



**AIRAH response to:
Australian Energy Market Commission**

Strategic priorities for the Australian energy sector

Discussion paper

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About AIRAH

AIRAH is the recognised voice of the Australian heating, ventilation, air conditioning and refrigeration (HVAC&R) industry. We aim to minimise the environmental footprint of our vital sector through communication, education and encouraging best practice.

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Executive summary

In Australia, heating, ventilation, air conditioning and refrigeration (HVAC&R) systems are significant consumers of electrical energy. In 2012 over 22% of all electricity generated was consumed by the refrigeration and air conditioning systems that are located throughout the Australian economy. In any discussion on energy market reform, emissions reduction and energy productivity HVAC&R needs special consideration and special treatment.

The discussion paper shows that the Australian energy sector needs to broaden its understanding of who energy consumers are and, more importantly, what their needs and expectations are for a 21st century energy supply service.

Australian energy generators and retailers have a responsibility to their consumers to ensure that the products supplied can be used efficiently and productively in the best long-term interests of the consumer. The industry needs to ensure that consumers understand how to extract the most value from their energy service. This reduces emissions and increases affordability while also providing more security and resilience to the energy market. This will however mean a significant shift in the perspectives and activities of the Australian energy sector.

The Australian energy sector needs to move to become a provider of energy services rather than just a supplier of energy. Distributed energy generation and storage is the new reality for a modern and future proof Australian energy market. The rules and the market will need to change to accommodate rapid change in this technology and practice.

AIRAH recommend the following initiatives to help the Australian energy sector better engage with energy consumers and influence the way they use and consume energy, to improve their energy productivity in their best long-term interests. The Australian energy sector should:

- Recognise that increased productivity and efficiency is a legitimate pathway to emissions reduction.
- Understand that energy consumers are interested in both energy productivity and reduced emissions, and can be informed/motivated to improve their energy performance.
- Take some responsibility for how efficiently and effectively the supplied energy is used.
- Inform and facilitate energy productivity improvements for their customers.
- Develop policy and reward schemes to promote industry investment in distributed energy generation and on-site energy storage systems.
- Develop policy and reward schemes to promote industry investment in energy efficiency interventions in buildings and in refrigeration cold-chain infrastructure.

AIRAH recommend the following activities to the Australian energy sector to help unlock the energy productivity and energy security opportunities offered by the HVAC&R industry:

- Engage with the HVAC&R industry's **PRIME initiative**, to develop and deliver low-emission high efficiency technology pathways for the Australian industry.
- Support and participate in the CSIRO/AIRAH/PRIME **Affordable Heating and Cooling Innovation Hub (i-Hub)** to promote innovation and change in this energy intensive end-user sector.
- Work in partnership with government, industry and end users to help achieve these goals.



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AIRAH response to Discussion Paper

Introduction

Please find the following as AIRAH comments on the issues raised in the discussion paper prepared by the Australian Energy Market Commission (AEMC). AIRAH notes that this discussion paper has been developed to consult with stakeholders to determine the advice that should be provided to the COAG Energy Council on the strategic direction for the Australian Energy sector and the associated work programme to support that direction.

AIRAH recognises that global energy systems are in a significant state of transition. In particular, the transformation of Australia's electricity system is focused on the challenge of integrating prominent levels of Variable Renewable Energy (VRE) into legacy market and grid architectures. Given the asynchronous and highly intermittent nature of VRE generation, AIRAH appreciates that a new range of system security and stability issues arise where VRE are incorporated into legacy systems without a commensurate level of 'dispatchable' demand-side flexibility.

Heating ventilation air conditioning and refrigeration (HVAC&R) systems have a large cumulative impact on the peak demands made of the National electricity grid and the overall energy consumption of the Australian economy. Importantly, the refrigeration and air conditioning value chain represented by AIRAH currently drives up to 50% of Australia's instantaneous electric demand (GW) and (in 2012) represented 22% of all electric energy consumption (GWh), (DSEWPaC 2013).

It is estimated that there are at least 45 million pieces of refrigeration and air conditioning equipment working in Australia. A significant percentage of the energy consumed by these millions of electro-mechanical systems has the potential to be made flexible and dispatchable in response to market signals and incentives. In many cases, the thermal and fluid systems that make up the HVAC&R value chain can also function as a form of 'energy storage' for use in peak demand reduction and/or the storage of excess VRE production.

As such, AIRAH strongly supports the efforts of the Australian Energy Market Commission to provide advice on setting strategic priorities for the sector. Further, AIRAH believes that Australia's HVAC&R value chain could play a very significant role in providing economically efficient means to increase electric system flexibility.

AIRAH has consulted with our membership base, in the development of these comments. AIRAH's members work across all sectors of the Australian economy, from residential heating and cooling systems through to complex HVAC design and construction for larger buildings, through to the cold food chain, industrial refrigeration, health, agriculture and refrigerated transport and storage.

The work of AIRAH's members not only impacts on our own heating, ventilation, air conditioning and refrigeration (HVAC&R) industry productivity, it also has significant impact on the productive use of HVAC&R assets over their lifetime in almost every other industry sector. HVAC&R



technology is used in every facet of modern life including buildings, industry, manufacture, agriculture, cold chain research, education and health to name but a few.

These comments are offered in good faith by AIRAH as a constructive submission in support of setting the Australian energy sector strategic priorities and developing the analytical framework, defining the strategic goals, and outlining the initiatives and work programs needed to achieve those goals.

AIRAH

The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) welcomes the opportunity to work with the Australian Energy Market Commission to help develop the strategic direction for the Australia energy sector; a sector which is central to the productivity and economic development of the Australian community.

AIRAH is an industry-led organisation that represents the entire heating, ventilation, air conditioning and refrigeration (HVAC&R) value chain, from trades people to university-educated engineers and business leaders. This overarching perspective – and reach to more than 25,000 industry participants – positions AIRAH to promote and develop the most efficient, productive and resilient HVAC&R industry for Australia's future.

The 21st century imperatives of emissions reductions and energy productivity present our nation with notable change, challenges and opportunities. It is important that all energy stakeholders come together to meet these challenges, because all have a part to play in the journey towards net zero emissions and in ensuring that individual concerns and challenges are mitigated.

AIRAH wants to work in collaboration with the all levels of government, industry and end-users to improve the environmental performance of existing and new HVAC&R systems. AIRAH believe that increased engagement of the Australian energy sector with energy end users (including HVAC&R end users), either individually or collectively, will be a significant step forward in the Australian emission-reduction journey.

Analytical framework

AIRAH supports the Australian Energy Market Commission suggesting strategic priorities for the energy market and developing the analytical framework, defining the strategic goals, and outlining the initiatives and work programs needed to achieve those goals.

While we understand that the advice provided to COAG Energy Council must be broad, concise and based on a high-level analysis we also recognise that some level of detail must be included to ensure the advice is meaningful and understandable.

One of the main changes that needs to come about is a shift in the thinking of the Australian energy sector away from being just an energy generator and seller towards becoming an energy service provider. The contemporary energy market is not only about selling energy but is also about ensuring that the energy is used safely and effectively and in the best long-term interests of the energy consumer.

The energy consumer is not just the entity that pays the energy bill, we are all energy consumers to some extent and the Australian energy sector needs to broaden its perspective of who the consumer actually is, and what they need.

The energy system is comprised of multiple markets: the wholesale energy market, the retail energy market, and many other markets (appliances, buildings, etc) that deliver the final services for which energy is one input. Many of those 'behind the meter' markets pay little attention to the energy consequences of their decisions, yet they are larger in financial terms than energy supply, and often have major implications for investment and operational issues within the energy sector. Increasingly, behind the meter investment is including energy generation and storage.

In these energy markets, split incentives between owners, suppliers, trades, and end users can significantly distort market signals. For example, wholesale energy markets do not adequately reward some services such as voltage and frequency management, availability to manage peak demands. Retail markets send crude signals to consumers: high fixed charges, flat tariffs etc. that do not reward consumer action. In the refrigerated cold chain, food retailers benefit from reduction in loss of food in the supply chain, but that supply chain must invest and change practices to deliver that outcome, with no guarantee of a financial return.

Clearly energy policy and markets cannot take responsibility for this entire system, but it should engage actively with it, and with policy makers in other areas. It should incorporate into its own pricing structures, and encourage in other policy areas, clear signals to drive optimal investment across the whole energy system. For example, it is common for investors in energy efficiency measures to expect a 30 to 100% pa rate of return on energy efficiency investments. This is much higher than the rates of return expected by energy suppliers. This clearly is distorting the economic efficiency of the Australian economy, through over-investment in energy supply and under-investment in demand side measures.

Proposed suite of goals

Enhance the goals

AIRAH proposes that the proposed suite of goals include the following

Consumers: - The principle that the Australian energy sector generators and retailers should be provided with incentives (and/or penalties) to motivate them to actively engage with energy end users to improve their energy efficiency and energy productivity and to optimise their energy consumption. This could include information, education, facilitation and reward mechanisms as well as research and analysis of the long-term cost impacts of consumer and supply chain decisions on energy and overall societal costs.

Integration of energy/emissions policy – Policy makers need to recognise that government and the energy sector must work in partnership with (not dictate to) other industries and consumers, and collaborate to achieve mutually agreed outcomes.

There should be an objective, within government policy, to reduce the ‘silo’ effect of government departmentalisation which can have government departments working at cross purposes or refusing to act in what is (considered to be) another departments area of responsibility. There are often tensions between energy policy, environmental policy, building policy and health and safety policy. Where there are overlaps these should be resolved by partnership and collaboration.

System security and reliability – The energy market needs to facilitate and enable technical innovation that improves system security and rewards resilience where it is being built-in to systems. Resilience in HVAC&R and resilience in buildings and infrastructure act to improve the stability and security of energy supplies.

Effective markets and regulation – The energy network and market needs to be opened up and regulated so that it:

1. supports distributed energy generation, storage and demand management side action; and
2. reduces its reliance on centralised large capacity generation assets.

A diverse approach to energy generation and storage needs to be regulated for the market to continue to be effective into the 21st century.

Governance – must be developed to provide transparency and support broad industry and consumer engagement. Governance must ensure that the energy sector adopts a holistic approach to energy and emissions. The energy sector has a significant role to play in addressing end user emission reductions and should engage with all energy end user sectors through industry initiatives such as PRIME, through organisations such as AIRAH, ASBEC and through government programs such as the National Energy Efficient Buildings Project (NEEBP) and the National Energy Productivity Plan (NEPP).

Consumers

The discussion paper frequently refers to consumers largely in terms of the residential energy market. Although the paper recognises that consumers can be residential, commercial or industrial most of the discussion points relate to residential consumers only, with a particular focus or emphasis on consumers understanding retail contracts and retail power pricing plans.

The reality is that the consumers of energy are in many cases non-residential small and medium sized enterprises (SME) or very large industrial consumers, all of whom have that have diverse needs and very different characteristics to residential consumers. These SMEs operate within complex supply chains, in which split incentives, use of market power by large firms, lack of access to global best technologies and other distortions lead to non-optimal outcomes.

Given this AIRAH believes that the discussion paper oversimplifies the needs of energy consumers by bundling all consumers under one single category. Energy consumers exist across a wide range of industry segments, each with different behaviours, needs and response triggers. The energy sector needs to become more sophisticated and nuanced in its approach to energy consumers. (One example of more sophisticated customer segmentation is provided by the [CSIRO/ ENA Electricity Network Transformation Roadmap, Interim Program Report – Chapter 1](#)), (ENA 2015).

Yes, consumers need to be able to understand retail and wholesale pricing and the advantages and disadvantages of the various industry offerings, but they also need to understand so much more in relation to how, when and why they consume energy. The industries that advise, supply equipment and finance consumer action must also have a 'place at the table' to ensure appropriate price signals and policy is implemented within the energy sector.

Consumers and decision-makers (who may be consumers, specialist staff within consumer firms, or external advisers, suppliers or specialists) need to be able to understand energy use, how they are using energy, how and where they are potentially wasting energy and how to improve their energy productivity, either by improving efficiency, reducing consumption or by optimising their energy supply/demand characteristics.

Energy generators and energy retailers currently supply electrical energy to consumers without ensuring that their consumers understand how to use the product efficiently. Energy supplies that have a significant carbon component (i.e. non-renewable supplies) can be environmentally harmful and the industry has a responsibility to ensure that energy consumers are not inadvertently causing themselves or others harm through their energy use and consumption profile. The main ways this occurs is via energy wastage caused by system inefficiencies (technology) and sub-optimal behaviours (human).

The Australian energy sector needs to understand that price is not the only consideration for an energy consumer and indeed in some instances a higher energy price can be acceptable if it is combined with reduced energy consumption and increased energy productivity leading to an overall reduction of energy cost. Stability of price as well as reliability of service delivery (which may not involve reliable grid energy supply) is also important for businesses and households to plan investment decisions that drive long-term energy demand. Emissions and emissions reduction is also a significant priority for some energy consumers.

AIRAH strongly disagree with the proposition that emissions reduction is not a high priority for energy consumers. While overall cost is typically the highest consumer priority, the associated emissions (or carbon content) of the energy is also a significant consideration for many consumers. Consumers generally want the carbon emissions optimised as well as the cost, productivity and reliability of their energy supplies. In any case, carbon emissions are a societal priority as reflected by Australia's international commitments.

Government, the energy sector and energy consumers need to begin to look at energy more holistically and with a view to optimising energy productivity rather than focussing solely on energy pricing.

Integration of energy and emissions policies

AIRAH strongly support the integration of energy and emissions policy.

Uncertainty in Australian Government energy and emissions policy, which includes poor incentives and misalignment of drivers/motivation for building and refrigeration infrastructure energy efficiency and a very low focus on actual building/system energy performance are significant barriers to investment.

The Australia Government Direct Action policy and the associated Emission Reduction Fund (ERF) is not readily open to the participation of the commercial or residential building sectors or the commercial refrigeration sector, largely due to the requirements of the scheme for aggregation (over time and sites) to meet minimum bid sizes.

Good policy must be made based on evidence. In our world of HVAC&R, the refrigeration technician has a significant role to play in emissions reductions, as does everyone in the "system" supply chain. Few people within government policy departments understand the coal face evidence well, they don't understand the behaviours exhibited at the coal face by technicians and end-users, and no one has worked out how to change the emissions reduction story so that behaviour change is not seen as a challenge but rather as an opportunity.

The key elements of an integrated energy and emissions reduction policy to support investor confidence would include:

- Transparency – including genuine cost benefit justification and state clear objectives;
- Strong technical background – Provide the technical justification and don't leave implementation to be worked out;
- Good information – unbiased and honest information is key to investor confidence and government is often reluctant to talk in plain English;
- A focus on measurement helps to ensure program success. Does the project actually reduce emissions and on what basis? Measurement and reporting protocols must be transparent.
- Collection of quality data at all stages is key to developing robust tools that can better estimate future program costs and benefits;

- Publication of program learnings and insights (what works and what doesn't work) is essential if the impact of a particular policy or action is to extend beyond the life of the program.

The incentivising and support of distributed energy generation and storage is an immediate strategic policy action that can be taken. Buildings and industrial infrastructure should now be viewed as energy generators and thermal energy storage devices rather than solely as energy consumers. The reality is that in the future many buildings will become micro 'gentailers' and will have the capacity/need to generate energy, store energy, sell energy locally, consume energy and purchase energy.

Correct building-energy policy should see:

- Buildings becoming more energy efficient, more productive and less costly to operate;
- Buildings becoming more resilient and helping local electricity distribution networks to become more resilient;
- Planning regulations that consider buildings at the precinct or community level;

System Security and reliability

The discussion paper does not adequately address the system security issues associated with large-scale synchronous generation assets. These assets typically have a large electricity generation capacity concentrated onto a single site. These sites and their grid connections are potential weak points when it comes to assessing risks associated with natural disasters or man-made misadventure. Large scale generation assets can be viewed as a network weak link or security soft target within the energy system.

These security risks can be offset by increasing the amount of distributed energy generation within the network and increasing the amount of energy storage outside of the network.

There is also scope to adapt end-user equipment and appliances to improve power factor, frequency and voltage control and to help consumers to protect themselves from variations in these factors of grid supplied energy

Effective markets and regulation

Australian emission reduction goals apply constraints within which the energy market and power system must be operated and maintained. This is a known truth and represents a growing reality for energy generators and retailers. AIRAH believes that individual, corporate and governmental emission-reduction goals will also start to apply constraints on how energy is used, or on how effectively energy is used.

The contract market should provide incentives for investment in energy storage at the point of energy end use as well as dispatchable sources. Diversity in capability always improves reliability.

Australia's electricity transformation is seeing an increasing proportion of VRE assets being privately owned and located on the customer side of the meter. In such a context, and especially

in a free market economy like Australia, the role of markets designed for valuing, monetising and incentivising the ‘dispatchability’ of privately owned demand response and energy storage assets is key to long-term system stability and efficiency.

In the case of the industrial, commercial and residential thermal and fluid systems that make up Australia’s HVAC&R value chain, many of these can be made to function as an economically efficient form of ‘energy storage’. Where a sufficiently sophisticated market architecture exists, millions of HVAC&R systems may be made dispatchable, able to provide firm, targeted benefits at the wholesale, transmission and distribution levels of the electric system.

For example, industrial cold storage or commercial air-conditioning may both be made dispatchable to achieve targeted peak demand reduction, either at the national or local levels. The same dispatchable functionality may also be enacted at different times to ‘absorb’ excess VRE production and avoid electric system instability. In the case of residential and SME air conditioning and electric hot water systems, both peak demand reduction and excess VRE absorption can be provided today by appliances compliant with Australia’s ground-breaking AS/NZS 4755 series of standards. Where implemented, AS/NZS 4755 enables tens of millions of new and existing high-demand loads to be converted into dispatchable resources -- all that is lacking in many jurisdictions are effective market incentives and remote dispatch systems.

The market should provide incentives for demand-side resources to be built and/or retrofitted. End users can hedge against their exposure to economic (price) fluctuations in the energy market by investing in energy storage (electric or thermal), onsite or local renewable energy generation assets and even co-generation or tri-generation capabilities at the site or precinct level.

The Australian energy sector needs to both educate and facilitate end user consumers, and equipment and building supply chains and related policy makers, in this approach, to deliver these investments in energy systems, possibly in partnership.

Incentives and work programs

There are a range of incentives and work programs that the Australian energy sector can apply to help the sector achieve the stated goals. These could include

- The adoption of innovative technologies and practices to provide an energy uplift to existing buildings and refrigeration infrastructure.
- Addressing peak energy demand in end users to promote system security and energy affordability.
- Programs to address the barriers to energy efficiency and HVAC&R efficiency in particular
- Programs to facilitate improvement in consumer energy productivity, to reduce energy consumption without any loss in associated service.
- Engagement with the HVAC&R industry PRIME initiative – pathways to a low-emission future.
- Engagement with the AIRAH/CSIRO/PRIME i-hub affordable heating and cooling initiative to help develop innovations in technology and practice.

Governance

Good policy must be made based on evidence.

The incentivising and support of distributed energy generation and storage is an immediate policy action that can be taken.

New planning frameworks are needed to help planners to consider buildings as energy generators and energy storage devices. There is a need to move away from the idea of buildings as stand-alone assets, with town planning playing a significant role in ensuring for instance that waste heat can be usefully used to offset other energy needs.

Technical frameworks should be developed to support energy retailers to help energy consumers reduce loads and overall consumption including technical and financial assistance to promote tuning and recommissioning programs for existing buildings. HVAC&R demand management programs can also be used to manage peak loads and their impact on the electricity grid.

Resilience should also be a key consideration. One energy policy goal could be to turn every building into a distributed energy generation and storage device and incentivise every building to be as energy efficient as it can be. In Japan, for example, many new buildings and communities are designed to cope with several days of grid failure. The New York region is also shifting to microgrids to enhance resilience to extreme weather events or other disruptions.

Both of these jurisdictions have learned from harsh experience the benefits of resilience.

Emission reductions

There are two sides to the emission reduction story that the Australian energy sector needs to address:

1. The emissions that are physically created when generating and delivering the energy flows; and
2. The emissions that are realised when that energy is used.

The Australian energy sector must direct attention and action to emission-reduction strategies for both sides of the issue.

The discussion paper recommends that emission reduction activities applying to the energy sector be clearly identifiable within the broader national emission reduction objectives. AIRAH recommends that the energy sector should be encouraged to not only address emission reduction in electricity generation but also emission reduction in energy use or more specifically the energy productivity of individual energy end users and consumers.

Energy affordability

In the perspective of the energy consumer or end user, energy efficiency or energy productivity is the key to managing energy costs and ultimately energy affordability.

Consumers need to be informed not only of the cost of their energy but also of the productivity outcome, they need to know how to make the most efficient service out of the energy investment. They must have access to information that is useful in making the best energy choices including benchmarking their energy use against their peers and networks.

Many energy consumers use more energy than they need to and are not even aware of it. They have no tools that are accessible for benchmarking their energy usage against good- or best-practice levels. Consumers need to be educated in methods for the reduction of energy consumption without sacrificing productivity or comfort, this includes methods for increasing energy productivity and efficiency.

The discussion paper takes a too-limited view of energy affordability in that it centres solely on energy price and efficient contract structures for consumers, but energy use and consumption and energy waste is also an important affordability consideration. Reducing energy consumption without reducing service levels acts to increase energy affordability. Consumers with affordability issues are usually those that have the least access to information on energy productivity benefits and the least ability to invest in energy saving initiatives.

The energy sector should engage with energy consumers on energy productivity and this could be through existing and new energy saving certificate schemes operated by state governments.

Energy sector and consumer energy productivity

At the surface level it would seem incongruous to require the energy sector to facilitate consumer energy productivity. Energy companies want to sell as much energy as possible to end users are generally not concerned with what happens “behind the meter”. This principle is deeply imbedded in the Australian energy sector, that energy companies need to maximise energy sales to each consumer. For a 21st Century industry this thinking needs to change. While the Finkel Review (Rec 6.10) sees ‘energy efficiency’ as a job for governments, it does see demand response as an area for the energy sector.

Just as the refrigeration and air conditioning industry is help end-users consume less refrigerant so the energy sector needs to help its end-users to consume less power. Energy companies need to start providing a holistic energy service as opposed to simply selling units of energy as a commodity.

At first glance it may seem counter-intuitive to put the energy sector in charge of helping energy users consume less energy. Yet this happens in other economies – e.g. California. This also relates to the National Electricity Objective. AIRAH believes that energy generators and energy retailers are well placed to facilitate consumer energy productivity for the following reasons:

1. They understand energy, it is their business;
2. They have the energy use data for each of their customers, they often know more about their customers energy use than the customers themselves
3. They know the specific and local energy consumption patterns, and where many of the demand side opportunities lay
4. They are well placed to provide interventions at their customers sites
5. They already have a responsibility to ensure their customers know how to use their energy effectively, productively, and in their own best long-term interests.
6. They have the resources to co-ordinate information and action

Energy and peak demand

Heating, ventilation, air conditioning and refrigeration (HVAC&R) systems have a large cumulative impact on the peak demands made of the National electricity grid and the overall energy consumption of the Australian economy, (see the graph below from the Residential Energy Baseline Study). This is also evidenced in the Australian Alliance for Energy Productivity Cold Chain optimisation report, (A2EP 2017).

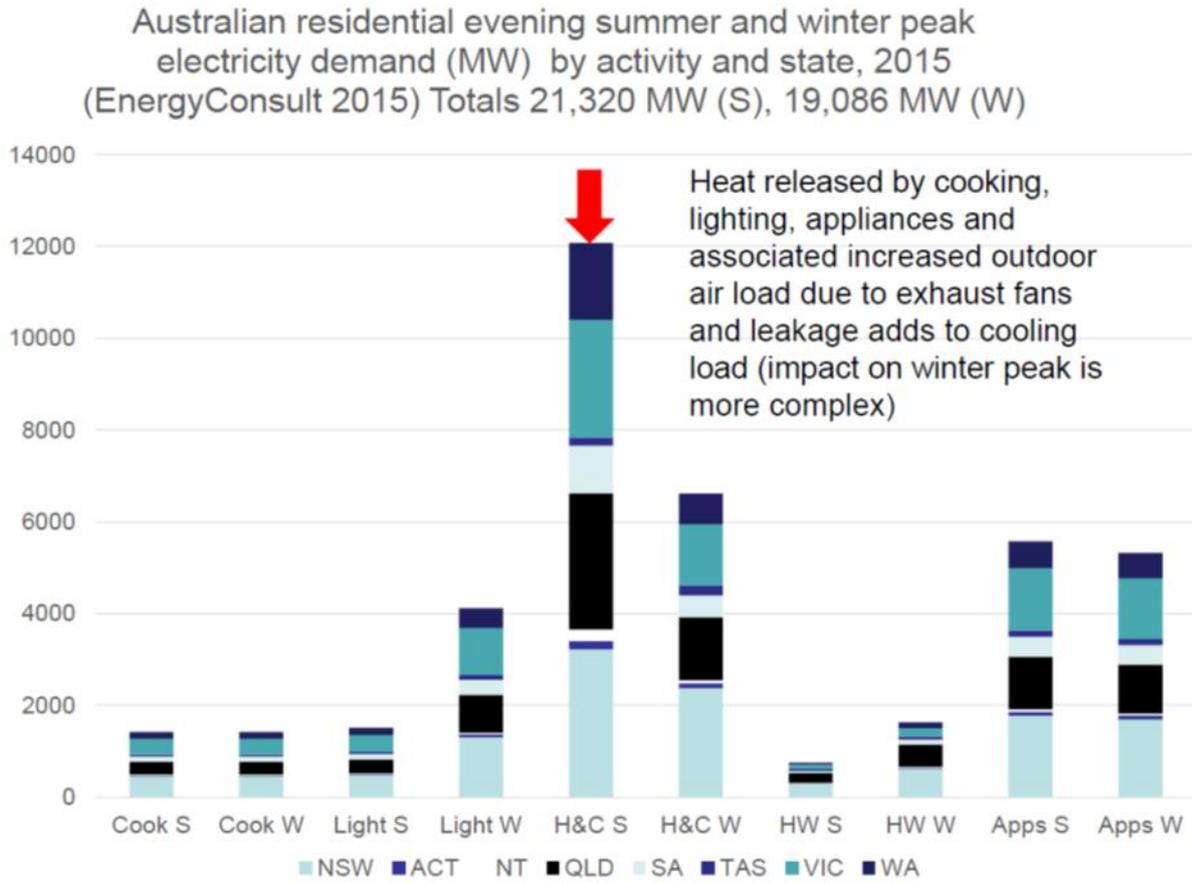
AIRAH considers that one of the most cost-effective energy interventions that can be made would be to incentivise and encourage the property sector and cold chain participants to better manage refrigeration and air conditioning infrastructure peak demand and the energy costs and emissions associated with these end-use sectors.

The main conclusions are that:

- Lowering peak demand by improving HVAC&R plant and systems is very achievable.



- Where you have aged existing plant, central plant performance (COP) up-lift makes the most sense for property and cold chain sectors.
- Building and system tuning is a good approach, although it is often hard to implement successfully for non-technical reasons.
- The correct design and application of thermal storage could significantly improve market penetration of these facilities.



Distributed energy generation and storage

While the discussion paper does mention distributed energy, in particular the current trends for increased distribution energy generation and the resulting issues this poses for the energy market system, there does not seem to be an appreciation in the paper of how much this trend will change the energy market or any move to embrace or support and strengthen this trend.

An increased and reliable distributed energy generation and storage system, that is properly integrated into the national grid, will act to solve many of the problems that have been identified with moving away from large-scale synchronous generation assets.

Similarly integrating energy storage with large scale intermittent renewable energy generation assets will mitigate many of the issues associated with intermittent generation.

Because the generators are changing, the distribution network and the energy market will also have to change. It is unrealistic to retain the current market structure in the face of these wide-spread changes.

Energy storage

Energy storage can be either thermal (storing energy in purpose built tanks or in the structure) or electrical (storing energy in batteries or in the fuel tanks of supplementary local generation systems). There are opportunities to integrate thermal and/or electric power storage systems into buildings. However, leasing arrangements may present barriers to owners relinquishing control (of IEQ related systems) to third parties.

Thermal storage - Refrigerated warehouse and storage is an untapped sector when it comes to demand response strategy. These facilities combine large electricity demand with in-built thermal storage capability and they may provide a significant opportunity where circumstances align. Thermal storage can also be (relatively easily) retrofitted onto a range of conventional HVAC&R systems.

Electricity storage – retrofitting electric battery banks or standalone electricity generation systems to support buildings and systems is possible. Batteries are a simpler approach than generators but both need to correctly match the system supply and building demand curves. An important and emerging capability is applying energy storage technologies to improve the ability of renewable energy generation systems to meet the demand curve.

New technologies

There are many technologies available today that can significantly reduce building cooling and heating energy consumption. Reduced energy consumption and particularly reduced cooling demands on hot days can significantly improve energy supply reliability and security. New and innovative cooling and heating technologies, building integrated renewables, thermal storage and phase change materials will all impact the market in the future.

Innovation to address energy consumption has the potential to significantly reduce costs to consumers. Innovation, training, skills maintenance and continuing professional development are the key ways to ensure that new high-efficiency and low-emission HVAC&R technologies are adopted and applied effectively and safely. Continuous improvement in this highly technical field also requires a strong research impetus.

Without a concerted effort to provide effective training to all stakeholders, including suppliers, manufacturers and end users, new technologies and innovative approaches will be seen, by the mainstream of the industry, as attracting increased risk.

Training and familiarity reduces risk or reduces the perception of risk.

Energy consumption in HVAC&R

Energy and particularly electricity is at the heart of HVAC&R technologies. Refrigeration and air conditioning consumed more than 22% of all grid produced electricity in Australia in 2012.

Motors move air and water around distribution systems, compressors in refrigeration and air conditioning plant turn 1 Watt of electric power into 4,5 or 6 Watts of heating or cooling power. HVAC&R can be incredibly productive and efficient but there is also a lot of potential and realised energy wastage associated with these services.

HVAC&R will often continue to operate and provide the cooling or heating service even when operating very inefficiently and wasting energy. Energy wastage leads to reduced energy productivity and increased emissions.

Energy consumption in the property sector

Australian buildings consume considerable amounts of electrical energy and are typically responsible for the peaks of energy demand. Energy use in buildings is significantly driven by heating and cooling loads and the associated heating, ventilation, air conditioning and refrigeration (HVAC&R) plant. The energy sector, property sector and HVAC&R sector need to collaborate and play a leading role in helping Australia to meet our agreed greenhouse gas reduction targets and improving energy productivity.

Through three key activities; (1) more efficient buildings, (2) more efficient systems combined with (3) cleaner low-carbon energy sources, the emissions associated with HVAC&R, buildings and the cold chain can be dramatically reduced.

Monitoring and improving the energy performance of existing buildings and existing HVAC&R systems is a key action to help reduce peak demand, improve energy security and improve the reliance of buildings and the electricity grid and infrastructure.

The Australian energy sector needs to engage with, and facilitate, owners of existing buildings to address and optimise electricity demands. Buildings need to be viewed as energy generators (power stations) and energy storage devices that can be used to reduce peak demand on grid infrastructure.

Building energy efficiency

Commercial and residential buildings are a major source of greenhouse gas emissions, creating around 23 per cent of Australia's national emissions through their energy consumption. This consumption is split approximately 50:50 between residential and non-residential buildings. The Australian Bureau of Statistics estimates that around 60% of Class 1 residential buildings in Australia are air conditioned to some extent. For commercial buildings the number is more likely to be close to 95%. Refrigeration, space heating and cooling, mechanical ventilation and hot water delivery are all significant energy demands generated in buildings, typically amounting to 40 to 60 per cent of a building's total energy use. Building energy use therefore has a direct and marked effect on Australia's energy performance and emissions targets.

Improving building energy efficiency is a way for households, occupants, commercial building owners, and small and large businesses to reduce energy bills.

AIRAH have collaborated with other members of the Australian Sustainable Built Environment Council (ASBEC) to deliver the **Low Carbon High Performance** report which shows that cost-effective action across the property sector could deliver a 23 per cent reduction in Australian building sector emissions by 2030 and a 55 per cent reduction by 2050. (ASBEC 2016)

AIRAH encourages the ASBEC-recommended Energy market reforms to ensure that the energy market supports roll-out of cost-effective energy efficiency and distributed energy improvements, including thermal energy storage and distribution, and a range of supporting data, information, training and education measures to enable informed consumer choice, innovation, commercialisation and deployment of new technologies and business models.

AIRAH are also working with a range of stakeholders to establish a plan of action for energy efficiency improvements in existing mid-tier buildings. The plan intends to accelerate improvements to mid-tier buildings and harness their emissions-reduction potential through the following activities:

1. Supporting further research to better understand the number, location, size and performance of mid-tier buildings.
2. Develop a Building Retrofit Toolkit, to bring together existing resources and tools and create new ones based on confirmed gaps and needs, together with an informed communications plan for building owners and their trusted advisers and service providers.
3. Advocate for the expansion of initiatives such as the Commercial Building Disclosure program to apply to smaller buildings and other non-office building types.
4. Promote innovative financing mechanisms and Government/industry incentives to encourage existing building upgrades and retrofits.

AIRAH are also supporting the National Energy Efficient Buildings Project (NEEBP) series of projects and support the proposed NEEBP strategies for change. This includes the development of requirements and training for designing and constructing air-tight buildings and for validating construction quality using building pressurisation testing.

Barriers to investment in energy efficiency

To help explore the opportunities we must first consider the barriers to change.

Investor confidence

Investor confidence in the clean energy sector is low. Incentives applied should switch from incentivising fossil fuel resource development to incentivising renewable energy technologies and developing new technology and innovative approaches to improving energy productivity within all energy end uses.

Language and understanding

Language and understanding is often a key barrier. Stakeholders on one side of the energy meter, (e.g. energy generators and technical service providers) don't understand the language, drivers and problems of the HVAC and other energy users on the other side of the meter. Stakeholders in the electricity supply industry all the way through to the electricity end user don't understand (or want to understand) the language and issues, and they don't know how to influence change back up the supply chain and how to influence government policy.

Barriers to low emission HVAC&R

The comparatively low cost of energy, when compared to other business costs such as salary and inventory, is often a prohibitive factor in end user acceptance of energy efficiency interventions or energy saving HVAC&R equipment investments. Energy costs are accrued over extended time frames, while equipment and building costs are seen 'up-front' (even when they are financed). For example, the lifetime energy use of an electric motor is far greater than its purchase cost, but is not visible. Maybe we need to be suggesting a requirement that equipment suppliers provide 'lifetime energy cost' information at time and point of sale?

The drive for lowest 'first-cost' construction in property development is also a barrier because good life-cycle solutions are not considered by developers or their designers. There is also a split incentive between the developer or builder and the owner or operator because the entity that pays for the innovative low-emission solution is not the same as the entity that benefits from its installation.

While the construction industry is evolving in this regard, there is still a significant divide between high end premium buildings and lower-cost/quality developments. The mainstream of the construction industry overall does not like change. There is a preference to deliver tried and tested solutions rather than adopt innovative solutions and a general tendency to "do it the same way as we did it for the last project". This can be attributed to economic and time related budget pressures as well as a general tendency for the industry to be risk averse and time poor. Change needs to be incentivised and the Australian energy sector has a role to play in this.

Actions the Australian energy sector can take

Role of the Australian energy sector - Potential energy interventions

There are a range of well-understood interventions that can be made to address building energy consumption and the productivity of energy use within the built environment.

The Australian energy sector could facilitate and leverage these types of interventions to improve their customers energy productivity.

Improve consumer energy productivity and reduce energy waste

There are several straight forward strategies that the Australian energy sector could employ to improve energy productivity and reduce energy waste. AIRAH have recommend the following strategies to help reduce peak demand, in order of preference –

1. Incentivise building owners to upgrade central plant (chillers and boilers) based on installing new plant with a high/very high coefficient of performance (COP) and/or integrated part load value (IPLV). This is a simple change-over program where the new plant purchase is incentivised by a grant.
2. Incentivise and facilitate building owners to have an energy audit completed for their building and provide independent support for the owner to help them interpret and use the audit findings to procure either capital upgrades or building tuning programs.
3. Incentivise or subsidise capital plant upgrades for targeted sectors following the building audit. In some cases, the provision of financial incentive grants (% of the costs) for a building owner to upgrade their building to provide demand reduction and/or energy efficiency improvements can produce a very cost-effective demand reduction strategy.
4. Encourage the market in the uptake/delivery of building services maintenance practices for the purposes of improving energy efficiency/productivity of the building asset. There is a “maintenance for energy efficiency” value proposition here that is not understood at all by building owners.
5. Signal the market on future increases in mandatory energy disclosure requirements for buildings and start to develop the tools needed to support the expansion of mandatory disclosure of energy performance,

Energy efficiency incentive schemes

The Australian energy sector should collaborate with governments to create a National Australian market for the white certificate/energy efficiency certificates generated by state/territory based energy efficiency schemes such as; NSW ESS and Victorian VEET scheme, ACT scheme, and SA scheme. These schemes are being opened up to energy savings derived from refrigeration system replacement, refrigeration system upgrades, building tuning, retrocommissioning and in particular HVAC&R optimisation, providing an incentive to owners to save energy.

The Australian energy sector should collaborate with governments to share these tools and methodologies to create a single harmonised white certificate/energy efficiency certificate scheme that can be applied to energy savings in HVAC&R and buildings/facilities anywhere in Australia.

Supporting innovative technology and practice

The Australian energy sector can help promote innovation in building heating, cooling and freezing technology and practices by sponsoring programs that evaluate innovative HVAC&R technologies. Innovation in HVAC&R in Australia has led to successful small businesses start-up and niche manufacturing opportunities. Small businesses often need incentives and financial or resource assistance to make the jump to some new technology or process. For optimum effectiveness HVAC&R technology demonstration and evaluation projects should:

- Include direct approaches to property/asset owners, to determine the level of interest and the window of opportunity for potential innovative technology projects.
- Work with property/asset owners and HVAC&R consultants to decide which innovative solution(s) would be most suited to particular situations.
- Ensure that potential projects and their funding requirements are individually assessed by independent HVAC&R consultants.
- Ensure that the outcomes from the projects are individually verified and evaluated by independent HVAC&R consultants, and the information is shared with the wider industry (warts and all).

With this approach property/asset owners would install the most appropriate new technology, while clearly understanding the risks involved. Over time property owners and technical service providers would become comfortable with the new approaches, and be more open to incorporating these new technologies and practices within their new projects.

Demonstrating changes in attitude is often as important as demonstrating the technologies themselves, particularly in the risk averse construction industry. The measurement of costs and savings by independent consultants would generate the accuracy of information required.

Living laboratories for product testing, development and evaluation are ideal environments to help prove and improve new technologies. Learnings must be consolidated and shared for maximum impact.

Building tuning and re-commissioning interventions

From an energy efficiency perspective, the first best investment in building energy productivity is always in building and systems tuning - making the best of what you already have (Mills 2009). Getting existing plant and systems to work together properly can also have a positive effect on reducing peak electrical demand on degree cooling days and, in the southern climate zones, gas demand on degree heating days. Simple pay back for these types of activities, from electricity usage reduction only, is typically 0.5 - 1.5 years. The process takes a couple of seasonal cycles to fully make the changes and bed them in. Whilst there are always quick wins the challenge is always building-in the changes, i.e. perpetuating the savings into the long term.

For a range of reasons (good and bad) getting a building and its energy consuming systems tuned is challenging for the owners and operators.

For one thing, it's hard to sell. Building tuning is somewhat ephemeral – you can't touch it and feel it like a new piece of kit, it's a promise, and it is iterative and, while it is based on very empirical activities, it is not a precise science.

In addition, the property industry is not exactly over-stocked with people who can apply building tuning programs effectively, let alone sell the concept to owners. It is often difficult to find practitioners with the appropriate skill sets.

Building tuning is not always straightforward to deliver, in practice:

- There ends up being several stakeholders to line up before a successful program can be undertaken.
- It is not something your normal HVAC maintenance provider does.
- There are often several players, including the BMCS provider, that must be engaged in a 'collegiate' fashion, for a successful program.

Rarely is a building 'ready' to be tuned, there is almost always some degree of (relatively minor) investment needed in setting up the BMCS so it can be tuned (access to information/diagnostics and access to control/code etc. to make changes). BMCS are usually installed and commissioned to 'run' the systems not as tuning tools.

In Australia, Sustainability Victoria's Energy Efficient Office Buildings (EEOB) program demonstrated that the savings potential in mid-tier office buildings is significant, real and feasible. The report *Energy Efficient Office Buildings: Transforming the Mid-tier Sector* by Sustainability Victoria (2016) showed that across the program's 20 participating Victorian buildings, average benefits included:

- 29% reduction in energy use;
- A 1-star NABERS Energy rating improvement;
- Less than 3-year payback on efficiency investment.

Overall, the program is estimated to deliver the following:

- Over 4,000 tonnes CO₂ emissions reduction over a 12-month period;
- Over \$1.1m in savings in energy bills per annum;
- Over \$10m in co-investment from building owners;
- Over 90 jobs.

Broadening these types of programs to more buildings and diverse types of buildings can generate significant energy savings and economic activity.

Existing building tuning and recommissioning programs are becoming more common, and some jurisdictions in the USA have mandated existing building tuning of large commercial buildings through government regulation, (e.g., City of Seattle, Office of Sustainability and Environment, Director's Rule 2016-01, Implementation of Building Tune-Up Requirement). (City of Seattle, 2016).

Seattle's Building Tune-Ups policy phases in a periodic tune-up requirement for non-residential buildings 50,000 square feet or larger (excluding parking), beginning in 2018, with buildings 200,000 square feet or greater due first. Tune-ups aim to optimize energy and water performance by identifying no- or low-cost actions related to building operations and maintenance, focusing on actions that typically pay back within 3 years and generate 10-15% in energy savings, on average.

Energy analysis and diagnostics

Buildings and associated HVAC&R will often continue to operate and provide the service even when operating very inefficiently. What is needed is an assessment (energy audit or building tuning assessment) by a technically competent person to show where energy is currently being used, where energy is being wasted and why and what are the potential solutions including the costs and benefits of particular selected interventions (tailored to the owner's objectives).

The results of the assessment can be used by owners but could also be used by government to identify the worst performing buildings/sectors for further targeting of incentives and policy.

System plant replacement

In many existing buildings and refrigeration systems the central plant at the core of the systems are old and outdated. Upgrading and replacing outdated inefficient equipment with new high-efficiency equipment can provide significant energy productivity improvements with limited disruption. Any plant replacement should be considered in association with potential cooling/heating load reduction strategies.

Maintenance for energy efficiency

In many sectors, the application of maintenance strategies to target building services and refrigeration operation and performance is not well adopted. Applying maintenance strategies - cleaning out the filters, cleaning coils, tubes and heat exchangers, monitoring key performance indicators and assessing energy use - all with the purpose of addressing annual and peak energy use is a very beneficial activity and can help reduce demand.

This is potentially the quickest way to reduce peak demand, to make sure the HVAC&R plant is clean and actually working optimally so that the required indoor climate conditions can be achieved with lower and minimal energy input.

Reducing direct emissions from HVAC&R through better maintenance and improved system design and operation also improves energy efficiency, delivering a range of other benefits, including increases in asset values, improvements in worker productivity, process productivity, occupant health benefits, and importantly, improved building resilience, as buildings and industrial facilities become less reliant on energy and HVAC&R.

Without further targeted action, however, emissions from the HVAC&R sector are expected to increase, as this industry grows and the focus on efficiency is sacrificed in return for reductions in initial capital costs.

AIRAH and the HVAC&R industry have ideas and expertise that can generate tangible solutions for the future. We have already been an effective participant in this space.

Smart buildings have great energy productivity potential, however if any innovation or technology initiative is going to gain acceptance in the mainstream industry, it needs to make commercial sense to main-stream development. There needs to be trusted information made available to end-users with regards to the potential costs and benefits. Presently there is a tendency for sporadic but notable energy efficiency achievements in the refrigeration sector to remain hidden from mainstream industry.

Proper scientific assessment combined with realistic economic analysis are necessary to provide the input data for any study/recommendation/measure. The Australian energy sector could provide funds to support these studies which should be undertaken by independent specialists/organisations.

Identifying and maintaining appropriate levels of expertise and professionalism in the construction industry to ensure targeted performance of buildings is achieved is a significant challenge. The key aspect of a building performance measure is “is it measurable”. The building regulations must enforce a measurable set of performance criteria that can be used whether the building is 12 months or 30 years old.

Demand reduction using air conditioning and refrigeration

Because they represent significant energy end use demands, air conditioning and refrigeration systems, particularly when combined with thermal energy storage, can also be used to manage peak load impacts on the local, regional and national electricity grid.

Potential peak demand strategies

Demand response (switching things off) and energy storage (deferring the need or powering from onsite electrical storage) are the two main strategies that apply to reducing a building’s peak demand.

Demand response

The discussion paper identifies the current ‘low level’ of demand response capacity in the national electricity market when compared with the level of price-responsive energy loads.

Demand response means turning refrigeration and air conditioning systems off (or down) at the time when electricity demand is approaching its peak level. There are a range of technical strategies that can be used to extend the period for which the systems can be turned off including pre-cooling and passive storage. Alternatively, instead of turning off systems can be adjusted to consume less energy than they normally would in the same time period (e.g. by adjusting operating set points).

Normally the demand response adjustment is made remotely by the electricity retailer. Large capacity systems such as commercial office block air conditioning chillers and refrigeration plant in cold storage warehousing needs to be targeted using different strategies than would apply to smaller packaged and split air conditioning and refrigeration systems. Commercial chillers and

large systems can be targeted directly but smaller systems need a more broad-scale approach (possibly through electricity retailers).

In demand response strategies time of use is critical, the strategy shifts the time of use away from the peak demand time thereby limiting the peak load. For example, a scheme whereby building systems pull the temperature down low and then turn off by say 3.00pm (by the time the building heats up again the occupants may have left). The strategy does not necessarily save energy or greenhouse emissions but shifts the time of use thereby limiting peak load.

Very few HVAC systems are currently set up for this and demand reduction is not commonly applied in the building sector. Several energy retailers have carried out (limited) technical trials with this approach.

HVAC&R technology in buildings and refrigeration infrastructure is ideally placed to facilitate the development of a broad, diversified and distributed demand response capability in Australia. The Australian energy sector could facilitate, in partnership with energy consumers, demand response programs that reduce energy cost, improves supply side reliability, and improves the resilience of the energy distribution network.

Facilitation activities could be in the form of:

- Information – freely provided to energy end users/consumers on the why and how of energy efficiency and energy productivity.
- Technology – subsidies for optimum equipment, feasibility and demonstration studies, encouragement of innovation
- Price - rebates and rewards to recognise the benefits.
- Contracts – agreements, rules and arrangements to generate and support the behaviour change

Demand response systems can be combined with energy storage to broaden the application outcomes.

Central plant replacement incentives

All plant gets replaced at end of technical life and sometimes at end of economic life. What an incentive program can do is move the economic life forward to get accelerated change. The Green Building Fund was a very effective example of that approach, and the 'new chiller' was often the favoured project of that program. That program materially and measurably improved the COP of many Australian commercial office buildings in a very effective and efficient way.

In terms of potential market interventions for the mid-tier and refrigerated warehouse sector to bring economic end of life forward, get an uplift in energy efficiency and a reduction in connected load it is this type of scheme that would be most successful. Something canted towards chiller replacement. The intervention needs to be simple and not tied to post installation bona fides, i.e. complicated measurement, verification and normalisation protocols. Post installation M&V is more complicated than it appears and a real barrier to uptake. Verification could be linked to NABER's ratings, most buildings have one and if they don't it's not an expensive exercise to get one. The program could also be linked to demand reduction or management capabilities, as modern plant often comes with these capabilities (either standard or as an option). Previous

experience with this type of intervention, where the chiller replacement is the first thing done, is that it seems to encourage further investment in improvements not less. It is in effect a positive learning exercise for those involved and almost always a success.

The challenge with this intervention/incentive is Government requirements for probity and proof of additionality and the lack of sophistication in the mid-tier space with respect to identifying and then successfully applying for grants and delivering the project outcomes. There would need to be an element of 'Goodwill' about the program and protocols to 'means test' it applied to ensure it wasn't soaked up by the top end of town as the Green Building Fund was (by design). Potential applicants may need to be coached or assisted in the application process (which should not be seen by owners as a barrier).

The capacity of companies already doing replacements or retrofits is an important issue to consider in any program, as are the technical credentials of those eligible to do the work.

Energy audit and decision-making support

For buildings using more than a specified kWh/annum energy use, the Australian energy sector could provide a subsidised energy audit (50% or 100%) program for a building owner and then provide a building performance coach to assist the owner in making energy efficiency and energy productivity decisions based on the results of the audit. Subsidies could be capped at \$10,000 (to subsidise the audit plus provide the coaching).

For highly effective strategic projects energy companies could also facilitate improvements by providing financial implementation support for the upgrade in the form of price incentives, grants, or no-interest loans. Grants would need to be matched by owners.

Subsidies and grants could be weighted for buildings with excessive energy use

Role of the Australian energy sector - Supporting innovation

Innovation to address energy consumption has the potential to significantly reduce costs to consumers. Due to the many failures in our imperfect free market in Australia, energy consumers often do not have the knowledge or skills to effectively address consumption issues. Excessive consumption or using more energy than is needed reduces productivity.

There is no concerted effort in Australia to support innovation in electricity consumption. Continuous improvement in this highly technical field requires innovation and a strong research impetus.

There is increasing demand for improved energy performance in buildings and industrial processes and HVAC&R technologies and industry practices will have to continue to drive improvement in energy efficiency and energy productivity outcomes to meet this demand.

The construction and refrigeration industries in Australia are risk averse. Innovation and technology uptake means changes to practices and procedures. These changes and innovations need to be supported in the traditionally conservative construction and cold chain industries. The

increased awareness of how innovation has been successfully undertaken in practical implementation can reduce this perceived risk and encourage increased uptake.

There is increasing demand for improved energy performance in buildings and industrial processes and HVAC&R technologies. Industry practices must continue to drive improvement in energy efficiency and energy productivity outcomes to meet this demand.

HVAC&R innovation and business development opportunities are significant and the development of resilience within those industries will help support Australian economic growth.

The Australian energy sector can play an essential role in innovation and commercialisation of low emissions and clean technologies by supporting technology demonstration projects and facilitating the development and distribution of independently verified Case Studies of actual innovative HVAC&R solutions being delivered in Australia, providing the industry with detailed benefit and cost analysis of real installations and construction methods.

The Australian energy sector could partner with Australian research institutions and industry associations to provide the market with trusted and comprehensive information on these new technologies, and new design or construction tools, that will help the sector and the buildings it delivers, operate more efficiently. These projects can then be used to support demonstration of the technologies and processes to the wider construction industry. Technology examples include passive building, solar cooling, district cooling, low charge ammonia refrigeration systems, trans critical CO₂ based refrigeration systems for tropical climates, PV assisted air conditioning, thermal mass, phase change materials, ammonia based air conditioning systems for high rise air conditioning and many more.

All participants and actors in the construction sector need better information about what is possible in today's construction industry including information about those innovative approaches that are currently being applied and working in real life applications. There are some remarkable success stories about innovative low-emission approaches to the construction and installation of heating, ventilation, air conditioning and refrigeration (HVAC&R) services in buildings and the design and installation of refrigeration systems associated with the Cold Chain. The construction and refrigeration industries are risk averse, and awareness of how innovation has been successfully undertaken locally can reduce this perceived risk and encourage uptake.

These stories are being told by AIRAH and other industry associations but they need to be promulgated to a much wider audience of investors, developers, owners, operators and end users in Australia. HVAC&R is a hidden and technical supply chain industry and investment decisions in it are often controlled by non-technical people. The Australian energy sector can help by assisting the HVAC&R industry reach a much wider audience to promote increased awareness of the benefits of improved practices, innovative technologies and integrated approaches to HVAC&R.

In regard to innovation to address energy consumption AIRAH have the following additional recommendations:

1. Support **low-emission demonstration projects** – The energy sector can support innovation and commercialisation of low emission HVAC&R technologies by supporting technology demonstration projects and facilitating the development and distribution of independently verified Case Studies of actual delivered innovative HVAC&R solutions, providing the industry with detailed benefit and cost analysis of real installations and construction methods. Learnings must be consolidated and shared for maximum impact.
2. Support **low-emission technology learning** - The energy sector could collaborate with industry associations and training providers and help to facilitate the delivery of demonstration/training technology to all TAFEs/VET colleges and universities that provide training and education in the sector, so that industry entrants are more technology and innovation aware.
3. Provide **incentives to reward innovation** - Government and industry should encourage and support new innovative processes by providing incentives in the form of financial tax breaks or accelerated depreciation and encouragement in the form of awards and showcase materials developed to support and promote new innovative processes and materials.

Supporting start-ups

The HVAC&R industry's innovative start-ups want more recognition, engagement, promotion and support from the energy sector. Australian energy sector assistance could take the form of:

- Grants to support and promote the uptake of innovative technologies;
- Facilitation and support of applied research in the HVAC&R field that can generate commercial and other benefits for the sector;
- Facilitate the development of educational tools to support new technologies.

Incentivising the application of innovative approaches

The Australian energy sector could encourage and support new innovative processes by providing encouragement in the form of awards and showcase materials that are developed to support and promote new processes, materials, and innovations.

Small businesses often need incentives and assistance to make the jump to some new technology or process. Firms can be encouraged and supported by industry sponsored programs to evaluate innovative HVAC&R technologies. For optimum effectiveness HVAC&R technology demonstration and evaluation projects should ensure that the outcomes from the projects are individually verified and evaluated by independent HVAC&R consultants, and the information is shared with the wider industry (warts and all).

Under this approach, property owners would install the most appropriate technology, while clearly understanding the risks involved. Over time property owners and technical service providers would become comfortable with the new approaches, and be more open to considering new technologies and practices. Demonstrating changes in attitude is often as important as demonstrating the technologies themselves, particularly in the risk averse construction industry. The measurement of costs and savings by independent consultants would generate the accuracy of information required.

In this context, it is important to ensure the qualifications of assessors/verifiers fall within the same envelope as the assessment task(s). In view of the long history of educational neglect within the refrigeration sector and particularly within the industrial refrigeration sector, identification of appropriately qualified assessors/verifiers may pose a challenge.

Research

AIRAH has significant oversight and engagement with the industry's research activities. The Australian energy sector can help firstly with engagement and recognition, then with facilitation and forums, and finally with encouragement and funding. By and large research in the HVAC&R, building physics, thermal comfort and indoor air quality fields is 'applied research'.

There needs to be much stronger links between academic institutions and a bridge between academia and industry. Some of the activities proposed to help facilitate better collaboration include:

- A research roadmap for energy productivity in HVAC&R should be developed.
- The key energy productivity in HVAC&R research needs should be identified and matched to institution research capacity.
- Findings from existing research projects should be disseminated more widely (beyond academia) while encouraging discussion and debate.

Continuous improvement in this highly technical field requires innovation and a strong research impetus in a range of areas such as:

- New building design and delivery methods;
- Emerging technologies for HVAC;
- Higher performance standards for buildings and appliances;
- New controls and building monitoring and metering, incorporating fault and energy diagnosis;
- Thermal energy storage and distribution systems;
- Reliable energy estimating software that can be used across a range of skill levels;
- New energy sources to drive HVAC&R systems.

Education and skills

Education and skills are critical if Australia is to have safe, sustainable, healthy and comfortable built environments in a low-carbon economy.

A significant focus for AIRAH is the 20,000 VET-trained technicians who design, install, maintain, repair, and decommission refrigeration and air conditioning plant and components every day. The switch in refrigerant technology to low-GWP gasses, through the HFC phase-down, demands new knowledge and skills to operate safely.

Australia's success in limiting ozone-depleting substances can be replicated with carbon. These technicians are the key to realising emission reduction targets as we move to a low carbon economy.

These targets can only be achieved if technical services workers are equipped with the appropriate knowledge and tools to implement new technologies. AIRAH is keen to collaborate with the Australian energy sector and the VET sector to enable this outcome.

We will continue to advocate for and collaborate on initiatives that support the resilience of our industry and its valuable contributions.

Training

The Australian energy sector could facilitate the delivery of demonstration/training technology to TAFEs/VET and universities that provide training and education in the sector, so that incoming industry entrants are more technology and innovation aware. For example, every university that provides training in building engineering, architecture, building physics or construction management should have a state of the art building management and energy diagnostic system operating on their premises so that their students can become familiar with these technologies. Energy retailers could partner with their customers to facilitate this.

There are significant skills gaps in the industry regarding energy efficiency and low emission tools and processes including:

- Designers and contractors with experience in the application of clean energy technology and low emission HVAC&R.
- Technicians with installation and diagnostic capabilities for building controls and management systems.
- Professionals with experience in building energy optimisation.
- Technicians and designers with experience in the application of natural refrigerant technologies (e.g. NH₃, hydrocarbons, air, water or CO₂).
- Technicians and designers with experience in the application of low life cycle climate performance (LCCP) technologies such as energy recovery systems, high efficiency equipment and systems, or equipment/systems using low GWP refrigerant technologies.

PRIME and the HVAC&R industry

PRIME is an initiative developed by a coalition of stakeholders from within the Australian heating, ventilation, air conditioning, and refrigeration (HVAC&R) industry. The industry has been under pressure to help reduce the environmental impact of HVAC&R. Key stakeholders have taken a step back and spent some time evaluating exactly what needs to be done to develop low-emission solutions for the essential HVAC&R services we all depend upon.

PRIME stands for the five pathways to transition: Professionalism, Regulation, Information, Measurement, and Emission abatement. All of the industry-sourced emission-reduction solutions have been allocated into one of these five categories.

Information for PRIME stakeholders is available [here](#).

AIRAH recommend that the energy sector engage with the PRIME initiative to develop and deliver projects that improve energy efficiency and increase energy productivity.

Informing government regulation, policy, programs and research is an essential element of the PRIME approach. Low emission HVAC&R can improve Australian productivity and competitiveness in international markets, as well as reduce emissions and improve sustainability at home and globally.

PRIME is fundamentally about reducing the direct and indirect emissions arising from the HVAC&R sector, it is a conduit for emission reduction proposals and projects from grassroots and throughout all sectors of the industry.

PRIME offers the energy sector a transparent and open platform from which to address those issues that are best addressed with a whole-of-industry approach. PRIME improves coordination and removes duplication of effort.

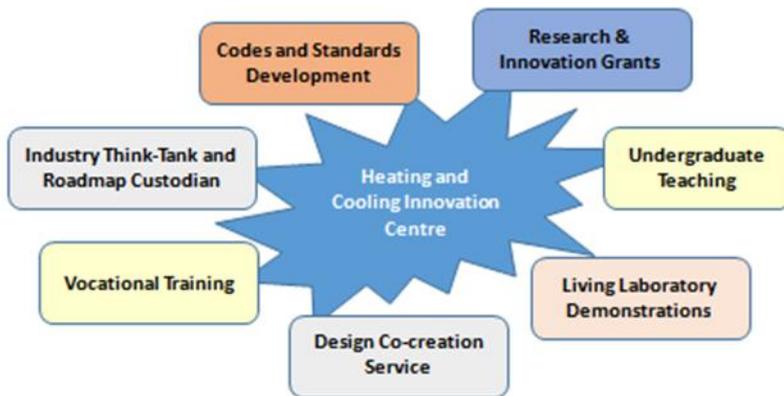
Reducing direct and indirect emissions from HVAC&R means optimising life-time system performance and minimising life-time refrigerant leakage rates. This is only achievable through better maintenance and improved system operation which not only improves energy efficiency, but also delivers a range of other co-benefits, including increased asset values, improvements in worker productivity, process productivity gains, occupant health benefits, and importantly, improved building and electricity infrastructure resilience.

iHub – The HVAC&R energy innovation opportunity

In association with the CSIRO and PRIME, AIRAH is proposing to establish the Innovation Hub for Affordable Heating and Cooling, or iHub. AIRAH recommend that the energy sector engage with the Innovation Hub for Affordable Heating and Cooling as a vehicle to help energy consumers increase their energy productivity.

The Innovation Hub for Affordable Heating and Cooling will facilitate the HVAC&R industry’s transition to a low-emissions future, stimulate jobs growth, and showcase HVAC innovations in buildings.

The Innovation Hub will provide virtual and physical spaces where a community of industry innovators, designers, and educators can easily access knowledge and research infrastructure to incubate ideas and reshape industry practice to the needs of the 21st century.



The Innovation Hub will enable Australian SMEs to accelerate product development through access to cutting-edge intellectual property, independent technology validation, and interfaces with venture capital investment.

The iHub provides clear low-emission and emission reduction development pathways for the HVAC&R industry and is consistent with the NEPP and as range of government policies.

The Australian energy sector should partner with AIRAH, CSIRO and our PRIME partners to help set up, launch and deliver the iHub.

Key iHub activities and their linkage to the PRIME pathways include:

1	Industry road-mapping	<ul style="list-style-type: none"> • Professionalism 	PRIME identifies the need to provide the predominantly SME HVAC industry, with more clarity and strategic foresight on the key transition steps to a low emissions future. A participatory process will be maintained over the life of the Hub.
2	Research and seed innovation grants	<ul style="list-style-type: none"> • Emissions abatement 	Grant funding and PhD stipends will be provided to research institutions on a competitive basis. Funding priority will be given to projects focusing on the development of commercialisable IP. Seed funding will also be available to SMEs for product prototyping and market testing. Intellectual property will be held in a "Team Australia" entity, with preferential access provided to Australian SME members.
3	Living laboratory accelerators	<ul style="list-style-type: none"> • Measurement 	Exemplar building spaces (e.g. Shopping Centre, Office, Hotel, School etc.) will be established as research infrastructure for accelerated real-world testing of new products and services.
4	Design co-creation labs	<ul style="list-style-type: none"> • Emissions abatement 	The building design consulting industry will be supported with additional funding to enable more detailed exploration of innovative HVAC solutions, in partnership with educators. This will extend the scope of innovations that can be explored, and help train the next generation of design engineers.
5	Undergraduate and vocational training centre	<ul style="list-style-type: none"> • Professionalism • Information 	Australia does not have a dedicated undergraduate Building Services degree. A process will be implemented to recruit a training provider to establish a suite of undergraduate and vocational courses. This will also provide a physical "incubator" location for the Hub.
6	Codes, standards and evidence base	<ul style="list-style-type: none"> • Regulation • Information • Measurement 	Part of the industry will always build to the minimum code. So, the HVAC industry has an ongoing need to provide high quality evidence to support practical codes and standards development. A structured program of engagement will be established with international knowledge brokers (e.g. ASHRAE, IEA, ISO). Additional adhoc measurement campaigns will be commissioned, where required.

Industry contributions supplemented with government funding will be used to fund the activities. The Innovation Hub aims to build its membership base and IP returns, to a point where it is self-sustaining.

Reference Documents

The following Documents have been referred to in these comments:

Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions, Prepared for California Energy Commission - Public Interest Energy Research (PIER) (Mills 2009)

City of Seattle, Office of Sustainability and Environment, Director's Rule 2016-01, Implementation of Building Tune-Up Requirement (City of Seattle, 2016)

Cold Hard Facts 2: *A study of the refrigeration and air conditioning industry in Australia*, Prepared for the Department of Sustainability, Environment, Water, Population and Communities, Peter Brodribb and Michael McCann, 2013 (DSEWPaC 2013)

LOW CARBON, HIGH PERFORMANCE: *How buildings can make a major contribution to Australia's emissions and productivity goals*, Prepared for the Australian Sustainable Built Environment Council, ClimateWorks, 2016 (ASBEC 2016)

Transformation Roadmap: Interim Program Report CSIRO and Energy Networks Association 2015, (ENA 2015)

FOOD COLD CHAIN OPTIMISATION: Improving energy productivity using real time food condition monitoring through the chain Australian Alliance for Energy Productivity (A2EP 2017)

End of submission