RACE for 2030
RELIABLE AFFORDABLE CLEAN ENERGY

E3 Research Project

Energy efficiency definitions for the Australian Energy Employment Report

Final report

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Energy efficiency definitions for the Australian Energy Employment Report

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The authors of this report would like to respectfully acknowledge the Traditional Owners of the ancestral lands throughout Australia and their connection to land, sea and community. We recognise their continuing connection to the land, waters, and culture and pay our respects to them, their cultures and to their Elders past, present, and emerging.

What is RACE for 2030?

RACE for 2030 CRC is a 10-year cooperative research centre with AUD350 million of resources to fund research towards a reliable, affordable, and clean energy future. racefor2030.com.au

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Executive Summary

This work aims to enable the Australian Energy Employment Report (AEER) survey to measure the energy efficiency workforce by developing definitions for when an activity may be considered energy efficiency. The energy efficiency service sector, and retrofit programs, will need to expand substantially if Australia is to achieve its climate targets[a]. This makes energy efficiency and management services a key sector to capture in the AEER.

The AEER is an initiative of the Commonwealth Government, and addresses the need for good quality baseline data and systematic workforce projections for the Australian energy sector, as identified in the RACE for 2030 Report *Developing the future energy workforce: Opportunity Assessment*[1]. The Commonwealth Government funded a pilot survey which tested the applicability of the survey to Australian conditions, developed an initial survey instrument, and recommended a methodology for implementation[2].

This report aims to inform the development of the AEER by proposing definitions for energy efficiency and energy management as they may apply in the survey. The report covers proposed approaches in relation to:

- Energy efficiency and management services and products
- Products which are inherently energy efficient
- Boundaries between efficient and non-efficient products and buildings
- Whether definitions should be relative to regulatory standards[b].

Energy efficiency and energy management as defined here include traditional energy efficiency activities to systematically reduce consumption (such as insulation), demand management, and behind-the-meter energy management activities to maximise the use of renewable energy generation. All of these are highly relevant to the energy transition.

The project team undertook desktop research for a draft discussion paper proposing definitions which formed the basis for industry consultation. Feedback was gained via an Industry Reference Group (IRG) comprised of industry associations, companies involved in energy efficiency activities, academics, and government representatives, a survey of IRG members on the proposed definitions, two workshops, and expert interviews. The proposed definitions have been modified to reflect that feedback.

Proposed definitions

Proposed definitions are presented here for a range of energy efficiency activities, products, and services. It is suggested that during the AEER surveys, respondents are first asked whether they offer energy efficiency, energy management, or demand management services, and only then asked about energy efficient or high efficiency products.

The AEER survey administered in 2023 will collect information from a non-statistically representative group of respondents and will not collect the baseline data needed on the energy sector. The full AEER is intended for rollout during 2024 with benefit from the trialling undergone during 2023 as well as from the pilot survey in 2021.

[a] For example, the IEA suggests energy efficiency represents more than 40% of the emissions abatement needed by 2040 https://www.iea.org/commentaries/how-energy-efficiency-will-power-net-zero-climate-goals.

[b] That is, once a current energy efficient product becomes the regulated minimum should it cease to be defined as 'energy efficient' and therefore included in the definition of the sector and workforce

The primary survey questions proposed are:

A) Do you provide energy efficiency, energy management, or demand management services?

B) Do you design, manufacture, supply, install, or maintain energy efficiency or high efficiency products, or provide energy efficiency services? These include products and services for:

- highly energy efficient buildings
- energy efficiency building retrofits
- energy efficient building products, building shell products or automation
- energy efficient water heaters
- high efficiency HVAC or cooling for homes or other buildings
- high efficiency heating and cooling systems
- LED or photoluminescent lighting (all considered energy efficient)
- high efficiency motor systems
- communications & monitoring technology to monitor or manage energy
- industrial repair and maintenance aimed at improving energy performance

The proposed definitions and additional information associated with each of the questions are given below. The definitions were tested in two stages, alongside testing for the 2023 AEER survey, and alongside the survey itself. Testing included observation of where help is needed and some specific interrogation of the proposed definitions.

Proposed definitions – energy efficient or high efficiency products or services

Primary Survey Question

Do you design, manufacture, supply, install, or maintain energy efficiency or high efficiency products, or provide energy efficiency services?

Follow up information – the "purpose test" for products or services:

- *Energy efficiency products or services are those where the primary purpose is to reduce or manage energy consumption for an end-user.*
- *High efficiency products or services are those for which reducing or managing energy consumption is a significant purpose or benefit, compared to the standard product or service.*

Proposed definitions – energy efficiency services

Energy efficiency services are those that are intended to reduce energy or peak load for an end-user. Enabling services are those that are intended to support energy efficiency services.

Table 1 ***Energy efficiency services*** *include*

- *Building energy efficiency services*
- *Energy efficiency / management schemes*
- *Design services*
- *Consumer services*
- *General services*

Table 1 gives details of the services

Table 2 ***Cross cutting or enabling services*** *include*

- *Government (regulation, standards, policy, and programs)*
- *Industry (advocacy, promotion, accreditation, professional development)*
- *Higher education*
- *Vocational education and training*

Table 2 gives details of the services

Proposed definitions - residential new build and major retrofits

Primary Survey Question

Do you construct highly energy efficient buildings, or perform energy efficiency building retrofits?

Follow up information – thresholds for highly efficient residential buildings

a) A highly energy efficient residential building is defined as either being rated as NatHERS 8-star or above or being certified as Passive House or Green Star 6-star.
b) A highly energy efficient major retrofit is defined as either being rated as NatHERS 7-star or above, or achieving an increase in 2-stars, or being certified as Passive House or Green Star 6-star.

Proposed definitions – non-residential new build and major retrofits

Primary Survey Question

Do you construct, install, and/or design energy efficient building products?

Follow up information – highly efficient non-residential buildings

a) A highly energy efficient new commercial building is defined as either 6-star NABERS or Green Star rating or Passive House certified.
b) Major commercial building retrofits either increase the NABERS Energy or Green Star rating by two or more stars or achieve a 6-star rating or Passive House rating.

Proposed definitions – building products

Primary Survey Question

Do you design, manufacture, supply, install, or maintain energy efficient building shell products or automation?

Follow up information – energy efficient building products

a) All thermal insulation
b) All draught proofing
c) Advanced glazing products (double or triple glazing, low-E glass, heat rejecting film)
d) All external shading products
e) Wall cladding with R-value greater than 2 (with no thermal bridging during installation)
f) Thermal roof treatments
g) Lagging of hot water pipes
h) Products designed to prevent thermal bridging
i) Internal window coverings that are either honeycomb blinds, or opaque drapes that have a pelmet or reach the ceiling
j) Phase change materials
k) Swimming pool covers
l) All building energy management systems (BEMS)
m) All software and hardware to enable energy management such as smart phone apps
n) All Demand Response Enabled Devices (DREDs)

Proposed definitions – water heating

Primary Survey Question

Do you design, manufacture, supply, or install energy efficient water heaters?

Follow up information – energy efficient water heaters and associated controls

a) All heat pump hot water systems
b) Solar PV diverters and control systems for water heating
c) Solar water heating (note that this will be categorised as renewable energy employment, not energy efficiency employment)

Proposed definitions – residential HVAC

Primary Survey Question

Do you design, manufacture, supply, or install energy efficient heating, cooling and ventilation for homes?

Follow up information – HVAC (Residential)

Energy efficient products are defined as:

a) Mechanical ventilation with heat recovery
b) DC ceiling fans
c) Air-conditioning equipment that meets or exceeds the following E3 Energy Rating:

	Cold zone	Mixed zone	Hot zone
Cooling		5.5 stars	5.5 stars
Heating	4 stars	4.5 stars	

Proposed definitions – non-residential HVAC

Primary Survey Question

Do you design, manufacture, supply, or install energy efficient mechanical heating, cooling and ventilation for buildings other than homes?

Follow up information – HVAC (Non-residential)

Energy efficient products are defined as:

a) Variable refrigerant flow/volume systems, or
b) Inverter-based systems having an integrated part load value AEER of 10 or ACOP of 5

Proposed definitions – data centres

Primary Survey Question

Do you design, manufacture, supply, or install energy efficient HVAC equipment for data centres?

Follow up questions and information – HVAC (data centres)

Energy efficient products are defined as those that are produced for the purposes of compliance with the ASHRAE 90.4 standard

Proposed definitions – lighting

Primary Survey Question

Do you design, manufacture, supply, or install LED lighting, photoluminescent technology or smart lighting controls?

Follow up questions and information – lighting

Energy efficient products defined as:

a) All LED lighting
b) Photoluminescent technology used for exit lighting
c) All smart lighting control systems such as sensors and timers

Proposed definitions – motor systems

Primary Survey Question

Do you manufacture, distribute/supply, install, repair, or maintain high efficiency motor systems?

Follow up information – definitions of high efficiency motor systems

a) All variable speed drives (VSDs), soft starters, high-efficiency belt drives, gears
b) Electric motors meeting IE4 or IE5 (based on European standards)
c) High efficiency pump systems > 67.5% system efficiency
d) High efficiency fan systems > 57.5% system efficiency
e) High efficiency compressed air systems > 10.6% system efficiency

Proposed definitions – communications and monitoring technology

Primary Survey Question

Do you manufacture, distribute/supply, install, repair, or maintain communications and monitoring technology to monitor or manage energy use?

Follow up information – communications and monitoring technology

a) All energy and demand management/control systems, and all systems to maximise the use of behind-the-meter renewable generation
b) SCADA upgrades for improving energy efficiency

Proposed definition – process heating & cooling

Primary Survey Question

Do you manufacture, distribute/supply, install, repair, or maintain highly energy efficient heating & cooling systems?

Follow up information – highly efficient heating and cooling systems

a) All waste heat recovery systems
b) All passive coolers (adiabatic assistance)
c) High-efficiency cool rooms where the building is in receipt of NABERS star rating of 5 or above
d) High-efficiency boilers, chillers or heat pumps where the system is designed with a significant purpose to save energy – self-definition by respondent (in the absence of a standard)
e) All cooling towers or evaporative condensers where the auxiliary equipment power consumption / heat rejection is less than 0.015
f) All evaporators where the auxiliary equipment power consumption / heat rejection is less than 0.06

Proposed definitions – repair and maintenance

Primary Survey Question

Do you undertake industrial repair and maintenance that is intended to improve energy performance, for instance, that is on a more frequent basis than standard schedules?

Proposal for exclusions and future work

The recommendations are:

- Exclusion of consumer plug in appliances and retailing for energy efficiency consumer appliances from the AEER.
- AEER should report on both the total employees involved in energy efficiency, and the proportion of work which is incremental. In order not to complicate the AEER itself, it is recommended that the extrapolation method is developed in parallel to the AEER, and that a series of in-depth surveys are conducted alongside the AEER to address specific issues of additionality.

Table 1 and Table 2 lists the energy efficiency services and cross cutting services defined under each of the categories in the proposed definitions.

Table 1 Energy efficiency services

Service	Definition
Energy services	Energy efficiency advisory and consultancy, including strategy, planning, and target-setting
	Energy metering, submetering and monitoring with the purpose of reducing energy use or peak loads
	Energy auditing, energy measurement and verification
	Energy management system advice and accreditation
	Energy and emissions reporting and disclosure relating to energy efficiency scheme compliance obligations
Building energy efficiency services	Energy efficiency design, architecture, and engineering related to reducing energy use or thermal loads, or managing peak loads
	Building rating, modelling, certification, and assessment related to energy efficiency and thermal performance (e.g. NatHERS modelling, energy efficiency compliance certification, NABERS ratings, blower door testing)
	Building/facilities management relating to optimisation, reduction, and maintenance of energy use, and managing peak loads *Note: requires identification of how much time the facility managers spend on energy efficiency work*
	Energy efficiency retrofits (these may be part of energy efficiency programs)
Energy efficiency / management schemes	All participants in the energy efficiency, demand management, and energy productivity schemes, including: - Victorian Energy Upgrades - NSW Energy Savings - NSW Peak Demand Reduction - ACT Energy Efficiency Improvement - SA Retailer Energy Productivity - Business Energy Advice Program - Queensland Business Energy Savers Program - Small-scale Technology Certificates (in respect of heat pump hot water systems only) *Note: includes certificate creators, brokers, advisory, installers/field workforce, relevant staff of liable energy retailers/entities, others* *This list will require modification as additional schemes are established*
	Participants in the Wholesale Demand Response Mechanism *Note: Include relevant staff of WDRM aggregators but not workers at aggregated facilities*
Design services (heating, cooling lighting and information technology)	Building, HVAC, cooling, lighting design relating to energy efficiency or energy management products *Note that these services could be relevant to both professional services (all types of engineering), and in some cases to trades (plumbers, refrigeration mechanics, carpenters, and builders*)
	Information technology services, including programming, software engineering, implementation, testing and QA
	Communications services
Consumer services	Production and dissemination of energy efficiency advice and resources to end-users
	Awareness / literacy / training of indirect advisors (e.g. retail staff)
	Supply, advice, or installation of direct-to-consumer energy efficiency products

Service	Definition
General services	Research and development of energy efficiency or energy management products or services
	Sales, marketing and promotion of products or services that are specifically aimed at reducing energy use or managing peak loads *Note that this does not include general retail*
	Supply chain activities – e.g. sourcing, importation, compliance/market preparation of energy efficiency or management products
	Software packages and IT services for building data analysis

Table 2 Cross cutting services

Sector	Definition
Government	Energy efficiency policy
	Energy efficiency standards and regulation
	Energy efficiency promotion
	Energy efficiency program administration
Industry bodies / NGOs	Energy efficiency promotion and advocacy
	Professional development, certification and accreditation of energy efficiency service providers
Higher education	Research and development related to energy efficiency and energy management
	Teaching related to energy efficiency and energy management e.g. a subject on energy efficiency technology
Vocational education and training	Trades training related to energy efficiency and management trades and services, e.g.: Insulation installer course, parts of Green Plumbers course
	General training related to energy efficiency businesses or products, e.g. Energy auditor, Continuous Professional Development (CPD) courses
Finance and business services	Finance provision and associated services that relate specifically to financing energy efficiency activities.

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List of abbreviations

Acronym	Term
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ACOP	Annualised Coefficient of Performance
AEER	Australian Energy Employment Report
AEER	Annualised Energy Efficiency Ratio
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AISC	Australian Industry and Skills Committee
ANZSCO	Australian and New Zealand Standard Classification of Occupations
ANZSIC	Australian and New Zealand Standard Industrial Classification
ARENA	Australian Renewable Energy Agency
ASQA	Australian Skills Quality Authority
BAU	business as usual
BEMS	Building Energy Management Systems
BIM	building information modelling
CEC	Clean Energy Council
CEM	Certified Energy Manager
CEFC	Clean Energy Finance Corporation
CGE	computable general equilibrium
CHP	combined heat and power (usually called cogeneration in Australia)
CMVP	certified measurement and verification professional
COP	coefficient of performance (measures performance of air conditioners heating cycle)
COVID-19	coronavirus
CPD	continuing professional development
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVC	corporate venture capital
DC	direct current
DER	distributed energy resources
DISER	Department of Industry, Science, Energy and Resources
DM	demand management
DNSP	distributed network service provider
E3 program	The Equipment Energy Efficiency program

Acronym	Term
EEC	Energy Efficiency Council
EECS	Energy Efficiency Certification Scheme
EEI	energy efficiency index
EER	energy efficiency ratio (measures performance of air conditioners cooling cycle)
EM	energy management
EnMS	energy management systems
ESD	Education for Sustainable Development
EV	electric vehicles
FTE	full time equivalent
GBCA	Green Building Council of Australia
GDP	gross domestic product
GEMS	Greenhouse and Energy Minimum Standards
HVAC	heating, ventilation, and air conditioning
I/O	input-output
IBER	integrated building energy retrofit
IEA	International Energy Agency
ISF	Institute for Sustainable Futures
LEED	Leadership in Energy and Environmental Design
MEPS	Minimum Energy Performance Standards
NABERS	National Australian Built Environment Rating System
NatHERS	Nationwide House Energy Rating Scheme
NCC	National Construction Code
SCADA	Supervisory Control and Data Acquisition
SCOP	Seasonal Co-efficient of Performance
STCs	Small-scale Technology Certificates
UNIDO	United Nations Industrial Development Organization
USEER	US Energy and Employment Report
VRF	Variable Refrigerant Flow
VRV	Variable Refrigerant Volume
VSDs	Variable Speed Drives

1 Introduction

This work aims to enable the Australian Energy Employment Report (AEER)[c] survey to measure the energy efficiency workforce by developing definitions for when an activity is related to energy efficiency. The energy efficiency service sector, and retrofit programs, will need to expand substantially if Australia is to achieve its climate targets[d]. This makes energy efficiency and management services a key sector to capture in the AEER.

The project partners are the Institute for Sustainable Futures, University of Technology Sydney (ISF) and the Energy Efficiency Council (EEC). The project is funded by the Reliable, Affordable, Clean Energy (RACE for 2030) Cooperative Research Centre and the NSW, South Australian and Victorian state governments, with the EEC and ISF contributing in-kind to the project.

The AEER is an initiative of the Commonwealth Government, and addresses the need for good quality baseline data and systematic workforce projections for the Australian energy sector, as identified in the RACE for 2030 Report *Developing the future energy workforce: Opportunity Assessment*[3]. The survey is modelled on the US Energy Employment Report (USEER), which is accepted as best practice internationally for data collection on the energy workforce[4]. The Commonwealth Government funded a pilot survey alongside the RACE for 2030 project which tested the applicability of the USEER to Australian conditions, developed an initial survey instrument, and recommended a methodology for implementation[5]. The pilot project found that in general the USEER methodology was applicable in Australia.

The AEER will be developed in two stages. The first iteration of the survey is being undertaken in early 2023 and will primarily collect qualitative information from a non-statistically representative group of respondents. This will not collect the baseline data on the energy sector needed to enable workforce projections. The second iteration is intended to be the full AEER, with statistically significant response rates enabling baseline data. This is intended for rollout during 2024, benefitting from the trialling undergone during 2023.

Energy efficiency and energy management as defined here include traditional energy efficiency activities to systematically reduce consumption (such as insulation), demand management, and behind-the-meter energy management activities to maximise the use of renewable energy generation. All of these are highly relevant in the energy transition.

Developing definitions of energy efficiency which are as precise as possible, acceptable to the industry, representative of industry practices and terminology, and understandable to the target audience is an important step to delivering an AEER which can report on the energy efficiency workforce.

1.1 Purpose of the report

The purpose of this report is to inform the development of the AEER by proposing definitions for energy efficiency and energy management as they may apply in the survey. The report covers proposed approaches in relation to:

[c] https://www.energy.gov.au/government-priorities/energy-workforce/australian-energy-employment-report

[d] For example, the IEA suggests energy efficiency represents more than 40% of the emissions abatement needed by 2040 https://www.iea.org/commentaries/how-energy-efficiency-will-power-net-zero-climate-goals.

- Energy efficiency and management services and products
- Products which are inherently energy efficient
- Boundaries between efficient and non-efficient products and buildings
- Whether definitions should be relative to regulatory standards[e].

The project team gained feedback via an Industry Reference Group for the project, followed by a survey of IRG members (eight respondents), two workshops, and expert interviews. The proposed definitions have been modified to reflect that feedback.

Proposed definitions will be tested in two stages. Stage one will include initial testing of the pre-AEER survey, with observation of where help is needed, and some specific interrogation of the proposed definitions, with supplementary testing once the pre-AEER survey has been finalised.

1.2 Structure of report

The report is structured as follows:

- Section 2 *Background* – covers the energy efficiency market and the approach to energy efficiency taken in the USEER
- Section 3 Approach to defining energy efficiency for the AEER – covers the project team's proposed approach to defining energy efficiency
- Sections 4, 5 and 6 - give proposed definitions and boundaries for *Energy efficiency services*, *Buildings and building products,* and *Industrial energy efficiency products* respectively, and make proposals for how these may be captured in the AEER
- Section 7 Exclusions and future work – provides an overview of exclusions and next steps
- Appendix 1 lists the Industry Reference Group members
- Appendix 2 contains an overview of the consultation undertaken during the project, including the consultation questions, a summary of consultation responses, and the outcome in terms of modification of the original proposal
- Appendix 3 gives detailed consultation questions and outcomes
- Appendix 4 describes company testing, in which proposed questions were trialled with energy efficiency companies alongside either pre-AEER testing or during the 2023 AEER
- Appendix 5 gives additional guidance on survey questions and follow up information

Proposed definitions are at the end of each of the sections 4 – 7.

[e] That is, once a current energy efficient product becomes the regulated minimum should it cease to be defined as 'energy efficient' and therefore no longer included in the definition of the sector and workforce

2 Background

2.1 The energy efficiency market and energy efficiency employment

There is no universal definition of the energy efficiency market due to its complexity, nor of what constitutes energy efficiency employment. In 2013, the International Energy Agency noted the challenge of defining the energy efficiency market:

"The market for energy efficiency is as diffuse as energy consumption patterns themselves. It is composed of many market actors who demand more efficient provision of energy services, and those that supply the necessary goods and know-how to deliver this greater efficiency … The supply of energy efficiency cannot be considered as a distinct sector of the economy. Its magnitude is intimately linked to economic structure and the sectors in which the potential for energy savings lie" (IEA 2013, p.17 & 36).

The IEA defined the energy efficiency market as a collection of energy-saving technologies, products and services related to end-uses within appliances and lighting, buildings, and the industrial sector. Adapting and extending the IEA definition for characterising the NSW energy efficiency market, Common Capital (2014) defined the energy efficiency market as a sub-sector within energy services for a range of products within each of the three segments identified by the IEA and cross-cutting services (see Figure 1).

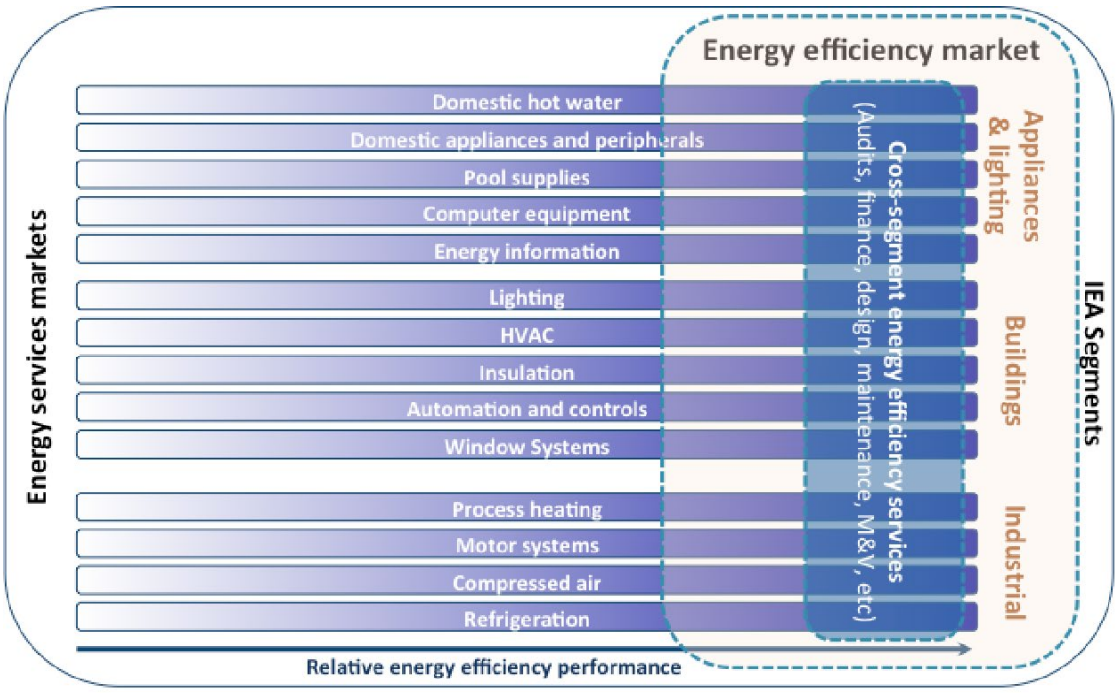

Figure 1 – The energy efficiency market

From Common Capital, 2014.

The energy efficiency workforce may be thought of as anyone working to provide goods or services within the energy efficiency market, and the challenge is how to capture this involvement in a survey instrument. This necessitates definition of what constitutes an energy efficiency product or service.

Energy efficiency products and services can be defined as those that are either:

- *Inherent energy efficiency* products and services, where this product is almost by definition energy efficiency (for example, building insulation or an energy audit)
- *High efficiency* products and services, where only some sub-categories of that product are defined as energy efficiency, based on their energy performance.

For products that are not inherently energy efficiency products, a threshold is required to separate what is a high efficiency product, and what is not.

The overall approach proposed to define what is an energy efficient product or service is explored in Section 3.

2.2 Approach to energy efficiency in the USEER

The U.S. Energy and Employment Report (USEER) survey generally uses definitions of what are energy efficiency activities or products by referring to the Energy Star[f] standards.

The survey seeks to identify jobs that manufacture Energy Star appliances and other Energy Star labelled products. Energy Star sets definitions in efficiency for different residential and commercial products, and the USEER includes employment involved in the production, installation, construction and maintenance of these products.

The USEER also identifies employment in building design and contracting services that provide energy efficiency, such as insulation, an improvement in natural lighting, or otherwise reducing overall energy consumption across homes and businesses.

The USEER does not include employment related to energy-efficient manufacturing processes, nor direct employees of utility companies that are involved in the implementation of internal energy efficiency programs.

Additionally, the USEER captures employment associated with combined heat and power (CHP)[g] and waste-heat to power (WHP), though this employment is included in the Electric Power Generation section. Retail workers are not included in the USEER, including those who sell energy efficiency products.

There are many energy utilities and third parties in the United States that sponsor or manage energy efficiency programs for residential, commercial, and industrial properties. However, the USEER Energy Efficiency employment numbers do not include direct employees for the utilities that administer these programs. These employees are included in the numbers for "utility" employees in either the electricity or the transmission and distribution sections of this report. Though the Energy Efficiency section does not capture these employees, the programs include many different incentives and tools that reduce energy consumption and improve energy efficiency in meaningful ways.

[f] https://www.energystar.gov/

[g] Generally called co-generation in Australia

2.3 Recommendations from "Developing the Future Energy Workforce"

Development of energy efficiency definitions

Finding 1.9 in the Developing the Future Energy Workforce[6] Report was that definitions should be developed for energy efficient products and services in the Australian context, as many of the definitions used in the USEER are not relevant in Australia.

In the AEER pilot survey undertaken in 2020[7] respondents were asked to use their own definition of high efficiency as an interim measure. Developing the Future Energy Workforce recommended:

- *"All products and services for insulation, high efficiency glazing and LED lighting should be defined as energy efficiency;*
- *Consultation on other energy efficiency products and technologies should be undertaken to establish where the boundary should lie between efficient and non-efficient products;*
- *Consultation* [*should be undertaken*] *on which definitions, if any, should be relative to regulatory standards, that is, once a current energy efficient product becomes the regulated minimum, should it cease to be included?"*

This report proposes a set of definitions which have been refined through consultation with industry, government, and other stakeholders reflecting this recommendation.

All energy efficiency work or incremental work?

Should *all* work on energy efficient products or buildings be counted *or* only the *additional* energy efficiency component of investment and work – what is often known as the 'energy efficiency premium'? This applies to both cost and employment, as one may aim to determine either all the work associated with constructing or installing a high efficiency product or building, or only the additional work associated the energy efficient option compared to the non-efficient option.

This is brought into relief by considering a residential new build: while an 8-star home will certainly involve additional employment and costs compared to a 6-star home, the incremental labour will be a fraction of the total.

In practice this question needs to be considered for different methodologies and aligned with the purpose of the information. Finding 1.10 of the Developing the Future Energy Workforce[8] Report was that 'all energy efficiency work' should be measured and reported, and that the portion of this that is 'incremental energy efficiency work' should also be reported as far as possible. The report acknowledged the survey would be aimed at capturing all work in the first instance, with identification of the incremental portion likely to be achieved in later iterations.

"Measure and report both metrics as far as possible, that is, 'all work' and 'incremental work' for energy efficiency activities for both current workforce and projections, as this is perhaps closest to reporting net energy sector jobs. This will require developing indicators to adjust baseline measurements of energy efficiency activities for the incremental proportion."

This is discussed in section 7.5.

3 Approach to defining energy efficiency for the AEER

3.1 Defining energy efficiency and management through products and services

The AEER seeks to capture the workforce involved in energy efficiency and energy management. At its most basic, energy efficiency and management are any activities undertaken with the intention to reduce the volume or intensity of energy usage, or to alter how and/or when energy is used. As variable renewable energy resources form an increasingly large part of the energy system, managing electricity time of use is becoming a vital strategy to reduce the cost and emissions associated with energy usage – outcomes previously achieved through managing the volume of energy use (traditional energy efficiency).

The energy efficiency workforce can be defined through their involvement in activities related to energy efficiency products and services. This necessitates consideration of what constitutes an energy efficiency product or service.

3.2 Defining energy efficiency activities – the purpose test

Energy efficiency products and services can be defined as those that are either

- *Inherent energy efficiency* products and services; or
- *High efficiency* products and services.

Whether a product or service is inherently an energy efficiency product or service, a high-efficiency product or service – or neither - depends on the **purpose** of the product or service.

Inherent energy efficiency products or services

Inherent energy efficiency products and services are those where the ***primary*** or ***dominant*** purpose of the product or service is to reduce or manage energy consumption for an end-user.

Example: Building insulation is inherently an energy efficiency product, as its primary purpose is to reduce the energy required to maintain the intended temperature of a building or space.

High efficiency products or services

High efficiency products and services are those for which reducing or managing energy consumption is a ***significant*** purpose or benefit of the individual product or service or type of product or service. In this case, the dominant or primary purpose of the product would be unrelated to saving energy.

In some cases, an entire class of products could be high efficiency, in comparison to a different class of product that serves the same function. In other cases, a product or service could be deemed to be a high-efficiency product or service where its energy performance is significantly better than similar, standard-efficiency products or services.

Example: Double-glazed windows are a high-efficiency product. Their primary purpose is to allow the transfer of light into a building, however reducing energy usage is also a significant purpose of double-glazed windows as a product type (*compared to single-glazed windows*).

Products or services for which reducing or managing energy consumption is neither a dominant or significant purpose of the product are not energy efficiency products or services.

3.3 Capturing an activity as a product or a service

Defining energy efficiency products and services also needs to be guided by the practical purpose of the definition – it requires the product or service to relate to *employment* in energy efficiency. For inherent energy efficiency products or services, almost all work in their design, production, supply, installation, maintenance, and promotion would be energy efficiency work, as all these activities are contributing to the primary purpose of reducing or altering an end-user's energy consumption.

For products that are not inherently energy efficiency products, a demarcation point is required to define what is considered high efficiency, which can be arbitrary.

It is also important to determine whether dealings with a high efficiency product give rise to additional employment that would not have occurred for their non-efficient counterpart. Considering the supply chain, supply of products that are high-efficiency products might not give rise to significant energy efficiency employment - particularly in the case of products that are imported and retailed as part of a broad portfolio of products where energy efficiency is only a significant purpose for a minority of products. For example, sales, delivery, and installation of high efficiency refrigerators are unlikely to create additional employment compared to supply and fitting of standard appliances.

The situation in Australia is different to the United States, as a very small proportion of manufactured goods are produced onshore, with most highly efficient products likely to be imported. In cases where dealings with high-efficiency products are not substantially different from their non-efficient counterparts, no additional employment related to energy efficiency is created.

Services first approach

In some cases, it may be simpler to determine whether an activity is related to energy efficiency by considering the activity as a service, rather than considering the product that an activity revolves around. Services undertaken on a commercial basis *de facto* give rise to employment, and if a dominant, primary or significant purpose of the service is to reduce or manage energy consumption, then the activity is energy efficiency work.

It is proposed to ask respondents whether they provide energy efficiency services – that is, whether they provide services that have a dominant or significant purpose of saving or managing energy use – before asking whether they supply, install, or maintain energy efficient products or buildings, and identifying the relevant products to aid in their response.

3.4 Proposed definitions – energy efficient or high efficiency products or services

a) Purpose test for energy efficiency products or services

Energy efficiency products or services are those where the primary or dominant purpose is to reduce or manage energy consumption for an end-user.

High efficiency products or services are those for which reducing or managing energy consumption is a significant purpose or benefit of the individual product or service or type of product or service, compared to the standard product or service.

4 Energy efficiency services

4.1 Introduction

Energy efficiency and management services represent an important element of the energy efficiency workforce. These services include advising, supplying, and financing energy efficiency upgrades, and may include installing, maintaining, or repairing products, particularly if associated with an energy efficiency program.

Installation may in many cases be performed by unrelated companies installing specified products, that are unlikely to respond to questions about provision of efficiency services. For example, a joinery company installing windows and doors may be tasked with installing high performance glazing but would identify as a joinery rather than an energy efficiency service company. In this case the portion of their employment relating to energy efficiency is intended to be captured under energy efficiency building products (see *Section 5.3*).

4.2 What companies and services is this intended to capture?

Energy efficiency and/or management services may form all or part of the business of a company, and many companies will provide both services that are related to energy efficiency or management, and services that are not. In this context, the key consideration is whether the primary or dominant purpose of the service, or a significant purpose of the service is to reduce or manage energy use of an end-user.

It is likely that respondents will need to estimate the proportion of their work that comprises energy efficiency work. For example, consultants and engineers may spend some, but not all of their time, on providing services where energy efficiency or management is the main purpose of the service.

The primary survey question for this element would be *Do you provide a service intended to reduce or manage energy use for an end-user?*

4.3 What does energy efficiency services cover?

A list of energy efficiency services is proposed in Table 1. The table also indicates whether the employment is likely to be captured in the AEER. Where a significant proportion of employment in a particular service is unlikely to be captured, this is noted as 'partial'.

In determining whether a service is an energy efficiency service or not for the purpose of counting employment, it is necessary to consider whether the service gives rise to additional employment that would not exist in the absence of energy efficiency. For example, general retail, logistics, and warehousing of consumer products that may be energy efficient is unlikely to give rise to *additional* employment due to energy efficiency, as these functions would occur regardless of whether the products are energy efficient or not. Where services relate to a product with a specific energy efficiency purpose, then the services (and consequent employment) would be unlikely to occur in the absence of the wish to reduce energy use or manage peak loads and should be captured as energy efficiency work.

Table 1 Energy efficiency services

Service	Definition	Employment in AEER?
Energy services	Energy efficiency advisory and consultancy, including strategy, planning, and target-setting	Yes
	Energy metering, submetering and monitoring with the purpose of reducing energy use or peak loads	Yes
	Energy auditing, energy measurement and verification	Yes
	Energy management system advice and accreditation	Yes
	Energy and emissions reporting and disclosure relating to energy efficiency scheme compliance obligations	Partial
Building energy efficiency services	Energy efficiency design, architecture, and engineering related to reducing energy use or thermal loads, or managing peak loads	Yes
	Building rating, modelling, certification and assessment related to energy efficiency and thermal performance (e.g. NatHERS modelling, energy efficiency compliance certification, NABERS ratings, blower door testing)	Yes
	Building/facilities management relating to optimisation, reduction and maintenance of energy use, and managing peak loads *Note: requires identification of how much time the facilities managers spend on energy efficiency work*	Partial
	Energy efficiency retrofits where the purpose is to improve the energy performance of the building (these may be part of energy efficiency programs)	All
Energy efficiency / management schemes	All participants in the energy efficiency, demand management, and energy productivity schemes, including: •Victorian Energy Upgrades •NSW Energy Savings •NSW Peak Demand Reduction •ACT Energy Efficiency Improvement •SA Retailer Energy Productivity •Business Energy Advice Program •Queensland Business Energy Savers Program •Small-scale Technology Certificates (in respect of heat pump hot water systems only) *Note: includes certificate creators, brokers, advisory, installers/field workforce, relevant staff of liable energy retailers/entities, others* *This list will require modification as additional schemes are established*	Yes
	Participants in the Wholesale Demand Response Mechanism *Note: Include relevant staff of WDRM aggregators but not workers at aggregated facilities*	Yes
Design services (heating, cooling lighting and information technology)	Building, HVAC, cooling, lighting design relating to energy efficiency or energy management products *Note that these services could be relevant to both professional services (all types of engineering), and in some cases to trades (plumbers, refrigeration mechanics, carpenters and builders*)	Partial
	Information technology services, including programming, software engineering, implementation, testing and QA	Partial
	Communications services	Partial

Service	Definition	Employment in AEER?
Consumer services	Production and dissemination of energy efficiency advice and resources to end-users	Yes
	Awareness / literacy / training of indirect advisors (e.g. retail staff)	Yes
	Supply, advice or installation of direct-to-consumer energy efficiency products	Yes
General services	Research and development of energy efficiency or energy management products or services	Partial
	Sales, marketing and promotion of products or services that are specifically aimed at reducing energy use or managing peak loads *Note that this does not include general retail*	Partial
	Supply chain activities – e.g. sourcing, importation, compliance/market preparation of energy efficiency or management products	Partial
	Software packages and IT services for building data analysis	Yes

4.4 Cross-cutting or enabling services

Beyond services that have a focus on delivering energy efficiency directly, there are also cross-cutting or enabling services. These activities enable the development or provision of products and services that reduce or manage energy use, and in some cases are directly linked to significant reductions in energy use (for example standards and labelling programs).

In considering these types of services, it is important to isolate as far as possible the employment that is specifically related to energy efficiency. For example, while a university may teach engineers who might be involved in energy efficiency projects generally, only the area of teaching which directly relates to energy efficiency should be counted.

Table 2 lists cross cutting services and indicates whether the employment is likely to be captured in the AEER. Where a significant proportion of employment in a particular service is unlikely to be captured, this is noted as 'partial'.

Table 2 Cross cutting or enabling services

Sector	Definition	Employment in AEER?
Government	Energy efficiency policy	Yes
	Energy efficiency standards and regulation	Yes
	Energy efficiency promotion	Yes
	Energy efficiency program administration	Yes
Industry bodies / NGOs	Energy efficiency promotion and advocacy	Yes
	Professional development, certification and accreditation of energy efficiency service providers	Yes
Higher education	Research and development related to energy efficiency and energy management	Partial

Sector	Definition	Employment in AEER?
	Teaching related to energy efficiency and energy management e.g. a subject on energy efficiency technology	Partial
Vocational education and training	Trades training related to energy efficiency and management trades and services. e.g.: Insulation installer course Relevant parts of Green Plumbers course	Partial
	General training related to energy efficiency businesses or products, e.g. Energy auditor course Continuous Professional Development; or CPD courses	Partial
Finance and business services	Finance provision and associated services that relate specifically to financing energy efficiency activities. This could include: • Finance brokering • Accountancy, financial advisory services and audit • Capital raising, investment, and venture capital	Partial

4.5 Possible survey questions

The potential survey questions for this element are:

1) *Do you provide energy efficiency services – that is, services that are designed to reduce or manage energy for an end-user?*

What may prevent company identification as an energy efficiency service provider?

The project team is concerned that there may be service providers that do not recognise their services as being energy efficiency work. For example, engineering firms that design energy efficiency equipment or systems may not recognise their work as relating to energy efficiency – they may see their work as designing industrial systems. Additionally, there may be overlap between workers who improve business efficiency and productivity more generally (such as process engineers or designers), who work to reduce costs overall, but may be reducing energy consumption as a part of that service. Ultimately, this section will rely on respondents accurately self-classifying the services they provide as energy efficiency services or not, based on the proposed definition.

4.6 Proposed definitions – energy efficiency services

- Energy efficiency services are those that are intended to reduce energy or peak load for an end user.
- Enabling energy efficiency services are those services that are intended to enable other energy efficiency services

Follow up information – for the list of service definitions refer to

Table 1 ***Energy efficiency services*** *for*

- *Energy services*
- *Building energy efficiency services*
- *Energy efficiency / management schemes*
- *Design services*
- *Consumer services*
- *General services*

Table 2 ***Cross cutting or enabling services*** *for*

- *Government (regulation, standards, policy, and programs)*
- *Industry (advocacy, promotion, accreditation, professional development)*
- *Higher education*
- *Vocational education and training*

5 Buildings and building products

5.1 Introduction

Buildings (and building products) are seen as a key sector in which energy efficiency is practiced. Buildings account for around 20 per cent of Australia's energy use and are the subject of several policy frameworks to improve energy performance.[9]

In some cases, workers providing services for building energy efficiency are likely to be captured through their provision of energy efficiency services – such as consultants, designers and others. However, many energy efficiency workers in buildings, construction and building products may not recognise themselves as energy efficiency workers and may be captured through their work on energy efficient buildings or products.

Companies intended to be captured by these elements include:

- Companies that construct highly efficient buildings (residential, commercial and other)
- Companies that design, manufacture, market, install, service, repair, supply or are otherwise involved with highly efficient building energy products, like advanced glazing, insulation, or LED lighting.

The primary survey questions for this element would be:

Do you construct highly energy efficient buildings, or perform energy efficiency building retrofits?

Do you design, manufacture, market, install, service, repair, supply or perform another function relating to high energy efficiency building products, or building energy management products?

The rest of this section will propose the follow up questions to define what high energy efficiency building products are.

5.2 Energy efficient buildings

This sub-section proposes definitions for highly energy efficient buildings. If viewed as a type of product, the primary purpose of a building is to shelter or secure people, businesses or goods, so buildings are not inherently energy efficiency products themselves. However, some buildings can be classified as 'high efficiency', so the following sections propose suggested demarcation points for highly efficient buildings.

5.2.1 Residential new build and retrofits

In Australia, the energy efficiency of new residential buildings is set by the National Construction Code (NCC), which requires new residential dwellings to achieve the equivalent of a 6-star rating (on a scale of 10 stars) under the Nationwide House Energy Rating Scheme (NatHERS).[h] This means that a *standard* product for a new residential building is a 6-star building. To be classed as a high efficiency building, a building should perform significantly better than the minimum standard.

At the time of writing, Australian building ministers have confirmed an increase to the stringency of the National Construction Code to a 7-star rating under NatHERS from 1 October 2023, which

[h] Some states and territories have not implemented a 6-star requirement – notably in northern Australia.

would make the standard performing building a 7-star building.[i] However, there is a non-trivial portion of the residential buildings market which is already creating 7-star designs – 19.8% of new homes constructed in 2021 achieved NatHERS ratings of 7 star or better[10], suggesting 7-star dwellings may be fast becoming standard practice.

It is proposed that a highly efficient residential building is defined as a dwelling that achieves a minimum **8-star NatHERS rating**. An 8-star residential building would perform significantly better than a standard building, and energy efficiency would have been a significant consideration in its construction. Additionally, any residential building that achieves Passivhaus certification[j] is considered to be a highly energy efficient building.

The project team also propose to extend this definition to major retrofits. A major retrofit is typically described as any renovation that alters more than 50 per cent of the existing building. Different jurisdictions have different compliance pathways for renovations. In a major retrofit, a requirement is triggered in some jurisdictions to bring the entire building up to current NCC standards.[11] This means that for a major retrofit, a building would be required to achieve a 7-star NatHERS rating. It is proposed that highly efficient major retrofits are those that perform significantly better than the standard requirement – so highly efficient major retrofits should logically be those that achieve an 8-star rating or better, but consultation advice indicates that this is challenging in practice.

Other jurisdictions may not require upgrading of the whole dwelling to the current minimum standard, if not reasonably practicable[12]. This means that in practice, high efficiency retrofits might be those that achieve a substantial improvement in their NatHERS rating – for example, an improvement of two whole NatHERS stars or better.

Should the energy efficiency requirements of the NCC continue to be upgraded, the demarcation point would need to be updated. For upgrades to the NCC beyond 7-star energy efficiency, it is suggested that highly efficient homes are those that perform at least one whole star better than the minimum standard in the NCC[k].

5.2.1.1 Residential minor retrofits

For minor residential retrofits, the energy efficiency activity associated with the retrofit can be captured through the installation of energy efficiency building products. This could be captured through the supply chain of building products, or through the service of installing them.

5.2.2 New non-residential buildings and major retrofits

Non-residential buildings have a more diverse set of functions than residential buildings, meaning there is a much wider range of building types. Building energy performance varies according to building type – for example, the energy performance of an aquatic centre or a cold store is significantly different to that of a commercial office building. New non-residential buildings must

[i] The new requirements for a 7-star minimum will take effect from October 2023 in NSW, Vic, ACT and Qld. Other jurisdictions, including Tasmania, have indicated that they will implement a longer transition period before 7-star ratings are mandatory.

[j] Passivhaus, or Passive House, is a holistic construction certification standard to attain a rigorous level of energy efficiency within a specific comfort level under a 'fabric first' design philosophy. Administered by the Australian Passivhaus Association, the standard demands a very high building thermal performance, well beyond minimum code compliance.

[k] Expert advice suggests that the NCC minimum is unlikely to increase further as it then becomes more difficult to achieve with reducing marginal benefit, so a different measure would be anticipated.

meet the minimum energy efficiency requirements set out in Section J of the NCC, and there are a range of ways for buildings to demonstrate compliance with the eight broad elements of the code.

However, it is more challenging to identify a metric for highly energy efficient buildings based on the provisions of the NCC. The National Australian Built Environment Rating System (NABERS) is a *de facto* rating standard for a range of non-residential building types, although it has been most widely adopted in office buildings to date. Due to the requirements of the *Commercial Building Disclosure Act*, most larger office buildings will have already acquired a NABERS-equivalent rating. However, outside of office buildings, NABERS coverage is lower.

Nonetheless, it is proposed that NABERS Energy ratings are the most practical avenue to determine which buildings are highly efficient (and consequently those where energy efficiency has been a significant consideration during construction). NABERS ratings are continually updated, so that the highest rating (6-star) continues to represent market-leading performance.

While NABERS coverage is not universal, it is proposed that those buildings that have been designed to be highly efficient – and have therefore generated employment in energy efficiency – are likely to have acquired a NABERS rating, and this therefore seems the most practical and robust method for designating high-efficiency non-residential buildings.

The project team therefore proposes to define a highly efficient commercial building as one that achieves a **6-star** NABERS Energy rating, and employment related to construction of highly efficient non-residential buildings as energy efficiency employment. An equivalent 6-star Green Star rating will also denote a highly efficient building.

5.2.2.1 Retrofits – non-residential buildings

For non-residential buildings, retrofits can encompass a wide range of activity, and to isolate energy efficiency employment in non-residential building retrofits is challenging. It may be practical to determine that where a NABERS Energy rating is increased significantly through the retrofit, energy efficiency has been a significant purpose of the retrofit. To that end, it is proposed to consider that where a non-residential building retrofit increases the **NABERS Energy rating by two or more stars (or achieves a 6-star rating)**, energy efficiency has been a significant purpose of the retrofit and has given rise to energy efficiency employment.

5.3 Energy efficient building products

Building products play a large part in energy efficiency, and there is a supply chain for a range of building products in Australia. This means that building products are likely to give rise to measurable employment in Australia. Therefore, the report should measure employment associated with the supply chain for energy efficiency building products.

Employment in building products would cover design, manufacture, supply, installation, maintenance, and ancillary services related to building products.

Building products can either be *inherent* energy efficiency products – where the primary or dominant purpose of the building product is to save or manage energy – or high efficiency products, where saving energy is a significant secondary purpose of the product.

In some cases, it may still be more effective to measure employment through consideration of services performed. For example, while silicone sealants are used to help draught-proof houses, it would be impractical to classify silicone sealants as energy efficiency products, given the multiple other uses for the product. In this case, it would be more robust to capture draught proofing

services, rather than by attempting to determine what proportion of employment in the silicone supply chain is for energy efficiency.

5.3.1 Building shell products – insulation, draught proofing, and air tightness

In most cases, these products are inherent energy efficiency products – their primary or dominant purpose is to save or reduce the energy required to maintain the desired internal temperature of a building.

Table 3 Building shell products

Product type	Energy efficiency product?	Employment in AEER?	Notes
Roof and wall insulation	Inherent energy efficiency product	Yes	Reducing energy transfer is dominant purpose
Roof thermal treatments	Inherent energy efficiency product	Yes	Reducing energy transfer is dominant purpose
Insulative wall cladding	High efficiency product where R-value >2 Exclusions: Cladding with no/low insulative properties	Yes	Some wall claddings are energy efficiency products. Propose setting R-value[l] threshold
Draught-proofing products (seals)	Inherent energy efficiency product	Yes	Stopping hot/cold air transfer is an inherent energy efficiency activity
Products designed to prevent thermal bridging	Inherent energy efficiency product	Yes	Reducing energy transfer is dominant purpose
Advanced glazing products (double or more glazing, low-E glass, heat rejection glazing film)	High-efficiency products Exclusion: Standard single-glazed windows, safety treatments	Yes	While the primary purpose of a window is to permit light transfer, advanced glazing has a significant secondary purpose of saving energy
Phase change materials	Inherent energy efficiency product	Yes	Purpose is to passively moderate internal temperatures reducing need for active heating or cooling
Lagging of hot water pipes	Inherent energy efficiency product	Yes	Reducing energy transfer is dominant purpose
Shading treatments **External (all)**	High efficiency products: All external shading	Yes or partial	External treatments are largely about light/heat

[l] The R-value is the resistance to heat flow through a material, calculated by using the formula R = [thickness of the material in metres] / [thermal conductivity in W/m°C]

Product type	Energy efficiency product?	Employment in AEER?	Notes
			exclusion, so inherent efficiency products
Internal (some)	Those internal shading products that market their efficiency benefits		Internal shading (curtain/blinds) may have a significant efficiency aspect (e.g. honeycomb blinds)
Swimming pool covers	High efficiency product	Partial	A significant purpose is to reduce loss of pool heating

5.3.2 Automation and controls

Building automation and control systems are common technologies used to reduce or manage energy usage in buildings – especially commercial buildings. Increasingly automation is being employed in residential dwellings, although it is not yet clear that energy reduction or management is a substantial purpose of home automation.

Some building automation products are clearly intended to save or manage energy. In other cases, it may be more robust to consider automation products, where installed as part of a service to save energy.

Table 4 Automation and controls

Product type	Energy efficiency product?	Employment in AEER?	Notes
Building energy management technologies/systems	Inherent energy efficiency product	Yes	Reducing or managing energy usage is dominant purpose
Building automation system components	Potentially high efficiency	Partial	Can be high efficiency where controlling energy usage is a significant purpose. Includes Demand Response Enabled Devices (DREDs)
Automation software and computer systems	Potentially high efficiency	Partial	Can be high efficiency where controlling energy usage is a significant purpose

5.3.3 Domestic hot water

Domestic/sanitary hot water systems can be either high efficiency or standard products, as their primary purpose is to heat water.

Table 5 Domestic hot water

Product type	Energy efficiency product?	Employment in AEER?	Notes
Heat pump hot water systems	High efficiency	Yes	Reducing or managing energy usage is a significant purpose of heat pump HWS, compared to standard resistive electric or gas storage system
Solar hot water system	No, renewable energy product	Yes, but not as energy efficiency	Solar HWS will be captured under renewable energy employment
Gas instantaneous HWS	No	No	High-efficiency gas instantaneous systems are energy saving compared to storage systems, but are also common practice, or de facto standard in some places
Solar PV diverters and associated control systems	Inherent energy efficiency	Yes	Solar PV diversion and associated control systems seek to save or manage energy used to heat water as their primary and only function
Storage HWS	No	No	Storage heaters are standard products. Even better-performing products are still not significantly energy efficient

5.3.4 HVAC & fans

5.3.4.1 Residential

HVAC products are difficult to categorise as energy efficiency products. While in many cases they are efficient ways of heating and cooling dwellings (for example, reverse cycle air conditioners), they are infrequently sold on the basis of being highly efficient – rather, they are sold with the purpose of heating and cooling houses.

It is possible to consider very high efficiency systems as energy efficiency products, however separating out the supply and installation of very high efficiency HVAC (particularly in residential settings) is difficult. Energy rating labels are the obvious method for determining whether air-conditioning units are high-efficiency, however as the Zoned Energy Rating Label now provides different performance for different areas, it is difficult to establish a single threshold.

Determining which residential HVAC units are highly efficient requires the use of a demarcation point. The demarcation point should ideally be a consistent, well-understood metric, so that

producers, suppliers, installers and other HVAC workers could easily identify when they were working with an energy-efficient system.

The Greenhouse and Energy Minimum Standards (GEMS) regime requires residential sized air conditioners (<30 kW) to both satisfy minimum energy performance standards (MEPS) and display an energy rating label that scores the equipment's heating and cooling performance in stars. From 1 April 2020, the energy rating label is zoned, and displays heating and cooling performance in three different climate zones. The MEPS requirement is calculated as the annualised coefficient of performance (ACOP) or annualised energy efficiency ratio (AEER) in one climate zone.

This means that the ACOP/AEER value calculated for the purposes of compliance with MEPS is the most consistent metric and is tested against a set of standard conditions. In some ways, this makes it a preferable metric. However, workshop attendees noted that the ACOP/AEER calculated for MEPS purposes is not well understood or highly visible to many HVAC workers, outside of manufacturers. Workshop attendees therefore recommended the energy star rating as a better metric, as it would be understood by a wide range of people.

The zoned energy rating label has up to six individual energy ratings, meaning that it is difficult to pick one single rating as a threshold for high-efficiency air conditioners. This is particularly challenging as units can perform differently in different climate zones.

Having accepted that the energy star rating was the better metric, the project team needed to determine a threshold for high efficiency air-conditioning units, for which the Equipment Energy Efficiency program registration dataset was used.[13] The ratings – for heating and cooling functions by climate zone - show an approximately normal distribution. For air conditioning cooling functions, there is limited difference in the energy star rating across climate zones. However, the midpoint of the distribution of energy star ratings for the heating functions are substantially different across climate zones. This suggests that a range of thresholds will be necessary to demarcate high efficiency air conditioners. Attendees were not able to arrive at a consensus on the most appropriate threshold values.

For cooling, the midpoint of the distribution of energy star ratings occurs at around 4.5 stars (see Figure 2). While there are complications with energy star ratings – for example, energy star ratings will tend to show smaller units as being more energy efficient – a single rating point for cooling can give a reasonable guide as to highly efficient air conditioner systems. The project team has recommended a threshold of 5.5 stars for highly efficient air conditioners. This would capture around the top 15 per cent of air conditioner unit ratings in the hot and mixed zones, where air conditioning load is highest.

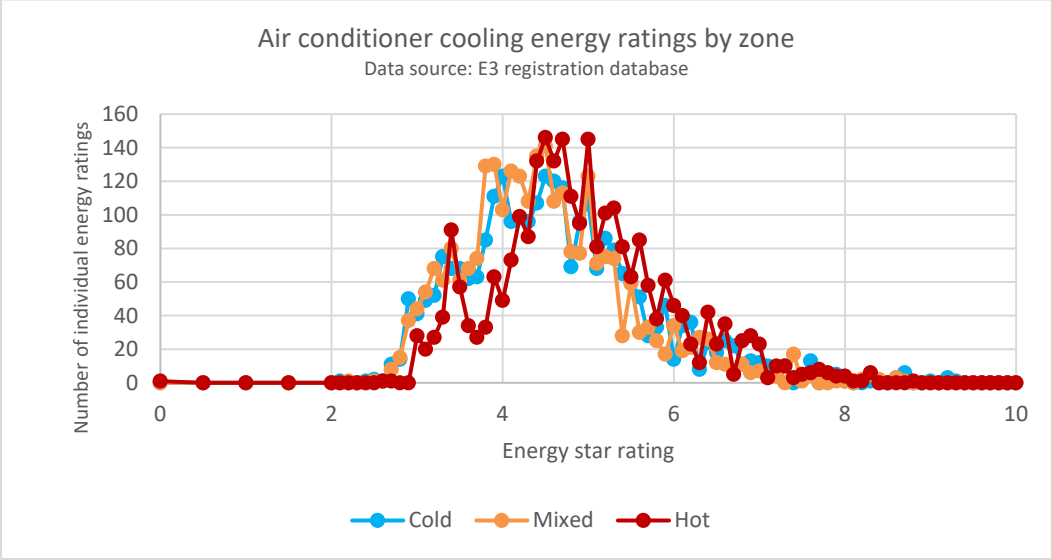

Figure 2 – Energy star ratings for cooling function of air conditioner by climate zone

For heating, establishing a threshold is more difficult, due to the significant difference in performance across different climate zones. In this case, providing a climate zone-specific threshold is necessary to ensure that high-performing air conditioning systems are captured. In this case, the cold zone is the most relevant, where the highest heating load is. In the cold zone, an energy rating threshold of 4 stars would capture the top 15 per cent of air conditioners registered. This would be equivalent to a rating of 4.5 stars in the mixed zone, and around 5.2 stars in the hot zone. However, given the lower heating load in the hot zone, the cold and mixed zone ratings are most relevant.

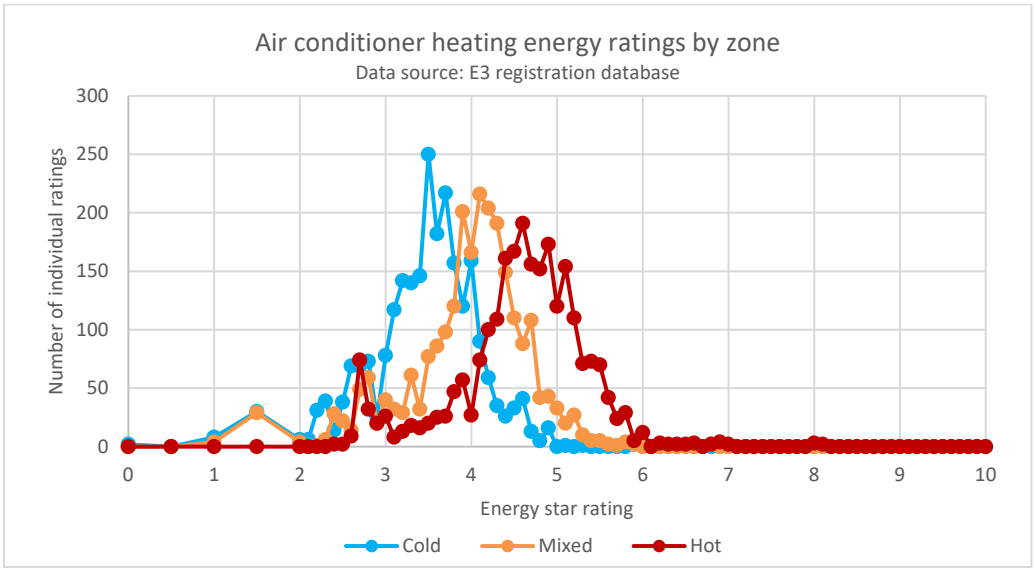

Figure 3 – Energy star ratings for heating function of air conditioner by climate zone

Following consultation, it was decided to determine a high-efficiency cut-off rating based on high-performance units based on both climate zone and function (e.g. heating in the cold and mixed zone, and cooling in the mixed and hot zones). This provides the most workable and recognisable way for respondents to determine if they work with high-efficiency equipment. The outcome was a proposal that high-efficiency residential HVAC systems are ones that satisfy one or more of the criteria in 6.

Table 6 Proposed thresholds for residential HVAC systems

Energy star rating	Cold zone	Mixed zone	Hot zone
Cooling		5.5 stars	5.5 stars
Heating	4 stars	4.5 stars	

5.3.4.2 Non-residential HVAC

In non-residential buildings, HVAC systems are typically installed through a service provider that will size a system to requirements. Determining which of those products are energy efficiency products, rather than standard heating and cooling products, is not straightforward. A substantial portion of the efficiency of a non-residential HVAC system relates to the design and integration of the system, rather than the efficiency of its constituent components.

In general, energy efficiency work with non-residential HVAC systems will be best captured as a service. However, there are some producers of high-efficiency HVAC equipment in Australia and their employment should be counted in the AEER, at least partially. For this reason, thresholds are proposed based on product class and measured performance. It is proposed that all Variable Refrigerant Flow / and Variable Refrigerant Volume (VRF/VRV) systems be counted. Other inverter-based systems would be counted where they have an integrated part load value (IPVL) annualised energy efficiency ratio of at least 10, or an annualised coefficient of performance of at least 5.

Workshop attendees were asked the following questions:

1. *Should air conditioning systems using water-cooled chillers or 'free-cooling' strategies automatically be included?*

Attendees did not agree that free-cooling systems should necessarily be defined as high-efficiency.

2. *Is the MEPS-based COP/EER a reasonable way to determine a high-efficiency product?*
    - *If so, what should the cut-off be?*

Workshop attendees discussed what would be an appropriate demarcation point for non-residential HVAC systems (> 30 kW) that could determine high-efficiency components. Attendees noted that in commercial HVAC systems, overall efficiency was the combination of many factors, many of which are considered as part of the system design process. Workshop attendees considered that the ACOP/AEER calculated for the purposes of MEPS was a poor metric for determining energy efficient systems, as it relied too heavily on the full-load performance of the component. Attendees considered that performance at part-load was a better measure of energy efficiency, as it provided an estimation of the energy efficiency of commercial HVAC systems under the circumstances that they are most used – at part load.

Respondents indicated that as a class, energy efficient systems would be those based on inverter-based technology. Inverter-based HVAC systems are understood to provide better part-load performance and can ramp performance up and down to match HVAC service demand.

Workshop attendees also suggested that variable refrigerant flow systems are some of the most energy efficient systems possible and would be considered high efficiency as a class.

Attendees suggested that for non-VRF components, Integrated Part Load Value (IPLV) would be a suitable metric to use for commercial HVAC systems. Attendee consensus was that high-efficiency systems would have an IPLV rating of at least 10 for cooling (IPLV annualised energy efficiency ratio) and/or 5 for heating (IPLV annualised coefficient of performance).

Consultation outcome: high-efficiency non-residential HVAC components/systems

High-efficiency commercial HVAC products are defined as those which are:

- Variable refrigerant flow (VRF/VRV) systems, or
- Inverter-based HVAC plant having an IPLV AEER of 10 or more and/or an IPLV COP of 5 or more.

Further information on the rationale for these thresholds is provided in Appendix 3.

5.3.4.3 Fans

In residential and small commercial applications, ceiling fans can be used as a method of achieving thermal comfort. Although ceiling fans use relatively little energy compared to air-conditioners, their primary purpose is not to reduce energy usage, and their use is widespread and standard practice. Alternating current fans are standard practice, whereas direct current ceiling fans are significantly more efficient.[14] It was therefore proposed to include DC fans as inherently energy efficient products.

In non-residential applications, fans are a component of the overall HVAC system, and constitute an increasing portion of building energy usage. However, no appropriate high-efficiency threshold was identified to enable inclusion in the AEER.

5.3.4.4 Data centres

Data centres are a special case in HVAC, as the cooling systems for data centres are a principal determinant of the performance of a data centre. However, consultation was not able to identify any workable metric to determine high-efficiency data centre equipment. Instead, it was proposed to classify energy efficiency work in data centres as any work relating to the Association of Heating, Refrigeration and Air-Conditioning Engineers' (ASHRAE) standard 90.4 – *Energy standard for data centers*. This standard is a framework for the energy efficiency of data centres, and any work related to design, measurement, validation, optimisation and so on against this standard is energy efficiency work.

Table 7 HVAC and fans

Product type	Energy efficiency product?	Employment in AEER?	Notes
Reverse-cycle air conditioners (residential)	Yes, if the product meets an energy star threshold	Partial	Some air-conditioning units are high efficiency The determination of a high efficiency threshold is based on the zoned energy rating
Evaporative air conditioners	No	No	Although evaporative coolers use less energy than refrigerative air conditioning systems, consultation indicated evaporative coolers are standard practice and not high efficiency
Ceiling fans	Partial AC fans: No DC fans: Yes	Partial	Ceiling fans are used as a low-cost, low energy method of circulating air to improve space comfort AC fans are standard practice. DC fans are more energy efficient

Product type	Energy efficiency product?	Employment in AEER?	Notes
Mechanical heat recovery ventilation	High-efficiency products	Yes	Mechanical heat recovery ventilation and energy recovery ventilation systems are expressly designed to minimise heat loss (or gain) associated with ventilation
Non-residential HVAC components (air handlers, chillers)	Partial: Gas boilers: No Air-conditioning units: • Variable refrigerant flow systems: Yes • Other inverter-based systems: Where the equipment achieves an IPLV energy rating threshold	Partial	Non-residential air conditioning equipment is difficult to capture as high-efficiency or not, as overall system design plays a large role in efficiency Most HVAC energy efficiency work is better captured as a service, but some high efficiency HVAC components are also produced in Australia and the related employment should be counted High-efficiency non-residential HVAC equipment will be determined through an integrated part-load value rating.
Data centre equipment	When ASHRAE standard 90.4 compliant	Partial	Any work on data centres or data centre equipment related to the ASHRAE standard 90.4

5.3.5 Lighting

The primary purpose of lighting is to provide light in or on a room, surface or space. Some lights may be high efficiency. The project team proposes that:

- **Incandescent luminaires** and halogen lamps are below minimum standards in most cases, or at minimum standards, and do not qualify as energy efficient products.
- **Mercury vapour fluorescent luminaires** are minimum standard in most cases and are not highly efficient products.
- **LED luminaires** are designated as high efficiency products as a product class, as they are currently significantly above minimum requirements - this may change over time.
- **Photoluminescent lighting** is an inherently energy efficient product as it uses no energy.
- **Control systems** that automatically turn off lights are inherently energy efficient because they are primarily for the purpose of reducing energy use.

It is possible that over time minimum standards for lighting will increase, and at some point LED lighting will become standard practice. LED lighting may also be installed for primarily aesthetic purposes, rather than having a significant energy efficiency function, and this may increase over time. The inclusion of LED luminaires as an inherently energy efficient product class may therefore need to be revisited at some point.

Table 8 Lighting

Product type	Energy efficiency product?	Employment in AEER?	Notes
LED Luminaires	High efficiency product	Yes	Above minimum requirements
Photoluminescent	Inherently energy efficient	Yes	Avoids need for powered lighting
Smart control systems	High efficiency product	Yes	Allow for more energy efficient operation. Includes sensors and timers

Sections 5.4 to 5.11 list the proposed definitions for energy efficient buildings and building products that have been discussed in Section 5.

5.4 Proposed definitions – residential new build and major retrofits

Primary Survey Question
Do you construct highly energy efficient buildings, or perform substantial energy efficiency building retrofits?

Follow up information – thresholds for highly efficient residential buildings

a) A highly energy efficient residential building is defined as either being rated as NatHERS 8-star or above or be certified as Passive House or Green Star 6-star.
b) A highly energy efficient major retrofit is defined as either being rated as NatHERS 7-star or above, or achieve an increase in 2-stars, or be certified as Passive House or Green Star 6-star.

5.5 Proposed definitions – non-residential new build and major retrofits

Primary Survey Question
Do you construct, install, or design energy efficient building products?

Follow up information – highly efficient non-residential buildings

a) A highly energy efficient new non-residential building is defined as either 6-star NABERS or 6-star Green Star rated or Passive House certified.
b) Major commercial building retrofits either increase the NABERS Energy or Green Star rating by two or more stars or achieve a 6-star rating or Passive House rating.

5.6 Proposed definitions – building products

Primary Survey Question
Do you design, manufacture, supply, or install energy efficient building shell products or automation?

Follow up information – energy efficient building products, automation and control include

a) All thermal insulation
b) All draught proofing
c) Advanced glazing products (double or triple glazing, low-E glass, heat rejecting film)
d) All external shading products
e) Wall cladding with R-value greater than 2 (with no thermal bridging)

f) Thermal roof treatments
g) Lagging of hot water pipes
h) Products designed to prevent thermal bridging
i) Internal window coverings that are either honeycomb blinds, or opaque drapes that have a pelmet or reach the ceiling
j) Phase change materials
k) Swimming pool covers
l) All building energy management systems (BEMS)
m) All software and hardware to enable energy management such as smart phone apps
n) All Demand Response Enabled Devices (DREDs)

5.7 Proposed definitions – water heating

Primary Survey Question
Do you design, manufacture, supply, or install energy efficient water heaters?

Follow up information – energy efficient water heaters and associated controls

a) All heat pump hot water systems
b) Solar PV diverters and control systems for water heating
c) Solar water heating (note that this will be categorised as renewable energy employment, not energy efficiency employment)

5.8 Proposed definitions – residential HVAC

Primary Survey Question
Do you design, manufacture, supply, or install energy efficient mechanical heating, cooling and ventilation for homes?

Follow up questions and information – HVAC (Residential)

Energy efficient products are defined as:

a) Mechanical ventilation with heat recovery
b) DC ceiling fans
c) Air-conditioning equipment that meets or exceeds the following E3 Energy Rating[m]:

	Cold zone	Mixed zone	Hot zone
Cooling		5.5 stars	5.5 stars
Heating	4 stars	4.5 stars	

[m] The Equipment Energy Efficiency (E3) program is an initiative of the Australian and New Zealand governments to deliver a single, integrated program on energy efficiency standards and energy labelling for equipment and appliances. The underpinning legislation for the program is the Greenhouse and Energy Minimum Standards (GEMS) Act 2012.

5.9 Proposed definitions – non-residential HVAC

Primary Survey Question
Do you design, manufacture, supply, or install energy efficient mechanical heating, cooling and ventilation for buildings other than homes?

Follow up questions and information – HVAC (Non-residential)

Energy efficient products are defined as:

a) Variable refrigerant flow/volume systems, or
b) Inverter-based systems having an integrated part load value AEER of 10 or ACOP of 5

5.10 Proposed definitions – data centres

Primary Survey Question
Do you design, manufacture, supply, or install energy efficient HVAC equipment for data centres?

Follow up questions and information – HVAC (data centres)

Energy efficient products are defined as those that are produced for the purposes of compliance with the ASHRAE 90.4 standard

5.11 Proposed definitions – lighting

Primary Survey Question
Do you design, manufacture, supply, or install LED lighting or photoluminescent technology?

Follow up questions and information – lighting

Energy efficient products defined as:
a) All LED lighting
b) Photoluminescent technology used for exit lighting
c) All smart lighting control systems such as sensors and timers

6 Industrial energy efficiency products

6.1 Introduction

Increasing industrial energy efficiency can result in increased productivity, lower energy and maintenance costs, increased competitiveness, and reduced exposure to fluctuating energy prices. Efficiencies can be achieved by initiatives that reduce final demand, better align demand with times when power is plentiful, or optimise production to reduce energy use. Examples can include electric motor efficiency improvements, demand response, or waste heat recovery, [15], and may increasingly include fuel switching and electrification.

This section aims to produce definitions and explanations to ensure that organisations that support industrial sectors to achieve energy efficiency goals through sales and installation of these technologies are captured by the AEER survey. In addition to the auditors, advisors and consultants (covered in Section 4), this includes manufacturers, distributors and suppliers, installers and maintenance personnel of industrial energy-efficient equipment and technology.

The primary survey questions proposed for this sector are:

Do you design, manufacture, transport, distribute or retail industrial energy efficiency products?

Do you install, repair or maintain industrial energy efficiency products?

6.2 Industrial Energy Efficiency Products

This sub-section proposes definitions for industrial energy efficiency. Since a large variety of sub-sectors are included in the industry sectors, we propose providing definitions for technology groups that are commonly used across various industries. Three broad categories are:

- motor and compressed air systems
- energy efficiency equipment for process heating and refrigeration
- communications and monitoring technology such as demand control, energy management systems, etc.

Employment in industrial energy efficiency products covers design, manufacture, distribution, sales, installation and repair and maintenance services related to these products.

There are no overarching ratings or standards that establish thresholds or definitions for all industrial energy efficiency in Australia. Hence the project team approach is to look at key technologies and propose energy-efficient demarcation points for each category.

6.2.1 Motor systems

Motor systems are an integral part of most industrial operations. While motor systems are themselves not inherently energy efficient, there are components of the system that increase energy efficiency. This includes specifically energy efficient types of motors alone, some types of components (e.g. gears and drives), and some motors system end uses such as pumps, fans, and compressors.

Electric motors are covered by the MEPS standards. The 2018 determination aligns the minimum level of energy efficiency to IE2[n] levels and high-efficiency levels with IE3 levels[16]. This is well behind international standards; for example, China has a minimum standard of IE4 and Europe is moving to a minimum standard of IE4 in 2023[17].

Pump, fan and compressed air systems are not covered by Australian MEPS. There are reports on pumps and compressed air systems that recommend MEPS, but no regulation has been progressed to date. The recommendation for some pump systems is an energy efficiency index (EEI)[o] of not more than 0.27 based on the EU standard[18]. For these end uses, the UNIDO (2010) ratings of high, low, and medium are used[19]. These typical system efficiencies have been used in the Industrial Efficiency Technology Database[20].

Table 9 Motor systems energy efficiency definitions

Product type	Energy efficiency product?	Employment in AEER?	Notes
Variable frequency drives, soft starters	Inherent energy efficiency products	Yes	Reducing energy consumption is dominant purpose
Efficient gears and gear avoidance, high-efficiency belt drives	Inherent energy efficiency product	Yes	Reducing energy consumption is dominant purpose
Electric Motors	High efficiency products available	Partial	Efficiency of IE4 or IE5 based on the European standard[21].
Pump systems	The recommendation for pump systems is an energy efficiency index (EEI) of not more than 0.27	Partial	System efficiency levels (High, Med, Low) based on UNIDO (2010) Motor Systems Efficiency Supply Curves
Fan systems	Defined as high efficiency based on UNIDO	Partial	These have 50-65% system efficiency. System efficiency levels (High, Med, Low) based on UNIDO (2010) Motor Systems Efficiency Supply Curves
Compressed air systems	Defined as high efficiency based on UNIDO	Partial	These have 8-13% system efficiency. System efficiency levels (High, Med, Low) based on UNIDO (2010) Motor Systems Efficiency Supply Curves

6.2.2 Heating & cooling

This includes common heating and cooling equipment. Some technologies like waste heat recovery and passive coolers are inherently energy efficient. However most other industrial applications are not regulated in Australia, so it is very difficult to propose a suitable threshold that is recognised. In these cases, there is a choice of whether to omit or accept self-definition of high efficiency from the respondent.

Although heat pumps are inherently more energy efficient that many alternatives, their efficiency depends on the temperature differential and system conditions, making it hard to define. They are

[n] IEC 60034-30-1 published in March 2014, defines four level of motor efficiency for three-phase induction motors. IE1 (Standard Efficiency), IE2 (High Efficiency), IE3 (Premium Efficiency), IE4 (Super Premium Efficiency).

[o] EEI specifies how much the power of a pump is below one predefined reference power source. The lower the EEI, the less energy the circulator uses.

inefficient if both the cooling and heating outputs are not utilised. Self-definition is considered the only practical option.

Commercial chillers currently are subject to MEPS requirements but there are no definitions for high efficiency as seen above for the motors. However, the scope and MEPS will be revised and replaced through a different E3 process[p] by April 2023[22] as they are sunsetting[q]. Refrigerated cabinets are subject to GEMS determination (2020) based on an EEI and a star rating[23]. However, these are plug-in units and thus excluded from the employment survey (see section 7).

Other hard-wired refrigeration units for industrial applications like cool rooms are part of an industrial kit. Efficiency can be defined in terms of Specific Energy Consumption, which has a NABERS equivalence that can be referenced.

Similar to the pumps above, there is a technical discussion paper for boilers that recommends a MEPS requirement based on EU/USA standards, but no decision has been taken to date. The E3 programme Industrial Efficiency Technical Working Group was of the view that that a single measure of gross thermal efficiency should be used[24].

The efficiency of evaporative condensers, evaporators and cooling towers can be defined by their ratio of auxiliary equipment power consumption to heat rejection.

The priorities for transport refrigeration (trucks and shipping containers) are reliability and uptime, not energy efficiency, and there are no standards for them in Australia, so this category has been excluded from the survey.

Retail refrigeration does not warrant a separate definition as it is generally covered by refrigerated cabinets and cool rooms, dealt with separately. To be considered efficient, it needs interlocking of space cooling and product refrigeration, which is covered by design services (see Section 4).

Table 10 Industrial heating and cooling systems energy efficiency definitions

Product type	Energy efficiency product?	Employment in AEER?	Notes
Waste heat recovery	Inherent energy efficiency product	Yes	Reducing or managing energy usage is significant purpose of waste heat recovery
Boilers	Self-definition	Partial	Most industrial boilers are field constructed with no testing standards in Australia[25], with the efficiency reliant on the entire system design Only inclusion option is respondent self-definition as high efficiency
Heat pumps	Self-definition	Partial	Heat pumps are not always energy efficient as they can be used very inefficiently e.g. in aquatic centre where cooling is wasted and heating utilised Very dependent on system design, which can move COP enormously which depends on the temperature differential and system conditions.

[p] The Equipment Energy Efficiency (E3) program is an initiative of the Australian and New Zealand governments to deliver a single, integrated program on energy efficiency standards and energy labelling for equipment and appliances. The program is underpinned by the GEMS Act.

[q] GEMS determinations are covered by the government's default sunsetting provisions i.e. they will sunset or cease to have effect after a 10-year period unless action is taken to update and renew the determinations

Product type	Energy efficiency product?	Employment in AEER?	Notes
			Only inclusion option is respondent self-definition as high efficiency
Chillers	Self-definition	Partial	MEPS requirements but no high efficiency definition Only inclusion option currently is respondent self-definition as high efficiency
Refrigerated cabinets	Plug-in devices, with no additional energy efficiency employment generation	No	Star rating based on EEI as part of GEMS determination
Cool rooms (above 0°C) / freezer stores (below 0°C) / mixed	Can be high efficiency; above NABERS rating of 5 is considered high efficiency	Yes	Mixed refrigerated stores – high efficiency should have Specific Energy Consumption (SEC) in kWh/m³/year < (16,000 x refrigerated volume)$^{-0.61}$, which is equivalent to NABERS rating of 5
Adiabatic assistance (passive coolers)	Inherent energy efficiency product	Yes	Minimum 70% efficiency and are also water conserving
Evaporative condensers	Can be considered high efficiency if auxiliary equipment power consumption / heat rejection is less than 0.015	Yes	Consume less energy than refrigerators. Auxiliary equipment power consumption / heat rejection to be less than 0.015 i.e. consume <15kw for a 1000 kW condenser heat rejection
Cooling towers	Can be considered high efficiency if auxiliary equipment power consumption / heat rejection is less than 0.015	Yes	Auxiliary equipment power consumption / heat rejection to be less than 0.015 i.e. consume <15kw for a 1000 kW condenser heat rejection
Evaporators	Can be considered high efficiency if auxiliary equipment power consumption / heat rejection is less than 0.06	Yes	Auxiliary equipment power consumption / heat rejection to be less than 0.06
Transport refrigeration (trucks and shipping containers)	Rarely high efficiency	No	No Australian standard. Energy efficiency not a high priority (reliability and uptime is key)
Retail refrigeration	Covered in other categories	No	Generally very energy inefficient - no separate category needed as is covered by design services, refrigerated cabinets and cool rooms

6.2.3 Communications and monitoring technology

The communication and monitoring technology included here are primarily for the purpose of energy and demand management (EMS). Anecdotal evidence suggests that most businesses would require an upgrade or the installation of a more sophisticated EMS software to leverage demand flexibility[26]. This would be inherently energy efficient as the primary purpose is managing the loads and improving efficiency of the process. While they are listed as products, these products might often be coupled with energy efficiency services. These have been discussed in Section 4.

Supervisory control and data acquisition (SCADA) systems can help in managing energy consumption and contributing to energy efficiency. While there are standards that govern the communication protocols and technology used in this system, the team did not find a direct reference to energy efficiency.

Table 11 Industrial communications and monitoring systems energy efficiency definitions

Product type	Energy efficiency product?	Employment in AEER?	Notes
Energy and demand management systems	Inherent energy efficiency product	Yes	Reducing or managing energy usage is the dominant purpose - this includes reducing peak demand by maximising behind-the-meter renewable energy generation
SCADA upgrades for improving energy efficiency	Potentially high efficiency	Partial	SCADA systems are routinely upgraded This would only consider an upgrade specifically for the purpose of energy efficiency/management Only inclusion option is respondent self-definition as high efficiency

6.2.4 Repair and maintenance

Regular maintenance is essential to maintain process and energy efficiency in industries. However, repairing leaks and improving operational control also usually improve energy efficiency. Industry guides often suggest this as the first step in improving industrial energy efficiency. However, distinguishing regular repair and maintenance from that targeted at energy efficiency is very difficult. To some extent this will be captured under services (Section 7). However, if the energy efficiency audit suggests increasing regular maintenance, the personnel carrying it out may well consider themselves as providing maintenance rather than energy efficiency services.

6.3 Possible questions

The potential survey questions for this element are:

1. *Do you install, repair or maintain industrial energy efficiency products?*
2. *Do you undertake industrial repair and maintenance, which includes the purpose of improving energy performance?*

6.4 What may prevent company identification as an industrial energy efficiency provider?

Companies may identify their supply, installation, or maintenance services according to the primary purpose of the product, even if some of their activities are driven by reducing energy use or managing peak load. The purpose of providing energy-efficient product lists is to enable those companies to identify their work as related to energy efficiency.

Sections 6.5 to 6.8 list the proposed definitions for energy efficient buildings and building products that have been discussed in Section 6.

6.5 Proposed definitions – motor systems

Primary Survey Question

Do you manufacture, distribute/supply, install, repair or maintain high efficiency motor systems?

Follow up information – definitions of high efficiency motor systems

a) All variable speed drives (VSDs), soft starters, high-efficiency belt drives, gears
b) Electric motors meeting IE4 or IE5 based on European standards
c) High efficiency pump systems > 67.5% system efficiency
d) High efficiency fan systems > 57.5% system efficiency
e) High efficiency compressed air systems > 10.6% system efficiency

6.6 Proposed definition – process heating & cooling

Primary Survey Question

Do you manufacture, distribute/supply, install, repair or maintain highly energy efficient heating & cooling systems?

Follow up information – definitions of highly efficient heating and cooling systems

a) All waste heat recovery systems
b) All passive coolers (adiabatic assistance)
c) High-efficiency cool rooms where the building is in receipt of NABERS star rating of 5 or above
d) High-efficiency boilers, chillers or heat pumps where the system is designed with a significant purpose to save energy – self-definition by respondent (in the absence of a standard)
e) All cooling towers or evaporative condensers where the auxiliary equipment power consumption / heat rejection is less than 0.015
f) All evaporators where the auxiliary equipment power consumption / heat rejection is less than 0.06

6.7 Proposed definitions – communications and monitoring technology

Primary Survey Question

Do you manufacture, distribute/supply, install, repair or maintain communications and monitoring technology to monitor or manage energy use?

Follow up information – definitions for communications and monitoring technology

a) All energy and demand management/control systems, and all systems to maximise the use of behind-the-meter renewable generation
b) SCADA upgrades for improving energy efficiency

6.8 Proposed definitions – repair and maintenance

Primary Survey Question

Do you undertake industrial repair and maintenance that is intended to improve energy performance, for instance, that is on a more frequent basis than standard schedules?

Follow up information – definitions for high efficiency industrial equipment

Industrial energy efficiency equipment includes:

a) All variable speed drives, soft starters, high-efficiency belt drives

b) Efficient gears and gear avoidance
c) All waste heat recovery equipment
d) Electric motors with a MEPS High Efficiency label
e) Pump systems with 60-75% system efficiency
f) Fan systems with 50-65% system efficiency
g) Compressed air systems with 8-13% system efficiency
h) All passive cooling
i) Cool room in NABERS rated buildings 5 star or above
j) All cooling towers or evaporative condensers where the auxiliary equipment power consumption / heat rejection is less than 0.015
k) All evaporators where the auxiliary equipment power consumption / heat rejection is less than 0.06
l) High-efficiency boilers, chillers or heat pumps where the system is designed with a significant purpose to save energy
m) All energy management and demand management control and monitoring equipment

7 Exclusions and future work

7.1 Introduction (exclusions and future work)

The definitions and approaches proposed in this report are aimed at enabling the AEER to capture as high a proportion of energy efficiency employment in Australia as possible. The proposed definitions and boundaries do not aim to provide a comprehensive definition of energy efficiency as a whole, nor to encompass all products that reduce energy usage.

This section considers products and services which are either recommended for exclusion from the AEER, and areas which may not be possible to include in the first iteration of the full survey.

7.2 Consumer plug in appliances

The Minimum Energy Performance Standards and Labelling program in Australia and internationally has been one of the most significant contributors to reductions in energy consumption, resulting in a 7.5% annual reduction in Australian electricity use in 2018, and a 20% annual reduction in some jurisdictions[27]. However, the contribution to employment in Australia is likely to have been marginal apart from personnel engaged in standards and regulation, particularly for consumer products.

In some cases, suppliers of products may be specialised suppliers of energy efficiency products, but in most cases high-efficiency consumer products are supplied through supply chains to major retailers that do not have a primary or significant focus on energy efficiency products – meaning that there is essentially no additional employment due to energy efficiency associated with these products. Taking the example of a refrigerator, while energy consumption has been reduced by more than 40% since 1993, the Australian employment involved in selling and delivering the highest rated energy efficient product is the same as its inefficient counterpart. This is likely to apply to all or most consumer appliances.

Employment is undoubtedly created by the MEPS and labelling programs, however, this employment is likely to be all or predominantly in manufacturing and design[r], or associated with the standards programs themselves. As little manufacturing occurs in Australia[s], putting effort into capturing the small amount of additional work in the wholesale and retail sectors seems disproportionate to the likely scale of additional employment.

It is therefore recommended that consumer plug in appliances is not included in the AEER as examples of energy efficiency products.

7.3 Retailing

Retailing is a very large sector, employing approximately nearly 1.3 million people, or 9.5% of the workforce. Two 4-digit ANZSIC codes could be relevant for energy efficiency products, namely *4221 Electrical, Electronic and Gas Appliance Retailing* and the *4229 Other Electrical and Electronic Goods Retailing,* with a total of approximately 69,000 workers.

In order to capture the energy efficiency work involved, retail human resources departments or managers would have to estimate the proportion of employee time spent on promoting energy

[r] Harrington and Waide estimated that each €80k increment on spending in appliances in the European Union creates one job in the entire manufacturing, wholesale, retail and maintenance value chain.

[s] Fisher & Paykel manufacture specialist products in Australia e.g. refrigerators for meat industry; wine coolers for restaurants and caterers.

efficiency, which would be a difficult task. In most cases, this will be a very small proportion of time for a small proportion of workers. For example, if the energy efficiency proportion of work was estimated to be 0.5%, that would mean approximately 350 workers, even if that applied to the entire code. Gaining a statistically significant survey would entail gaining approximately 250 survey returns, or nearly a single return per energy efficiency worker, and a large effort on the part of whoever is completing the survey. In this case the effort does not appear to justify the number of workers who would be counted.

There is an element of retail which will be included via non-retail ANZSIC codes, when the main purpose of the company is energy efficiency products which are installed and marketed. This applies to other aspects of the energy sector, for example solar panel installation, when the installer also sells the panels. In both these cases the purpose of the company is the energy aspect, and it would be recommended that all employees are included.

The team recommendation is that the retail sector is not included; this is also the case for the USEER.

Table 12 Companies and estimated employees in relevant retail ANZSIC codes

Four-digit ANZSIC Code	Number of companies	Estimated number of employees
4221 Electrical, Electronic and Gas Appliance Retailing	2,917	59,310
4229 Other Electrical and Electronic Goods Retailing	1,397	9,885
TOTAL	4,314	69,195

Source ABS [28]

7.4 Energy management in sectors outside energy and construction

There is a substantial 'indirect' energy sector comprising energy managers spread across a diversity of non-energy industries, including manufacturing, agriculture, health, and education. While it is difficult to estimate the numbers of workers at least partially concerned with energy management, there are at least 200 relevant 4-digit ANZSIC company codes, including approximately 55,000 companies.

The first iteration of the AEER will not include these codes, as further work is needed to develop the survey instrument to cover these companies without imposing too onerous a burden on the respondents. This work is planned to commence after the 2024 AEER is underway and has in principle funding from RACE for 2030 CRC, and the New South Wales, Victorian, and South Australian State Governments. In the interim, these energy managers will not be measured by the AEER.

7.5 Differentiating between incremental and all energy efficiency work

Should *all* work on energy efficient products or buildings be counted *or* only the *additional* energy efficiency component of investment and work – what is often known as the 'energy efficiency premium'?

"A consumer or business that decides to invest in more energy-efficient equipment must pay the full cost of the equipment, which can be separated into two parts: the cost of a new but very standard and less efficient piece of equipment (the 'base cost'), plus the cost of the added increments of energy efficiency. This second cost represents the 'energy efficiency premium'. The base plus the premium equals the full technology cost, or the 'total investment' in efficiency."

'Separating out the energy efficiency component of total spending on goods and services, as opposed to ongoing expansion, renovation and replacement of the stock of buildings and goods, is challenging' (IEA, 2014, p.33, 43)[29].

This same consideration applies to employment. Using the example of building an 8-star home, there is a base level of cost and employment, and an increment as a result of the features that change because it is 8-star.

In practice this question needs to be considered for different methodologies and aligned with what the purpose of the information is.

Looking at the practical questions first, in a broad survey, the default position is to collect information covering all work rather than the incremental work, as it is not reasonable to expect a company to report on how much additional time their employees spend on efficiency activities compared to a hypothetical installation of baseline, non-efficient products (for example, standard glazing rather than high efficiency). Thus, for the current workforce, it is common practice to collect information on the total workforce employed on energy efficiency activities (however energy efficiency activities are defined), and the total value of those activities or products. These could potentially be adjusted, provided additional research is done to identify the incremental proportion of work, so that both can be reported, that is, that there are X workers engaged with energy efficiency activities, with Y of those estimated as additional jobs resulting from increases in energy efficiency or energy efficiency programs.

In projections, by contrast, the usual method would be to use incremental spend in Input/Output tables, which will by default produce the incremental energy efficiency employment. This could potentially identify both incremental and total work, provided the I/O tables are calibrated to do this. There are several options:

- Option 1: Measure all work for the current workforce and incremental work for the projections of the workforce, as these are the default outputs from the two main methods. The disadvantage of this approach is that the numbers will not match, so that it will always appear as if energy efficiency jobs have either disappeared or been exaggerated.
- Option 2: Measure all work, or incremental work only, for both the current workforce and the projections, by estimating the proportion of current work which is non-incremental, or by calibrating the I/O tables to produce all the work on energy efficiency products. The disadvantage of this approach is that in the first case there is likely to be considerable double counting in the projected work, while in the second case there is likely to be significant underestimation of the current workforce who are engaged on energy efficiency activities.
- Option 3: Report both all work and incremental work for energy efficiency activities for both current workforce and projections; this is perhaps closest to reporting net energy sector jobs, with the caveat that the jobs that are being 'moved' to energy efficiency are likely to be in construction rather than energy.

The recommendation in the Developing the Future Energy Workforce Report, and of the project team, is Option 3, that is, to collect information on all work via the AEER, and report both all

employees working on energy efficiency products and services, and an estimate of how much of this is incremental work over and above what would be carried out otherwise.

It may be that the AEER could collect some information to assist with this estimation. There is a need to commence developing the indicators to enable this estimate, ideally before the first full AEER.

7.6 Proposal for exclusions and future work

The recommendations are:

- Plug-in appliances and retailing for energy efficiency consumer appliances should not be included in the AEER.
- AEER should report on both the total employees involved in energy efficiency, and the proportion which is incremental. In order not to complicate the AEER itself, it is recommended that the extrapolation method is developed in parallel to the AEER, and that a series of in-depth surveys are conducted alongside the AEER to address specific issues of additionality.

8 Company testing

8.1 Methodology

The project team invited Energy Efficiency Council member businesses to be involved in co-testing both the first iteration of the Commonwealth Government's Australian Energy Employment Report (AEER) survey and the energy efficiency definitions for the AEER, which occurred simultaneously.

Fifty members representing different parts of the energy efficiency sector and of different sizes were contacted, with ten individuals participating in the testing. These included six large businesses and five small to medium enterprises (SMEs). The sectors covered by the respondents included the following:

- Auditing, measurement, and assessment
- Consultancy
- Demand management/flexibility services
- Energy upgrades
- Finance
- Research and development; and
- Retail and distribution.

The testing sessions were conducted over Zoom by the EEC over the course of two weeks:

- Monday 12 – Friday 16 December 2022; and
- Monday 6 February – Friday 10 February 2023.

The first round involved two representatives from the EEC – one to go through the survey and ask questions and the other providing context of the AEER and objectives of testing. A standardised script was used to ensure consistency across sessions.

The questions asked during the sessions were dependent on the answers from the respondent as there were different pathways through the AEER survey that could be taken. A list of questions asked during testing can be found in Appendix 4.

The second round of testing was more specifically focused on asking participants questions about the proposed energy efficiency definitions. These sessions were administered by one representative from the EEC as they only focused on the proposed energy efficiency definitions.

The questions asked during these sessions were focused on going through the proposed definitions and asking participants for feedback and comments. A list of the questions asked can be found in Appendix 4.

8.2 Feedback on Commonwealth AEER survey

The feedback received on the Commonwealth AEER survey was largely focused on the difficulty respondents encountered when attempting to accurately answer questions. Depending on the role of the representative from the company, different parts of the survey presented a challenge. For example, when the respondent had a technical role and/or experience, they found the questions regarding energy sector, energy efficiency and demand management easier to answer but they struggled with questions around employment and diversity. On the other hand, a respondent from the human resources department found the technical questions challenging, but the employment

and diversity questions simpler to answer. It was suggested by multiple participants that the survey felt like the first half was made for one type of employee and the second half was made for another, as one respondent could not answer all the questions being asked.

Another general observation was that the initial definition of energy sector was very specific and could exclude certain companies. It was frequently suggested that a more general, less specific definition may be more inclusive as many companies have energy employees but would not identify themselves as part of the energy sector.

The common feedback on the employment and diversity sections was that the questions were too difficult to answer without advance knowledge that this information was required. Respondents emphasised that many of them are unable to disclose this information or need permission to do so, which suggests that notifying potential respondents of these questions prior to starting the survey would be useful.

8.3 Feedback on energy efficiency definitions

The feedback on the proposed energy efficiency definitions was minimal. Most respondents said that the proposed definitions made sense and were sufficient to provide additional information should it be required by those completing the survey.

Where appropriate, in that the testing feedback raised new queries or ideas that hadn't previously been workshopped, relevant amendments were incorporated into the final definitions included in this report (see Section 8.4 regarding the definition of the 'Managing energy use' sub-sector). Feedback is recorded here where no action has been taken because the matter is considered to have been sufficiently considered to remain as written. Feedback included:

- Data centres: One respondent highlighted the fact that the definition for data centres referred to the ASHRAE 90.4 standard which is an American standard. They suggested a local standard might be more relevant for this question (e.g. NABERS).
- Energy efficient building products: It was suggested by two respondents that the definition for energy efficient building products could include building management systems. Another respondent suggested that the examples often seemed more focused on comfort rather than energy efficiency (e.g. external shading products, internal window coverings). The same respondent also noted that 'Building Energy Management Systems' could mean various things to different people and perhaps it would be clearer to use 'Building Automation System' here if that is what is implied.
- Residential and non-residential new build and major retrofits: One respondent suggested it is necessary to decouple design for new builds and actual construction outcomes. The respondent noted that often the design is not executed properly which means the energy efficiency outcomes are not as intended.
- Lighting: One respondent noted that the definition for lighting could be expanded to include other types of energy efficient lighting or inclusion of technologies such as light sensors or motion sensors. One respondent disagreed with the inclusion of all LED lighting being deemed as energy efficient. The main reason for this was the fact that LED lighting includes most options available on the market and there are still varying levels of efficiency

within this category. They noted that given the saturation of the market with LED lighting, how useful is it to include this?

- Motor systems: Two respondents noted the definition for motor systems was not as useful as the others, given the specific calculations required for the definition to be meaningful. The point was raised that many respondents will not know the exact percentages of efficiency for their products and therefore will be estimating. Another respondent noted that soft starters are more a method of managing demand and may not reduce energy consumption. They also suggested the compressed air system efficiency seems too unambitious.
- Process heating and cooling: A similar critique was made about the definition for process heating and cooling. The ratios provided as guides may not be useful if the respondent is not aware of the performance of their products.
- Water heating: Two respondents noted that the definition for water heating would benefit from including a coefficient of performance for heat pumps.

The approach taken by the project team to creating the definitions was questioned. Respondents did not always agree that there are inherent energy efficient products, when the purpose for any product or service is to deliver a specific purpose (lighting, for example) and unless this is energy efficiency, energy efficiency will always be secondary.

The majority of respondents agreed with most of the energy efficiency definitions provided and noted they were suitable.

8.4 Discussion

The respondents were all members of the EEC, which suggests that they would identify themselves as working in energy efficiency. Despite this, one respondent who works for a company that provides goods and services in line with the 'Managing energy use' sub-sector, failed to choose this sub-sector.

This indicates that the respondent potentially misunderstood what was meant by 'Managing energy use' and that this could lead those doing the survey down the wrong path. Therefore, it was recommended that the wording and description of the 'Managing energy use' sector be clarified to ensure those who work in that sector are able to identify it. The Commonwealth Government consequently amended the wording to 'Managing energy use (including energy efficiency, energy management and demand management/flexibility)' for the AEER survey that went live on 30 January 2023.

Robust and accurate definitions of energy efficiency in the AEER survey will help to generate reliable data for the AEER. Consequently, this will give the Commonwealth Government an indication of the current state of the energy sector workforce, and where jobs and skills development could be promoted to ensure gaps in the workforce are filled with skilled professionals.

Appendix 1 Industry Reference Group/Expert Interviews

Industry Reference Group
Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH)
Australian Sustainable Built Environment Council (ASBEC)
Business Australia
City FM
Commonwealth, Department of Climate Change, Energy, the Environment and Water
Ecovantage
International Energy Agency
Mark Ellis & Associates
New South Wales, Office of Energy and Climate Change
Shell Energy
South Australia, Department for Energy and Mining
Victoria, Department of Energy, Environment and Climate Action
Western Australia, Department of Training and Workforce Development
Expert interviews were conducted with representatives from
ABB
Fantech
Scantec
Sustainability Victoria

Appendix 2 Consultation summary

This report summarises the findings gathered in the Race for 2030 CRC project "Energy Efficiency definitions for the Australian Energy Employment survey".

The project team gained feedback via an Industry Reference Group (IRG for the project, followed by a survey of IRG members (eight respondents), two workshops, and expert interviews.

Table 13 Summary of consultation methods and outcomes

Method	Topic/ Purpose	Number of participants/ respondents	Outcomes
IRG	Consultations with stakeholders to inform the process of defining energy efficiency activities	13	Identified areas that require further stakeholder consultation to clarify definitions
Survey	Feedback on proposed definitions	12	Identified areas that require further stakeholder consultation to clarify definitions
Workshop 1	HVAC (residential)	13	Zoned energy rating selected as metric to determine high efficiency residential HVAC, and thresholds set for heating and cooling zones
Workshop 2	HVAC (non-residential)	8	IPLV AEER/ ACOP selected as metric to determine high efficiency non-residential HVAC components
Expert Interview 1	Industrial motors	2	Thresholds set for industrial motors
Expert Interview 2	Industrial heating and cooling	2	Thresholds set for industrial cooling equipment; self-definition agreed for heat pumps, boilers and chillers

Industry Reference Group

The Industry Reference Group (IRG) first met on 16 August 2022 to discuss the proposed definitions of various energy efficiency activities. Attendees at this workshop provided advice on the proposed definitions and assisted the project team in identifying areas that needed further clarification. This feedback informed the next steps of stakeholder consultation undertaken by the project team, including holding workshops on residential and non-residential HVAC and conducting expert interviews on motor and pump systems and industrial process heating and cooling.

A second IRG meeting was held on 1 March 2023.

Workshop 1: Residential HVAC

A workshop was held with 14 HVAC industry participants on 13 October 2022 to discuss questions arising from survey responses on residential HVAC equipment. Attendees at this workshop provided feedback on the practicality of different metrics for a threshold for high efficiency residential HVAC systems. Feedback from this workshop informed the project team's decision on the most workable, understandable and meaningful way to designate high efficiency residential HVAC equipment.

Workshop 2: Non-residential HVAC

A follow-up workshop on non-residential HVAC was held on 2 November 2022. Eight industry participants provided feedback at this workshop about potential metrics for designating high efficiency non-residential HVAC systems, including in data centres, which were not resolved through the consultation survey. Feedback from this session was used to create proposed thresholds for high efficiency non-residential HVAC equipment.

In the following, we have captured the consultation questions, survey responses and outcomes.

Expert interviews

Two expert interviews were conducted to cover aspects of industrial energy efficiency. These were:

- Motor and pump systems: ABB
- Industrial process heat and cooling: Scantec and Fantech

Valuable insight was given on the appropriate thresholds for industrial equipment, with recommendations adopted.

Appendix 3 Consultation questions and outcomes

This Appendix lists the consultation questions and responses from the survey given to the IRG in July 2022, the questions addressed in the project workshops, and the questions addressed in expert interviews. The outcomes from the consultation are also listed.

CONSULTATION: DEFINITION APPROACH

Consultation & outcomes: approach to defining energy efficiency for the AEER (Section 3)

Proposed definitions: energy efficient or a high efficiency products or services

> Purpose test for energy efficiency products or services
>
> Inherent energy efficiency products or services are those where the primary or dominant purpose is to reduce or manage energy consumption for an end-user.
>
> High efficiency products or services are those for which reducing or managing energy consumption is a significant purpose or benefit of the individual product or service or type of product or service, compared to the standard product or service.

Consultation questions

a) Do you agree with the proposed purpose test for defining energy efficiency products and services? If not, what would you propose?

b) Do you agree with the proposed services-first approach? If not, what would you propose?

c) Are there any activities that would be better captured as a product, rather than a service (or vice versa)?

Survey response

There was general agreement with the proposed purpose test (eight out of eight respondents), with one respondent suggesting that 'significant' was too vague a term, and one suggesting that it should be clarified whether reducing energy consumption referred to energy content or energy cost.

A similar number (seven out of eight) agreed with the services first approach.

One survey respondent noted that software packages and IT services that capture and analyse building data could be better classed as products.

Outcome

The 'purpose test' for energy efficient products or services will be used, as will the 'services first' approach. It is suggested that software packages and IT services for building data analysis are categorised under products as well as services.

Consultation & outcomes: energy efficiency services (Section 4.6)

Proposed definitions: energy efficiency services

- Energy efficiency services are those that are intended to reduce energy or peak load for an end user.
- Enabling energy efficiency services are those services that are intended to enable other energy efficiency services.

Follow up information – for the list of service definitions refer to Table 1 and Table 2

Consultation questions: energy efficiency services

a) Do you agree with the proposed definition of energy efficiency services?

b) Do you agree with the definition of each service as given in *Table 1* and *Table 2*? If not, please say how they should be revised

c) Are there any services missing from the list, or any services listed which should not be?

d) Is there anything you would like to add?

Survey response and outcome

There was general agreement with the proposed definitions (seven out of seven respondents), with one respondent suggesting it should be clarified whether reducing energy consumption referred to energy content or energy cost, and one highlighting that both tables should be provided to AEER respondents.

The proposed definitions will be used, and some suggested additions to the tables have been implemented.

CONSULTATION: BUILDINGS AND BUILDING PRODUCTS

Consultation & outcomes: residential new build and retrofits (Section 5.4)

Proposed definition: residential new build and major retrofits

Primary Survey Question

Do you construct highly energy efficient buildings, or perform substantial energy efficiency building retrofits?

Follow up information – thresholds for highly efficient residential buildings

a) A highly energy efficient residential building is defined as being 8-star or above

b) A highly energy major retrofit is defined as being 8-star or above

This topic is discussed in Section 5.2.1.

Survey questions

a) Do you agree with the threshold of 8-star for residential new build? If not, what would you suggest?

b) Do you agree the same requirement should apply for major retrofits? If not, what would you suggest?

c) If the NCC is upgraded again, should highly efficient homes be those that outperform minimum standards by one star, or by more? If not, what would you suggest?

d) Do you agree that minor residential retrofits should be captured via the installation of energy efficient building products, or the associated services? If not, what would you suggest?

Survey responses

a) Five survey respondents agreed that above standard or a two-star increase should be considered energy efficient. However, two respondents suggested alternative, more stringent ratings or certification tools such as Passive House or Green Star be cited as the threshold, one respondent remarking that NatHERS has reached its practical limit for this sort of assessment.

b) Three respondents agreed with 8 stars for major retrofits, and one agreed with an increase of 2-stars. Another respondent said that 8-stars is almost impossible, and that 7-stars will be a stretch.

c) Five respondents agreed that the definition should be 1-star more than the NCC for any future increases in minimum standard. On the other hand, 2 respondents suggested that alternative metrics will be required beyond 7 stars.

d) Respondents were unanimous that products and services will capture energy efficiency for minor retrofits.

Outcome

Passive House and Green Star 6-star certification were added as alternatives to the definitions for both new and retrofits.

A decision was made to change the major retrofit threshold to options of an increase of NatHERS by 2-stars or to more than 7-stars, which will be difficult to achieve but is still ensuring it is defined above minimum standards.

Definitions will need further consideration for future increases in NCC minimums; alternative measures such as NatHERS Whole of Home will probably be preferable.

Minor retrofits to be defined by products and services.

Consultation & outcomes: non-residential new build and major and minor retrofits (Section 5.5)

Proposed definition: non-residential new build and major retrofits

Primary Survey Question

Do you construct install, design, energy efficient building products?

Follow up information – highly efficient non-residential buildings

a) A highly energy efficient new commercial building is defined as 6-star NABERS rating.
b) Major commercial building retrofits that *either* increase the NABERS Energy rating by two or more stars or achieve a 6-star rating.

This topic is discussed in Section 5.2.2

Survey questions

Do you agree with the threshold of a 6-stars NABERS rating for new build? If not, what would you suggest?

a) Do you agree with the proposed threshold for major commercial building retrofits (an increase of 2 stars or achieving 6-star NABERS rating)?

b) Are there other metrics that could be used in place of NABERS that have better or wider coverage?

Survey responses

a) Three respondents agreed with 6-stars NABERS Energy being the threshold, and another suggested consulting the NABERS team. A further respondent thought anything above standard would be acceptable, although they did not define this.

b) Four respondents agreed with the proposed definitions for retrofits, although one of these thought 5-stars as minimum might be acceptable.

c) Passive House Certification or similar was the only suggested alternative to NABERS, from one respondent. Two agreed with using NABERS.

Outcome

Passive House certification was added as an alternative measure.

Consultation & outcomes: building shell products (Section 5.6)

Proposed definitions: building products

Primary Survey Question

Do you design, produce, supply, or install energy efficient building shell products or automation?

Follow up information – energy efficient building shell products, automation and control include

a) All thermal insulation
b) All draught proofing
c) Advanced glazing products (double or triple glazing, low-E glass, heat rejecting film)
d) All external shading products
e) Wall cladding with R-value greater than 2
f) All building energy management systems (BEMS)

This topic is discussed in Section 5.3.1

Survey questions

a) Do you agree that all thermal insulation, draught proofing, advanced glazing products (double or triple glazing, low-E glass, heat rejecting film) external shading, and building energy management systems should be defined as energy efficient? If not, what would you modify?

b) Do you agree that wall cladding with R-value greater than 2 should be defined as energy efficient? If not, what would you propose?

c) Are there additional building shell product types that should be considered in order to identify energy efficiency employment?

d) Would you advise including internal shading treatments, and what would you propose for the definition of when they are energy efficient?

e) Would you attempt to include building systems automation (other than BEMS) as energy efficiency products, and if so, how would you define what is energy efficient?

Survey responses

a) Six respondents agreed with the proposed product list and limits. One disagreed, questioning whether there should be a minimum R-value for insulation and recommending that building energy management systems be captured under services for those who use the information to improve the energy efficiency of the building because as a tool they often fail to improve the energy performance in the manner claimed.

b) Six respondents agreed with the definition for wall cladding although one of them thought R1.5 would be an adequate limit, and another felt that avoiding thermal bridging should be included in the definition.

c) Other products that were suggested for inclusion were cool roof coatings (suggested twice), hot water pipe lagging, and systems that provide for air sealing and blower door validation testing.

d) Different views were given regarding internal window coverings. One respondent agreed that it was too hard to define when they are energy efficient and another suggested that although they do aid energy efficiency it is not their primary purpose. Three respondents thought they should be included, especially if they are honeycomb blinds or installed with pelmets or floor to ceiling heavy curtains, although one queried how to define 'heavy drapes'.

e) When asked whether to include building systems automation (other than BEMS) as energy efficiency products, one respondent said not at this stage and another thought it worthwhile but could not define it. Three thought they should be included if they were developed with the primary aim of energy efficiency, one warning that some automation products increase energy use, and another on the proviso that it could be backed by a rating or report. A sixth respondent said any system that can control operations for demand management should be included.

Outcome

The product list was revised to include good suggestions from respondents.

Consultation & outcomes: water heaters (Section 5.7)

Proposed definitions: water heating

Primary Survey Question

Do you design, manufacture, supply, or install energy efficient water heaters?

Follow up information – energy efficient water heaters and associated controls

a) All heat pump hot water systems
b) Solar PV diverters and control systems for water heating
c) Solar water heating (note that this will be categorised as renewable energy employment, not energy efficiency employment)

This topic is discussed in Section 5.3.3

Survey questions

a) Do you agree that all the work associated with heat pump hot water heaters should be classed as energy efficiency employment? If not, what would you propose?

b) Do you agree that Solar PV diverters and associated control systems for water heating should be defined as energy efficient? If not, what would you propose?

c) Do you agree that solar water heating should be classified as renewable energy?

d) Do you agree that instantaneous gas water heaters and storage water heaters should be excluded from the energy efficient category? If not, what would you propose?

Survey responses

a) & c) Four respondents agreed that solar water heating should be classified as renewable energy with one of these warning that the seasonal performance of many systems is very poor and dependent on the supplemental energy source. Another respondent was inclined to keep solar and heat pumps the same as they both attract STCs and are considered renewable energy sources via

that scheme. One respondent disagreed because ultimately they contribute to saving more energy. A seventh respondent was unsure if the system is energy efficient anyway.

b) All respondents agreed that solar PV diverters and associated control systems for water heating should be defined as energy efficient.

d) All respondents agreed that instantaneous gas water heaters and storage water heaters should be excluded.

Outcome

Retain proposed definitions.

Consultation & outcomes: HVAC (Sections 5.8 and 5.9)

Proposed definitions: HVAC

Primary Survey Question

Do you design, manufacture, supply, or install mechanical ventilation with heat recovery?

Follow up questions and information – HVAC

a) **Mechanical ventilation with heat recovery is defined as an energy efficient product**

This topic is discussed in Section 5.3.4

Survey questions

The project team have not found workable product thresholds to determine when employment on HVAC systems become energy efficiency employment, and welcome input in this area.

a) Are there sensible demarcation points or metrics to determine high efficiency HVAC components that perform significantly better than standard?

b) Would capturing employment relating to high efficiency HVAC be more easily achieved by asking whether the company offers HVAC design, supply, and installation as a service with the intention of managing or reducing energy?

c) Should fans be considered as inherently energy efficiency products, and should this be all fans or only DC fans? If not, should they be included in some other way? (please describe how)

d) Can you suggest a demarcation point to define high efficiency residential HVAC? If not, should we ask respondents to self-define – "do you install high efficiency HVAC systems?

e) Is there a reasonable and accessible way to include commercial HVAC equipment in this survey? How would you define high-efficiency commercial HVAC equipment?

Survey responses

a) One respondent believes that all HVAC should be included in order to capture the market that will be required to grow as part of electrification. Another asked if it could be linked to the building criteria meeting the minimum threshold because it is the combination of the performance of the building enclosure with the systems operated efficiently that results in real energy conservation.

One respondent recommended a distinction between residential and commercial HVAC because even a minimum performance residential AC is a very efficient appliance due to MEPS. They would include all residential AC and all mechanical ventilation with heat recovery.

A further respondent suggested using minimum seasonal coefficient of performance (SCOP) or similar for chillers.

Three respondents thought asking about intention would be preferable, but two disagreed with one saying the survey should avoid asking questions about clients' intentions as this is subjective and often not known and the other saying there should be further evidence to support the claim. Another wasn't sure but thought it might help in the commercial space.

b) Three respondents think all ceiling fans should be included, one noting that they are already covered by rating schemes. This respondent suggested further input was needed from the industry regarding whether it should be limited to DC fans and another of the 3 thought restricting it to DC fans would be justifiable. A fourth respondent also recommended speaking with the industry (AIRAH).

   There was one disagreement saying it may be better to consider the system, rather than the components.

c) All those who provided responses acknowledged the complexity of this definition. Two said to use the label rather than the term high efficiency with one saying to focus on being above minimum and the other some simple classification or assessment on the range of the offering products. One said all Australian residential AC is efficient, that 'high efficiency' is hard to define and efficiency decreases with size. Another argued that all replacement HVAC will be more efficient than its predecessor, so a primary driver for installation is useful, and that it is easier to just capture all HVAC.

   Another respondent repeated that it should be about the efficiency of the building and added that an efficient air conditioning unit with a poor duct installation will not be energy efficient. They went on that there are more fundamental changes to industry custom and practice required to realise real-world energy savings for consumers. A sixth respondent again suggested speaking with industry experts.

d) One respondent thought commercial HVAC demarcation should be based on seasonal coefficient of performance (SCOP) or similar for chillers. Another thought it would be worthwhile, but difficult, adding that basically any heat pump that replaces a gas boiler or electric resistance would be a start, and heat recovery equipment, water-cooled chillers for cooling (as opposed to air-cooled), and units that use 'free-cooling' strategies.

   The proponent for building based definitions thought it should be defined by considering NABERS ratings. They added that any activity that improves what is currently in place could be considered energy efficiency work, such as replacement and maintenance. A fourth respondent again suggested speaking with industry experts.

   Note: A respondent pointed out that it is now usually represented as HVAC&R to overtly include refrigeration in the definition.

Outcome from survey:

The complexity of this question required further consultation, so two industry workshops were held to gain expert input.

HVAC workshops

Due to the complexity of categorisation of HVAC products as high-efficiency or not, the project team held two workshops on HVAC with representatives from HVAC industry associations, as well as consulting experts. One workshop was focussed on residential HVAC, with the second workshop focussing on non-residential HVAC. The workshops provided the project team with expert insight into contemporary industry practice.

Workshop attendees were given a presentation on the original and some additional research, followed by group discussion and the use of online collaboration tools (a MIRO board) to indicate their views on which metrics should be used and at what point the threshold for high efficiency should be set.

The first workshop was attended by 13 people and the second workshop by 8 people.

Residential HVAC

Attendees at the workshop were asked to provide input into the following questions:

a) *Should evaporative coolers be considered high-efficiency products?*

Respondents considered that evaporative coolers – as a class – are standard practice and not highly efficient. However, there are some products that are exceptionally high-performing evaporative coolers which could be included. There is currently no dataset available on performance of evaporative coolers in Australia, so it is not possible to make a determination as to define which evaporative coolers are highly efficient and which are not. Attendees also highlighted that the design of evaporative coolers introduced air leakage into buildings, compromising overall building energy efficiency. The consensus of attendees was that evaporative coolers should not be considered as energy efficiency products.

b) *Is an energy star rating, or the ACOP/AEER calculated for compliance with MEPS an appropriate way to determine high-efficiency air conditioners?*

Consultation outcome: high-efficiency residential HVAC systems

- Evaporative coolers are not defined as inherently high efficiency products
- MEPS star ratings should be used due to their accessibility
- High-efficiency residential HVAC systems are ones that satisfy one or more of the following criteria:

Energy star rating	Cold zone	Mixed zone	Hot zone
Cooling		5.5 stars	5.5 stars
Heating	4 stars	4.5 stars	

- DC fans are also considered high-efficiency residential HVAC products.

Non-residential HVAC

Workshop attendees were asked the following questions:

a) *Should air conditioning systems using water-cooled chillers or 'free-cooling' strategies automatically be included?*

Attendees did not agree that free-cooling systems should necessarily be defined as high-efficiency.

b) *Is the MEPS-based ACOP/AEER a reasonable way to determine a high-efficiency product? If so, what should the cut-off be?*

Workshop attendees discussed whether there is an appropriate demarcation point for non-residential HVAC systems (defined here as greater than 30 kW) that could determine high-efficiency components. Attendees noted that in commercial HVAC systems, overall efficiency was the combination of many factors, many of which are considered as part of the system design process. Workshop attendees considered that the ACOP/AEER calculated for the purposes of MEPS was a poor metric for determining energy efficient system, as it relied too heavily on the full-load performance of the component. Attendees considered that performance at part-load was a better measure of energy efficiency, as it provided an estimation of the energy efficiency of commercial HVAC systems under the circumstances that they are most used – at part load.

Respondents indicated that as a class, energy efficient systems would be those based on inverter technology. Inverter-based HVAC systems are understood to provide better part-load performance and can ramp performance up and down to match HVAC service demand.

Workshop attendees also suggested that variable refrigerant flow systems are some of the most energy efficient systems possible and would be considered high efficiency as a class.

Attendees suggested that for non-VRF components, Integrated Part Load Value (IPLV) would be a suitable metric to use for commercial HVAC systems. Attendee consensus was that high-efficiency systems would have an IPLV rating of at least 10 for cooling (IPLV AEER) and/or 5 for heating (IPLV ACOP).

Consultation outcome: high-efficiency non-residential HVAC components/systems

High-efficiency commercial HVAC products are defined as those which are:

- Variable refrigerant flow (VRF/VRV) systems, or
- Inverter-based HVAC plant having an IPLV AEER of 10 or more and/or an IPLV COP of 5 or more.

c) *Is HVAC in data centres different?*

    - *Are there energy efficiency products that are specific to HVAC in data centres?*

Workshop attendees noted that data centres were a different case, where HVAC is such a significant input cost that efficiency is defined by the HVAC performance of the data centre as a whole, rather than through individual components.

Attendees noted that data centre performance was measured by the Power Utilisation Effectiveness index and noted the ASHRAE standard 90.4 – Annualized Mechanical Load Component as the guiding standard for energy efficiency in data centres.

There is no reasonable, widely-available metric that could easily define a high-efficiency data centre or specific data centre products. However, any work related to design or compliance of a data centre to the ASHRAE 90.4 standard is inherently energy efficiency work, and hence can be included in the AEER.

Consultation outcome: data centres

If data centre work relates to the ASHRAE 90.4 standard, it should be classed as energy efficiency work. A candidate question to capture this work could be:

Do you design, construct, operate or verify data centres against the provisions of the ASHRAE 90.4 standard, or design, produce, install or maintain products or equipment for the purposes of compliance with the ASHRAE 90.4 standard?

Consultation & outcomes: lighting (Section 5.10)

Proposed definitions: lighting

Primary Survey Question

Do you design, manufacture, supply, or install LED lighting?

Follow up questions and information – lighting

a) All LED lighting is defined as an energy efficient product

This topic is discussed in Section 5.3.5

a) Do you agree that only LED lighting should be defined as energy efficient, and that all LED lighting should be defined as such? If not, what would you propose?

Survey response

a) There was general agreement (four respondents) with the proposal, although with various comments that LEDs are now standard practice.

Two respondents disagreed with one preferring to see the definition based on lumens/watt. The other stated that not all LED is inherently energy efficient and many LED replacement schemes do not deliver good lighting performance or acceptable quality/longevity of products. They suggest this is excluded other than through overall building actual performance such as NABERS.

A sixth respondent suggested adding photoluminescent technology which can be used for exit lighting purposes.

Outcome

Add photoluminescent technology for exit lighting

All LED lights will be included until there is a rating system that will allow definition within the class.

Consultation & outcomes: buildings and building products overview (Sections 5.4 to 5.10)

a) Are there products or services that should be included here that have not been?

b) Is there anything you would like to add?

Survey response

Two respondents offered suggestions:

- Buildings and the services within them are complex, and products and services in isolation may not provide for energy efficiency improvement necessarily. Performance ratings such as NABERS can assist, as the resultant outcome is the measure rather than a product or service.
- Allow for companies that provide consumers with the means to monitor and augment their energy use - smart phone apps that a consumer can connect to their smart home network to analyse their energy use in real time. (It's not an option in "Consumer Services", table 1.)

Outcome

Smart phone apps for energy use monitoring were added to the list of building products.

CONSULTATION: INDUSTRIAL ENERGY EFFICIENCY PRODUCTS

Consultation & outcomes: motor systems (Section 6.5)

Proposed definition: motor systems

Primary Survey Question

Do you manufacture, distribute/supply, install, repair or maintain high efficiency motor systems?

Follow up information – definitions of high efficiency motor systems

a) All variable speed drives (VSDs), soft starters, high-efficiency belt drives, gears
b) Electric motors with High Efficiency (HE) Label (MEPS)
c) High efficiency pump systems > 67.5% system efficiency
d) High efficiency fan systems > 57.5% system efficiency
e) High efficiency compressed air systems > 10.6% system efficiency

This topic is discussed in Section 6.2.1

Survey questions

a) Do you agree with the VSDs, etc. being inherently energy efficient?

b) Do you agree with electric motors with the HE label should be defined as energy efficient?

c) Do you agree with the thresholds for motor system end uses in terms of system efficiency? If not, what would you suggest?

d) Are there products or services that should be included here that have not been?

Survey response

a) In relation to VSDS, the one respondent agreed they should be defined as inherently energy efficient.

b) In relation to electric motors with the high efficiency label being defined as inherently energy efficient, two respondents agreed whilst a third respondent disagreed stating 'It doesn't exist. IE3 motors and above are defined as above the minimum.' In relation to motor system thresholds, one respondent agreed whilst a second respondent suggested the motor system was being confused with the unit containing the motor.

c) Another respondent expressed concern that the definitions in this section were more specific than other sections and whether respondents would be able to answer the questions.

d) No responses.

Survey outcome

Further consultation was required on what standard to use for motors.

Industrial motors interview

Interview attendees agreed that VSD systems should be considered energy efficiency products. Interview attendees were also asked about the appropriate level of energy efficiency standard for motors to qualify as high efficiency products. Interviewees felt that where clients required energy efficient products, motors conforming to the IE4 or IE5 standards would be specified.

Consultation outcome

- Variable speed drive systems should be considered inherent energy efficiency products.
- Industrial motors conforming to IE4 or IE5 standards should be considered high-efficiency products.

Consultation & outcomes: heating & cooling systems (Section 6.6)

Proposed definition: heating & cooling

Primary Survey Question

Do you manufacture, distribute/supply, install, repair or maintain highly energy efficient heating & cooling systems?

Follow up information – definitions of highly efficient heating and cooling systems

a) All heat pumps
b) All waste heat recovery systems
c) All evaporative and passive coolers
d) High-efficiency boilers – self-definition by respondent (in the absence of a standard)
e) High-efficiency chillers & cool rooms – self-definition by respondent (in the absence of a standard)

This topic is discussed in Section 6.2.2

Survey questions

a) Do you agree with heat pumps and waste heat recovery being inherently energy efficient?

b) Do you agree that evaporative and passive coolers should be defined as inherently energy efficient?

c) Can you suggest standards or thresholds for high-efficiency boilers (perhaps in terms of thermal efficiency)? If there aren't external standards, should the AEER accept respondent self-definition?

d) Can you suggest standards or thresholds for high-efficiency chillers and cool rooms (perhaps in terms of EEI)? If there aren't external standards, should the AEER accept respondent self-definition?

e) Do you agree on leaving out cooling towers, and other technologies where operational control is the primary purpose rather than energy efficiency?

f) Are there products or services that should be included here that have not been?

Survey response

In relation to products being defined as inherently energy efficient

- Respondents agreed with the proposition for heat pumps
- For evaporative coolers, 4 agreed, 2 were 'maybe' or 'unsure' and 1 disagreed saying it wasn't inherently energy efficient because it often compromised the building thermal enclosure and air sealing

No clear picture emerged in response to standards or thresholds for high-efficiency boilers. No respondents identified a standard, but 3 respondents advised against self-definition due to the complexity of factors influencing efficiency. One respondent recommended a review of European and US standards to identify a standard for the survey.

Similarly, there was a range of responses for high-efficiency chillers and cool rooms. One respondent suggested referring to MEPs, one respondent suggested referring to the VEEP system, one respondent suggested anything water cooled, one respondent suggested seeking advice from AIRAH and the final respondent suggested using DA12 (but noted respondents may not know it).

Outcome

This topic was identified as needing further consultation and was the subject of expert interviews.

Industrial heating and cooling interview

Due to the complexity of categorisation of industrial heating and cooling systems as high-efficiency or not, the project team held an online interview with two industry representatives recommended by AIRAH. The interview provided the project team with expert insight into contemporary industry practice.

Interviewees were asked to provide input into the following questions:

a) *Do you agree with heat pumps and waste heat recovery being inherently energy efficient?*

Respondents agreed that waste heat recovery is inherently energy efficient but disagreed that heat pumps are. This is because they can be used very inefficiently, such as in an aquatic centre when the heating output is used but the cooling is wasted. Their efficiency also depends on the system design and temperature differential, which can significantly impact COP.

Because application knowledge is needed for this definition, self-definition was agreed to be suitable for heat pump related employment.

b) *Do you agree that evaporative and passive coolers should be defined as inherently energy efficient?*

Respondents differentiated between evaporative condensers and evaporators. They advised that efficiency can be measured as a ratio of auxiliary power consumption to heat rejection. An efficient evaporative condenser would be less than 0.015, and evaporator less than 0.06. Addition of a VF fan can reduce energy consumption.

Passive coolers, more correctly 'adiabatic assistance', were agreed to be inherently energy efficient.

c) *Can you suggest standards or thresholds for high-efficiency boilers (perhaps in terms of thermal efficiency)? If there aren't external standards, should the AEER accept respondent self-definition?*

After some discussion about boiler efficiency being limited by condensation, and a metric of 0.9 being good, it was agreed that self-definition will work because the measure is not readily recognised. One of the respondents offered to research whether there is any level or standard that could be used.

d) *Can you suggest standards or thresholds for high-efficiency chillers and cool rooms (perhaps in terms of EEI)? If there aren't external standards, should the AEER accept respondent self-definition?*

There is a European standard for chillers so anyone using European products should know their efficiency, but this does not cover all installations. There is no easy metric, so it was agreed to accept self-definition.

Mixed cool rooms and cold rooms are set above 0°C, freezers are below 0°C. Their energy efficiency can be measured by Specific Energy Consumption (SEC) in kWh/m^3 of refrigerated volume/year. An SEC of 16,000 x refrigerated volume $^{-0.61}$ is considered efficient. This measure equates to a NABERS rating of 5 stars.

e) *Do you agree on leaving out cooling towers, and other technologies where operational control is the primary purpose rather than energy efficiency?*

The efficiency of cooling towers can also be measured by the ratio of auxiliary power consumption to heat rejection. An efficient cooling tower would be less than 0.015.

f) *Are there products or services that should be included here that have not been?*

Transport refrigeration (trucks and shipping containers) were discussed but it was agreed that energy efficiency is not a high priority in this application because reliability and uptime are so important. Current industry focus is on the impact of hydrofluorocarbon phase down. As there is no Australian Standard to reference it was agreed that this is not a category to include.

A discussion about retail refrigeration agreed that it is generally very inefficient. To become more efficient advantage needs to be taken of combining space cooling and product refrigeration. This would be covered under services in the instances where it occurs. Refrigeration cabinets are plug in appliances and not being included due to minor associated employment, although it was noted that Fisher & Paykel does manufacture refrigerators for the meat industry and wine coolers for restaurants and caterers in Australia. Cool rooms have their own category. On balance, it was agreed that no additional category is needed for retail.

Consultation outcome: industrial heating and cooling systems

- Waste heat recovery and passive coolers are inherently energy efficient.
- Employment related to heat pumps, boilers and chillers should be self-defined.
- Highly efficient evaporative condensers and cooling towers have auxiliary power consumption / heat rejection less than 0.015.

- Highly efficient evaporators have auxiliary power consumption / heat rejection less than 0.06.
- Highly efficient cool rooms and freezer stores have a NABERS rating of 5 or above.

Consultation & outcomes: communications and monitoring technology (Section 6.7)

Proposed definition: Communications and monitoring technology

Primary Survey Question

Do you manufacture, distribute/supply, install, repair or maintain communications and monitoring technology to monitor or manage energy use?

Follow up information – definitions for communications and monitoring technology

a) All energy and demand management/control systems, and all systems to maximise the use of behind-the-meter renewable generation.
b) SCADA upgrades for improving energy efficiency.

This topic is discussed in Section 6.2.3

Survey questions

a) Do you agree with energy / demand management systems as being inherently energy efficient?

b) Do you agree with the inclusion of SCADA system upgrades for the purpose of energy efficiency? Is there a way of defining these in any other way?

c) Are there products or services that should be included here that have not been?

Survey response

There was broad consensus on defining energy management systems as inherently energy efficient; 5 respondents said yes, the other respondent asked if it should be part of energy services.

Three respondents agreed on defining SCADA energy efficiency upgrades as inherently energy efficiency.

Outcome

The definition as proposed remained.

Consultation & outcomes: repair and maintenance (Section 6.8)

Proposed definition: Repair and Maintenance

Primary Survey Question

Do you repair or maintain industrial energy efficiency equipment?

Follow up information – definitions for high efficiency industrial equipment

Industrial energy efficiency equipment includes:

- All Variable speed drives, soft starters, high-efficiency belt drives
- Efficient gears and gear avoidance
- All waste heat recovery equipment

- Electric Motors with a MEPS High Efficiency label
- Pump systems with 60-75% system efficiency
- Fan systems with 50-65% system efficiency
- Compressed air systems with 8-13% system efficiency
- All heat pumps
- All energy management and demand management control and monitoring equipment

Primary Survey Question

Do you undertake industrial repair and maintenance that is intended to improve energy performance, for instance, that is on a more frequent basis than standard schedules?

This topic is discussed in Section 6.2.4

Survey questions

a) Do you agree that repairing or maintaining any of these inherent energy-efficient industrial equipment should be included as energy efficiency work?

b) Do you agree with the suggested question to determine whether the repair and maintenance is energy efficiency work? Are there other questions that would work better?

Survey response

Three respondents agreed repairing inherently energy efficiency equipment should be included as energy efficient work. One respondent suggested having a separate section on maintenance of energy use equipment.

Outcome

The definition as proposed remained.

CONSULTATION: EXCLUSIONS AND FURTHER WORK

Consultation & outcomes: proposed exclusions (Section 7.6)

Survey questions

a) Do you agree with the exclusion of consumer plug in appliances from listed energy efficiency products for the purposes of the AEER?

b) Do you agree with the exclusion of the retailing energy efficiency products for the purposes of the AEER? (other than in cases where a company has retail as an element of their energy efficiency business, which is captured by alternative (non-retail) codes)

Exclusion of appliances is discussed in Section 7.2

Exclusion of retail is discussed in Section 7.3

Survey response

a) & b) Seven of eight respondents agreed with the exclusion of consumer appliances, with one respondent disagreeing.

Outcome

It is recommended to exclude consumer plug-in appliances and retailing for energy efficiency consumer appliances from the AEER.

Consultation & outcomes: determining the incremental energy efficiency workforce (Section 7.6)

Survey questions

a) Do you agree that the AEER should report both the total employment involved in energy efficiency, and the proportion which is incremental to the standard workforce?

b) Do you have suggestions on what information could be collected from the survey to assist this estimation?

Survey response

a) All five respondents agreed with this approach, with various caveats, and one respondent added that the key metric should be all those involved in energy efficiency. The chief concern was that this could be methodologically complicated and should not complicate the survey itself. One person suggested that both methods should be undertaken on a trial basis, to see how useful it is, and one noted in some cases efficiency would reduce employment rather than increase it.

b) One respondent suggested that a number of in-depth surveys are conducted into several types of businesses to really understand how they operate and the employment structure alongside the main AEER to act as a guide as to how fill in gaps in data.

Outcome

In principle it is recommended that the AEER should report on both the total employees involved in energy efficiency, and the proportion which is incremental. In order not to complicate the AEER itself, it is recommended that the extrapolation method is developed in parallel to the AEER, and that a series of in-depth surveys are conducted alongside the AEER to address specific issues of additionality.

Appendix 4 Company testing

The following questions and prompts were used to guide the testing sessions to obtain feedback.

Questions for feedback on AEER survey:

a) How does the provided description of "energy sector" compare with your understanding of an "energy sector" business?

b) Should respondents be told to prepare certain information in advance of beginning the survey? E.g. ABN, employment and diversity details.

c) Was it easy or difficult to place your business in the suggested sectors? What made you choose that as your main sector? Would it be beneficial to include a more detailed explanation of the sectors?

d) Was it easy or difficult to allocate employees into 'energy activity' categories?

e) Is it okay to ask diversity questions in a survey of this kind, or is it sensitive information?

Questions for feedback on energy efficiency definitions:

If you were contemplating selecting "energy efficiency and energy related products", would the following definition help? This question was repeated, and the corresponding definition shown for the following:

- Energy efficiency and energy related products and services
- Efficient plant and equipment
- Efficient products and appliances
- Building products
- Residential new builds and major retrofits
- Non-residential new builds and major retrofits
- Data centres
- Communications and monitoring technology
- Lighting
- Residential HVAC
- Non-residential HVAC
- Motor systems
- Process heating and cooling
- Water heating

Appendix 5 Draft survey questions and information

The questions and further information provided in this appendix reflect the definitions developed in this project. The further information is intended to be offered as links within the survey.

Survey question

a) ***Do you provide energy efficiency, energy management, or demand management services?***

Follow up information

Energy efficiency services are those that are intended to reduce energy or peak load for an end user. Enabling services are those that are intended to support energy efficiency services.

Table 1 ***Energy efficiency services*** *include*

- *Building energy efficiency services*
- *Energy efficiency / management schemes*
- *Design services*
- *Consumer services*
- *General services*

Follow up list for energy efficiency services

Table 2 ***Cross cutting or enabling services*** *include*

- *Government (regulation, standards, policy, and programs)*
- *Industry (advocacy, promotion, accreditation, professional development)*
- *Higher education*
- *Vocational education and training*

Follow up list for enabling services

Survey questions

b) ***Do you design, manufacture, supply, install, or maintain energy efficiency or high efficiency products, or provide energy efficiency services? These include working on:***

1.	highly energy efficient buildings	Follow up 1 & 2
2.	energy efficiency building retrofits	Follow up 1 & 2
3.	energy efficient building products, building shell products or automation	Follow up 3
4.	energy efficient water heaters	Follow up 4
5.	high efficiency HVAC or cooling for homes or other buildings	Follow up 5
6.	high efficiency heating and cooling systems	Follow up 6
7.	LED or photoluminescent lighting (all considered energy efficient)	
8.	high efficiency motor systems	Follow up 8
9.	communications & monitoring technology to monitor or manage energy	Follow up 9
10.	industrial repair and maintenance aimed at improving energy performance	Follow up 10

1 & 2) Follow up information – highly efficient non-residential buildings

a) A highly energy efficient new commercial building is defined as either 6-star NABERS or Green Star rating or Passive House certified.
b) Major commercial building retrofits either increase the NABERS Energy or Green Star rating by two or more stars or achieve a 6-star rating or Passive House rating.

3) Follow up information – energy efficient building products

a. All thermal insulation
b. All draught proofing
c. Advanced glazing products (double or triple glazing, low-E glass, heat rejecting film)
d. All external shading products
e. Wall cladding with R-value greater than 2 (with no thermal bridging during installation)
f. Thermal roof treatments
g. Lagging of hot water pipes
h. Products designed to prevent thermal bridging
i. Internal window coverings that are either honeycomb blinds, or opaque drapes that have a pelmet or reach the ceiling
j. Phase change materials
k. Swimming pool covers
l. All building energy management systems (BEMS)
m. All software and hardware to enable energy management such as smart phone apps
n. All Demand Response Enabled Devices (DREDs)

4) Follow up information – energy efficient water heaters and associated controls

a. All heat pump hot water systems
b. Solar PV diverters and control systems for water heating
c. Solar water heating (note that this will be categorised as renewable energy employment, not energy efficiency employment)

5) Follow up information – HVAC

Residential energy efficient products are defined as:

a. Mechanical ventilation with heat recovery
b. DC ceiling fans
c. Air-conditioning equipment that meets or exceeds the following E3 Energy Rating:

	Cold zone	Mixed zone	Hot zone
Cooling		5.5 stars	5.5 stars
Heating	4 stars	4.5 stars	

d.

Non-residential energy efficient products are defined as:

d. Variable refrigerant flow/volume systems, or
e. Inverter-based systems having an integrated part load value AEER of 10 or ACOP of 5

6) Follow up information – highly efficient heating and cooling systems

a) All waste heat recovery systems
b) All passive coolers (adiabatic assistance)
c) High-efficiency cool rooms where the building is in receipt of NABERS star rating of 5 or above
d) High-efficiency boilers, chillers or heat pumps where the system is designed with a significant purpose to save energy – self-definition by respondent (in the absence of a standard)
e) All cooling towers or evaporative condensers where the auxiliary equipment power consumption / heat rejection is less than 0.015
f) All evaporators where the auxiliary equipment power consumption / heat rejection is less than 0.06

7) Follow up information – high efficiency motor systems

a) All variable speed drives (VSDs), soft starters, high-efficiency belt drives, gears
b) Electric motors meeting IE4 or IE5 (based on European standards)
c) High efficiency pump systems > 67.5% system efficiency
d) High efficiency fan systems > 57.5% system efficiency
e) High efficiency compressed air systems > 10.6% system efficiency

8) Follow up information – communications and monitoring technology

a) All energy and demand management/control systems, and all systems to maximise the use of behind-the-meter renewable generation
b) SCADA upgrades for improving energy efficiency

9) Follow up information – repair and maintenance

Do you undertake industrial repair and maintenance that is intended to improve energy performance, for instance, that is on a more frequent basis than standard schedules?

Energy efficiency services – further information

Service	Definition
Energy services	Energy efficiency advisory and consultancy, including strategy, planning, and target-setting
	Energy metering, submetering and monitoring with the purpose of reducing energy use or peak loads
	Energy auditing, energy measurement and verification
	Energy management system advice and accreditation
	Energy and emissions reporting and disclosure relating to energy efficiency scheme compliance obligations
Building energy efficiency services	Energy efficiency design, architecture, and engineering related to reducing energy use or thermal loads, or managing peak loads
	Building rating, modelling, certification and assessment related to energy efficiency and thermal performance (e.g. NatHERS modelling, energy efficiency compliance certification, NABERS ratings, blower door testing)
	Building/facilities management relating to optimisation, reduction, and maintenance of energy use, and managing peak loads *Note: requires identification of how much time the facilities managers spend on energy efficiency work*
	Energy efficiency retrofits (these may be part of energy efficiency programs)
Energy efficiency / management schemes	All participants in the energy efficiency, demand management, and energy productivity schemes, including: - Victorian Energy Upgrades - NSW Energy Savings - NSW Peak Demand Reduction - ACT Energy Efficiency Improvement - SA Retailer Energy Productivity - Business Energy Advice Program - Queensland Business Energy Savers Program - Small-scale Technology Certificates (in respect of heat pump hot water systems only) *Note: includes certificate creators, brokers, advisory, installers/field workforce, relevant staff of liable energy retailers/entities, others* *This list will require modification as additional schemes are established.*
	Participants in the Wholesale Demand Response Mechanism *Note: Include relevant staff of WDRM aggregators but not workers at aggregated facilities*
Design services (heating, cooling lighting and information technology)	Building, HVAC, cooling, lighting design relating to energy efficiency or energy management products *Note that these services could be relevant to both professional services (all types of engineering), and in some cases to trades (plumbers, refrigeration mechanics, carpenters and builders)*
	Information technology services, including programming, software engineering, implementation, testing and QA
	Communications services
Consumer services	Production and dissemination of energy efficiency advice and resources to end-users
	Awareness / literacy / training of indirect advisors (e.g. retail staff)
	Supply, advice, or installation of direct-to-consumer energy efficiency products
General services	Research and development of energy efficiency or energy management products or services
	Sales, marketing and promotion of products or services that are specifically aimed at reducing energy use or managing peak loads.

Service	Definition
	Note that this does not include general retail
	Supply chain activities – e.g. sourcing, importation, compliance/market preparation of energy efficiency or management products
	Software packages and IT services for building data analysis

Enabling or cross cutting services further information

Sector	Definition
Government	Energy efficiency policy
	Energy efficiency standards and regulation
	Energy efficiency promotion
	Energy efficiency program administration
Industry bodies / NGOs	Energy efficiency promotion and advocacy
	Professional development, certification and accreditation of energy efficiency service providers
Higher education	Research and development related to energy efficiency and energy management
	Teaching related to energy efficiency and energy management e.g. a subject on energy efficiency technology
Vocational education and training	Trades training related to energy efficiency and management trades and services. e.g.: Insulation installer course, parts of Green Plumbers course
	General training related to energy efficiency businesses or products, e.g. Energy auditor, Continuous Professional Development (CPD) courses
Finance and business services	Finance provision and associated services that relate specifically to financing energy efficiency activities

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