Passive House Standard & Green Star – Design & As Built

Streamlined recognition for Passive House certified buildings in Green Star

greenstar Developed by the Green Building Council of Australia

AUSTRALIAN PASSIVE HOUSE ASSOCIATION

Document Information

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Partnering to deliver energy efficient and comfortable buildings

The Green Building Council of Australia, the Australian Passive House Association (APHA), and the Passive House Institute (PHI) have agreed to work collaboratively to promote the design, construction and operations of energy efficient and comfortable buildings in Australia.

The three organisations announced the partnership in 2017 after signing a memorandum of understanding which outlines their commitment to work towards common goals. The organisations will now work together to identify opportunities to align the two rating systems, develop events and education offerings, and promote building practices that significantly raise the standard of what green buildings should be.

About Green Star – Design & As Built

Launched by the GBCA in 2003, Green Star is an internationally-recognised sustainability rating system that sets best practice benchmarks for the design, construction and operation of buildings, fitouts and communities.

A trusted mark of quality, Green Star has transformed Australia's built environment. More than 1,400 projects – the equivalent to more than 21 million square metres of space – have achieved Green Star ratings, delivering environmental efficiencies while recognising the implementation of resilient, restorative solutions.

The Green Star rating system features four rating tools:

- **Green Star – Design & As Built** for building design and construction
- **Green Star – Interiors** for fitout design and construction
- **Green Star – Performance** for building operations and maintenance
- **Green Star – Communities** for precinct planning and development

Green Star-rated buildings and fitouts are assessed against nine impact categories: Management, Indoor Environment Quality, Energy, Transport, Water, Materials, Land Use & Ecology, Emissions and Innovation

The GBCA understands that sustainable buildings not only addresses environmental impact, but social and economic impact too. Green Star can help building owners and manages costs, boost productivity, enhance their brands and demonstrate their long-term commitment to improving our planet.

About Passive House Standard

The Passive House standard was launched in 1991, in response to research into best practice in building energy efficiency, comfort and IEQ.

Passive House is a fabric-first standard where the building delivers very high performance, by design, for the lifetime of the building. It relies on building physics and carefully integrated, optimised building services and technology. It eliminates the need to bolt expensive additional technology onto a poorly performing building. And it eliminates the risk of bolt-on green-bling compromising the architecture.

Passive House is not a brand name, but a construction methodology that can be applied by Certified Passive House Practitioners and that has been proven with thousands of built examples. Passive House is possible and suitable anywhere in the world.

Passive House is the world's leading standard in high performance buildings. It delivers healthy, comfortable and energy-efficient projects, with energy savings versus new building standards of up to 90% for heating and cooling when compared with building standards. Also known as Passivhaus, it better translates as 'Passive Building' and applies to any building typology. There are Passive House fire stations, schools, hospitals, high rise office buildings, apartment towers and tens of thousands of homes. Passive House is a standard that targets thermal comfort, and manages to deliver superior energy efficiency in one of the best win-win approaches to design.

Passive House Certification assists a project with verification of the ultra-high performance aspirations, and can also represent added value for the project.

Purpose of this document

GBCA and APHA recognise the value of projects pursuing both Green Star and Passive House Standard in order to promote high energy performing and thermally comfortable buildings.

This document provides assistance for new buildings seeking to obtain a certified Green Star – Design & As Built rating through compliance with the Passive House Standard. To simplify the process for projects pursuing both programs, GBCA and APHA have developed the following guidance to show how Passive House can assist projects seeking a Green Star rating.

Typically, complying with Passive House Standard will act as a stepping stone to achieving a Green Star rating. This means there will be outstanding Green Star credits that will still need to be met to achieve a Green Star rating. However, critical decisions related to building fabric and systems will assist projects in scoring high in Green Star's 'Indoor Environment Quality' and 'Greenhouse Gas Emissions' categories.

Unless noted, this document addresses Green Star – Design & As Built v1.2 and the Passive House Classic Standard version 9f.

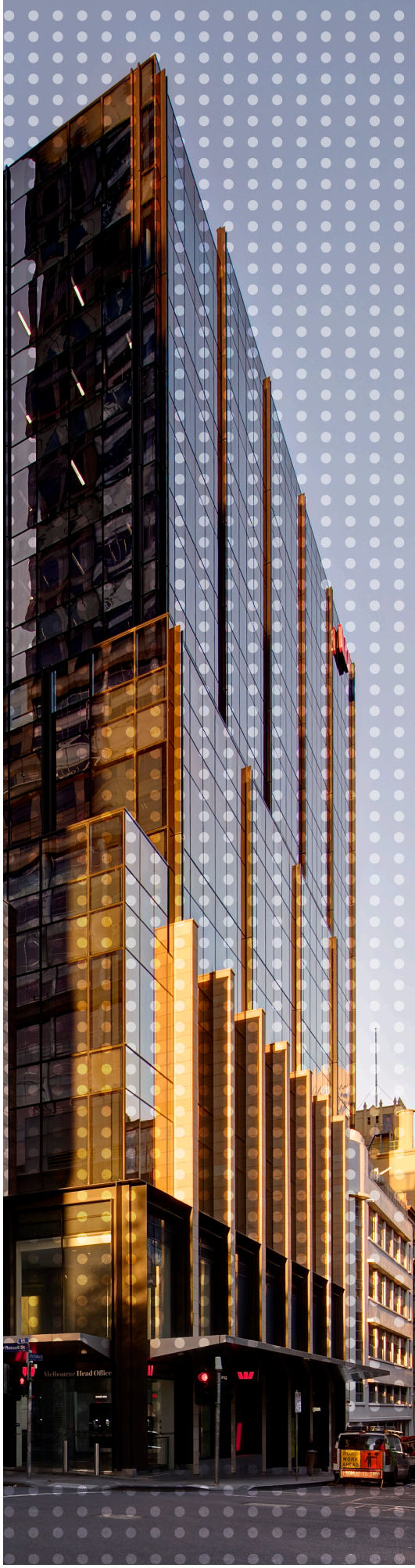
How to read this document

This document maps out Green Star credits that will be met by those buildings that comply to Passive House standard. In all cases, the credits will be met once the building has been Passive House Standard certified. Future compliance, or part compliance will not be accepted in Green Star.

Claiming compliance with Passive House Standard in Green Star

Where a project has achieved Passive House standard certification and seeks to achieve a Green Star rating, the following must be provided:

- Submission template for each claimed credit, highlighting the alternative pathway option, and filling in all required fields.
- Statement from a Passivhaus Building Certifier that the building is compliant with the Passive House Standard.



Credit overview: Passive House Standard to Green Star

This table provides an overview of the Green Star credits met by complying with the Passive House Standard.

Green Star Credit		Alignment
1	Green Star Accredited Professional	–
2	Commissioning and Tuning	Partial
3	Adaptation and Resilience	–
4	Building Information	–
5	Commitment to Performance	–
6	Metering and Monitoring	–
7	Construction Environmental Management	–
8	Operational Waste	–
9	Indoor Air Quality	Complete
10	Acoustic Comfort	Partial
11	Lighting Comfort	–
12	Visual Comfort	–
13	Indoor Pollutants	–
14	Thermal Comfort	Complete
15	Greenhouse Gas Emissions	Partial to complete
16	Peak Electricity Demand Reduction	Complete
17	Sustainable Transport	–
18	Potable Water	–
19	Life Cycle Impacts	–
20	Responsible Building Materials	–
21	Sustainable Products	–
22	Construction and Demolition Waste	–
23	Ecological Value	–
24	Sustainable Sites	–
25	Heat Island Effect	–
26	Stormwater	–
27	Light Pollution	–
28	Microbial Control	–
29	Refrigerant Impacts	–
30	Innovation	Partial

Detailed guidance: Green Star & Passive House Standard

The following table provides a more detailed guidance on what aspects of Passive House contribute to Green Star credits, and the number of points that will be awarded. Only those credits where alignment exists are mentioned.

Green Star Credit	Passive House Standard requirement	Alignment	Projects complying with Passive House:	Points achieved
2 Commissioning and Tuning				–
2.0 Environmental Performance Targets	• It is a minimum requirement that Passive House buildings be designed towards meeting the prescribed environmental performance targets set out in the Passive House Criteria.	Partial	Are required to state targets beyond just IEQ and energy or greenhouse gas emissions to claim this credit. The targets required for a PH certified building would be used as the benchmarks for the OPR in the GS submission.	–
2.2 Building Commissioning	• A building commissioning report is conducted to meet minimum requirements for Passive House projects. • As part of the building commissioning report submission for Passive House, information on testing and adjustments of the MVHR system is a minimum requirement of a Passive House project. • Extracts will be provided via the Passive House HRV commissioning report, that provides the name and address of the tester, time of adjustment, ventilation system manufacturer and type of device, adjusted volume flow rates for standard operation, mass flow/ volumetric flow balance for outdoor air and exhaust air (maximum imbalance of 10 %)	Partial	Are required to commission all additional systems noted in the submission guidelines to claim this credit. PH certification would contribute to compliance for some of the commissioning elements required in this credit.	–
9 Indoor Air Quality				
9.1 Ventilation System Attributes	• The system must be run before occupancy and will be clean upon installation. Best practice standards apply to storage of the components during construction • The entry of outdoor pollutants is mitigated as per DIN 1945. • The system is designed for ease of maintenance and cleaning via air tight inspection openings into air ducts	Complete	Automatically achieve this criteria.	1

Green Star Credit	Passive House Standard requirement	Alignment	Projects complying with Passive House:	Points achieved
9.2 Provision of Outside Air	For mechanically ventilated, or mixed mode spaces: • 100% of fresh air at 20/30 m^3/h (roughly 7 – 9.6L/s) is assumed for each per person in households and 15-30 m^3/h (roughly 4.8 – 9.6 L/s) per person for non-residential buildings. This is assumed to meet maximum CO^2 concentrations. For naturally ventilated spaces: • Minimum requirements on openable area, to the local building code (AS 1668.4:2012 would be met as minimum)	Complete	Automatically achieve this criteria	2
9.3 Exhaust or Elimination of Pollutants	• All source pollutants are removed as per DIN 1945 direct to the outside while limiting their entry into other areas of the layout.	Complete	Automatically achieve this criteria	1
10 Acoustic Comfort		Partial	While the extent of works in a Passive House certified building likely means the acoustic requirements may be met, project teams are still required to demonstrate compliance with acoustic levels as set out in the Green Star submission guidelines.	–
14 Thermal Comfort	• Passive House buildings are designed for thermal comfort at all times (100%). There exists a minor allowance for overheating, being 10% of hours in a given year with indoor temperatures above 25 °C without active cooling. Thus, thermal comfort is obtained >90% hours. For a building with active cooling, the requirement is for thermal comfort 100% hours. • Advanced Thermal Comfort - 1 additional point – The requirements of Passive House, being based on ISO7730, are targeting PMV ±0.5, or PPD <10%.	Complete	Automatically achieve this credit.	2

Green Star Credit	Passive House Standard requirement	Alignment	Projects complying with Passive House:	Points achieved
15 Greenhouse Gas Emissions	• Base energy efficiency is achieved with focus on the building envelope, serving to reduce demands for HVAC as well as whole building energy consumption significantly. All projects must meet the minimum certification criteria for heating and cooling load and/or demand, as well as primary energy.	Partial to complete	Can automatically claim up to 20 points depending on the BCA Class of the building as follows: For all classes, • 4 points can be claimed for the Energy Consumption Reduction requirement in Pathway 15E. In addition, the following can be claimed for greenhouse gas emissions reduction for Pathway 15E: In addition, the following can be claimed for greenhouse gas emissions reduction for Pathway 15E: • For Class 1a, 1b, and 2 buildings – 10 points • For all other classes – 8 points Projects can claim further points based on the amount of renewable energy on site. Projects teams are required to provide the total amount of energy consumption without on-site renewable installation (a), the amount of on-site renewable installation (b), and the total of remained energy consumption from the grid. For every 15% reduction over (a) a point can be claimed. In addition, points may be claimed in accordance with the GreenPower requirements in the submission guidelines. The maximum number of points that can be achieved in this credit is 20.	12-20
16 Peak Electricity Demand Reduction	• The peak energy demand is largely achieved under the load criteria, with options to utilise an annual demand in lieu. The Primary Energy requirement serves to bring the HVAC under a whole building model. Overall, the combination serve to significantly reduce the peak energy demand.	Complete	Automatically achieve this credit.	2
30 Innovation	• The airtightness measurement is carried out in accordance with EN 13829 (method A). Alternatively, the measurement can be carried out in accordance with ISO 9972 (method 1). However, the net air volume (not gross) in accordance with EN 13829 must be used for calculation of the n50 value in any case. • The air tightness of the envelope must be tested using a pressurization test. The resulting air changes may not exceed 0.6 h-1for Passive House compliance.	Partial	Automatically comply Best Practice requirements in 'Exceeding Green Star Benchmarks: Building Air Tightness' innovation under 'Commissioning and Tuning'.	2

Appendix: Demonstrating the energy efficiency of Passivhaus in Green Star

1. What does Passivhaus predict for building energy use?

The Passivhaus standard is based on the premise that it is possible to reduce the energy demand to near zero without relinquishing comfort. Energy efficiency does not have to be about frugality; thus in order to be sustainable we do not need to need to compromise.

The genesis of the Passivhaus standard was research into global best-practice in passive design, utlilising building physics and new technological innovations to inform future applicability and advancements to form a new 'best-practice'.

Passivhaus is based wholly around delivering comfortable and healthy buildings whilst cost-effectively maximising energy efficiency. Based around a small number of key principles, the standard delivers rationalised design of buildings with regards to their thermal envelope and building services. Complementary requirements around optimising human elements of the design further enhance both aspects while delivering best practice projects. Though the Passive House approach utilises best practice solar principles, there is a fundamental difference to the "mass and glass" solar passive approach, providing a more robust and resilient built product.

The threshold which Passive House exploits is that at which there is a demonstrable evidence of cost effectiveness; thus the overall cost of delivering an ultra-efficient building is optimised and minimised. The long-term cost is also significantly reduced, and the case for life-cycle emissions reduction can also be demonstrated.

The primary energy-related Passive House criteria are:

Heating/cooling demand	15 kWh/m²a
Heating/cooling load	10 W/m²
Primary energy demand	120 kWh/m²a

The parameters may vary for more extreme climates or for buildings with particularly high loads, with additional or shifted allowances. It should be noted that primary energy is the energy at the source (e.g. power plant) and this criterion also accounts for all loads within a building.

In addition, with a move towards assessment under the Primary Energy Renewable target, the standard is encouraging the transition to low-carbon intensive fuel supplies. This is in line with the GBCA's advocacy position to achieve more productive, liveable, sustainable and healthy cities, more resilient communities, and to – most critically – deliver a low carbon, high performing built environment.

2. How does this align with Green Star energy calculations?

The comparison between the NCC, Green Star and Passivhaus can be demonstrated best with project-specific modelling. Few projects, to date, have undertaken comparative modelling to compare the energy performance between the tools. For that reason, the proposed metrics in Green Star have been conservative; however, the international experience (BREEAM) places Passivhaus alongside exceedingly high performance metrics (Palmer et al, 2016).

One of the few available comparisons has been undertaken on a multi-residential building of 300+ dwellings. The below chart details the energy comparison between the building as designed (9 points, Green Star Multi-Unit Residential) and then recast to achieve Passivhaus.

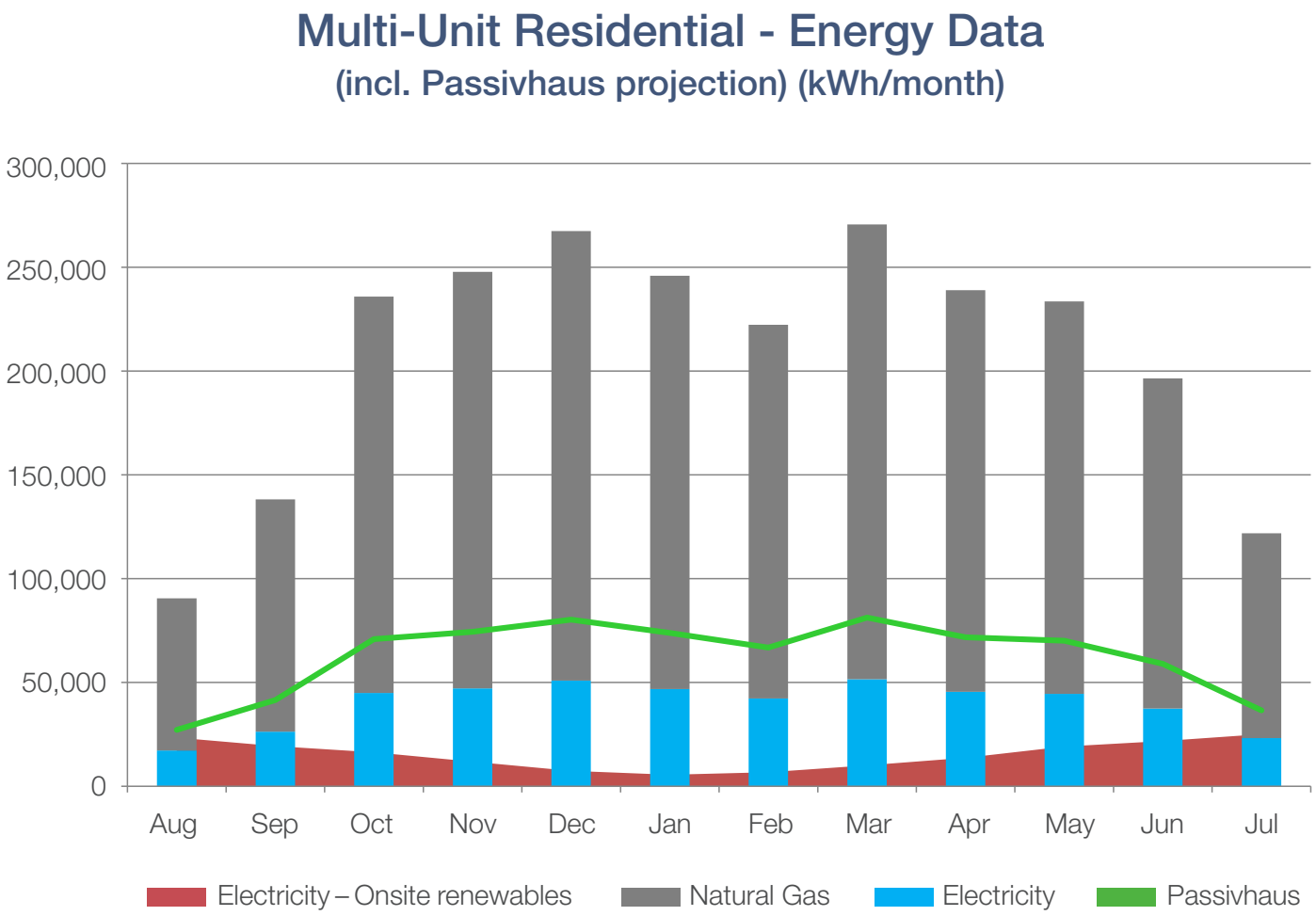


Figure 1: Projections for Passivhaus against accepted modelling for Green Star Multi-Unit Residential v1

Though outside the current scope of Green Star, available modelling for a single residence presents a compelling case for the comparison of the National Construction Code (NCC) and Passivhaus, per below.

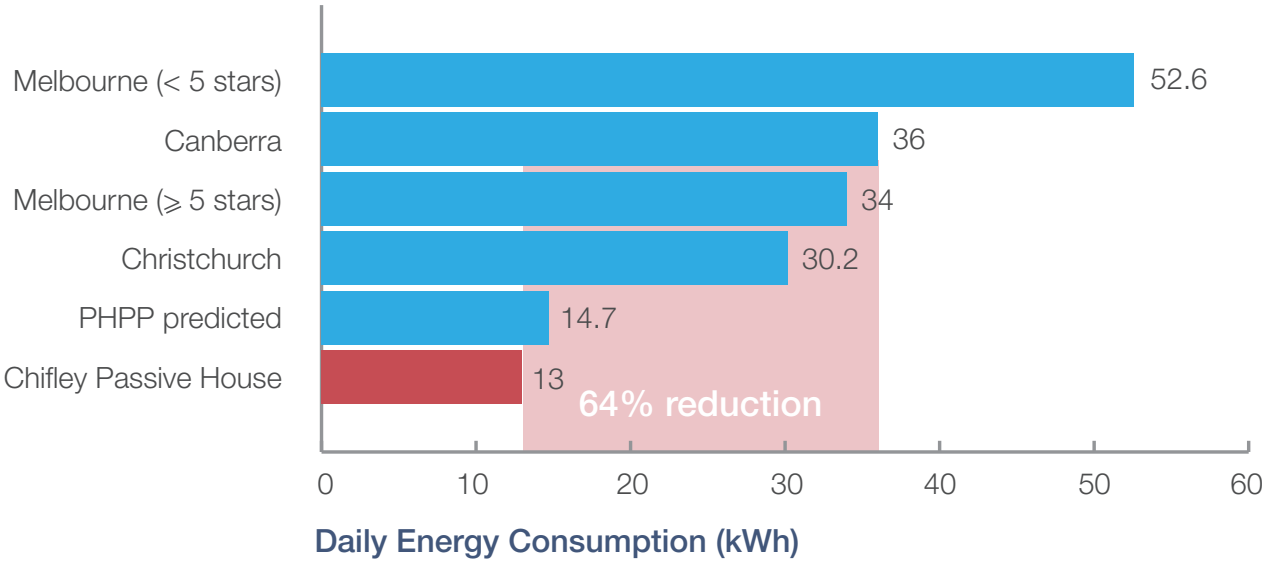


Figure 2: Comparative modelling of a single dwelling for Passivhaus and NatHERS (Garvie & Truong, 2016)

Further projects are currently working to achieve dual ratings under Green Star and Passivhaus. As relevant case studies become available, data will be pooled for further comparison.

3. What is the As-Built evidence in Passivhaus buildings?

Overall, the evidence from built examples of Passivhaus buildings, including those in operation over 25 years, is that the performance gap does not exist (on average) and that the performance of these buildings is durable.

The chart below is an extract from various studies into the post-occupancy performance of Passivhaus buildings. This shows a number of developments (147 dwellings), including low-energy but not Passivhaus dwellings, that were modelled in the Passivhaus software and then monitored during occupancy. The results show a very close result of as-built to predicted performance.

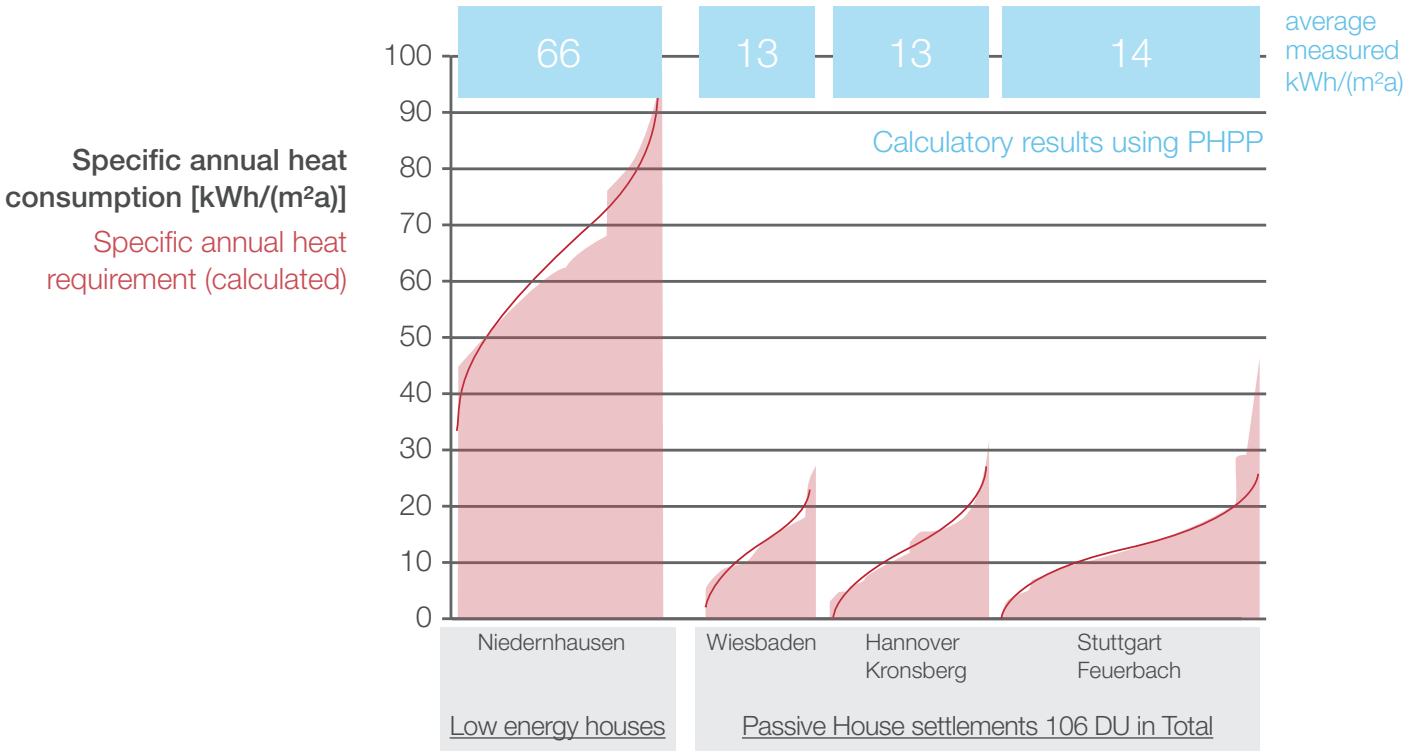


Figure 3: Overview of consumption measurements. This diagram summarises the measured heat consumptions from four housing estates, a low-energy settlement (left) and three Passive House settlements. [Passivhaus Institut, 2017]

Early data from Australian projects supports this international experience, with both near-Passivhaus and certified projects exceeding the expectations predicted via modelling (Brimblecombe, 2017, Garvie & Truong, 2016).

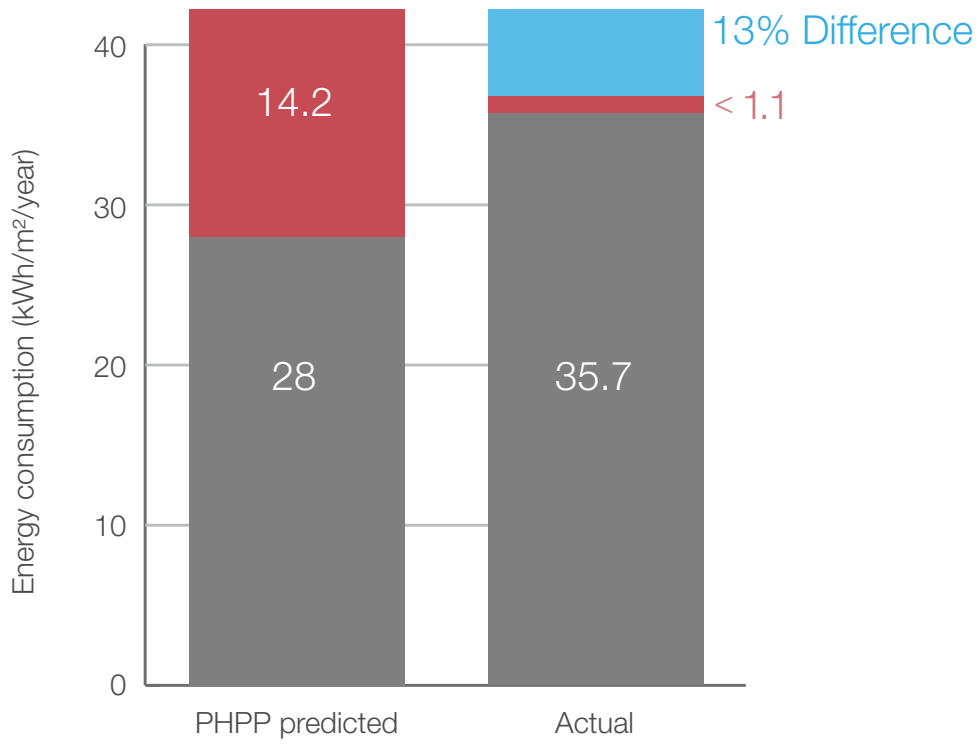


Figure 4: Comparison of predicted and measured energy consumption in a dwelling in Canberra (Garvie & Truong, 2016)

References

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