heat pumps or electrode boilers.
- High-temperature cooking / frying / baking: Electrification is possible but may need staged or hybrid approaches to manage peak electricity loads.
- Drying or evaporation processes: Typically suitable for MVR.
- CIP and cleaning: Can often be electrified and paired with heat recovery to reduce net energy demand.
- Refrigeration: Already electric, but heat recovery from condensers can preheat water for CIP, process uses or matched with a heat pump.
- Small-batch or artisanal production: Electric systems offer flexibility, rapid temperature control, and reduced safety risks compared to gas or steam.

Success Stories

Sugar Australia (Yarraville, VIC) – installing an MVR system aiming to reduce scope 1 emissions by ~17%, equal to ~6,200 tCO_2-e per year at that site. This project is receiving $4.1m in ARENA funding. More information can be found here.

Mars (Netherlands) – installed a heat pump that captures waste heat from refrigeration systems and uses this to generate hot water (up to ~63 °C). The heat pump system reduces gas dependence for heating and yields significant CO_2-e savings – reportedly around 1,000 tCO_2-e avoided per year. More information can be found here.

NON-ALCOHOLIC BEVERAGES

Coffee, tea, cocoa, waters, soft drinks, juices

Non-alcoholic beverage production typically uses medium-temperature hot water and low- to medium-pressure steam for cleaning, sterilisation, pasteurisation, concentration, brewing, and flavor extraction. High-energy steps include HTST pasteurisation and sterilisation, while lower-temperature processes such as syrup preparation, and pre-heating are well-suited to electrification via heat pumps or electrode boilers.

Electrification-Relevant Notes

- Most thermal loads are low- to medium-temperature (<95°C), making them ideal for electrification via heat pumps or electrode boilers.
- Pasteurisation and sterilisation can benefit from electric heating with heat recovery loops.
- Cooling and chilling are already electric but can provide recovered heat for preheating process water and matching with a heat pump.

Success Stories

While the successful case studies below are for alcoholic beverages, the processes, applications and take-aways remain very similar to non-alcoholic beverages:

Port Phillip Estate Winery (Red Hill, VIC) – replaced its LPG boiler with two air-to-water heat pumps, almost halving their annual consumption. They now make better use of their 99.8kW rooftop solar system. More information can be found here.

De Bortoli Wines (NSW) – recovers waste heat from the refrigeration system and uses an ammonia heat pump to generate process hot water. More information can be found here.

NON-DURABLE HOUSEHOLD PRODUCTS

Cleaning and maintenance products, personal care products, pharmaceutical products, other non-durable household products

Production of non-durable household products typically requires a vast range of processes. These typically use low- to medium-temperature hot water and steam for mixing, dissolution, emulsification, pasteurisation, and mild sterilisation across cleaning products, personal care items, pharmaceuticals, and consumables. High-energy steps occur in drying, extrusion, and thermoforming processes, while most other heating tasks are well-suited to electrification via heat pumps or electrode boilers.

Electrification-Relevant Notes

- Low- to medium-temperature thermal needs (<90°C): Ideal for heat pumps or electrode boilers (cleaning, personal care, household consumables).
- High-temperature drying (paper, tissue, plastics): Electrification possible via electric steam boilers, thermal fluids, or resistance heaters; hybrid approaches may help manage peak electricity loads. MVR could be considered in this application.
- Plastics extrusion and molding: Already largely electric, but efficiency can be improved via waste-heat recovery and process optimisation.
- CIP and process water heating: Easy to electrify and can leverage heat recovery loops.

Success Stories

Blackmores (Braeside, VIC) – installed a 800 kW heat pump system with 10 kL hot water storage. The project was co-funded by ARENA ($724,000 of the total project cost of $1.45m) and uses purchased renewable electricity and the site's refrigeration condensate water as a heat source for hot water. The upgrade aims to reduce natural gas consumption at the site by ~ 25% (9,900 GJ per year) and cut ~512 t CO_2-e (Scope 1) emissions. More information can be found here.

Industry Electrification Technology

A range of electric technologies are available to suit almost any processing condition or requirement. Below is a high-level overview of key technologies, with further detail provided in separate factsheets.

HEAT PUMPS

Heat pumps transfer heat from a low-temperature source (air, water, or waste heat) to typically a water loop using electricity and a refrigeration cycle. They can replace gas or steam for low- to medium-temperature heating in industrial processes.

Medium: Hot Water or Hot Air

Temperature Range: Typically <90°C

Best Use Cases:

- Processes with high hot-water demand (CIP, ingredient heating, washing, pasteurisation)
- Utilising low-grade waste heat from refrigeration, compressors, or cooling systems
- Continuous, predictable heat demand at moderate temperatures

When do the economics stack up?

- When electricity costs are competitive with gas and thermal efficiency (COP) is high
- When heat recovery from waste streams is possible
- High and continuous heat demand improves payback
- Less suitable for intermittent or very high-temperature loads (>90°C)

Potential Savings Example:

A site using 20,000 GJ of natural gas each year at a price of $15.00/GJ utilises a heat pump with a COP of 3.5 and power price of $41.67/GJ ($150/MWh). As a result, the site reduces energy costs by ~$62,000 and emissions by over 1,000 tCO_2-e (assuming renewable electricity is used) per year.

Note: High-temperature heat pumps (providing temperatures between 90 – 120°C) are only just emerging in Australia. A few pilot and early-market systems are available, but widespread commercial options are still limited, with most industrial-grade units expected to enter the market over the next several years. Because this fact sheet focuses on technologies currently available; they have been excluded at this time but should be included in any future options assessments when exploring electrification.

MVR

Mechanical Vapour Recompression (MVR) uses a steam compressor (typically a fan or centrifugal compressor) to recover low-pressure waste steam from a process, increase its pressure and temperature, and recycle it as process heat. This reduces fresh steam demand and lowers energy consumption for thermal processes

Medium:
Low Pressure Steam

Temperature Range:
Typically 1 – 8 bar

Best Use Cases:

- Processes with steady, clean water vapour waste
    - E.g. Drying (paper, cereals, vegetables) or evaporation or concentration (milk powder, juices)
- Cooking or blanching operations with continuous waste steam output
- Situations where steam demand is large and continuous

When do the economics stack up?

- When electricity costs are competitive with gas and thermal efficiency (COP) is high
- High and continuous heat demand improves payback

Potential Savings Example:

A site using 10,000 GJ of natural gas-fired steam each year at $18.75/GJ of delivered energy utilises an MVR system with a COP of 10 and power price of $41.67/GJ ($150/MWh). As a result, the site can reduce energy costs by ~$146,000 and emissions by over 500 tCO_2-e (assuming renewable electricity is used) per year.

ELECTRODE BOILERS

Electrode boilers generate steam by passing electric current directly through water, which heats it rapidly and converts it to steam. They are a highly responsive alternative to gas or fuel-fired boilers.

Medium:
Steam

Temperature Range:
Typically 1 – 20 bar

Best Use Cases:

- Sites with high steam demand
- Locations with low-cost or surplus electricity
- Industrial processes requiring rapid steam availability
- Backup or peak-load steam generation where gas is unavailable or expensive

When do the economics stack up?

- When flexibility exists to utilise cheaper off-peak or wholesale power prices
- Coupled with site power generation and a Battery Energy Storage System (BESS)
- When steam demand is peaky or highly variable
- When old boilers need replacing

eTES

Electric Thermal Energy Storage (eTES) systems store electricity as thermal energy in a medium such as water, molten salt, specialised heat capacity materials or phase-change materials. Stored heat can be discharged later as steam or hot water to meet process demand, enabling load shifting and integration of variable renewable electricity.

Medium: Steam or Hot Water

Temperature Range: 100 – 1,000+°C

Best Use Cases:

- Sites with excess or low-cost electricity (e.g., during renewable generation peaks)
- Processes with high-temperature heat demand that can be time-shifted
- Complementing renewable energy or heat systems, electrode boilers, or other thermal processes
- Industrial sites aiming to reduce peak electricity costs

When do the economics stack up?

- When low-cost energy is available through off-peak tariffs or wholesale exposure
- When the site has continuous or long-duration heat demand
- When the site consumes high-cost fossil fuels
- When thermal storage gives operational flexibility

INFRARED/RADIANT HEATING

Infrared or radiant heating delivers heat directly to surfaces or products through electromagnetic radiation, rather than heating the surrounding air. This allows rapid, targeted heating and is widely used in industrial baking, roasting, and surface treatments.

Medium: Direct Surface Heating

Temperature Range: 150 – 400+°C

Best Use Cases:

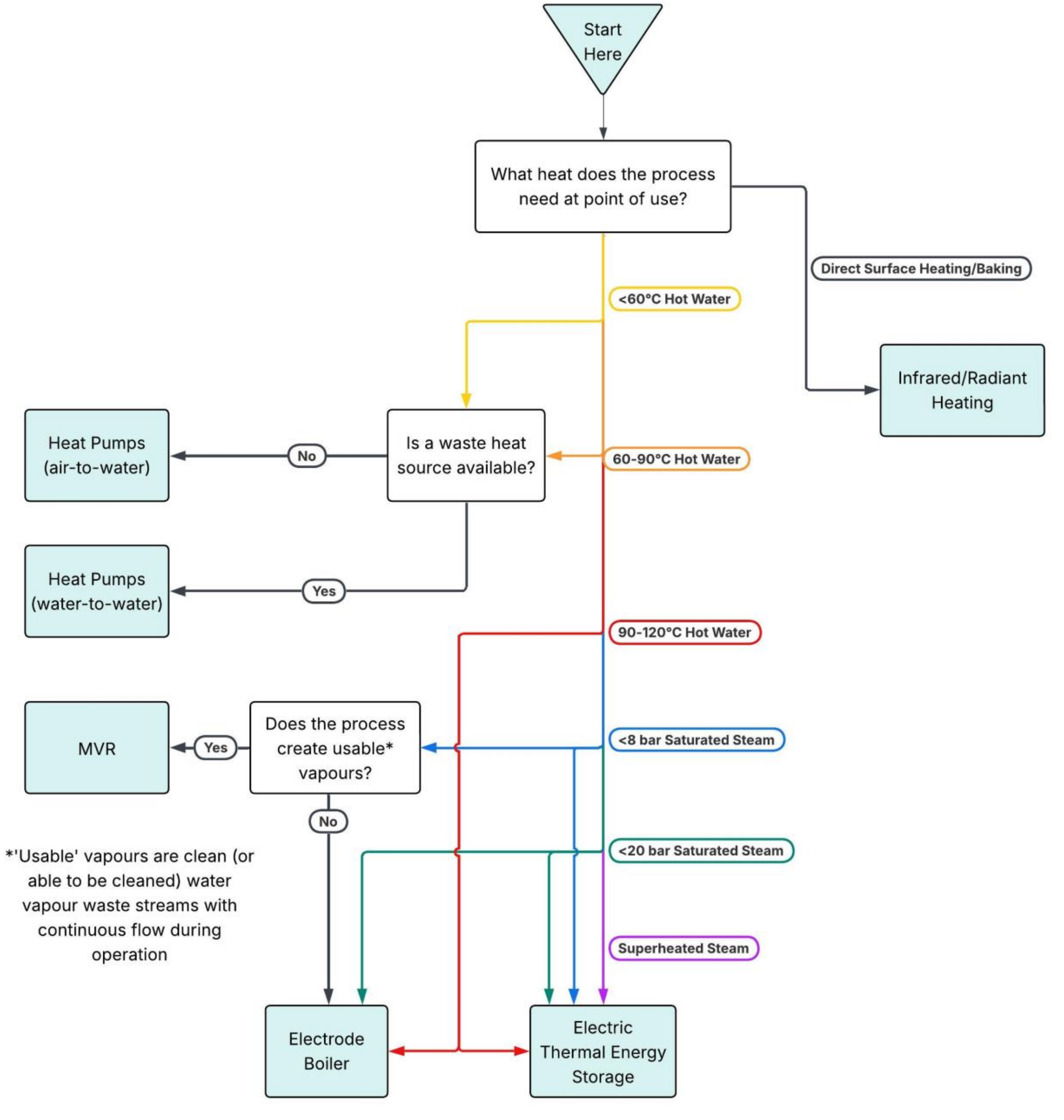
- Cooking, baking, roasting, or toasting processes (e.g., bread, biscuits, snacks, meat)
- Surface browning or caramelisation
- Processes where fast, targeted heating is more efficient than convective heating

When do the economics stack up?

- When the process is thin-layer heating or has large surface-area-to-mass ratio
- When rapid heating improves yield or throughput
- With site power generation and BESS

Decision-Making Matrix

The most cost-effective approach to electrification is to focus on the actual process requirements rather than simply replacing existing heating methods (such as a replacing a central boiler). In many industrial settings, significant energy is wasted by using high-temperature heat sources (such as steam) to produce low- or medium-temperature heat (such as hot water). High-efficiency electric technologies, including heat pumps, can instead be used to generate low- to medium-temperature hot water directly and far more efficiently.



Electrification Order

The most efficient and cost-effective strategy prioritises reducing wasted energy before investing in new technologies. Key steps include:

1

ENGAGE THE TEAM

Secure buy-in from operators, engineering, finance, and leadership

2

MEASURE AND BENCHMARK

Conduct an energy audit to understand current energy use and emissions

3

APPLY THE MITIGATION HIERARCHY

Avoid – optimise processes to eliminate unnecessary energy use.

Reduce – install equipment that reduces demand (e.g. heat recovery). Lowering thermal demand reduces electrical capacity required and CAPEX when electrifying later.

Electrify/Fuel Switch – address remaining emissions with clean-energy tech.

General Options For Heat Recovery Or Efficiency Gain		
Economisers (Boiler Heat Recovery)	**Standard Economiser** • Preheats boiler feedwater from hot flue gasses • Lowers flue gas from ~250°C to ~120°C • Heats water up to 110°C • Suited to any fuel type • Expected efficiency gain ~5%	**Condensing Economiser** • Ideal when low-temperature heat sinks (<70°C) are available • Cools flue gasses below dew point (~55°C) • Heats water up to 70°C • Best for natural gas/LPG boilers • Expected efficiency gain ~10%
Refrigeration Heat Recovery	Use waste heat from refrigeration systems (compressor oil, return lines, etc.) to pre-heat process water or supply low-grade heating. This has the additional benefit of reducing load on the chillers/freezers.	
Pre-Heating Combustion Air	Boiler combustion air is low temperature, so can be pre-heated by almost any waste heat stream. Pre-heating combustion air increases your boiler efficiency.	
General Good Practice	• Insulate pipes, tanks, heat exchangers • Recover steam condensate, maintain steam traps • Install VSDs on pumps, fans, compressors • Have a boiler technician optimize boiler operation at all firing levels	

Electrification Design Checklist

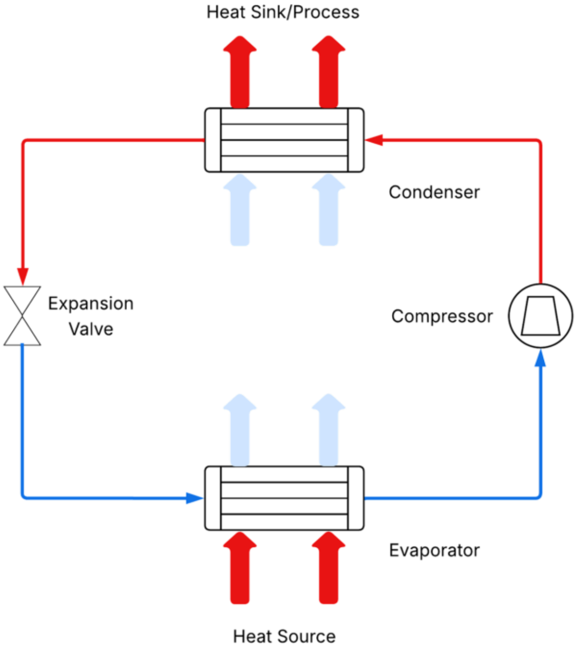
There is a minimum amount of information and details that a site should ensure it has available before spending significant time and resources on exploring electrification options. Below is a simple checklist to assist with understanding whether a facility has all the information necessary to enable a feasibility assessment to be completed.

✓ Information Required	Steps to take if information is missing	Criticality
Energy Demand and Consumption		
☐ Current power and fuel consumption trends and load profiles (hourly, daily, monthly, seasonal)	Request electricity (NMI) and natural gas (MIRN) data from retailers, install temporary or permanent sub-metering	High
☐ Process energy requirements (temperature, pressure, flow rate)	Install temporary or permanent sub-metering on steam/hot water lines	High
☐ Mapping of waste-heat sources and sinks	Install temporary or permanent sub-metering on all waste heat sources	Medium
Equipment and Infrastructure		
☐ Existing equipment specifications and ages	Inspect nameplates, consult original documentation	Medium
☐ Up-to-date technical drawings (P&IDs, PFDs, site layouts, SLDs)	Update old drawings (perform site walk) or create new drawings	High
☐ Electrical infrastructure capacity (grid, substations, switchboards)	Confirm with DNSP, perform on-site inspection and/or load testing	High
Process and Operational		
☐ Criticality of processes (downtime tolerance, sensitivities to process changes/variability)	Consult operations staff on processes, perform criticality assessment	High
☐ Operational scheduling (continuous vs batch)	Consult operations staff to understand production schedule	Medium
☐ Process thermal requirements (set points, ramp rates)	Work with operations staff to identify the temperature and form of heat required by the process, not just the current method used to deliver it.	High
☐ Available space for new equipment (footprint, access, clearances)	Perform site survey	Medium
☐ Future expansion plans	Consult operators and planning team	Medium
Energy Costs		
☐ Current electricity and fuel tariffs	Request recent invoices	High

Notes:

Heat Pump Fact Sheet

Heat pumps transfer heat from a low-temperature source – such as air, water, or waste heat – and upgrade it to a higher, usable temperature through an electrically driven refrigeration cycle. This allows them to deliver useful heating far more efficiently than systems that generate heat directly from fuel.



Are Heat Pumps Right for My Site?

Heat Pump Viability Checklist (in order of reducing necessity):

Required – Does your site need <90°C hot water?

Required – Does your site have spare electrical capacity?

Desirable – Does your site have cooling requirements such as cooling towers or refrigeration systems that could act as a waste heat source?

Desirable – Does your site have consistent or predictable hot water demand?

Potential Savings Example:

A site using 20,000 GJ of gas per year for hot water production at $15/GJ could switch to a heat pump (COP 3.5). At $150/MWh of electricity, this would cut energy costs by around $62k and reduce emissions by over 1,000 tCO_2-e annually (with renewable electricity). The project could also generate certificate value of approximately $930k from VEECs in VIC, $473k from ESCs in NSW, or $732k from REPS in SA.

Available support:

State-based grant programs are offered from time to time and may support feasibility studies or project implementation. Information on relevant funding opportunities can often be found through agencies such as DCCEEW, Sustainability Victoria, and ARENA, which periodically run programs supporting electrification and related initiatives.

Pros
High efficiency (2–6x energy delivered per unit electricity in optimal conditions)
Reduces fossil fuel use and greenhouse gas emissions
Can integrate with waste heat streams for extra efficiency
Provides precise temperature control
Cons
Limited maximum temperature (90°C) compared to steam or direct electric heating
High upfront capital cost for industrial-scale systems
Performance drops at very low ambient temperatures or with low-temperature heat sources
May require thermal storage to handle peak demands

WATCH THIS SPACE

High-temperature heat pumps (providing temperatures between 90–120°C) are only just emerging in Australia. A few pilot and early-market systems are available, but widespread commercial options are still limited, with most industrial-grade units expected to enter the market over the next several years. Because this fact sheet focuses on technologies currently available, they have been excluded.

Mechanical Vapour Recompression Fact Sheet

Mechanical Vapour Recompression (MVR) recovers and reuses waste vapour from drying, evaporation, or concentration processes by compressing it to a higher pressure and temperature (typically producing 1 – 8 bar steam). This upgraded vapour becomes the heating source, allowing MVR to replace most or all external steam or fuel.

MVR recovers and reuses waste vapour from drying, evaporation, or concentration processes by compressing it to a higher pressure and temperature (typically producing 1–8 bar steam). This upgraded vapour becomes the heating source, allowing MVR to replace most or all external steam or fuel.

Performance Snapshot:

- Typical pressure lift: 1-8 bar (higher with specialised compressors).
- Electrical demand: roughly 10–20 kWh per tonne of vapour(duty-dependent).
- Residual heat input: often <10–20% of total duty.

Potential Savings Example:

A site uses 10,000 GJ of natural gas-fired steam each year at $18.75/GJ of delivered energy. Utilising an MVR system with a COP of 10 and power price of $41.67/GJ ($150/MWh), the site reduces energy costs by ~$146k and emissions by over 500 tCO_2-e (assuming renewable electricity is used) per year. The project could also generate certificate value of approximately $465k from VEECs in VIC, $237k from ESCs in NSW, or $366k from REPS in SA.

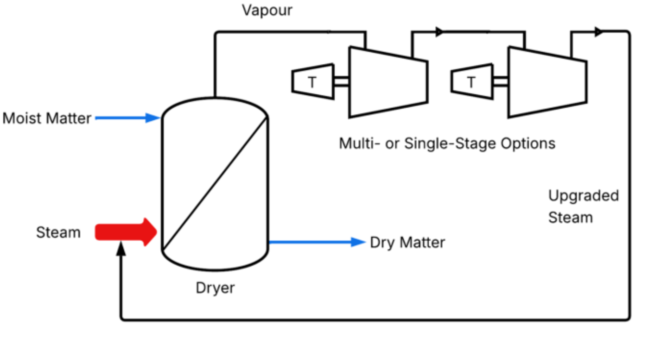
Available support:

State-based grant programs are offered from time to time and may support feasibility studies or project implementation. Information on relevant funding opportunities can often be found through agencies such as DCCEEW, Sustainability Victoria, and ARENA, which periodically run programs supporting electrification and related initiatives.

Is MVR Right for My Site?

MVR requires a fairly consistent waste vapour stream. Typical drying/evaporation/ concentration applications include:

- Dairy concentration (milk, whey, permeate)
- Food and beverage processing (e.g. sugar drying, juice concentration)
- Pulp and paper black-liquor or condensate evaporation
- Chemical and pharmaceutical evaporation



Pros	Cons
High energy efficiency for continuous processes, significantly reduces fresh steam and fuel consumption	Only suitable for clean, non-condensable-free vapour; fouled or contaminated vapour reduces performance
Reduces greenhouse gas emissions by minimising fossil fuel use	High capital cost for compressors and retrofits
Can integrate with existing steam systems	Not well-suited for intermittent processes or small-scale operations
Good payback in high-load, continuous operations	Requires maintenance for compressors and associated piping

Electrode Boiler Fact Sheet

Electrode boilers are fully electric steam generators that produce steam by passing an electrical current directly through water. In this system, water itself acts as the heating element. Because of this, electrode boilers can produce high-pressure steam (typically up to 20 bar) very quickly and efficiently, without the need for combustion, gas lines, or traditional burners.

Potential Savings Example:
A site using 20,000 GJ of gas per year for steam production at $15/GJ could switch to an electrode boiler. While increasing energy costs, the project could reduce emissions by over 1,000 tCO_2-e annually (with renewable electricity). The project could therefore also generate certificate value of approximately $930k (VIC VEECs), $473k (NSW ESCs), or $732k (SA REPS), depending on location.

Available support:
State-based grant programs are offered from time to time and may support feasibility studies or project implementation. Information on relevant funding opportunities can often be found through agencies such as DCCEEW, Sustainability Victoria, and ARENA, which periodically run programs supporting electrification and related initiatives.

Additional Thoughts:

- Hybrid Steam Systems: Can work alongside gas-fired boilers for peak shaving or redundancy.
- Renewable Energy Integration: Ideal for coupling with solar PV, wind, or other renewable sources.
- Automation and Smart Control: Can respond to process demand signals, minimising energy waste.
- Decentralised Steam Generation: Compact size allows installation close to point-of-use, reducing distribution losses.

What are the Best Use Cases for Electrode boilers?

- Sites with high or variable steam demand
- Locations with low-cost or surplus electricity, or that can access the wholesale market
- Industrial processes that require or value rapid steam availability
- Back-up or peak-load steam generation where gas is unavailable or expensive
- When coupled with an electric thermal energy storage system to utilise cheap power during off-peak times and use the steam during peak times

Pros	Cons
Very fast response and controllable steam generation	Operating costs can be high if electricity prices are high
Compact footprint and simple design	High electrical demand may require grid upgrades or dedicated supply
Can be used to balance renewable electricity supply	Limited suitability for very high-pressure or large-scale steam compared to large fuel-fired boilers
High efficiency (nearly 100% of electricity converted to heat), with high turndown	Requires tight water quality control to prevent scaling and electrode damage

Electric Thermal Energy Storage Fact Sheet

Electric thermal energy storage (eTES) systems store electricity as thermal energy in a medium such as molten salt, ceramic bricks, or phase-change materials. Stored heat can be discharged later as steam or hot water to meet process demand, enabling load shifting, power price optimisation and integration of variable renewable electricity generation.

Electricity can be converted to thermal energy either:

- **Indirectly:** Using an electrode boiler to produce steam, which is then stored as heat in the eTES system.
- **Directly:** By using embedded electric heating elements inside the storage medium to generate and store heat in a single step.

Potential Savings Example:
A site consuming 20,000 GJ of gas annually at $15/GJ could transition to an eTES system. If electricity is procured flexibly at an average price of $8.33/GJ ($30/MWh), annual energy costs could be reduced by more than $133k. Under current carbon accounting and certificate frameworks, the project is unlikely to be eligible for carbon certificates due to high grid electricity emissions factors; however, eligibility may improve as the grid decarbonises or frameworks evolve.

Available support:
State-based grant programs are offered from time to time and may support feasibility studies or project implementation. Information on relevant funding opportunities can often be found through agencies such as DCCEEW, Sustainability Victoria, and ARENA, which periodically run programs supporting electrification and related initiatives.

Additional Thoughts:

- Peak Shaving: Use stored thermal energy to reduce grid demand during peak periods.
- Hybrid Systems: Combine with gas, heat pumps, or electrode boilers to maximize flexibility and reliability.
- Renewable Energy Use: Charge eTES with solar, wind, or off-peak grid electricity.
- Process Decarbonisation: Displace gas-fired heat without extensive piping or system redesign.
- Smart Energy Management: Integrates with energy management systems for optimised charge/discharge scheduling.

What are the Best Use Cases for eTES?:

- When heat demand is cyclical, peaky, or varies by time of day
- If electricity prices offer strong off-peak or renewable-driven low-cost periods, or have access to wholesale markets
- There is capacity for additional electrical load or opportunity for staged upgrades
- Space is available for a storage vessel or modular blocks
- The site wants to displace gas without redesigning the entire heat reticulation system

Pros
Decouples electricity use from heat demand, potentially improving flexibility and energy costs
Enables efficient use of intermittent renewable electricity
Can supply very high-temperature heat for industrial processes (up to 1,000°C)
Can integrate with multiple process heating systems, such as steam, hot water or even thermal oil systems
High efficiency – modern systems deliver 90–98% round-trip efficiency, depending on temperature and configuration.

Cons
High upfront capital cost for storage tanks, insulation, and heat exchangers
Heat losses over time require careful insulation and management
Requires space for large storage volumes, especially for high-capacity applications
Complexity in integrating with existing process systems

Infrared/Radiant Heating Fact Sheet

Infrared (IR) or radiant heating delivers heat directly to surfaces or products through electromagnetic radiation, rather than heating the surrounding air. This allows rapid, targeted heating and is widely used in industrial baking, roasting, surface treatments, drying, and curing processes.

IR heating can be implemented using electric infrared lamps, ceramic emitters, or quartz elements, providing highly controllable, efficient, and clean (when using renewable electricity) heat.

Potential Savings Example:
A site using 10,000 GJ of gas per year for product baking or surface heating at $15/GJ could switch to IR/Radiative heating systems. While increasing energy costs, the project could reduce emissions by over 500 tCO_2-e annually (with renewable electricity). The project could therefore also generate certificate value of approximately $465k (VIC VEECs), $236k (NSW ESCs), or $366k (SA REPS), depending on location.

Available support:
State-based grant programs are offered from time to time and may support feasibility studies or project implementation. Information on relevant funding opportunities can often be found through agencies such as DCCEEW, Sustainability Victoria, and ARENA, which periodically run programs supporting electrification and related initiatives.

Additional Thoughts:
- Hybrid Ovens: Combine IR with convection or steam for even faster, energy-efficient baking or drying.
- Decentralised Heating: Compact footprint allows localised heating close to the process, reducing distribution losses.
- Process Optimisation: Integrates with automated control systems for precise timing, intensity, and quality outcomes.
- Renewable Energy Alignment: Fully electric, making it compatible with green electricity sources.

What are the Best Use Cases for IR/Radiant Heating?

- When heating needs are surface-focused rather than volumetric
- Where rapid start/stop or fast response is valuable
- Where space is limited or targeted zone heating is required
- Processes benefitting from precise, controllable heat
- When gas-based radiant heaters are being replaced or avoided

Pros
Very fast heating with high thermal efficiency delivers energy directly to the target, reducing environmental heat losses and allowing precise control of surface temperature.
Improved product quality – uniform surface heating; reduced scorching or uneven drying.
Compact design with minimal space requirements
Electrically powered, easy to integrate into decarbonised operations

Cons
Limited penetration – mainly heats surfaces, not bulk material
High local temperatures may require careful process control to avoid burning
Not suitable for large-volume convective heating or low-temperature applications
High electricity demand for large industrial systems