Further, faster, together

Opportunities for collaboration between Germany and Australia on energy efficiency in buildings

June 2021

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About the Energy Efficiency Council

The Energy Efficiency Council is Australia's industry association for energy management, energy efficiency and demand response. The Energy Efficiency Council is a not-for-profit membership association for businesses, universities, governments and NGOs.

Founded in 2009, the Energy Efficiency Council's members are diverse, but are united by a common cause: building a sophisticated market for energy management products and services that delivers:

- Healthy, comfortable buildings;
- Productive, competitive businesses; and
- An affordable, reliable and sustainable energy system for Australia.

The Energy Efficiency Council's job is to make Australia a global leader in smart energy management. To this end, the Council works with its members and partners to:

- Drive ambitious government policy by advocating for smart energy management policies and programs that deliver for all Australians;
- Support business decision making and growth with trusted, impartial information on energy so that businesses have confidence making the right energy management investments; and
- Ensure quality with standards and professional development by supporting standards development and benchmarking for the sector, and training and professional development for professionals across Australia.

The Energy Efficiency Council is a national organisation with headquarters in Melbourne.

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1. Introduction

Background

Australia and Germany have identified energy efficiency policy, programs and technology as an important area for bilateral cooperation. Cooperation on this area was formalised at the third meeting of the Australia-Germany Energy Working Group in September 2019, where a Sub Working Group on energy efficiency was established. The Sub Working Group is led by Luke Menzel, CEO of the Energy Efficiency Council, and Christoph von Spesshardt, CEO of the German-Australian Chamber of Industry and Commerce.

The creation of the Sub Working Group recognises that both the German and Australian Governments are acting to harness energy efficiency to lower carbon emissions and supporting the broader energy transition. The aim of the Sub Working Group's work is to advance the cooperation of Australia and Germany in energy efficiency.

The German Government has adopted 'energy efficiency first' as a central principle of its Energiewende (energy transition) because energy savings can drive cost-effective reductions in greenhouse gas emissions and ensure that the shift to renewable generation is affordable.

Similarly, the Australian Government's Technology Investment Roadmap has identified energy efficiency as a key 'enabling technology' for lowering carbon emissions across the economy and has acted to unlock this potential through a range of policies, programs and targeted investments.

This mutual commitment to energy efficiency provides a strong platform for collaboration around:

- Knowledge exchange, encompassing policy, programs, technology innovation and business models; and
- Commercial exchange, ensuring technology and expertise of each nation can be leveraged to accelerate a cost-effective energy transition.

About this project

In 2020, the Sub Working Group determined that a study was required to identify priorities for collaboration. Feedback was sought from both governments on what areas this study should address. While industrial energy efficiency and energy efficiency financing were both noted as areas of interest, it was improving the energy performance of existing buildings – both residential and commercial – that was identified as the most promising area for investigation.

In late 2020, the **German Federal Ministry for Economic Affairs and Energy (BMWi)** commissioned adelphi, the German-Australian Chamber of Industry and Commerce and the Energy Efficiency Council to identify 2-3 priorities for collaboration on energy efficiency in residential and commercial buildings. The key deliverables of the project were:

- A public, bilateral online webinar featuring German and Australian political leaders and experts that took place in December 2020 and helped refine the priorities for investigation; and
- This paper, which has been prepared taking into account the outcomes of the webinar, desktop research and interviews with experts in building energy efficiency, financing, and technology in Germany and Australia.

About the partners

adelphi is one of Germany's leading independent think tanks on climate, environment, energy and development. adelphi has been supporting the BMWi in their energy cooperation with Australia in the project "Supporting Germany's Energy Dialogue with Australia, Canada, New Zealand and the USA" since 2016.

The **German-Australian Chamber of Industry and Commerce** is an Australian non-profit organisation that supports German companies to build and extend their engagement with the Australian market.

The **Energy Efficiency Council** is an Australian not-for-profit membership association for businesses, universities, governments and NGOs. The Council aims to build a sophisticated market for energy management products and services that delivers healthy, comfortable buildings; productive, competitive businesses; and an affordable, reliable and sustainable energy system for Australia.

Scope

This short report surveys key energy efficiency policies targeting existing residential and commercial buildings in Germany and Australia. It is not intended as an exhaustive account of policy in both nations. Rather, it provides:

- A high-level survey of selected initiatives as a means of orienting experts in each nation as to the policy landscape in the other; and
- Recommendations on where collaborative efforts should focus, taking into account the relative strengths and priorities of each nation.

Out of scope

This report is focused on policies that seek to improve the energy performance of existing buildings. New buildings are out of scope, however building codes in each nation are addressed briefly, as they are often (and increasingly) linked to existing building policy.

Recommendations

Recommendation 1: Commission research and facilitate dialogue on energy efficiency financing in Germany, and lessons for Australia.

Australia is exploring the role of finance in facilitating energy efficiency upgrades and construction of residential buildings. Germany has a well-established and sophisticated market for energy efficiency finance, driven by its KfW Bank. Research and engagement on this topic will support Australia's efforts on the creation of a home energy rating scheme, and finance systems that support home energy upgrades. It will also build relationships between policymakers and financiers in the two nations (Chapter 3, p. 12).

Recommendation 2: Commission research and facilitate dialogue on NABERS Energy's role in Australia, and lessons for Germany.

German experts consulted for this report identified accelerating the rate of energy performance improvement in Germany's commercial building sector as a key priority. They also indicated deep interest in Australia's success with NABERS Energy. Research and engagement that explores the characteristics of NABERS Energy and lessons for Germany will support German activity in this space and build relationships between the policymakers and the commercial building industry in the two nations (Chapter 4, p. 18).

Recommendation 3: Commission research and facilitate dialogue on unlocking the potential of heat pumps.

Experts consulted for this report identified heat pumps as a cross cutting area for technology collaboration, relevant for both residential and commercial buildings, as well as industrial applications.

Australia can learn much from the sophisticated system of standards, policies and work practices that have developed around heat pumps in Germany, to inform future policy and regulation. Similarly, Australian innovations in aggregation and control of electric loads – including from air conditioners and hot water heaters – emerged as a topic of significant interest for German interviewees contemplating the role of load flexibility in supporting the transition to higher levels of renewables in the electricity system.

Research and engagement that explores best practice standards and work practices, and enabling the flexibility benefits of heat pumps, will support the growth of the heat pump market in both Germany and Australia. It will also build relationships between policymakers and the commercial, residential and industrial heat pump industry in the two nations (Chapter 5, p. 26).

2. Overarching policy context

This section summarises overarching energy efficiency policies and frameworks in Germany and Australia, as context for the detailed discussion of residential and commercial building policy that follows.

Germany

Germany has an interim emissions reduction target of 55% below 1990 levels by 2030 and has committed to carbon neutrality by 2050. Reducing energy consumption in buildings has been identified as a major priority, as the building sector in Germany accounts for 40.5% of final energy consumption and 17% of energy-related greenhouse gas emissions.[1,2] Indeed, Germany has committed to making its building sector 'virtually climate neutral'[3] by 2050 through a combination of energy efficiency and renewable energy.

Notably, Germany has adopted the principle of *energy efficiency first*, which aims to increase the focus on energy efficiency after a long legacy of supply-side measures. This principle recognises that prioritising energy efficiency measures where they make sense avoids unnecessary investments in generation and network infrastructure, lowering the overall cost of the energy transition.

There are a number of acts and policy frameworks that directly address energy efficiency in buildings:

- **The National Action Plan for Energy Efficiency (2014)** contains instruments to improve energy efficiency. These include funding for efficient building renovation, such as the CO_2 Building Renovation Programme, which supports energy efficient construction and renovation mainly in residential buildings;
- **The Energy Efficiency Strategy for Buildings (2015)** sets out long-term scenarios to 2050 for making Germany's building stock 'almost climate neutral', and introduced the concept of individual building 'renovation roadmaps';
- **Federal Climate Protection Act (Bundes-Klimaschutzgesetz or KSG, 2019)** includes binding annual emissions targets up to 2030 for each sector of the economy, including buildings. It includes an annual review with mandatory government action within a few months if targets are not met. The first review took place in March 2021 and found that the buildings sector was the only one to miss its 2020 target;[4]
- **The Long-Term Renovation Strategy of the Federal Government (2020)**, a requirement under the EU Energy Performance of Buildings Directive, sets out a plan to decarbonise Germany's building stock to 2050;
- **The Climate Action Program 2030 (2020)** is an economy-wide plan for reaching Germany's emissions reduction goals, setting out incentives for energy efficient building renovation and replacement of oil and gas heaters, and introducing a carbon price for heating and transport;

[1] "Energieverbrauch nach Energieträgern und Sektoren". Federal Environment Agency (UBA). (2021). https://www.umweltbundesamt.de/daten/energie/energieverbrauch-nach-energietraegern-sektoren

[2] "Energiebedingte Emissionen". UBA. 11 March 2020. https://www.umweltbundesamt.de/daten/energie/energiebedingte-emissionen#energiebedingte-treibhausgas-emissionen

[3] Federal Ministry for Economic Affairs and Energy (BMWi). (2015). *Energy Efficiency Strategy for Buildings*. Berlin: BMWi.

[4] "Greenhouse gas emissions will decrease by 8.7 percent in 2020". UBA. 15 March 2021. https://www.umweltbundesamt.de/presse/pressemitteilungen/treibhausgasemissionen-sinken-2020-um-87-prozent

- **Building Energy Act (Gebäudeenergiegesetz or GEG, 2020)** replaces several older pieces of legislation with a single piece of legislation that regulates energy performance requirements for new and existing buildings; and
- **Federal Funding for Energy Efficient Buildings (Bundesförderung für effiziente Gebäude or BEG, 2021)** provides funding for the measures set out in the Energy Efficiency Strategy for Buildings for both residential and commercial buildings and replaces the CO_2 Building Renovation Programme and the Market Rebate Programme for Renewable Energies (MAP). Funding will be implemented by the German Development Bank (KfW) and the Federal Office for Economic Affairs and Export Control (BAFA) from mid-2021.

In addition to these measures, funding has been available through the **German Development Bank (KfW)** for energy efficient construction and renovation of both residential and commercial buildings since 2006 and has been a major driver of building improvements. For more details see Section 3.

As a European Union (EU) Member State, much of German policy is framed by the EU. The **Energy Performance of Buildings Directive (EPBD, 2010)** sets out a legislative framework to decarbonise Europe's building stock by 2050, including requirements for:

- All buildings built after 2020 to be 'nearly zero energy buildings' (NZEB);
- All heated and/or air-conditioned buildings of a certain size to obtain and display an Energy Performance Certificate (EPC) at the point of sale or lease;
- Major building renovations to meet minimum energy efficiency standards; and
- Adoption of a long-term renovation strategy at the member state level.

In addition, as part of the Renovation Wave (2020), the European Commission aspires to double the rate of building renovation in Europe in keeping with European climate commitments. To this end, the Commission is proposing to increase funding for renovations, coupling funding with technical support and advice to increase accessibility for householders.[5] The Renovation Wave Strategy[6] was released by the European Commission in late 2020, which sets out the intention to revise the EPBD in 2021 to introduce:

- Stronger obligations around EPCs; and
- Minimum energy performance standards (MEPS) for existing buildings with renovation requirements triggered by either a set date, a trigger point (i.e. beginning of a new lease), or both.

Consultation around the revision of the EPBD in line with the Renovation Wave action plan is taking place in 2021.[7]

For further exploration of the drivers for energy efficiency policy in major global economies, see the Energy Efficiency Council's report **The World's First Fuel: How energy efficiency is reshaping global energy systems (2019)**.

Australia

Australia has committed to reduce its greenhouse gas emissions by 26-28 per cent on 2005 levels by 2030 and is targeting net zero emissions in the second half of this century.

[5] Building Performance Institute of Europe. (2020). *Briefing: The European Renovation Wave and their importance for Germany.* Brussels: BPIE.

[6] European Commission. (2020). *A Renovation Wave for Europe – greening our buildings, creating jobs, improving lives.* Brussels: European Commission. https://ec.europa.eu/energy/sites/ener/files/eu_renovation_wave_strategy.pdf

[7] "Energy efficiency – revision of the Energy Performance of Buildings Directive." (2021). European Commission. https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12910-Revision-of-the-Energy-Performance-of-Buildings-Directive-2010-31-EU

In 2015, the former Council of Australian Governments (COAG) Energy Council (now the Energy Ministers Meeting), a Ministerial forum for national, state and territory governments to work together in the pursuit of national energy reforms, agreed to the National Energy Productivity Plan (NEPP).[8] This plan includes a range of measures to improve Australia's energy productivity by 40 per cent between 2015 and 2030, including:

- Improving residential building energy ratings and disclosure;
- Expanding commercial building ratings and disclosure; and
- Improving compliance with building energy efficiency regulation through the National Construction Code (NCC).

A number of the elements in the NEPP related to commercial buildings focus on extending the National Australian Built Environment Rating System (NABERS), a sophisticated framework for driving energy performance improvements in the commercial building sector. NABERS, in concert with the Commercial Building Disclosure (CBD) program, has had a significant impact on the energy performance of Australian office buildings. For more details see Section 4.

In 2019, the former COAG Energy Council built on previous efforts by agreeing to the *Trajectory for Low Energy Buildings,* which outlines a national plan for a trajectory towards zero energy and carbon ready buildings. It comprises two main documents:

- The *Trajectory for Low Energy Buildings* is focused on new buildings and was agreed to by the former COAG Energy Council in early 2019; and
- The Addendum to the *Trajectory for Low Energy Buildings—Existing Buildings* focused on existing buildings and was agreed by the former COAG Energy Council in late 2019.

Both Trajectory documents are frameworks for policy collaboration, and emerged in response to calls from consumer groups and the built environment sector to improve the energy performance and affordability of buildings.

Key areas for collaboration identified for existing residential buildings include:

- Targeting financial incentives for energy efficient upgrades for vulnerable households;
- Establishing a national framework for energy performance disclosure; and
- Minimum energy efficiency requirements for rental properties.

Collaboration priorities for existing commercial buildings include:

- Expanding NABERS Energy to additional building sectors and extending the Commercial Building Disclosure program beyond offices;
- Conducting feasibility studies for minimum energy performance standards; and
- Strengthening energy efficiency obligation schemes for energy retailers.

In addition to nationally coordinated policy, four Australian states have established Energy Efficiency Obligation schemes. These schemes exist in New South Wales, Victoria, South Australia and the Australian Capital Territory, and place an obligation on energy retailers to meet emissions or energy reduction targets by supporting energy efficiency activity by energy consumers. Many of the upgrades supported by these schemes are focused on residential and commercial buildings. Because not all states have such schemes, the degree of deployment of energy efficient technologies, such as LEDs, differs depending on jurisdiction.

[8] Commonwealth of Australia. (2015). *National Energy Productivity Plan 2015-2030*. Canberra: Australian Government.

3. Residential buildings

Germany

In 2017, the residential building sector accounted for 27.7% of total final energy consumption in Germany.[9] There are about 19 million residential buildings in Germany, including 14 million single- and two-family houses and 5 million apartment buildings, totalling about 40 million housing units.[10] In 2018 about 287,000 new apartment units were completed, a new residential construction rate of 0.5%.[11]

About 70% of buildings constructed in Germany in 2020 are expected to exceed code, largely driven by the recent provision of government incentives. However, about 64% of existing building stock – around 7 million buildings – was built before the introduction of minimum energy efficiency requirements in 1977. Only about 46% of buildings contain thermal insulation, as compared to about 77% of buildings constructed after 2010.[12]

The German Government has put in place a broad mix of incentives, regulation, information and financing to improve energy performance, with the aim of steadily decarbonising the nation's residential building stock.

Minimum energy efficiency standards

Germany has minimum efficiency standards in place for both new buildings and renovations, with financial incentives available for renovations that achieve efficiency levels beyond minimum standards.

Minimum energy efficiency standards exist under the German Buildings Energy Act 2020 (GEG) and may be triggered either by a single upgrade, or a major renovation that alters 10-15% of the building envelope facade. Under these standards:

- Renovations of a single measure (i.e. windows) must meet a minimum efficiency standard, and funding is available for going beyond this level; or
- Whole building renovations must result in a level of primary energy efficiency no more than 40% higher than the reference building defined by the 2009

Germany's renovation roadmaps

Introduced in 2017, tailored modernisation roadmaps (individueller Sanierungsfahrplan; iSFP), or **renovation roadmaps**, are voluntarily taken up by householders and enable experts to recommend coordinated, phased renovations that fit a homeowner's unique situation. This enables renovations to occur in a manner consistent with long-term energy saving targets, rather than in an ad hoc manner.

A comprehensive audit results in a step-by-step, building-specific plan for renovation over 15-20 years. The long-term approach is key to increasing confidence of building owners to invest in efficient upgrades.

To assist homeowners with energy efficient home renovations, energy audits and advice are highly subsidised as part of energy advice for residential buildings, with additional funding available through the Federal Funding for Energy Efficient Buildings (BEG).

[9] Odyssee-Mure. (2021). *Germany Profile.* European Union Executive Agency for Small and Medium-sized Enterprises (EASME). https://www.odyssee-mure.eu/publications/efficiency-trends-policies-profiles/germany.html

[10] Federal Ministry for Economic Affairs and Energy (BMWi). (2020). *Long-term renovation strategy of the federal government*. Berlin: BMWi.

[11] BMWi, 2020.

[12] BMWi, 2020.

building code. Under the whole house standard, individual measures may vary in efficiency.

It is expected that minimum energy performance standards (MEPS) will become the trigger for building renovation standards in the near term, rather than component-specific upgrades or partial renovations.[13]

Minimum energy efficiency standards also exist for certain individual building components, though there are exemptions for long-term occupation of a building. For example, heating systems older than 30 years must be replaced, though heaters in homes occupied continuously since before 2002 are exempt from this rule. If a previously exempt house is purchased by a new owner, the heater must then be replaced.

Outside of Germany, some jurisdictions are introducing such targeted standards to ensure landlords upgrade their rental properties to meet minimum energy efficiency requirements. Germany does not currently have specific minimum energy efficiency standards for its 18 million rental homes.[14]

Energy performance ratings and disclosure

The European Union's EPBD requires building performance to be assessed and disclosed with an Energy Performance Certificate (EPC). The policy applies to residential, commercial and public buildings. In the residential sector, EPCs are required for all houses or units which are constructed, sold or rented.[15] EPCs are valid for up to 10 years and must be included in advertisements for buildings for sale or rent.

Ratings for EPCs can be calculated through one of two methods:

- The expected energy use based on building characteristics, i.e., building design and thermal characteristics; or
- Actual energy consumption used for heating, cooling, hot water and other typical energy needs.

The outcomes and costs of the two calculation approaches can differ. Owners of existing buildings are generally free to choose which calculation method they prefer, which can make it hard for tenants and home buyers to make comparisons between buildings.

Energy efficiency financing

The German Development Bank (KfW) has a robust financing and incentive scheme in place for energy efficient design and renovation in residential, commercial and public buildings. Funding is provided through the Federal Funding for Energy Efficient Buildings program.

The scheme has been operating since 2006. In 2020, the KfW's residential energy efficiency funding scheme supported the construction or partial renovation of over 450,000 housing units[16] – close to 200,000 new housing units constructed and about 260,000 housing units renovated – triggering an estimated €78 billion in investments. This means that €78 billion in total was invested in building or renovating homes, including KfW grants, interest rate subsidies and loans, plus additional investment committed by customers. Of

[13] European Commission. (2020). A Renovation Wave for Europe – greening our buildings, creating jobs, improving lives. Brussels: European Commission. https://ec.europa.eu/energy/sites/ener/files/eu_renovation_wave_strategy.pdf

[14] BMWi, 2020.

[15] *Energy Performance in Buildings Directive 2010* (EU).

[16] German Development Bank (KfW). (2020). *Funding report: KfW banking group*. https://www.kfw.de/KfW-Konzern/Newsroom/Pressematerial/F%C3%B6rderreport/

this, KfW committed €26.8 billion in loans, a 140% increase on the previous year,[17,18] and €5 billion was committed by the German Government for the grant component through the Energy and Climate Fund. The program has since been extended to municipal and commercial buildings.

The KfW has created a dedicated rating system for its home loans: the Efficiency House, or Effizienzhaus. To quality for support, homes must be renovated or built according to a certain standard of energy consumption and thermal insulation relative to the reference house in Germany's 2009 building code.

For example, a KfW Efficiency House 55 is one that has been renovated to the following criteria:

- It requires only 55% of the annual primary energy demand compared to a similar, (but newly constructed) standard home; and
- It has 30% better insulation compared to a similar, newly constructed standard home.

The standard home used for comparison refers to a newly constructed home, thus energy savings for older renovated buildings can be significant as efficiency standards increase over time.

Higher levels of efficiency unlock higher levels of financial incentive. The Efficiency House standard differs from EPC ratings in that Efficiency House considers primary energy demand and thermal insulation, while EPC ratings are based on final energy demand.

Customers that are self-funding construction or renovation can apply for a grant to offset part of the additional cost for reaching higher efficiency levels than legally required. Customers that are taking out a loan to fund building costs can use the grant to lower their outstanding debt; they also receive a modest reduction in the interest rate on the debt that remains. The flexibility of incentives is deliberate and designed to allow for adjustments to changing market conditions.

The clear 'Efficiency House' benchmark, and the flexibility of funding options, have underpinned the scheme's success, along with three additional elements.

Firstly, the KfW does not have a direct relationship with customers; it works with financing partners such as commercial and savings banks and insurance companies, which act as the customer-facing link to the KfW funding. This helps ensure that the availability of KfW funding is highlighted at the point when a customer is likely to find it most useful; when they are seeking finance for a new home, or an upgrade to an existing home. In addition, this ensures neutrality in relation to the market and ensures a broad distribution channel for the product.

Secondly, a pool of over 10,000 certified energy consultants has been created. These consultants must be engaged to receive KfW support, and they act as a trusted advisor for both householders and banks. Energy consultants provide:

- Explanations of the technical energy assessment and information about upgrade options to householders/homeowners; and
- Assurance to KfW that the home has been built or renovated to the required standard, thus deblocking the grant element. Independent checks of household energy consumption are undertaken on a randomly selected sample of buildings.

[17] Dominik Bach, personal communication, March 2021.

[18] KfW. (2021). *Financial report 2020.* https://www.kfw.de/PDF/Download-Center/Finanzpublikationen/PDF-Dokumente-Berichte-etc/3_Finanzberichte/Finanzbericht_2020.pdf

Grants are available to householders for 50 per cent of the cost of engaging an energy consultant, with a cap at €4,000. All energy experts involved in the KfW scheme must apply to be listed in an online register,[19] which requires proof of professional experience, ongoing training and an application to be re-listed every three years. These requirements help ensure quality assurance and control in the efficient construction and renovation sector.

Third, the conditions for borrowers are highly flexible: loans under the program can last up to 30 years, including the option for early repayment. And maximum financial support amounts are per housing unit, meaning multi-unit buildings can attract very substantial support for upgrades.

Australia

11% of greenhouse gas emissions and 29% of electricity use is attributable to Australia's residential buildings sector.[20] With an estimated 9 million existing residential buildings, upgrading these buildings presents a major opportunity for both energy savings and emissions reductions, opportunities that have been recognised by the *Addendum to the Trajectory for Low Energy Buildings.*

Minimum energy efficiency standards

Australia's National Construction Code (NCC) establishes a range of minimum standards – including energy efficiency requirements – for new buildings. A key plank of the *Trajectory for Low Energy Buildings* is a commitment to continue raising stringency requirements in the NCC over the course of the 2020s, consistent with the agreed goal of 'zero energy (and carbon) ready buildings'. The NCC is updated every three years; the update due in 2022 will be the first following the agreement of the Trajectory, and considerable work is underway on new energy efficiency provisions.

In addition to setting standards for new buildings, some state and territory governments require existing buildings to be upgraded to meet current code requirements in certain circumstances, such as when building works affect more than 50% of the property. However, these requirements vary significantly between jurisdictions, and to date the rate of improvement in the energy performance of existing residential buildings in Australia has been slow.

The National House Energy Rating Scheme (NatHERS) provides new homes with an energy efficiency rating out of ten depending on the building's thermal efficiency. The NCC requires a certain NatHERS star rating for new homes, currently 6 stars for a detached home. Work is currently underway to expand NatHERS to existing homes.

On average, the energy performance of existing Australian homes is significantly poorer than new homes; existing homes achieving an average rating of 1.7 stars on the Nationwide House Energy Rating Scheme (NatHERS) scale, compared with an average of 6.1 stars for new homes.[21] As a result, the Addendum to the *Trajectory for Low Energy Buildings—Existing Buildings* identifies the strengthening of energy efficiency requirements for renovations as a key priority.

[19] German Energy Agency GmbH (dena). (n.d.) *Energy efficiency experts for federally funded programs*. https://www.energie-effizienz-experten.de/

[20] Commonwealth of Australia. (2019). *Report for achieving low energy existing homes*. Canberra: Commonwealth of Australia. p. 6.

[21] Commonwealth of Australia, 2019, p. 7.

The *Trajectory* also identified the introduction of minimum energy efficiency standards for rental homes as an area for government attention. The energy performance of Australia's residential rental stock is poor, as significant upgrades are generally a low priority for landlords and not an option for tenants.

To date, two jurisdictions have committed to implementing minimum energy efficiency standards for rental homes. The Australian Capital Territory (ACT) has announced it will introduce legislation for staged minimum energy performance requirements for rental properties to come into force in 2022-23.[22] Victoria is planning to introduce minimum quality standards for rental homes in 2021. These are quality standards, rather than performance standards, focused on attributes associated with health, comfort and efficiency, such as the installation of heaters of a certain efficiency in homes. Victoria is also considering standards for insulation and hot water systems in rental homes.[23]

Energy performance ratings and disclosure

There is currently no nationally recognised rating system for energy efficiency in existing residential buildings. However, individual jurisdictions have developed ratings, notably the Victorian Residential Efficiency Scorecard (RES). The RES provides a star rating for homes, with a greater number of stars indicating a higher efficiency rating. RES assessments also provide suggestions for efficiency upgrades.

The *Addendum to the Trajectory for Low Energy Buildings—Existing Buildings* identifies energy ratings and tools as a key 'enabling mechanism' that supports good decision making around energy efficiency investments. As envisioned in the *Trajectory*, NatHERS, which currently enables efficiency ratings for new homes, is expected to roll out a rating scheme for existing homes in 2021.[24] NatHERS for existing homes will take into consideration the thermal performance, appliances and renewable power generation to generate a rating, and assessments will provide advice about potential efficiency upgrades.

To date, only one jurisdiction in Australia has implemented mandatory disclosure in a form akin to the regime operating in Germany. In the ACT, all homes for sale must carry an energy efficiency rating to enable potential buyers to consider and compare their energy performance. Dwellings that are advertised for rent must also advertise the energy rating.

Energy efficiency financing

The *Addendum to the Trajectory for Low Energy Buildings—Existing Buildings* identifies financial initiatives that overcome capital constraints that can discourage energy efficiency upgrades as a crucial supporting measure.

Historically, green loan programs targeting residential energy efficiency in Australia have had limited success. However, a new promising new effort to build momentum for energy efficiency financing was launched last year.

The Clean Energy Finance Corporation (CEFC) is Australia's 'green bank', tasked with increasing investment in Australia's transition to lower emissions. In 2012 it was allocated $10 billion to invest on behalf of the Australian Government, providing debt and equity finance. The CEFC works to deliver a positive return across its portfolio.

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[22] Australian Capital Territory. (2019). *ACT Climate Change Strategy 2019-25*. Canberra: ACT Government.

[23] Hinge, Adam. (2020). *Minimum energy standards for rented properties: An international review*. New York: Sustainable Energy Partnerships.

[24] Department of Industry, Science, Energy and Resources. (2019). *NatHERS Existing Homes*. https://www.nathers.gov.au/About/NatHERS-existing-homes

In 2020, the CEFC worked with a private retail bank, Bank Australia, to offer the Clean Energy Home Loan program, which enables homeowners to receive a discounted interest rate for loans on homes that reach a certain degree of energy efficiency. The program draws on up to $60 million in CEFC finance and supports both the retrofit and construction of energy efficient homes.

New homes must reach a NatHERS rating of at least one star beyond the minimum for new buildings (currently 6 stars) in order to receive a discounted interest rate.

For home renovations or retrofits, an assessment such as the Victorian RES must be performed before and after the upgrades have been undertaken. The CEFC requires a minimum one-star improvement in the Scorecard rating (excluding the impact of rooftop solar) in order for loans to qualify.

The CEFC and Bank Australia scheme currently operates at a small scale, however the CEFC is actively looking for opportunities to ramp up the loan program with other mortgage lenders. The Bank Australia program is expected to continue beyond the investment with the CEFC.

In addition, the state of New South Wales is currently leading a process under the *Trajectory* that investigates how the extension of NatHERS for existing homes can better align to the finance system. This process will also investigate how similar financing initiatives involving other retail banks can be encouraged.

Priority for collaboration: Energy efficiency financing

Recommendation 1: Commission research and facilitate dialogue on energy efficiency financing in Germany, and lessons for Australia.

One of the key actions in the Addendum to the *Trajectory for Low Energy Buildings—Existing Buildings* is to identify targeted financial initiatives that support homeowners to improve energy performance. Early feedback from the CEFC's work with Bank Australia is promising. However, the size and sophistication of KfW's residential financing program is unique around the world and learning from Germany's track record in this area has the potential to inform and accelerate Australia's efforts in this space.

Given this, the ecosystem that has developed around the KfW energy efficiency financing scheme is worthy of detailed exploration. Key elements of interest include:

- The particular characteristics of the Efficiency House benchmark that generate confidence in householders and financiers;
- The role of qualified energy assessors to identify and prioritise home upgrades and act as a link between homeowners and banks; and
- The relative impact of various support options, including partial debt relief.

This exploration should focus on learnings from Germany, and how they might be applied given the particular circumstances faced in Australia. A workshop that brings together finance and policy experts from both nations to facilitate knowledge exchange will support the development of detailed recommendations on this front and help build ties between the two nations.

4. Commercial buildings

Germany

Germany's commercial building stock consists of approximately 3 million buildings[25] including office buildings, hotels, manufacturing plants, hospitals, agriculture, and other categories, totalling about 2.35 billion square metres of floor area.[26] Within these 3 million buildings, there are 687,279 office buildings with 316 million square metres of floor area.[27] Despite only making up approximately 13% of Germany's building stock, commercial buildings are estimated to cause 47% of emissions in the building sector.[28]

The rate of improvement in the energy performance of Germany's commercial building stock has been slower than that achieved in the residential sector, for a number of reasons.

Previously, EU state aid rules restricted the provision of substantial subsidies to commercial building owners for energy efficiency upgrades.[29][30] However, recent changes mean that Germany is free to ramp up incentives, increasing its ability to drive efficiency improvements in the commercial building sector.

Another factor is lack of data. In its *Long-Term Renovation Strategy*, the BMWi acknowledges the need for more granular data around energy performance in commercial buildings to support policymaking, and notes plans for a survey to record the structure and energy efficiency of non-residential building stock.[31]

Finally, like the residential sector, split incentives are an issue for commercial buildings; most landlords do not pay energy bills so do not receive the direct benefits from energy efficient upgrades, and so are reluctant to invest.[32]

Energy performance ratings and disclosure

Like residential buildings, commercial buildings in Germany are required to display an EPC under the EPBD.

As with residential buildings, EPCs for commercial buildings can be calculated by measuring either actual energy consumption or energy requirements of a building based on its design and thermal characteristics, making comparison between buildings challenging.

Like residential buildings, EPCs are the main energy labelling mechanism for German commercial buildings. The labels are valid for up to 10 years and all commercial buildings with a useful floor area over 250 m^2 are required to display EPCs at the point of sale or lease.

EPCs are the only widely used method available for measurement of energy performance in Germany's commercial building sector. However, the different methods available to

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[25] German Industry Initiative for Energy Efficiency (DENEFF). (2017). *Climate-friendly commercial real estate: Building owner, investment processes and new tools for more investments in climate protection.* Berlin: DENEFF.
[26] BMWi, 2020.
[27] BMWi, 2020.
[28] DENEFF, 2017.
[29] Henning Ellerman, personal communication, January 2021.
[30] European Commission. (2021). Recovery and resilience facility – state aid. https://ec.europa.eu/competition/state_aid/what_is_new/template_RFF_energy_efficiency_in_buildings.pdf
[31] Federal Ministry for Economic Affairs and Energy (BMWi). (2021). Research database for non-residential buildings. https://datanwg.de/home/projektbeschreibung/
[32] DENEFF, 2017.

arrive at a rating, along with the long-lived nature of EPCs, has generated a lack of confidence in the link between the rating and the energy performance of a building.[33]

Some premium commercial buildings in centralised city areas tend to get certified with green labels such as the Leadership in Energy and Environmental Design (LEED), German Sustainable Building Council (DGNB), or Building Research Establishment Environmental Assessment Method (BREEAM). These certification systems assess a range of sustainability metrics, including energy performance. This – coupled with varying assessment methods from rating to rating – makes it difficult for buyers and tenants to determine the energy performance of a particular building and to compare it with like buildings.

Australia

The energy intensity of Australian commercial buildings is about 70% that of commercial buildings in Germany.[34] Commercial building stock represents about 10% of Australia's total greenhouse gas emissions.[35]

As in residential buildings, the *Addendum to the Trajectory for Low Energy Buildings—Existing Buildings* provides a framework for state and national governments to drive improvements in the energy performance for existing commercial buildings. Most effort on this front is focused on building on the well-established foundation of the National Australian Built Environment Rating System (NABERS).

Energy performance ratings and disclosure

The National Australian Built Environment Rating System (NABERS) is a building performance rating system for Australian commercial buildings which provides discrete ratings for energy, waste, water and the indoor environment. A key feature of NABERS is that ratings are tailored to particular types of commercial buildings.

Buildings are compared like-for-like and are given a performance rating on scale of 1 to 6 represented by stars. An achievement of 6 stars indicates a 'market leading' building, 3 stars indicates an average building, and 1 star indicates that the building is 'making a start'.

Two commercial building rating systems, **NABERS** and **Green Star,** have played important roles in driving world leading sustainability performance of Aussie commercial buildings.

Green Star is a building sustainability rating system launched by the Green Building Council of Australia in 2003 – its closest analogue internationally is LEED. The ratings include metrics around water, materials, transport, and other categories in addition to energy.

Green Star ratings are entirely voluntary and have driven significant competition on sustainability metrics at the premium end of the commercial property market.

Together, **NABERS** and **Green Star** have played an important role in Australian property portfolios consistently topping international rankings on the GRESB and DOW Jones Sustainability Index.

A NABERS Energy rating measures the actual impact of improvements in building performance and enables simple, reliable comparisons between rated buildings. Since its inception in 1998, $1 billion in energy costs has been saved by NABERS Energy-rated

[33] Building Performance Institute of Europe, 2016.

[34] American Council for an Energy Efficient Economy. (2018). *International Energy Efficiency Scorecard*. Washington, DC: ACEEE, p. 48.

[35] Department of Industry, Science, Energy and Resources. (2021). *Commercial buildings*. Canberra: Australian Government. https://www.energy.gov.au/government-priorities/energy-productivity-and-energy-efficiency/commercial-buildings

buildings and 7 million tonnes of CO_2 emissions have been saved from office buildings alone.[36]

NABERS Energy ratings are available for apartment buildings, office tenancies, shopping centres, data centres, hotels and public hospitals with the metrics and algorithms that generate these ratings tailored to each building type. At the conclusion of financial year 2020, a total of 4,399 buildings have been rated with NABERS Energy,[37] of which 2,568 were office buildings. In 2019-2020, nearly 40% of office buildings rated with NABERS Energy achieved 5 stars or more, up from 13.5% in 2009-2012.[38]

The success of NABERS has been underpinned by a robust rating system developed in partnership with industry, coupled with a number of strategic policy initiatives from state and national governments.

A 2005 Australian Government procurement policy, which required government departments renting from the private sector to have better than minimum NABERS Energy rating, provided a strong initial push for buildings to be rated. This policy was replicated by state governments over subsequent years and began to establish a benchmark for acceptable energy performance in offices that was voluntarily adopted by sections of the private sector.[39]

In 2011, the Australian Government built on this momentum with the Commercial Building Disclosure (CBD) program, announcing that all Australian office buildings over 2000 square metres must disclose their NABERS Energy rating at the point of sale or lease. The success of this policy saw the threshold for disclosure lowered to 1000 square metres in 2017. This brought the bulk of Australian office buildings into NABERS, with 78% of offices now rated under the scheme.

There are several important elements that contribute to the success of NABERS Energy:

- Ease of comparison between buildings which would otherwise be difficult to compare;
- Ability to be used as a mechanism for target-setting;
- Effectiveness in communicating energy ratings;
- Prompts for regular recertification encourages building managers to constantly improve their building's performance;
- Contribution towards the visibility of energy efficiency; and
- Associated creation of industries for services such as building management systems and analytics.

Measures for improving energy efficiency in commercial buildings targeted through the Australian Government's *Trajectory* work include:

- Expansion of NABERS ratings to be delivered to additional building sectors; and
- Expansion of the CBD program to additional building types.

NABERS Energy has been adopted in New Zealand and launched in the United Kingdom in late 2020.

[36] NABERS. (2019). https://www.nabers.gov.au/

[37] NABERS. (2020). *NABERS FY20 Annual Report.* Sydney: Department of Planning, Industry and Environment.

[38] NABERS, 2020.

[39] The New Zealand Government adopted a similar policy in late 2020.

Priority for collaboration: Energy performance ratings in commercial buildings

Recommendation 2: Commission research and facilitate dialogue on NABERS Energy's role in Australia, and lessons for Germany.

German experts consulted for this report identified accelerating the rate of energy performance improvement in Germany's commercial building sector as a key priority. Interviewees also expressed deep interest in Australia's success with NABERS Energy, and how lessons from this program could support Germany's efforts in this area.

A focus on the role on ratings in commercial building is timely; recent changes to state aid rules will make it easier to provide financial support to German companies for energy efficiency upgrades; however, the absence of robust energy performance ratings in the commercial building sector could continue to hamper progress.

In light of this, an exploration of the particular characteristics that underpin the success of NABERS Energy would be of benefit to German industry and policymakers. Such a study should include:

- History and key characteristics of NABERS Energy;
- A detailed briefing on the mechanics of NABERS Energy, including building types covered, the NABERS algorithm, joint industry/government governance, and the ecosystem of NABERS assessors and energy efficiency services that have grown up around it;
- Interaction with the Commercial Building Disclosure program, and impact on building performance and emissions over time; and
- Insights generated from the expansion of NABERS Energy to New Zealand and the United Kingdom.

This exploration should focus on learnings from Australia, and how they might be applied given the particular circumstances faced in Germany. A workshop that brings together industry and policy experts from both nations to facilitate knowledge exchange will support the development of detailed recommendations on this front and help build ties between the two nations.

5. Cross-cutting technology: heat pumps

Policy measures – such as minimum standards, rating systems and incentives – play a crucial role in driving improvements in energy efficiency in buildings. However, it is important to identify promising technologies that can support emissions reduction, enabling governments to target investment in areas that will drive down the costs of abatement from these technologies.

In preparing this report, interviewees were quizzed on which technologies should be considered as priorities for collaboration between Australia and Germany. Heat pumps emerged as the clear priority. With heating and cooling representing 60% of final energy demand in Germany[40] and 64% of total energy consumption in residential buildings in Australia,[41] heat pumps present a significant opportunity to improve energy efficiency in buildings and decarbonise heating and cooling.

Experts also expect heat pumps to play a significant role in lowering emissions in the manufacturing sector in both nations, as larger capacity and higher temperature heat pumps become more commonly utilised.

The term 'heat pump' can refer to several technologies, including water heaters, space heaters and coolers, and heat pumps used in industrial settings (e.g. low temperature process heating).

Heat pumps are characterised by their heat source and heating medium:

- Air, water, or ground (geothermal) to water heat pumps are used for hydronic heating systems which distribute heated water through floors, walls or radiators. These heat pumps are the most commonly used type of heat pump in Germany for indoor space heating and hot water.
- Air to air heat pumps, also known as reverse cycle air conditioners, are used to both heat and cool indoor air. They are the most commonly used type of heat pump in Australia and are used to a lesser extent in Germany.
- Air to water heat pumps are also used for heat pump water heating systems, and are well known in Australia for residential hot water heating.

In terms of indoor air heating and cooling, heat pumps have the benefit of being able to heat and cool air. In industrial settings, heat pumps can capture waste heat and increase its temperature. This enables its use in a wide array of processes, while reducing both energy waste and the need for additional energy to be purchased.[42]

Further, a heat pump can provide both heating and cooling at the same time, which can be very useful for commercial buildings and industrial sites with both heating and cooling requirements. When used this way, heat pumps are especially energy efficient.

An important characteristic of heat pumps is that they are electric, enabling them to be powered by renewable energy for zero-emissions heating and cooling. Heat pumps can be utilised at times of peak renewable generation to create 'thermal batteries', by storing hot

[40] German Heat Pump Association (Bundesverband Wärmepumpe e. V.; BWP). (2020). Opportunities and risks for Germany's heating industry in a competitive global environment.

[41] International Energy Agency. (2021). *Total consumption by end use – Residential, Australia 2000-2018.* Paris: IEA. https://www.iea.org/data-and-statistics?country=AUSTRALI&fuel=Energy%20consumption&indicator=ResidentialConsByEndUse

[42] US Department of Energy. (2003). *Industrial heat pumps for steam and fuel savings: A best practice steam technical brief.* Washington, DC: US Department of Energy.

water for later use, or to pre-heat or pre-cool a building. Good energy efficiency performance of the building or facility is an important enabler for this use case.

Germany and Australia are at different stages in the development of their heat pump markets, however the characteristics and opportunities in each market suggest collaboration on developing heat pump technologies would be fruitful.

German heat pump market

While the market for heat pumps in Germany has strengthened in recent years, heating in Germany continues to be dominated by gas- and oil-powered heaters.[43] Heat pumps are installed in 43% of new buildings in Germany, however just 6% of heating systems installed to replace old systems in existing buildings are heat pumps.[44]

One of the key barriers to market uptake of heat pumps in Germany is the high cost of electricity relative to gas and oil, which discourages Germans from switching away from traditional gas or oil heaters. The introduction of a fixed carbon price for the building and transportation sectors that covers heating fuels – starting in 2021 and ramping up over subsequent years – is expected to shift market sentiment over time.

Incentives

The German Government's 2019 Climate Package incentivises the replacement of gas and oil heaters with heat pumps, including:

- 35% subsidy up to €60k for installation of a heat pump which replaces a gas heater; or
- 45% subsidy up to €60k for installation of a heat pump replacing an oil heater;[45] and
- 5% subsidy on top when installation takes place as part of a renovation schedule.

These incentives have helped raise heat pump installation rates; 120,000 heat pumps were installed in Germany in 2020, a 40% increase compared to the previous year.[46]

Regulations and standards

Strict regulations around permissible heat load in new buildings – set out under the Building Energy Act (GEG) 2020 – is one of the main drivers for installation of heat pumps in Germany, as more energy-efficient buildings require smaller capacity, lower capital cost heat pumps. While heat pumps are not required in new or existing buildings, installation of a heat pump makes it easy to meet energy consumption requirements under the GEG.

The EU-level Ecodesign and Energy Labelling directive governs heat pumps, including their production, measurement of their efficiency and noise levels, and labelling of performance ratings.[47] Energy ratings are given on a scale from D to A+++, with the majority of heat

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[43] BWP, 2020.

[44] BWP, 2020.

[45] Federal Office for Economic Affairs and Export Control (BAFA). (2021). *Federal funding for efficient buildings: Systems for heat generation (heating technology).* https://www.bafa.de/DE/Energie/Effiziente_Gebaeude/Sanierung_Wohngebaeude/Anlagen_zur_Waermeerzeugung/anlagen_zur_waermeerzeugung_node.html

[46] "Positive signal for climate protection: 40 percent growth in heat pumps". German Heat Pump Association (BWP). 19 January, 2021. https://www.waermepumpe.de/presse/news/details/positives-signal-fuer-den-klimaschutz-40-prozent-wachstum-bei-waermepumpen/#content

[47] European Commission. (2012). Ecodesign and energy labelling - Air conditioners and comfort fans. https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/ecodesign/airconditioners_en

pumps performing in the A++ to A+++ range.[48] The stringency of these ratings increases over time, meaning appliances must increase their efficiency to maintain a high energy rating. Assurance of energy performance claims on heat pumps is strict: manufacturers must prove the claimed coefficient of performance (COP) of their products, and field testing is done to ensure accuracy of ratings.

Workforce

In Germany, there are around 75,000 people working in the heating sector.[49] Energy consultants (*Energieberater)* have the ability to recommend heat pumps to homeowners, while 'heating craftsmen' *(SHK-Handwerker)* are qualified to perform installations. A specific training and certification program for heat pump installers, the EUCERT, exists at the European Union level and is available in Germany, however it is not a requirement.[50] The workforce of heating craftsmen is ageing, due to low numbers of young people taking up the trade and the general ageing of the German population.

Demand for installation of heating systems outpaces the capacity of the workforce to supply installations; the low number of qualified installers causes long wait times for householders to receive new heating systems. This problem is exacerbated by the increased time, cost and skills required to replace a gas or oil heater with a heat pump, relative to a 'like for like' replacement.

Supply chain

Though Germany is home to a number of large heat pump manufacturers, manufacturing capacity is higher in a number of other countries as German heating system manufacturing remains geared towards the production of fossil-fuel based heating systems,[51] and many of the German-produced heat pump systems are exported to other countries. Similarly, installation rates for heat pumps are higher in other nations. Scandinavian countries install heat pumps at ten times the rate of Germany, and indeed the bulk of the global heat pump market is outside Europe, with 80% of heat pumps installed in China, Japan and the US in 2017.[52]

Australian heat pump market

In Australia, air-to-air heat pumps (reverse cycle air conditioners) for space heating and cooling are most common. Heat pumps used for hot water and industrial heat are growing, albeit from a low base. About 20,000 hot water heat pumps for domestic applications are sold each year in Australia.[53] Due to Australia's hot climate, cooling using reverse cycle air conditioners is the dominant use of heat pumps, with about 1.23 million reverse cycle air conditioners sold in 2018.[54] However, heating using reverse cycle air conditioners is another important application in some parts of Australia, with winter temperatures in the southern states regularly falling below 0°C.

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[48] BWP, 2020.

[49] BWP, 2020.

[50] European Heat Pump Association. (n.d.). EUCERT. https://www.ehpa.org/quality/eucert/

[51] BWP, 2020.

[52] BWP, 2020.

[53] Brodbribb, P. and McCann, M. (2019). *Cold hard facts*. Canberra: Commonwealth of Australia. https://www.environment.gov.au/system/files/resources/f75f18c0-9cf9-4029-b6e0-bb4527e6610e/files/cold-hard-facts-2019.pdf

[54] Brodribb and McCann, 2019.

At least 700-800 air, ground and water to water heat pump units (underfloor heating and radiators) are sold in Australia each year.[55] The market for these heat pumps is growing rapidly for new homes and retrofitting gas boilers.

Incentives

Small-scale Technology Certificates (STCs) are a national incentive mechanism for the installation of renewable technologies, such as solar photovoltaic (PV) panels and solar and heat pump water heaters, governed by Australia's Clean Energy Regulator (CER).[56] STCs are tradeable certificates generated upon installation and registration of an eligible system by the installing company and typically result in an immediate discount for consumers. Systems that generate a greater amount of renewable electricity receive a greater number of STCs, resulting in a greater 'discount' for consumers. Likewise, solar or heat pump water systems that displace a greater amount of electricity by using renewable energy receive a greater number of STCs.

STCs are available for heat pump hot water services. In addition, some Australian jurisdictions run dedicated programs to incentivise the replacement of old equipment with reverse cycle air conditioners and hot water heat pumps.

However, there is limited government support for heat pumps for commercial and industrial applications. This is mostly due to the lack of standards for commercial heat pumps and the uncertainty in the accuracy of data used in performance modelling, which discourages governments to offer incentives.

Regulations and standards

Australia has largely adopted international standards for design and safety of heat pumps, with minor variations addressing local conditions. However, standards for the production and performance of heat pumps are lacking.

There is one standard pertaining to the performance testing of domestic hot water heat pumps (*AS/NZS 5125.1*), which uses a simulated calculation of energy consumption, rather than a physical test. While physical tests would result in a greater degree of accuracy of consumption than a model, no testing models currently exist for heat pumps other than those used for domestic water heating applications.

Residential heat pump air conditioners fall under the Greenhouse and Energy Minimum Standards (Air Conditioners and Heat Pumps) Determination 2013, which calls up standard *AS/NZS 3823.2-2013*, *Performance of electrical appliances – Air conditioners and heat pumps*. This standard covers vapour compression air-to-air heat pumps up to 65kW. It does not cover domestic hot water heat pumps, air-to-water or liquid-to-water devices, such as groundwater or ground-loop sourced heat pumps. There are no available standards for noise or performance testing for large heat pumps.

Finally, in some jurisdictions, legacy regulations remain in place that disincentivise the installation of heat pumps. For example, in Victoria, plumbing regulations promoting the installation of a gas-boosted solar hot water systems in newly constructed homes were introduced to reduce the emissions of new homes in 2004. These regulations have not been updated and currently act as a barrier to the use of heat pumps.

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[55] Indicative numbers estimated based on the number of small-scale technology certificates claimed through the Clean Energy Regulator.

[56] Clean Energy Regulator. (2018). *Small-scale technology certificates*. http://www.cleanenergyregulator.gov.au/RET/Scheme-participants-and-industry/Agents-and-installers/Small-scale-technology-certificates

Workforce

Installation of heat pump hot water systems generally requires a plumber and an electrician, though for certain types of heat pumps a refrigeration or hydronic specialist may be required.

In most states, there is no specific training or qualification associated with the installation of most types of heat pumps. To fill this training gap, manufacturers generally provide training for water-to-air, underfloor and hydronic heat pumps. However, a training program exists for the installation, commissioning and decommissioning of reverse cycle air conditioners (UEE20120 - *Certificate II in Split Air Conditioning and Heat Pump Systems*), and plumbers in Queensland must take a one-day course on solar and heat pump installation (QLD334SWH01A – *Evaluate and plan the installation of solar water heating systems*) to legally install these units.

Interviewees reported installers have a degree of confidence with reverse cycle air conditioners and hot water heat pumps, however are less confident with other heat pump technologies, which contributes to the low installation rates of heat pumps in Australian buildings. Interviewees reported that knowledge and skills around heat pumps for commercial and industrial applications is very low in Australia.

Supply chain

Most reverse cycle air conditioners used for heating and cooling in Australia are imported, although a small percentage are manufactured locally. Similarly, the majority of heat pump hot water systems installed in Australia are imported, though tanks for a small number of hot water heat pump models are locally manufactured. The most recent market profile of heat pumps available in Australia was undertaken in 2012, which found 18 brands and 80 models of heat pump water heaters available in the Australian market.[57]

The Australian Renewable Energy Agency (ARENA) has funded pre-feasibility studies to encourage the exploration of electrification opportunities in industrial settings; further investment is needed to build both industry knowledge and supply chains for industrial heat pumps in coming years.[58]

Heat pumps and electrification

Heat pumps can play another important role – improving the security and stability of the grid as the electricity system decarbonises.

They do this by enabling demand-side flexibility, taking advantage of cheap renewable energy by enabling thermal energy storage and reducing grid demand during peaks.[59] In the residential and commercial sectors this can work by:

- Storing hot water for later use; or
- Taking advantage of load-shifting to pre-heat or pre-cool a building.

The potential for heat pumps to be used as a flexible resource has been identified as a major opportunity in both Germany and Australia to help manage the transition to high levels of renewables in the electricity system. Australia in particular has been taking a global leadership role on this front; for example:

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[57] Commonwealth of Australia. (2012). *Product profile: Heat pump water heaters.* Canberra: Commonwealth of Australia. https://www.energyrating.gov.au/sites/default/files/documents/Heat-Pump-Water-Heater-Product-Profile-June-2012-1_0.pdf

[58] Australian Renewable Energy Agency (ARENA). (2021). Renewable energy for process heat opportunity study. https://arena.gov.au/projects/renewable-energy-for-process-heat-opportunity-study/

[59] Nowak, T. (2018). *Heat pumps: Integrating technologies to decarbonise heating and cooling.* Brussels: European Copper Institute Copper Alliance.

- Since the 1950s, Australia has utilised off-peak tariffs for electric hot water;
- Since 2014, the PeakSmart program in Queensland has given network operators the ability to remotely reduce the load of enabled air-conditioners during peak demand periods; and
- In late 2019 the former COAG Energy Council announced a standard that will require air conditioners and other technologies to be demand response enabled.

In Australia, research through the RACE for 2030 Cooperative Research Centre (CRC), universities, research organisations such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and energy analysts is focused focus on the implications of electrification of industrial and commercial heating. The replacement of gas space heating in the residential sector is also being investigated, with a particular focus on the impact on peak electricity demand in winter. Finally, the Australian Institute of Refrigeration Air Conditioning and Heating (AIRAH) leads the Innovation Hub for Affordable Heating and Cooling (i-Hub). This ARENA funded program distributes funding to support projects to demonstrate how renewable energy technology can be optimally integrated with heating, ventilation, air conditioning and refrigeration equipment.[60]

Priority for collaboration: Unlocking the potential of heat pumps

Recommendation 3: Commission research and facilitate dialogue on unlocking the potential of heat pumps

Both Australia and Germany have a strong interest in rapidly developing their heat pump markets to support medium- and long-term emissions reduction goals.

Australia can learn much from the system of standards, policies and work practices that have developed around heat pumps in Germany to inform future policy and regulation. Similarly, Australian innovations in aggregation and control of electric loads – including from air conditioners and hot water heaters – emerged as a topic of significant interest for German interviewees contemplating the transition to renewables.

Interviewees from both nations also highlighted the strategic importance of heat pumps beyond the buildings sector – especially for lowering emissions from the manufacturing sector – and recommended any further work on this topic take a cross-sectoral approach rather than just focusing on buildings.

Based on this feedback, it is recommended that further research is undertaken on the characteristics of the heat pump markets in Germany and Australia, opportunities to support the development of this technology, and areas for collaboration. This research should encompass:

- Market enablers such as standards and workforce development;
- Best practices in terms of policies and incentives to drive deployment;
- Opportunities for unlocking the flexibility potential of heat pumps; and
- Opportunities to support early adopters to build experience in the market and support future uptake at scale.

While this study may generate insights and actions best pursued by each nation individually, it should focus on rapidly identifying areas of complementarity in which collaboration would be beneficial. A workshop that brings together technology and policy experts from both nations to facilitate knowledge exchange will support the development of detailed recommendations on this front and help build ties between the two nations.

[60] Australian Institute of Refrigeration Air Conditioning and Heating (AIRAH). (2021). What is i-Hub? http://www.ihub.org.au/