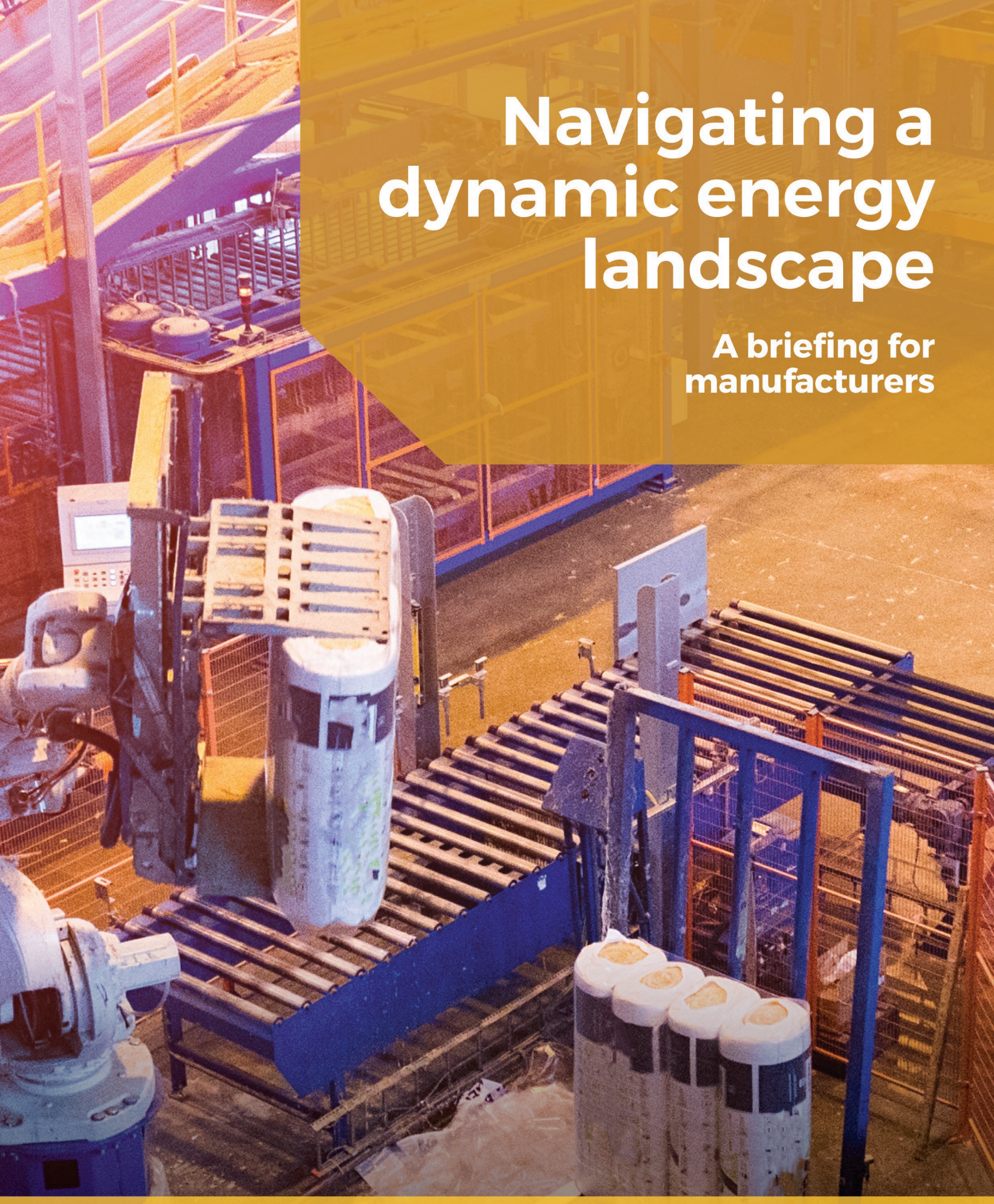
Navigating a dynamic energy landscape

A briefing for manufacturers



energy efficiency COUNCIL

SECTOR SPOTLIGHT

OCTOBER 2020

Critical insights

Over the last ten years energy prices in Australia have become increasingly volatile. Australian manufacturers know this better than anyone; since 2017 in particular, high electricity and gas prices have had a big impact. This is especially the case for energy intensive sub-sectors like primary metal and metal products, chemicals, polymer and rubber products, non-metallic mineral products and food and beverages.

While energy prices have come down from the peaks of 2017, the underlying fundamentals in both electricity and gas markets suggest that this is a temporary reprieve. And with the world grappling with recession associated with the COVID-19 pandemic, there is a higher premium than ever on managing costs.

Manufacturers that are leading the field in energy strategy and management have minimised their exposure to energy market volatility with early investments in energy efficiency, demand management and onsite generation, protecting their core business and boosting overall productivity.

Beyond cost, emissions are emerging as a strategic driver for some manufacturers. All Australian states and territories have adopted the goal of net zero emissions by 2050, while the Federal Government is targeting net zero emissions in the second half of this century. Manufacturers are also reporting that larger customers are looking to reduce the carbon intensity of their supply chains. For most manufacturers, energy makes up a large portion of their greenhouse gas emissions, making energy management investments a cost-effective way of meeting these expectations.

Understanding net zero

Net zero emissions means achieving an overall balance between greenhouse gas emissions produced and greenhouse gas emissions removed from the atmosphere.

To learn more see Section 3 of the *briefing for Australian businesses*.

Whether driven by cost or emissions, most manufacturers are paying closer attention to their energy use. Some manufacturers are just getting started, and can identify quick wins without much external support. However, manufacturers that are leading on energy strategy have gone further, working with external experts to review their sites for upgrade opportunities, and integrating a focus on energy management in their day to day systems and processes to drive continuous improvement.

As businesses deal with the first recession in thirty years and the biggest economic shock since the Great Depression, their priorities are shifting. Cost management is more crucial than ever. But for some, planned capital investments have been scaled back or stopped, with focus shifting to tuning and system optimisation.

However, many leading manufacturers are running the ruler over the Federal Government's new, time-limited immediate expensing provisions. They have recognised that the immediate deductions of the full cost of new, eligible assets and improvements to existing depreciable assets is an unprecedented opportunity to make strategic investments that drive major energy productivity improvements in their operations.

Leveraging tax provisions for energy management upgrades

In October 2020, the Federal Government announced an additional, significantly more generous scheme available to companies with an annual turnover of up to $5 billion; leading businesses are exploring opportunities to leverage this new provision for energy management upgrades.

To learn more read the *Energy opportunities for businesses in the FY20/21 budget* found at **energybriefing.org.au/fy20-21-budget**

This briefing for manufacturers is designed to guide businesses through the process of identifying and implementing energy management upgrades, illustrating businesses that are doing just that, and showcasing innovative financing and funding mechanisms that can support businesses to invest in energy upgrades.

Figure 1: Leaders in energy strategy are leveraging their energy data to drive investments behind-the-meter, and to optimise their energy procurement. They are actively monitoring the performance of these initiatives, which yields fresh data, informs future actions and enables continuous improvement.

Sector spotlight: October 2020

This briefing accompanies *Navigating a dynamic energy landscape: a briefing for Australian businesses*. It considers the specific issues faced by Australian manufacturers, and guides them in improving their energy management strategy.

To download the latest edition and other resources, sign up for updates or provide feedback, visit **energybriefing.org.au**

Navigating this briefing

This briefing for manufacturers is a companion to the annual *briefing for Australian businesses*. It is designed to provide additional information that is relevant for manufacturers that are acting to secure their energy position.

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Manufacturers have a range of particular factors they need to consider when recalibrating their energy strategy.

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There are a number of ways in which manufacturers can identify energy management opportunities, enabling them to move from quicks wins to strategic energy management.

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As large energy users, manufacturers have several opportunities to reduce their energy consumption and bills by implementing energy efficiency, demand management and renewable energy upgrades

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Manufacturers successfully navigating Australia's dynamic energy landscape are starting with what can be seen, before diving into existing data, working with an external expert and adopting energy management as a discipline.

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Information and support are available.

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The energy management journey

We talked with manufacturers that are leading the field in energy strategy and management, and they told us there were four key milestones in the journey towards improving their energy performance:

1. Start with what can be seen

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Changing habits and routines, and scanning the site for issues leverages the knowledge of the team on the ground to identify quick wins.

2. Dive into existing data

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Reviewing energy bills, interval meter data, asset registers and maintenance history connects the dots between easily accessible data and performance of processes and equipment.

3. Work with an external expert

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Finding the right auditor for your site, specifying the audit you need and preparing a post-audit action plan gives you a detailed understanding of energy performance and upgrade opportunities, and builds the case for more significant investments.

4. Adopt energy management as a discipline

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Establishing processes for continuous improvement in energy performance internalises smart energy management as a part of company culture, and drives ongoing, year-on-year improvements in energy performance.

Energy landscape for manufacturers

There are over 47,000 manufacturers in Australia. 93 per cent of them are small businesses with less than 20 employees, including sole traders. Of the remaining businesses, the vast bulk of them have less than 200 employees; only 0.6 per cent of manufacturers have 200 or more employees.

Collectively, manufacturers use 17.4 per cent of Australia's energy, making the sector the nation's third largest energy consumer.[1] How these businesses engage with energy varies greatly. For larger manufacturers, energy consumption – and the associated costs and emissions – can be very large, meaning savings can be huge.

However, for small manufacturers, energy often makes up a larger proportion of total operating expenditure (OpEx) compared with large manufacturers, making smart energy management a crucial opportunity for managing costs.

[1] Commonwealth Department of the Environment and Energy 2019, *Australian Energy Update 2019*, p. 12.

Business Energy Advice Program (BEAP)

BEAP is a free energy advisory program for small businesses (1-19 employees) across Australia that delivers face-to-face and phone consultations, helping them to discover industry specific energy saving opportunities. BEAP is funded by the Australian Government and delivered by Business Australia.

BEAP provides advice on energy procurement and energy efficiency opportunities to help small and medium enterprises (SMEs) manage their energy consumption and costs. The service also gives small businesses free access to information available online including case studies, fact sheets, and information on how businesses can access government grants.

State and territory governments also offer a range of advisory and financial support programs for businesses, including manufacturers – see **Section 5.2**.

To learn more go to **businessenergyadvice.com.au**

Energy-intensive manufacturing accounts for almost a fifth of Australia's total energy consumption.

1.1 Managing energy costs and market volatility

Over the last ten years energy prices in Australia have become increasingly volatile. Australian manufacturers know this better than anyone; since 2017 in particular, high electricity and gas prices have had a big impact, especially in energy intensive sub-sectors like primary metal and metal products, chemicals, polymer and rubber products, non-metallic mineral products and food and beverage.

While energy prices have come down from the peaks of 2017, the underlying fundamentals in both electricity and gas markets suggest that this is a temporary reprieve.[2] And with the world grappling with recession associated with the COVID-19 pandemic, there is a higher premium than ever on managing costs.

Manufacturers that are leading the field in energy strategy and management have minimised their exposure to energy market volatility with early investments in energy efficiency, demand management and onsite generation, protecting their core business and boosting overall productivity.

Energy efficiency upgrades, for example, can often save as much as 30 per cent.[3]

Want to get the latest on Australian energy prices and climate risk? Check out the latest edition of the ***briefing for Australian businesses.***

1.2 Managing emissions

All Australian states and territories have adopted the goal of net zero emissions by 2050, while the Australian Government is targeting net zero emissions in the second half of this century. Beyond government targets, the Reserve Bank of Australia (RBA), along with over 60 other central banks, has warned of the potential for global gross domestic product (GDP) to fall by 25 per cent below the expected level by 2100 if the world does not act to reduce emissions.[4]

This risk is being taken seriously by business, with Australian manufacturers reporting that larger customers are looking to reduce the carbon intensity of their supply chains.

We want to see our suppliers matching our ambitions. We have set a target to have 200 strategic suppliers report on emissions reduction activities by 2020 in order to decrease environmental impact in our supply chain.

Luc Broussaud
Chief Procurement Officer
Signify

[2] Ai Group 2020, *Post pandemic policy: climate and energy*, pp. 6-8.

[3] International Energy Agency (IEA) 2015, *Accelerating Energy Efficiency in Small and Medium-sized Enterprises*, IEA, p. 8.

[4] Network for Greening the Financial System 2020, *NGFS Climate Scenarios for central banks and supervisors*, p. 8.

Low carbon supply chains

On average, supply chains produce over five times more emissions than the direct operations of a business.[5] Given this, Australian corporates and multinationals have been working to track the emissions intensity of their supply chains through CDP's supply chain disclosure program.

Manufacturers like Ford Motor Company, Kellogg Company, Heineken, Signify and Unilever all ask their suppliers to respond to CDP's climate change survey so that they can track emissions in their supply chains as they work towards achieving net zero. Unilever is even taking steps towards having its suppliers declare, on each invoice, the carbon footprint of the goods and services provided.

But multinationals are not alone; the European Union is considering introducing a *carbon border adjustment tax* on imports as part of its plans to decarbonise.

Taking actions that lower the carbon intensity of their goods is a way for Australian manufacturers to ensure these trends do not adversely impact their business.

Energy management investments can cost-effectively lower emissions, making them a straightforward way of meeting the burgeoning demand for low carbon products.

For Australian manufacturers, thriving in a net zero economy is likely to involve fuel switching and a transition to range of new technologies. Options include:

- Electrification using high efficiency equipment;
- Renewable energy, including renewable – or green – hydrogen;
- Biofuels; and
- Other low carbon technologies, such as carbon capture, utilisation and storage (CCUS).

Some of these technologies are available and commercially viable now; others need to be developed.

Many manufacturing processes can be electrified – with electricity supplied from renewable sources – and made more energy efficient. For those processes that cannot be electrified, like high temperature processes, gas is likely to be replaced with other fuel sources, like renewable hydrogen.[6] Renewable hydrogen is produced by splitting water into hydrogen and oxygen with an electrical current that is produced from a zero-emissions source – like solar photovoltaics (PV).[7]

Electrification is already cost competitive in many, but not all, instances, whereas renewable hydrogen and other alternative low carbon technologies are not. To overcome this, the Federal Government is investing in driving down the costs of these technologies, through initiatives like the *National Hydrogen Strategy*, the *Technology Investment Roadmap* and bodies such as the Australian Renewable Energy Agency (ARENA).

[5] CDP 2019, *Changing the chain*, p. 5.

[6] COAG Energy Council Hydrogen Working Group 2019, *Australia's National Hydrogen Strategy*, p. 6.

[7] Bruce S, et al 2018, *National Hydrogen Roadmap*, p. 2.

1.3 The transition to Industry 4.0

The move to adopt the principals of Industry 4.0 – or the fourth wave of the industrial revolution – is integral to the ongoing global competitiveness of Australian manufacturing. And recent developments in energy management software – including smart automation systems, sensor technology, autonomous data collection and machine learning – are leading this transition.

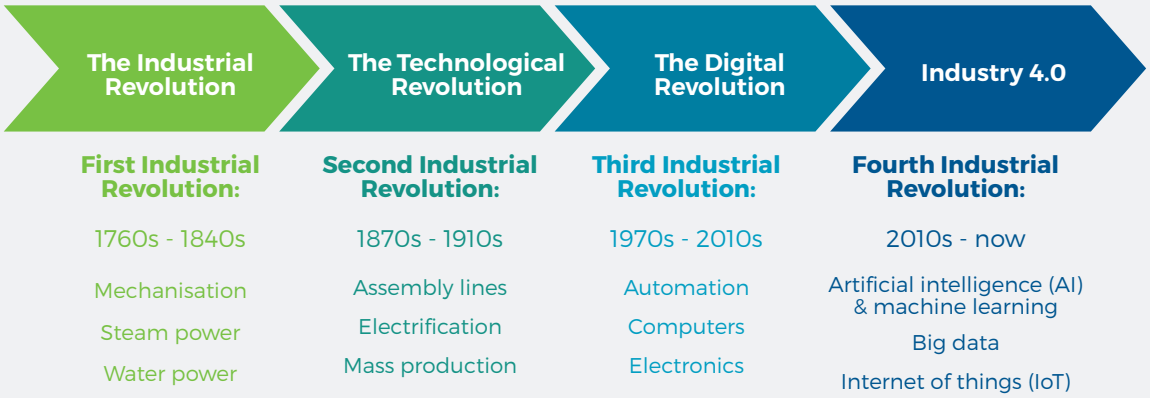


Figure 2: The four industrial revolutions

For many manufacturers, managing energy costs is a top priority. However, by taking action to understand and manage their energy use, leading manufacturers are also taking a big step towards Industry 4.0.

At its heart, improving the energy productivity of manufacturing processes is about understanding energy use at each point of the process, and how this use can be optimised. This requires granular data that enables better management of existing equipment, and investment in new equipment where appropriate. However, a lot of metering and monitoring technology – and the data it generates – is not just an enabler of better energy management, it is an enabler of broader productivity via the principles of Industry 4.0.

Energy productivity

Put simply, "energy productivity is a measure of the amount of economic output derived from each unit of energy consumed."[8] It is a useful indicator for understanding the energy efficiency of a business, an industry, or an economy.

Though energy productivity is more than just improving energy efficiency, encompassing both the supply and demand sides of energy, and interventions in front of and behind-the-meter to reduce energy costs.

Smart – or connected – devices, otherwise known as the internet of things (IoT), can use machine-to-machine communication to automatically optimise processes and conduct self-analytics and diagnostics. But smart devices can be as simple as smart switches that turn off lights from an app.

Previously the preserve of large companies, real-time metering and monitoring hardware and communication software is quickly dropping in cost. And the adoption of IoT for energy management purposes offers more than just reduced energy bills and emissions; it can increase productivity and reduce labour costs too.

[8] COAG Energy Council 2015, *National Energy Productivity Plan 2015 – 2030*, p. 9.

Identifying energy management opportunities

Manufacturers looking to take control of their energy position start by identifying energy management opportunities. It's possible – and sensible – to start simple and get some quick wins, by starting with what you can see and diving into existing data. Over time, manufacturers that are ahead of the pack go further; they invest in an energy audit, act on cost-effective upgrades, and put in place an energy management system (EnMS) to drive continuous improvement.

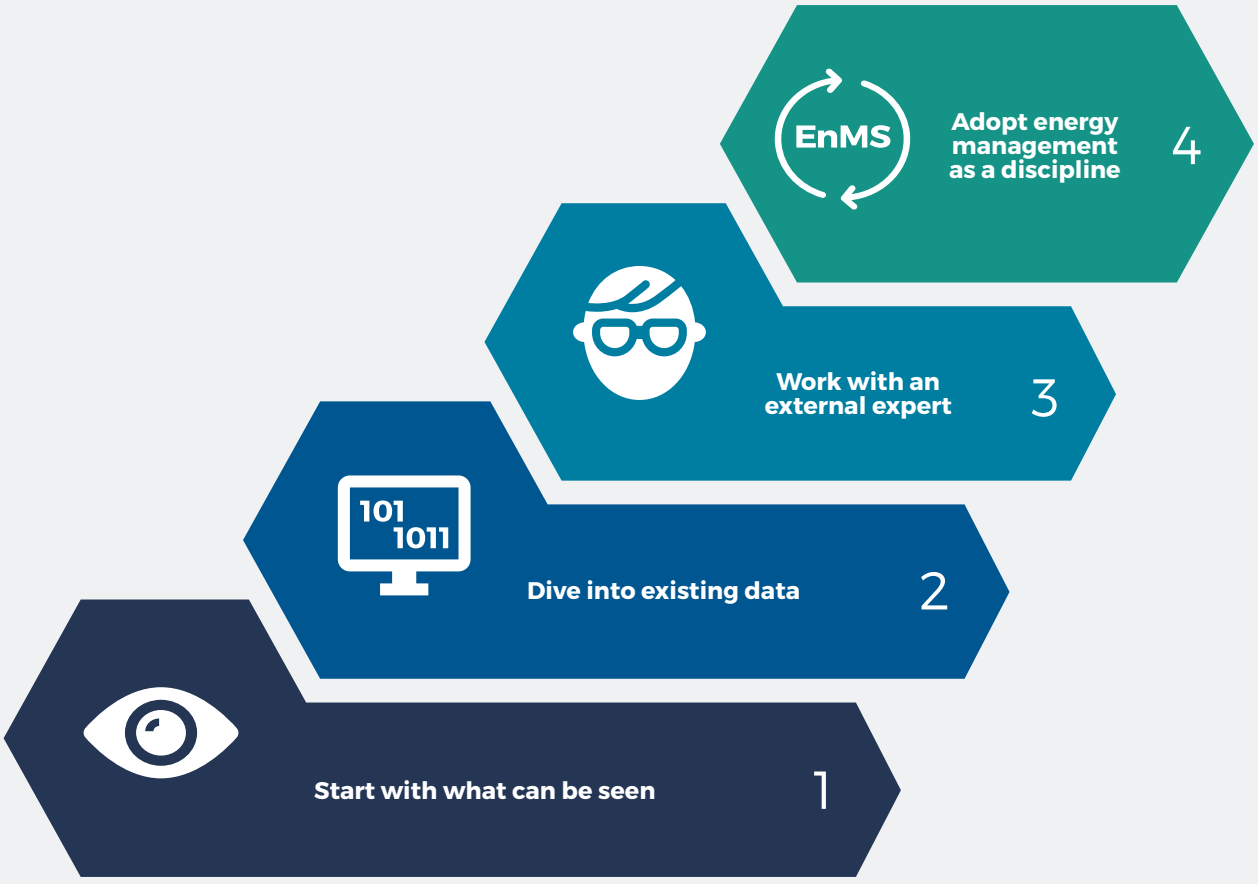


Figure 3: Leaders in energy strategy and management typically follow this four-step approach to identifying energy management opportunities, starting with easier opportunities and progressing to more complex ones.

2.1 Starting with what can be seen

Manufacturers looking to improve their energy management start by identifying quick wins, scanning their operations for obvious issues that may be easy to fix, such as:

- Changing habits and routines that result in energy waste; and
- Scanning a site for issues that could be causing energy waste.

Acting on these issues can result in immediate savings, often at no or very low cost.

2.1.1 Changing habits and routines

Energy waste often occurs because saving energy hasn't been high on the list of operational priorities. In some cases, equipment is left on overnight and out of hours. More commonly, equipment is left on during breaks. One of the simplest things a business can do is ensure that equipment and lights are being turned off when not in use.

Having signs on equipment and by doors reminding staff to turn things off during breaks and at the end of operating hours can help change behaviour.

Driving behaviour change

Incentivising action on energy saving activities can result in major cost savings in energy intensive businesses. Behaviour change is complicated, but experts agree that one of the simplest ways to encourage behaviour change is to facilitate high levels of both motivation and ability.

Motivation can be enabled by linking desired outcomes to professional development plans and key performance indicators. Whereas ability can be improved with training and resources.

Recognition and rewards can also help lock in self-sustaining culture around a given behaviour.

2.1.2 Scanning a site for issues

Simple energy savings opportunities – often related to maintenance issues – may be missed by equipment operators. Issues with equipment often build up over time, making it harder for regular operators to notice. However, they can often be picked up by:

- Using eyes to spot leaks or differences between equivalent equipment;
- Using ears to listen out for anything that sounds unusual – for example, if a piece of equipment is louder than usual; and
- Using touch – when safe to do so – to determine if heating or cooling is being wasted from a lack of thermal efficiency, leading to over- or under-heating and cooling. Fluctuations in temperature – both ambient and operational – are often a key indicator of wasted energy.

This sort of scan is often most effective when undertaken by regular equipment operators along with someone that doesn't typically operate that particular type of equipment; this gives you the benefit of both familiarity and a fresh pair of eyes, ears and hands.

2.2 Diving into existing data

All manufacturing businesses have a lot of existing data that can help them identify straightforward energy management opportunities. The most common sources for insights are:

- Energy bills;
- Interval meter data; and
- Asset registers and maintenance history.

2.2.1 Energy bills

Energy bills prove useful because they include:

- Energy consumption data;
- A breakdown of peak, shoulder, and off-peak energy usage; and
- A graph that compares current energy use with the same time in the previous year.

Comparing recent energy bills with historic bills enables manufacturers to benchmark and track the energy intensity of their operations. Leading manufacturers identify and track some key performance indicators, such as how energy usage relates to output or revenue.

Further, reviewing the breakdown of peak, shoulder and off-peak usage on electricity bills can help manufacturers identify demand management opportunities. These could include running equipment when energy is cheaper, which is known as load shifting. In some cases load shifting can even be a source of revenue through demand response programs – see **Section 3.2**.

Manufacturers that are familiar with their energy bill are well positioned to pursue innovative procurement options when their energy contract is due for renewal – see Section 3.3 of the *briefing for Australian businesses*.

2.2.2 Interval meter data

Manufacturers with interval meters can review their energy consumption in 15- to 30-minute intervals. Generally, interval data is available online on the electricity retailer's website, or following a request to the retailer, which must provide the data within ten business days.

A simple analysis of this data can provide insights into available energy management opportunities. For example, high overnight electricity consumption may indicate that equipment is being left on when it is not in use. Additionally, the data may demonstrate spikes in electricity consumption that align with certain processes or equipment usage, which can be investigated further.

As with standard energy bills, interval meter data can help a business analyse energy usage patterns and identify demand management opportunities.

2.2.3 Asset registers and maintenance history

Keeping asset registers current, including operating hours, installation dates and power ratings, helps ensure you have the information you need to manage energy investments. Correlating data from the asset register with data from energy bills enables manufacturers to build out an understanding of their energy use.

As a rule of thumb, if the maintenance history of a piece of equipment shows it is breaking down often or requires a lot of maintenance, there is a good chance that it is operating inefficiently and consuming too much energy. Some simple sub-metering of suspect equipment can help confirm if there is an issue.

Keeping an eye on asset registers and maintenance history also supports planned maintenance and replacement of equipment. It often pays to avoid reactive, rushed decision making when procuring equipment. And by keeping efficiency in mind when shopping for equipment, manufacturers can minimise total cost of ownership and improve productivity.

Sub-metering enables manufacturers to identify straightforward energy management opportunities.

2.3 Working with an external expert

After capturing, analysing and acting on easily available data, it can be worthwhile getting the support of an external expert to undertake an energy audit that is compliant with the Australian standard.

There are three key elements to a successful audit process:

- Finding the right auditor;
- Specifying the right type of audit; and
- Preparing a post-audit action plan.

Is energy auditing, is good

Founded in 1947, DON Smallgoods is one of Australia's largest smallgoods manufacturers. In 2017, with rapidly rising electricity and gas costs, the manufacturer set sustainability targets for itself. At the outset, there was no visibility of energy productivity and performance in DON's plants, so the manufacturer needed help achieving its goals.

The company had an unstructured approach to energy management, and limited capacity to change its approach. With the help of a virtual energy manager service, an energy assessment was performed to identify opportunities for energy saving improvements.

Opportunities included upgrades to air compressors, refrigeration, lighting and process improvement. The potential savings totalled $1.5m, saving 20 per cent of site energy use with a payback of less than three years.

2.3.1 Finding the right auditor

Finding the right auditor is important. When procuring an auditor, it is worth asking:

1. **Do they have a working knowledge of the Australian Standard?** All energy audits should comply with Australian/New Zealand Standard 3598:2014. Your energy auditor needs to be familiar with the Standard, preferably by having previously completed actual energy audits that are compliant with the Standard. Ask your auditor for references to past work.

2. **Do they have skills and experience with all the major energy uses within your site?** There is a lot of variability in the way energy is used on manufacturing sites, however for many sites, most energy will be consumed by one or two processes. Make sure your auditor has experience in those areas. For larger and more complex sites, it is often beneficial for the auditor to have a team that includes members with a range of technical expertise.

3. **What other technical and general skills will they bring to your audit?** An energy audit is not just about identifying savings measures; it is about evaluating the potential benefits and capital costs of those savings measures. That means an auditor must have a diverse range of technical and general skills.

Energy Auditing to Australian / New Zealand Standard 3598 training

Energy and facilities managers that want to familiarise themselves with Australia's energy audit standard can undertake the Energy Efficiency Council's training course, *Energy Auditing to Australian Standard 3598*.

2.3.2 Specifying the right type of audit

In 2014, Standards Australia released a major update to the Australian/New Zealand Standard for energy audits. The update focused on ensuring it supports the delivery of consistent, high quality audits, which enable businesses to make informed decisions on energy upgrades.

Because of the different needs of different sectors, the Standard is presented in three parts:

- AS/NZS 3598.1:2014 – Commercial buildings;
- AS/NZS 3598.2:2014 – Industrial and related activities; and
- AS/NZS 3598.3:2014 – Transport and related activities.

In most cases, manufacturing sites should specify an audit be undertaken in accordance with AS/NZS 3598.2:2014 – Industrial and related activities. They should also specify one of the three audit 'types', depending on their needs:

- Type 1: Basic energy audit;
- Type 2: Standard energy audit; or
- Type 3: Precision subsystem energy audit.

To learn more read the *Energy audits 101* found at **energybriefing.org.au/energy-audits-101s**

2.3.3 Preparing a post-audit action plan

A good energy audit is a briefing that drives informed action. It can help build the business case for more substantial investments that are unlikely to be pursued without some serious analysis.

Once an audit is handed over, the ball is in the business' court. There are countless stories of audits gathering dust on shelves. To avoid this, leading manufacturers prepare a post-audit 'action plan' for the Board, Managing Director or owners that responds to the auditor's recommendations, and sets out a plan for which of the recommended activities will be pursued, and when.

Check out **Section 3** for a review of common energy management opportunities that are recommended following audits for manufacturers.

2.4 Adopting energy management as a discipline

Manufacturers that are leading in energy management have moved beyond capturing and analysing data to identify low hanging fruit, and using occasional energy audits to drive upgrade investments. Instead, they have implemented energy management systems (EnMS) that facilitate continuous improvement. Systematically tackling energy management on site provides the following benefits:

- **A framework to manage energy** with structured policies, processes and action plans to implement energy saving opportunities, enabling businesses to implement continual improvement in energy management and build on experience and trusted expertise;
- **Organisational engagement** with buy-in from senior management and other stakeholders, which facilitates the prioritisation of energy management practices throughout the business, including the ongoing allocation of resources rather than ad hoc project funding as a reflection of the organisation's acknowledgment of the cumulative benefits to the organisation;
- **Improved corporate social responsibility (CSR)** with a framework and organisational engagement to reduce emissions through strategic energy management;
- **Improved risk management** with a structured risk management mechanism through the implementation of an energy management system; and
- **Ongoing energy use and cost reduction** with the establishment, implementation and preservation of the necessary systems and processes to manage energy on site.

Tooheys sips ongoing financial savings through strategic energy management

An Australian institution since 1869, Tooheys Brewery supplies around 250 million litres of beer to Australians each year, making up the lion's share of parent company Lion's annual 600 million litres. Producing that much beer across Lion's five major breweries guzzle a lot of energy. To tackle this, Lion has implemented strategic energy management practices.

With the support of expert advice facilitated by the NSW Government, and clear leadership from the executive team, Lion further improved its energy management systems at its Tooheys Brewery in Lidcombe, New South Wales.

Lion already had some relatively robust energy management practices, such as strong energy policies, energy saving targets against production (GJ/hectolitre), and energy monitoring systems at some sites like Tooheys. However, there was room for improvement, including the development of:

- Online energy e-learning modules to help employees understand energy consumption at the brewery and learn ways to improve energy performance;
- Energy models to provide the site with quantitative tools to track daily energy consumption against targets, predict future energy consumption and detect when energy consumption drifts outside of expected levels; and
- An *energy management guide* for employees to learn about Lion's energy management practices and support adherence and continuous improvement.

After making these improvements in 2020, it is expected that Tooheys will achieve ongoing energy spend reductions of three to five per cent each year.

2.4.1 Energy management systems

Energy management systems (EnMS) are established to drive continuous improvement in an organisation's energy performance. While energy management systems will include policies, plans and processes, it is executive buy-in and a dedicated energy manager and team with the necessary resources that is crucial to deliver ongoing energy management improvements. When these are in place, companies can achieve a reduction in energy intensity of three per cent or more each year, every year.

The international standard ISO50001 specifies an energy management system framework. While ISO50001 certification may make sense for larger organisations, its *Plan – Do – Check - Act* continual improvement framework is a useful reference for all organisations establishing an energy management system.

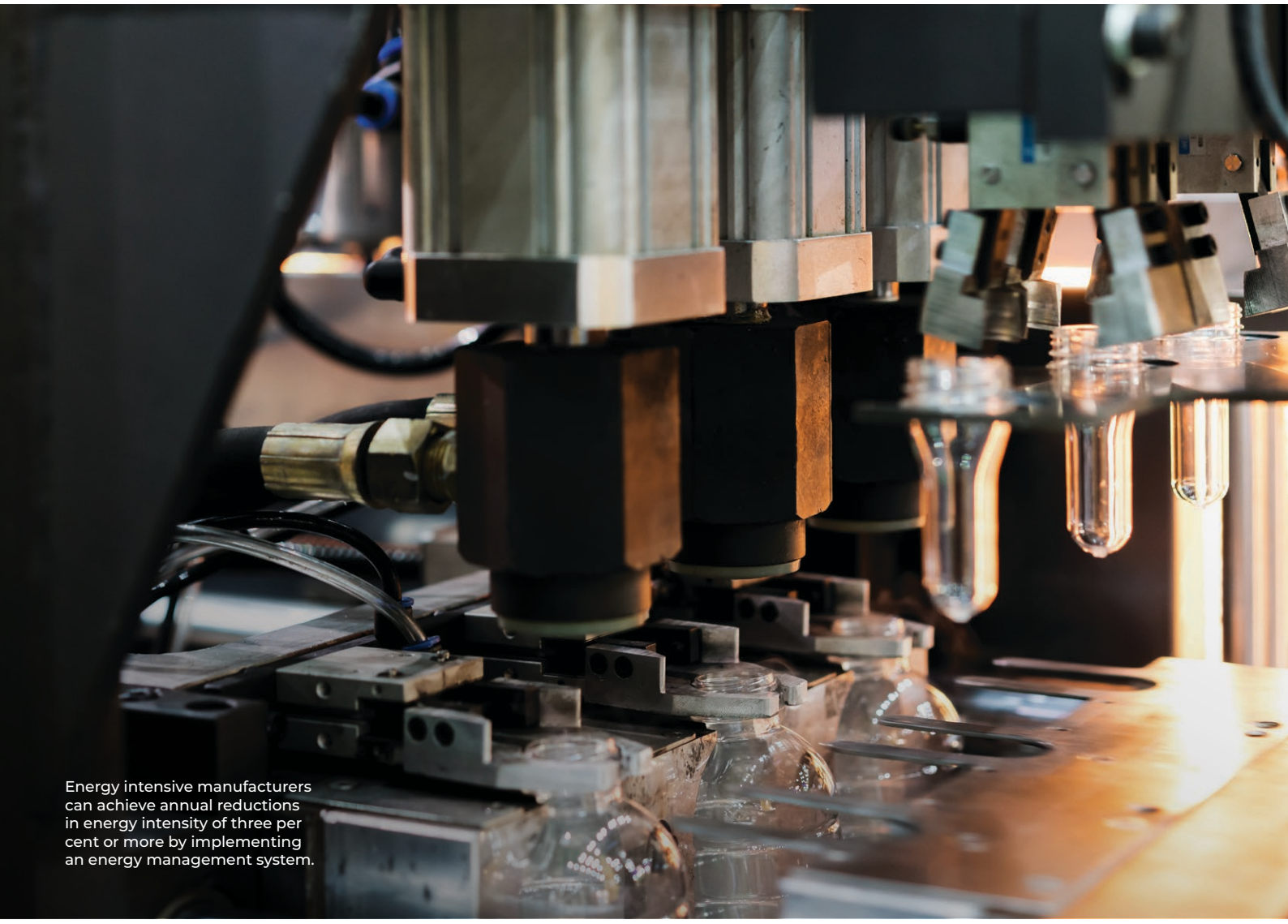
Figure 4: The Plan-Do-Check-Act cycle is central to EnMS, and management systems more broadly. It enables continuous improvement in energy management.

2.4.2 Integrating energy management into existing management systems

The International Organization for Standardization's (ISO) standard for energy management systems is ISO50001. While ISO50001 is commonly referred to as best practice in energy management systems, if a company is not familiar with ISO management systems, an energy management system can be aligned with other internal systems. For example, a company could use lean management, which focuses on delivering value, eliminating waste and continuous improvement.

Integrating energy management into existing management systems facilitates implementation as it can reduce the initial investment into documentation and processes.

However, if a company has previously implemented other ISO management systems – such as ISO9001 and ISO14001 in quality and environmental management systems respectively – adding ISO50001 to reporting processes will be a relatively familiar process.



Energy intensive manufacturers can achieve annual reductions in energy intensity of three per cent or more by implementing an energy management system.

Measurement and verification of energy savings

Measurement and verification (M&V) methods and processes are used to measure and verify, in a defined, transparent way, the energy savings resulting from planned changes to all or parts of a specific facility or a group of specific facilities.

M&V of energy opportunities gives businesses confidence that energy actions have an impact on the bottom line, and is often an effective tool for driving continuous improvement.

To learn more read the *M&V 101* found at **energybriefing.org.au/m-and-v-101**

2.4.3 Capturing the benefits of innovation

Ongoing improvement is fundamental to success, however, once an energy management system is well established it can be complemented by analysis and modelling of the fundamental physics, chemistry, energy and mass flows through processes, and exploration of potential for application of non-traditional technologies and business models.

Disruptive breakthroughs in materials, design techniques, digitalisation, technology development and decentralised business models are driving change. Modern technologies and analysis techniques mean that, for many manufacturing processes, radically different processes are emerging. For example, industrial heat pumps can capture waste heat, including latent heat in water vapour, then upgrade its temperature to a level usable within the same process, or in other processes that require higher temperatures than those provided by traditional heat recovery equipment.

Development of modular technologies with smart controls can replace inflexible central systems with high standby losses such as gas-fired steam boilers. New processes and materials can avoid the need for processes such as cleaning or painting.

In many cases, these new approaches can achieve significant business productivity improvements. For example:

- Fitting smart, connected electronic actuators to compressed air systems can reduce reject rates, increase speed of production lines and allow one actuator to replace several compressed air actuators, while sharing real time data via 'the cloud' to enhance other aspects of business productivity;
- Temperature sensors can alert process managers when problems are occurring, so they can be addressed;
- Monitoring of motor loads relative to production can flag bearing wear or other issues so that preventive maintenance can be carried out, avoiding unexpected loss of production; and
- Tracking of real time efficiencies of boilers can support optimisation of chiller scheduling.

The Commonwealth Government's previous Energy Efficiency Opportunities program developed assessment approaches that focused on these fundamentals. The *Energy Efficiency Opportunities Assessment Handbook* is still available at **energy.gov.au/publications/energy-efficiency-opportunities-assessment-handbook**

Energy management opportunities for manufacturers

There are several energy management opportunities that commonly emerge for manufacturers. This section outlines the key categories and technologies across energy efficiency, demand management and on-site generation.

By following the steps outlined in **Section 2** leading manufacturers are able to determine which of the following energy management opportunities offer the best value for their businesses. Manufacturers should also note that resource and water efficiency can also lead to energy savings, so opportunities in these areas should also be explored.

3.1 Energy efficiency

Energy efficiency opportunities are diverse and vary greatly from site to site. However, there are a number of technologies[9] that commonly appear on the 'hit list' for manufacturers looking to take control of their energy costs.

3.1.1 Compressed air

Compressed air plays a critical role in many large manufacturing plants. It is estimated that about 10 per cent of all industrial electricity consumption in Australia is used to power compressed air systems.[10]

Manufacturers can often reduce the energy consumption of their compressed air systems by up to 50 per cent.

Emerging technologies such as smart electronic actuators and electric tools can allow part or all of a compressed air system to be shut down, saving from 50 to 90 per cent of energy costs and increasing process productivity by speeding up production lines.[11]

3.1.2 Electric motors and pumps

Electric motors – or power drive systems – convert nearly half of global electricity into mechanical energy. Given this, appropriately sizing motors can save a lot of energy as most electric motors are designed to run at 50 per cent to 100 per cent of rated load.

Maximum efficiency is usually at 75 per cent or more of rated load. If the motor is not running at the required rate, replacing the motor may be the only course of action, though installation of a variable speed drive can also be worthwhile, especially because it increases the flexibility of the system.

Pumping systems, which use electric motors, are integral to many manufacturing processes, but are often extremely inefficient due to poor sizing and materials; the average pumping efficiency in manufacturing plants is less than 40 per cent. While energy savings can reach up to 50 per cent, maintenance savings amplify this.

Smart monitoring systems can be used to detect unexpected increases in process loads on down-sized motors optimised for efficiency, so that maintenance can be undertaken to avoid damage to the motor and loss of production.

[9] A series of relevant technology guides can be found in **Section 5.3.**

[10] Compressed Air Association of Australia 2017, *Efficient Compressed Air Systems: An overview of how to save energy, reduce costs and help the environment*, p. 2.

[11] Australian Alliance for Energy Productivity 2020, *Compressed air systems, emerging efficiency improvements and alternative technologies: Review, background research and examples*, p. 1.

3.1.3 Refrigeration

Widely used by cold storage facilities, wineries, food manufacturers, plastics and packaging factories and others, refrigeration, including process cooling, is a substantial energy user. In cold storage facilities for example, refrigeration can account for around 70 per cent of total energy consumption across a site.

There are multiple opportunities associated with refrigeration, with manufacturers able to realise energy savings of up to 50 per cent by making energy efficiency improvements. And industrial refrigeration is well suited for demand response – see **Section 3.2.**

Cold storage can account for up to 70 per cent of total energy consumption across a site, but leading manufacturers are implementing smart energy upgrades to reduce this.

AIRAH Design Application Manuals

The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) has a series of **Design Application manuals** that can help with improving energy performance in refrigerated areas like cool rooms.

3.1.4 Steam, hot water and process heating

Steam, hot water and process heating are all essential resources for many Australian manufacturers, and with estimates of their industrial energy consumption ranging from one-sixth to one-third of total consumption, the opportunity is clear.

Many steam systems are inefficient, and a lack of monitoring and system analysis means these inefficiencies may go undetected. Analysis of end-uses may identify processes that require lower temperatures that can be provided by heat pumps, improved energy recovery or other modular, distributed solutions.

Options range from reducing the temperature of hot water, to boiler refractory and air infiltration upgrades, to modular heat pumps and other electric technologies.

Australian manufacturing: gas efficiency guide

The Australian Industry Group, Clean Energy Finance Corporation and the Energy Efficiency Council have developed a practical **gas efficiency guide for Australian manufacturers** to help Australia's energy intensive manufacturing industry reduce operating costs and carbon emissions.

3.1.5 Voltage optimisation

Voltage optimisation is a well proven and reliable energy saving technology that is used to regulate, cleanse and condition power supply.

Voltage optimisation regulates incoming power supply from the grid to reduce the site voltage to the level needed for optimum operation – and efficiency – of on-site electrical equipment. It can deliver energy savings of up to 12 per cent.

Fuel switching

Fuel switching replaces inefficient fuels with cheaper and cleaner alternatives, such as substituting coal for natural gas, or natural gas for high efficiency electric technologies powered by renewable energy. Each of these fuels has advantages and disadvantages, with cost considerations often being the reason for fuel switching.

Emerging modular electric technologies allow manufacturing activities to be carried out beyond gas grids, closer to farms or other resource production, or downstream, integrated with retail or tourism facilities.

3.2 Demand management

Demand management – or managing when energy is used – is a significant opportunity for many manufacturers. Some large energy users expose themselves to the wholesale electricity market, so that they can benefit from shifting flexible loads to times when electricity is cheaper, such as when renewable energy generation is high.

Businesses can also monitor their site demand to ensure that they do not exceed the monthly demand thresholds outlined in their energy contracts, thereby increasing their network charges. To avoid this they may choose to ramp down for an hour when electricity demand is nearing the threshold. For smaller businesses, monthly demand charges are often levied for the highest half hour of demand in a month – or in some cases, a year – so demand management can reduce these charges.

Finally, large energy users like manufacturers can be compensated for reducing their energy load during peak times, through programs like the Australian Energy Market Operator's (AEMO) and the Australian Renewable Energy Agency's (ARENA) emergency demand response program. And rules in the National Electricity Market (NEM) are being changed so that many more businesses can benefit from engaging in demand response, either directly or by working with expert demand response aggregators.

To better understand wholesale and network charges on electricity bills, refer to Section 2 of the *briefing for Australian businesses.*

Australia has several voluntary demand response mechanisms. To learn more about demand response, refer to Section 3.2.2 of the *briefing for Australian businesses* and read the *Demand response 101* at **energybriefing.org.au/demand-response-101**

Energy storage and batteries

Storing energy is about more than hooking up a lithium ion battery to your solar PV system, especially for manufacturers that can harness thermal energy storage.

Leading manufacturers harness the thermal energy storage of refrigeration, heating, ventilation and cooling (HVAC) systems, and steam, hot water and process heating processes to minimise their energy demand at times when energy costs are high or capacity of on-site energy infrastructure hit their limits.

Using thermal storage alongside electric storage – i.e. batteries – that is connected to onsite renewables puts energy intensive manufacturers in the best position to seize demand management opportunities and lower their energy bills.

It is also possible to use stored partly processed product as a form of energy storage. For example, cement clinker or grain can be stored, then ground when energy prices are low.

Australian manufacturer Molycop discovers that demand response rocks

Molycop, a global manufacturing company, established its Australian outpost in Newcastle in 1918. The company pioneered electric arc steelmaking in Australia, and manufactures its products from recycled scrap steel feed in Newcastle.

Molycop's grinding media, in the form of hard steel balls, are used by the mining industry to grind and blend materials in ball mills. It is estimated that ball mills are solely responsible for four per cent of the world's electricity consumption.

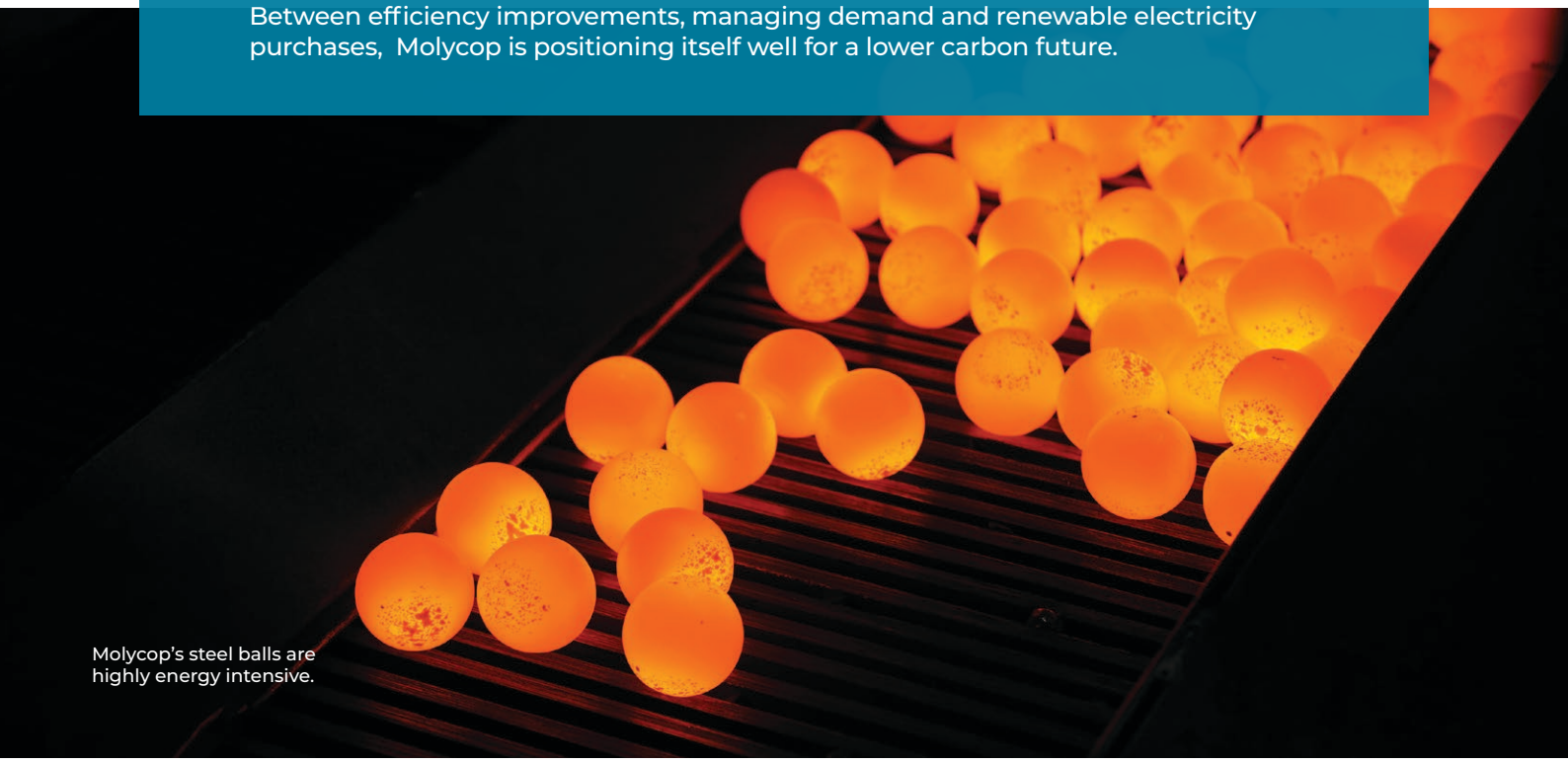
Manufacturing grinding media from ferrous scrap steel is a very energy intensive process. In particular, the initial melting of scrap steel consumes an enormous amount of electricity, so much so that Molycop has had to become quite innovative to keep energy costs – measured in millions of dollars per month – under control.

To manage costs, the Molycop Newcastle plant has historically purchased electricity from the volatile spot market. The secret to surviving in this market is to perfect the ability to temporarily shutter operations when prices rise, and restart when prices fall. This ability to stop and start energy intensive processes at short notice has been made possible through a combination of smart engineering and proactive operational procedures.

Molycop's capability in this area was further enhanced when it joined the AEMO-ARENA demand response program, which reduces load on the network at times of peak demand to prevent network power outages. By shutting down production activities within minutes of being requested, Molycop can support the reliability of the network for other consumers.

The Newcastle site also has an active energy management program modelled after the international energy management standard, ISO50001, and is continuously identifying and implementing energy and emissions savings opportunities. In 2019 Molycop signed a renewable power purchase agreement (PPA) for 100,000MWh of electricity per year from a mix of wind and solar generation, which is over half of the Newcastle site's electricity needs. The ability to tailor site demand to match renewables output is another opportunity under review.

Between efficiency improvements, managing demand and renewable electricity purchases, Molycop is positioning itself well for a lower carbon future.

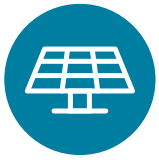


Molycop's steel balls are highly energy intensive.

3.3 On-site renewable generation

For many businesses, on-site solar PV is now cheaper than grid-supplied electricity, but solar PV is not the only behind-the-meter energy generation opportunity for energy intensive manufacturers.

3.3.1 Solar PV



Solar PV is a proven technology with a payback period generally between four and eight years for most manufacturers. It is an effective way to reduce reliance on electricity from the grid, lower energy bills, and potentially make some returns by exporting energy to the grid.

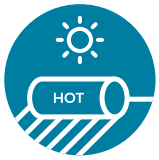
3.3.2 Concentrating solar thermal for heating and hot water

Concentrating solar thermal power can be an effective technology to meet a range of process heating temperature demands – anywhere from 100˚C to 1000˚C. There are several key factors that impact the feasibility of solar thermal technologies for manufacturers, including:

- Annual solar irradiation (higher in places like Western Australian than Tasmania);
- Operating schedule, noting that 24/7 processes can't benefit from concentrating solar power overnight or in cloudy weather; and
- Land availability.

There are a range of concentrating solar thermal technologies - including linear Fresnel, parabolic trough and central receiver – that would prove useful to manufacturers with substantial daytime process heat demand and available space. The downside to concentrating solar power is that manufacturers need to maintain back-up process heat supply, such as boilers, for when output is low.

3.3.3 Solar hot water



Solar hot water, made with evacuated tube technology, was the predominant solar energy generation at the turn of the 21st century. The rapid cost reductions in solar PV have quickly turned that around – see Section 2.1 of the *briefing for Australian businesses* – but solar hot water can still have benefits for manufacturers that require hot water. And unlike concentrating solar power, these systems can be installed on roofs.

However, using heat pumps to heat water can be integrated into the core manufacturing process, and supplied by electricity from a variety of sources including solar PV.

Taking action: cutting your energy costs

Taking action isn't just about making energy efficiency upgrades and putting solar PV on the roof, it's also about changing the behaviour of your employees and your business as a whole. Some of the simplest ways to cut energy costs are turning off lights and machinery when not in use.

4.1 Action plan

So where can manufacturers start?

Figure 5: Leading manufacturers in energy strategy and management follow the above checklist to leverage their energy data, make smart investments and continuously improve their energy management.

4.2 Funding and financing options

Manufacturers – and especially the SMEs among them – often have limited access to existing capital for investment in energy upgrades. This lack of capital can be a substantial barrier to investing in strategic energy management.

Despite this, several options exist for funding and financing energy services, including:

- Traditional financing options;
- Service agreements; and
- Government grants and incentives.

To learn more read the *Energy financing and funding 101s* found at **energybriefing.org.au/financing-and-funding-101s** and for the latest grants and incentives, go to **energybriefing.org.au/business-support**

An accountant's perspective on behind-the-meter investments

If manufacturers set the right objectives and investment criteria, the financial outcomes of behind-the-meter investments are compelling.

A $2 million investment in new LED lighting and rooftop solar, which yields annual savings of $350,000 in energy and maintenance costs, is accounted for like this:

Operating statement impact:

The $2 million capital investment is depreciated over 15 years, resulting in an annual expense of $133,000. Additionally, there is an annual reduction in other expenses (energy and maintenance) of $350,000. The net result of this is a $216,000 annual improvement to the operating statement.

Balance sheet impact:

The net impact on the balance sheet at the time of investment is zero. The $2 million capital investment increases non-financial assets by $2 million. However, it either creates a liability (if you borrow to fund the project) or reduces financial assets (if you use cash to pay for the project) by $2 million.

Net debt impact:

This impact varies over time, following the net cashflow for the project. At the time of investment, there will be an increase in net debt of $2 million. Over six years, the net debt impact will reduce to zero. Over the remaining years, the annual savings will achieve a net reduction in debt.

Net present value (NPV):

Over a 15-year period, assuming a discount rate of four per cent (real), the NPV is $2 million. A positive NPV indicates it is worth investing in the project.

Resources for manufacturers

The resources and information listed below complement those in Section 4 of the *briefing for Australian businesses*.

5.1 Industry support

Many businesses have existing relationships with trusted experts. For those that do not, sourcing a referral from professional networks is a natural first option.

Beyond that, seeking out a member of a well-established, credible industry association – like those outlined in the *briefing for Australian businesses* – is a good starting point.

For a full list of relevant industry associations go to **energybriefing.org.au/industry-associations**

5.2 Government support

Further information about government support can be found in Section 4 of the *briefing for Australian businesses*.

Manufacturers that are leading the field in energy strategy and management have minimised their exposure to energy market volatility with early investments in energy efficiency, demand management and onsite generation, protecting their core business and boosting overall productivity.

5.2.1 Business Energy Advice Program (BEAP)

For more information go to **businessenergyadvice.com.au**

5.2.2 Government grants

To see the latest offers from the Commonwealth, state and local governments, go to **energybriefing.org.au/business-support**

5.2.3 State based energy efficiency schemes

Manufacturers in the ACT, NSW, South Australia and Victoria can access their energy efficiency scheme – the **ACT Energy Efficiency Improvement Scheme (EEIS)**, **NSW Energy Savings Scheme (ESS)**, **SA Retailer Energy Efficiency Scheme (REES)** and **Victorian Energy Upgrades (VEU)** program – to subsidise energy efficiency upgrades.

These schemes operate by requiring energy retailers to meet targets in relation to emissions reductions via energy efficiency upgrades. These reductions are generally met by providing subsidised energy efficiency products and upgrades to energy users, and can be used for a range of upgrades for manufacturers. In particular, project-based methodologies help manufacturers access incentives for large and custom projects.

5.3 Other resources

The following best practice energy efficiency guides from the NSW and Victorian Governments support manufacturers with technology specific energy performance improvements:

- Compressed air: **I am your compressed air guide**
- Electric motors and pumps: **Energy efficiency: pumping systems**
- Refrigeration: **I am your industrial refrigeration guide**
- Steam, hot water and process heating: the **Energy efficiency: steam, hot water and process heating systems**
- Voltage optimisation: **I am your guide to voltage optimisation**

Several other resources that support manufacturers with strategic energy management can be accessed at **energybriefing.org.au/guides**

Glossary

AEMO	Australian Energy Market Operator
AI	Artificial intelligence
AIRAH	Australian Institute of Refrigeration, Air Conditioning and Heating
ARENA	Australian Renewable Energy Agency
BEAP	Business Energy Advice Program
BIS	Building information systems
CCUS	Carbon capture, utilisation and storage
CEFC	Clean Energy Finance Corporation
CSR	Corporate social responsibility
EEC	Energy Efficiency Council
EEIS	Energy Efficiency Improvement Scheme (Australian Capital Territory)
EnMS	Energy management system
ESS	Energy Savings Scheme (New South Wales)
GDP	Gross domestic product
GJ	Gigajoule
HVAC	Heating, ventilation and cooling
IEA	International Energy Agency
IoT	Internet of things
ISO	International Organization for Standardization
LED	Light emitting diode
M&V	Measurement and verification
NGFS	Network for Greening the Financial System
NPV	Net present value
OpEx	Operational expenditure
PDCA	Plan – Do – Check – Act framework
PPA	Power purchase agreement
PV	Photovoltaics
RBA	Reserve Bank of Australia
REES	Retailer Energy Efficiency Scheme (South Australia)
SME	Small and medium sized enterprises
VEU	Victorian Energy Upgrades

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