



PRELIMINARY IMPACT ANALYSIS

PROPOSAL: to allow modelling within NatHERS software of centralised hot water and air conditioning services in Class 2 and Class 4 parts of buildings, through the addition of sections to the NatHERS Whole of Home National Calculations Method.

NCC REFERENCE:

For revisions or amendments to existing National Construction Code (NCC) referenced documents, provide additional information

BCA Volume One: Section J3D15

NCC referenced documents: The NatHERS Whole of Home National Calculations Method at <https://www.nathers.gov.au/Whole-of-Home-Calculations-Method>

PROPONENT:

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To differentiate between versions include the document date and/or version number

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EXECUTIVE SUMMARY

Due to limitations within the current Nationwide House Energy Rating Scheme (NatHERS) Whole of Home National Calculations Method, industry are currently unable to use the NatHERS Whole of Home assessment pathway for apartment buildings serviced by centralised hot water, a relatively common and energy-efficient system for apartment buildings. NatHERS Stakeholders have expressed concern with this situation and closing this gap will improve the NatHERS method.

A robust, industry supported method has been developed, which is fit for purpose for implementation under the National Construction Code (NCC) section J3D15 using NatHERS tools, this is available at:

- [NatHERS Apartment Centralised Services Method Consultation Paper \(docx\)](#)
- [NatHERS Apartment Centralised Services Method Consultation Paper \(pdf\)](#)

The method does not impact stringency and provides industry with additional choice in compliance pathways for apartment buildings with centralised services.

The key elements of the apartment centralised services method are:

- a methodology for calculating energy demand for centralised hot water and centralised space conditioning in Class 2 and Class 4 buildings, and
- a method of apportioning the energy demand of the centralised system to each sole occupancy unit in the building.

Subject to the outcomes of this PIA and associated processes, implementing the method in NatHERS with the adoption of National Construction Code (NCC) 2025 is the recommended option to address the identified problem and stakeholder concerns.

Feedback should be lodged via email to admin@nathers.gov.au and with the subject line **Apartment Centralised Services Consultation Feedback**. For further information on how to provide feedback on this PIA, see Attachment 1 at the end of this document.

NATURE AND EXTENT OF THE PROBLEM:

Nature of the problem

NatHERS provides a streamlined pathway to meet or beat the National Construction Code (NCC) 2022 energy efficiency requirements. Currently around 90 per cent of new home designs are assessed using the NatHERS pathway. In NCC 2022, Clause J1P3 (Energy usage of a sole occupancy unit of a Class 2 building or a Class 4 part of a building) defines the maximum energy value of the domestic services of a sole occupancy unit (SOU). Clause J2D2 (3) (a) (ii) states that compliance with J1P3 can be demonstrated using house energy rating software (NatHERS software). However, due to limitations within the current NatHERS Whole of Home National Calculations Method, industry are currently unable to use NatHERS software for Class 2 and Class 4 buildings using centralised systems for hot water and/or space conditioning (centralised services).

Centralised services, where a central system plant provides heating, cooling and/or hot water for a number of sole occupancy units in a building, are common in new Class 2 and Class 4 buildings, in particular for hot water. These systems have varying efficiencies, often with more efficient heating or cooling plant, but additional losses and auxiliary energy associated with distribution. It is important for industry, the environment and building occupants that designers are able to appropriately rate and compare the impact of a variety of central and decentralised systems.

For example, heat-pump hot water systems are an efficient system that are increasingly common in Class 1 dwellings, however within Class 2 dwellings heat-pumps are challenging to implement as decentralised systems, largely due to space and noise. Centralised heat-pump hot water systems are emerging as an important energy-efficient system which allows apartment buildings to contribute to net zero targets.

Currently, there is no NatHERS Whole of Home assessment pathway available for Class 2 and Class 4 buildings using centralised systems for hot water and/or space conditioning (centralised services). Practitioners have limited choice in compliance pathways and currently must use either Verification Using a Reference Buildings (VURB) or a performance-based design solution.

NatHERS provides a robust and streamlined measure of the energy demand of an apartment unit. Using NatHERS methods allows accredited assessors to estimate actual energy demand, through the approved NatHERS Whole of Home National Calculations Method, and the accredited, easy-to-use tools. To date NatHERS has been the preferred NCC pathway for industry to demonstrate compliance with the energy efficiency provisions due to these benefits.

The inability of NatHERS to assess sole occupancy units (SOUs) serviced by centralised hot water and/or space conditioning is a regulatory gap and a missed opportunity to streamline the assessment of these SOUs and thus promote greater energy-efficiency in apartment buildings, with both environment and cost benefits to future occupants. It also leaves a significant proportion of dwelling construction with limited compliance pathways within the NCC.

The existing NatHERS Whole of Home National Calculations Method can be updated to allow centralised services, with no impact on the current method for decentralised systems. The same fundamental approach will be followed, with three additional steps:

- 1- Account for pipe and ductwork heat loss associated with longer pipe and duct runs.
- 2- Account for auxiliary energy use associated primarily with fans and pumps.
- 3- Apportion the total energy use for the centralised services to each individual SOU.

Extent of the problem

In the past 12 months 50,295 SOUs were NatHERS certified¹ (in this period 167,000 dwellings were commenced in Australia²). NatHERS and other readily available data sources lack details regarding the type and extent of centralised heating, cooling and hot water systems in these SOUs.

To provide an estimate of how common centralised hot water and heating and cooling are in contemporary apartment buildings, the NatHERS administrator sought input from NatHERS accredited tools. Hero Software provided a survey they conducted with stakeholders. This informal survey found that, at least in some locations, centralised services, and in particular centralised hot water systems, are and will continue to be a common technology (quantitative estimates from respondents were that between 50% and 100% of Class 2 projects they had worked on used centralised Hot Water). As stakeholders note, most contemporary apartment buildings will utilise centralised hot water, whereas central heating and cooling whilst less common is still used.

Jurisdictions and NatHERS industry stakeholders have advocated to the NatHERS Administrator and the Australia Building Codes Board (ABCB) the need for a NatHERS pathway for apartment centralised services to support compliance with the Whole of Home provisions of NCC 2022.

The stakeholder's feedback highlight industry and jurisdictions concerns with the lack of an apartment building centralised services method in NatHERS, concerns with the use of VURB and uncertainty with the May 2024 implementation of NCC 2022 in Queensland and Victoria.

OBJECTIVES:

To increase available compliance pathways for apartments with centralised service by developing a NatHERS pathway in NCC 2025 for compliance with the Whole of Home provisions.

OPTIONS:

Two options are available for addressing this issue:

1. Do nothing. Practitioners will continue to be required to use J1V5 or a performance solution to demonstrate compliance for apartments with centralised hot water.
2. Implement the centralised service method developed by Bridgeford group as an approved method within the NatHERS Whole of Home National Calculations Method.

¹ Data from <https://ahd.csiro.au>

² Data from [Building Activity, Australia, September 2023 | Australian Bureau of Statistics \(abs.gov.au\)](https://www.abs.gov.au)

IMPACT ANALYSIS (OF ALL OPTIONS):

Option 1: Do nothing

This is the current state of centralised services in NatHERS, these are excluded, as such this option is the baseline from which to evaluate the need for alternatives.

Stakeholders, both industry and jurisdictional representatives have clearly outlined the importance of closing the centralised services gap in NatHERS. This is particularly important as NatHERS is the preferred pathway for demonstrating compliance with residential energy efficiency provisions within the NCC. The NatHERS Scheme also has the associated availability of appropriately trained and accredited assessors and software tools, and a strong acceptance of NatHERS certificates by certifiers.

Option 1 would fail to address the expressed need from industry and jurisdictions, and does not address the current gap within NatHERS.

Option 2. Implement the centralised services method developed by Bridgeford group.

Option 2 is to expand the choice of appliances currently supported by the NatHERS Whole of Home National Calculations Method to include centralised system for heating, cooling and hot water systems for Class 2 apartment buildings.

This option does not require any change to the current method for decentralised systems, and simple requires the addition of a new section in the method to cover centralised services.

The change has no impact on stringency and is the inclusion of a new option within NatHERS to meet the NCC requirements for centralised system in Class 2 buildings. There is no change to the performance requirement (J1P3) which defines the maximum energy value of the domestic services; the addition to NatHERS centralised services proposed NatHERS centralised system method simply outlines how to calculate and allocate the energy value from centralised services to individual SOUs. There will be no requirement to use this new method in preference to existing compliance pathways. This option would allow assessors to compare the energy performance of centralised systems against alternative centralised and decentralised systems, and thereby support energy-efficient buildings.

The proposed method is consistent with existing methods for hot water and heating and cooling within the NatHERS Whole of Home National Calculations Method, which is deemed to satisfy J1P3 requirements. The thermal load (hot water or heating/cooling) for each SOU is determined using the existing method, as for decentralised services. The proposed additions to the method account for auxiliary energy requirements associated with centralised services (from heat losses, pumps and/or fan power) and outline a procedure for apportioning loads from a centralised system to individual SOU's.

The NatHERS administrator has finalised a contract with Bridgeford Group to develop an approach and detailed method to assess the performance of centralised systems within the NatHERS Whole of Home National Calculations Method. This method was developed with significant input from the Hot Water industry and has been reviewed by the NatHERS Technical Advisory Committee.

For both Hot Water and Heating and Cooling, the key steps in the proposed method are:

- **Step #1 – Determine Thermal Load for all SOUs in apartment building:** Heating, cooling and/or hot water thermal loads of assessed dwellings/building must be first determined using the same method as currently applied for decentralised services. This step is identical to the current method.
- **Step #2 – Account for Design Efficiency:** Heat losses from pipes, ducts or storage tanks are then accounted for, based on length of pipe and/or duct runs, location of pipe and/or duct runs (conditioned or unconditioned spaces), external conditions, and insulation installed.
- **Step #3 – Determine System Type and Account for System Efficiency:** After determining total thermal loads, the technology intended for meeting the requirements is selected.
- **Step #4 – Calculate Auxiliary Energy Requirements:** The auxiliary energy requirement (i.e., pumps, cooling towers, air handling units (AHUs) varies with the chosen technology.
- **Step #5 – Calculate Total Annual Energy Requirement for Central Services:** The total energy demand can then be calculated.
- **Step #6 – Apportion to SOU's:** The overall energy requirement for the building is then apportioned to each SOU based on thermal load for the SOU, as well as length of pipe to SOU for reticulated hot water systems.

Option 2 would provide industry with an additional choice in compliance pathways for apartment buildings with centralised services. The approach is consistent with the existing method for decentralised services, has no impact on stringency, and supports energy-efficient buildings by allowing assessors to compare the energy performance of centralised systems against alternative centralised and decentralised systems. Option 2 is the preferred option.

Impact of method - demonstration.

It is not possible for us to fully compare a proposed method to model centralised services with the current NCC, using either the current NatHERS method, the performance requirement or a verification method (i.e. testing all types of centralised services):

- There is no current method within NatHERS to compare against, this is the gap being addressed in the current PIA. Comparing against decentralised systems is not a like-for like comparison (though this has been included below with caveats).
- Similarly, comparisons with J1P3 (performance requirement) and J1P5 (VURB) are impractical. The current proposal is not to include a system with a defined energy performance that could be compared with the energy performance calculated annually based on our method. Rather we are proposing a new method to account for a new appliance. As such, a comparison with J1P3 and J1P5 can only establish whether a **particular** centralised system performance meets the performance requirement, not whether the calculation method is appropriate.

To illustrate the impact of the proposal, we have provided some scenario analysis below comparing energy usages of apartment units using a centralised system to those without centralised systems. In short, in order to demonstrate the impact, the current NatHERS Whole of Home method (for decentralised services) is used as the benchmark to assess the impact.

The results of our analysis demonstrate that the method provides reasonable results given reasonable inputs, varies in expected ways to changes in input values, and is consistent with existing approaches. The results provide estimated energy consumption and Whole of Home ratings for several scenarios considering decentralised appliances, several different centralised appliances, and a number of different apartment building heights (with associated difference in pipe and duct lengths, and storage tank, pump and fan requirements)

Testing has been undertaken using realistic inputs for different centralised systems, in three different apartment building typologies. The intent was to demonstrate that the method produces results that vary as expected and are based on changes to the input parameters.

It is important to note that specific values selected for various input parameters will affect the output (which is the main advantage of this method). Best efforts have been undertaken to source realistic inputs, or rely on accepted industry rules, however not all scenarios may be realistic for a given building typology or climate.

Full results of testing are presented in [Appendix A](#) and [Appendix B](#), with a high-level summary for Hot Water and Heating and Cooling outlined below.

Hot Water

The results presented in [Appendix A](#) are within what is expected, centralised systems are comparable decentralised systems (noting that this comparison is inherently problematic). Where there are differences, these can be explained based on the number of SOU for which demand is apportioned, the technology assumed efficiencies and increased or decreased losses from pipes and storage tanks.

In low-rise buildings all modelled centralised systems perform worse than 'equivalent' decentralised systems, due to the increased auxiliary energy use. In mid-rise and high-rise buildings centralised heat pump systems generally perform similarly to decentralised.

Centralised gas (instantaneous and storage) and instantaneous electric appliances consistently perform worse to the 'comparison' decentralised in all examples. The efficiency of the centralised heating system is a significant input in determining estimated energy use, and more efficient heating systems (heat pumps) use less energy.

As the number of SOUs in the building grows the energy demand per SOU decreases for centralised systems. This is because there are several relatively fixed energy uses associated with

centralised system, that get shared by a greater number of apartments as the number of SOU increases. This apportioning based on thermal demand per SOU is the key feature of the Bridgeford method.

Considering only heat-pump systems, the Whole of Home score is around three points different in low-rise cases, and very close for mid-rise and high-rise buildings. The difference in the Whole of Home score for mid-rise and high-rise buildings in all three locations vary in a similar manner to decentralised systems³. For all other technologies, as well as for low-rise heat pump, the differences in the Whole of Home score are greater.

Heating and cooling

The results presented in [Appendix B](#) demonstrate that the centralised HVAC method produces results that are reasonable and vary in the expected manner to changes in the design parameters. The actual values achieved in this testing have been calculated using best estimates for many parameters, using engineering rules of thumb in many cases, as such these results should be considered a demonstration.

The results in all cases are within what may have been expected, centralised systems are comparable to 'comparable' decentralised systems (noting that this comparison is inherently problematic). Where there are differences, these can be explained based on the number of SOU for which demand is apportioned, the technology assumed efficiencies, auxiliary energy and increased or decreased losses from pipes and ducts.

In all building types and all technology types, the centralised systems perform worse than the decentralised reverse-cycle system. The selected decentralised system in this case had a relatively high COP, in comparisons with the minimum default values assumed for the centralised systems. This use of minimum default efficiency values for the centralised system in this demonstration testing means that the pipe and duct losses and auxiliary energy demand are not offset by higher COPs, as is expected to occur when actual tested COPs are used.

In Melbourne, the tested apartment was a relatively high thermal efficiency and consequently had a low demand for heating and cooling. This meant the pipe and duct losses, and auxiliary energy were a larger proportion of the total energy demand than for Brisbane, where the apartment had poorer thermal performance.

As the number of SOUs in the building grows the energy demand per SOU decreases for centralised systems. This is because there are a number of relatively fixed energy uses associated with centralised system, that get shared by a greater number of apartments as the number of SOU increases. This apportioning based on thermal demand is the key feature of the Bridgeford method.

Summary

Based on the results presented in [Appendix A](#) and [Appendix B](#), the proposed method produces realistic results when using realistic inputs, it is consistent with the existing decentralised method, and any differences in Whole of Home ratings are easily explained by inputs relating to design losses, auxiliary energy, or system efficiency.

The demonstration results support that this proposed addition to the NatHERS Whole of Home National Calculations Method have a minor positive regulatory impact:

- There will be no impact to buildings that do not utilise centralised systems.
- Buildings that include centralised services will have an additional compliance pathway choice (i.e. using J2D2 (3) (a) (ii) and NatHERS software), and a method that supports energy-efficient design by allowing comparison of the energy implications of different design choices.

³ The heat pump results suggest that an interim decentralised proxy solution may be suitable for inclusion prior to NCC2025. This will be raised separately.

TRANSITIONAL MEASURES

For example, continued reference to an old standard (and for how long), continued recognition of test reports to an old standard (and for how long).

The timing for implementation will seek to align with NCC 2025. When completed NatHERS accreditation processes will be updated and tools will be invited to submit for accreditation against the centralised services method.

This will be discussed separately in accordance with the *ABCB Protocol for the Development of National Construction Code Reference Documents: NatHERS Supplement*.

CONSULTATION:

In developing the apartment centralised services methodology, the NatHERS Administrator contracted Bridgford Group Pty Ltd (mechanical engineers). The draft methodology was reviewed by the NatHERS Technical Advisory Committee, ABCB staff, CSIRO, the DCCEE Commercial buildings team and NatHERS accredited tool providers.

Comments were sought separately from representatives in the hot water industry, and significant detailed feedback on the method was received and addressed from representatives of major manufacturers including Rheem, Rinnai and Stiebel Eltron.

Feedback received was considered and changes proposed, a second draft followed with a revised methodology paper for which no further feedback was received.

One question received was:

How likely it is that a building with a centralised hot water system will need to use PV to offset increased energy demand due to accounting for pump energy?

Answer: In testing the implications of the NatHERS centralised services method we have found that:

- Centralised heat pump hot water systems perform the same as decentralised despite the need for storage tanks and pumps. This means, for these systems there will be no need to find efficiencies elsewhere.
- All other technologies, instant or storage, gas or electric, will likely perform worst than centralised. Pumps are not necessarily the reason, it is the efficiency of the technology that is the greater influence. This means, for these systems there may be a need to find efficiencies elsewhere.
- The more SOUs there are in the building the more pumps and storage tanks may be required but the addition number of SOU means that, once the total energy demand for the central system is apportioned to each SOU, the result may be closer to the performance of a decentralised equivalent. As such, the greater number of SOU there are in the building, the need for additional efficiencies will diminish.
- If additional efficiencies are required, to offset increased energy demand from centralised hot water, these may be found in solar PV or elsewhere. Improvements to heating and cooling, lighting or cooking will likely make up for the shortfall before PV may be considered.

CONCLUSION AND RECOMMENDED OPTION:

Conclusions

A robust, industry supported apartment centralised services method has been developed, it is fit for purpose and is ready for implementation within NatHERS Whole of Home National Calculations Method, subject to the outcomes of this PIA and associated consultation processes. The proposed method does not impact stringency and provides industry with additional choice in compliance pathways for apartment building with centralised services.

The demonstration testing has shown that the results from the method vary in expected ways to changes in design parameters, and generally result in higher energy consumption than 'equivalent' decentralised systems.

Including this method as an approved method within the NatHERS Whole of Home National Calculations Method will provide industry with a consistent, accurate and cost-effective tool to demonstrate compliance with Whole of Home requirements for apartments with centralised services.

Expanding the NatHERS National Calculation Method to include centralised services for heating cooling and hot water is not expected to have a detrimental impact on industry. The relevant NCC clause remains unchanged, and there is no requirement for practitioners to use this method over any other available method for these building types. The proposed change allows for additional appliances to be modelled within NatHERS software. The NatHERS method supports accurate estimation of energy use, flexibility in design, and has strong governance of assessors and software tools and inputs.

Recommendation

Implementation of the centralised services method in the NatHERS Whole of Home National Calculations Method with the adoption of NCC 2025 is the recommended option to address the identified problem and stakeholder concerns.

IMPLEMENTATION AND REVIEW:

Implementing the methodology for apartment centralised services in NatHERS is consistent with existing NatHERS processes and therefore streamlined. NatHERS conducts assessment of tools against the Whole of Home National Calculations Method and accredited tools are used to this process. Thus, tool developers who wish to implement the methodology for centralised services in their software will be able to do so in a streamlined and timely manner.

The timing for implementation will align with NCC 2025. When completed NatHERS accreditation processes will be updated and tools will be invited to submit for accreditation against the centralised services method.

Following implementation, the changes will be reviewed along with all NatHERS processes at regular intervals that follow the NCC residential buildings energy efficiency changes cycle.

LIST OF ATTACHMENTS:

Provide a list of attached supporting documents.

Appendix A: Hot Water testing results

Appendix B: Heating and cooling testing results

APPENDIX A: HOT WATER TESTING RESULTS

Testing specification and limitations

The testing was conducted by obtaining realistic inputs provided by Stiebel Eltron to represent typical hot water systems in apartment buildings. This extends to all significant inputs such as the length and type of pipe, number and size of storage tanks and pumps and insulation and other properties of tanks and pipes. These are real-world inputs that meet relevant NCC requirements. Where necessary, assumptions based on accepted engineering heuristics or other references have been used.

Testing was conducted in Melbourne (see Table 1), Brisbane (Table 2), and Canberra (Table 3). These represent a balance of hot, mixed and cold climates and are the likely location for relevant apartments building, excluding Sydney where a BASIX method is used.

The range of municipal water inlet temperatures in the locations tested is representative of most capital cities, this mean our analysis represent a range that covers the predominate locations of apartment buildings in Australia considering over 80% of apartment buildings in Australia are in Sydney, Melbourne, Brisbane and parts of the QLD Coast⁴. As such these locations are also the likely locations for new apartment buildings construction.

We simulated the same 59.2m² dwelling in all examples, centralised and decentralised. This provides the same occupancy which determines the hot water load.

Low rise is assumed to be 3 storeys, mid-rise 8 storeys and high-rise 20 storeys and above, based on Australian Bureau of Statistics classifications, other key inputs related to apartment size are summarised as follows:

Input	Low-rise	Mid-rise	High-rise
Number of SOU's	8	80	400
Number of pumps	1	2	4
Number of storage tanks	1	2	4
Supply temperature (°)	70	70	70
Pipe length conditioned	80	800	4000

The choice of decentralised hot water systems for comparison is subjective. A 27 small-scale technology certificates (STC) system was used for heat pumps, 5-star efficiency for gas appliances, and for electric instant a constant coefficient of performance (COP) was used.

27 STC is a medium efficiency and sized system, not the best nor the worst on the market. A 27 STC system is suitable for all climates tested, please note in Canberra and Melbourne a 25 STC system, or less, is not suitable (note there are no 26 STC systems).

For gas appliances 5 star is used in the Whole of Home benchmark dwelling and as such all gas appliances are assumed to be 5-star.

Instant electric is assumed at a constant COP for both central and decentral based on NatHERS existing settings. Choosing better or worst appliances will change the comparison results significantly.

For this testing the Whole of Home rating was not prioritised, instead the focus was on energy use for hot water heating. We assumed no solar PV, no batteries, and had unchanged heating and cooling appliances in all scenarios; this explains the low scores obtained in some locations. It is important to note that we did not tune the building fabric to achieve 7 stars in each climate zone, rather used an off-the-shelf rating file with a ~6.5 star rating (in Sydney)

Whilst the number of simulations we conducted is low, re-simulating the same dwelling and buildings in these cities any number of times will deliver the same results as it is the temperature of incoming municipal water that is the determining climatic factor for hot water. We could simulate a different sized dwelling, which will result in a different occupancy and therefore hot water load, but

⁴ [2071.0 - Census of Population and Housing: Reflecting Australia - Stories from the Census, 2016 \(abs.gov.au\)](https://abs.gov.au)

the change in load and therefore energy demand will be linear and so will the change to the Whole of Home score. As such we consider the results sufficient for demonstrating the appropriateness of the proposed method.

For heat pump systems we also simulated a decentralised 27 STC heat pump in all other relevant capital cities, this is Table 4. The results confirm we can expect similar results in hot, mixed and cold climate in Australia to the testing in Melbourne, Brisbane and Canberra.

These results are designed to demonstrate that the proposed method performs as would be expected when changes are made to apartment building size and centralised system type. It is not intended that the current results be used to directly compare the performance of centralised vs decentralised systems, as there are many inputs that must be considered in such a comparison.

Testing results

The testing results are presented in the following tables.

Table 1 - Melbourne

	Low-rise	Mid-rise	High-rise	Whole of Home rating (decentralised/centralised, low-rise, mid-rise, high-rise)
Heat Pump (kWh/yr.)	990	861	841	58/55, 58/57, 58/58
Electric Instant (kWh/yr.)	2480	2205	2164	43/32, 43/32, 43/32
Gas storage (MJ/yr.)	10530	9385	9213	55/56, 55/57, 55/58
Gas Instant (MJ/yr.)	9270	9133	9112	60/58, 60/58, 60/58
Decentralised				
Heat Pump (kWh/yr.)	823			
Electric Instant (kWh/yr.)	1533			
Gas storage (MJ/yr.)	11056			
Gas Instant (MJ/yr.)	7365			

Table 2 - Brisbane

	Low-rise	Mid-rise	High-rise	Whole of Home rating (decentralised/centralised, low-rise, mid-rise, high-rise)
Heat Pump (kWh/yr.)	940	817	799	59/54, 59/56, 59/56
Electric Instant (kWh/yr.)	2350	2093	2054	59/38, 59/38, 59/34
Gas storage (MJ/yr.)	9975	8908	8748	39/40, 39/42, 39/43
Gas Instant (MJ/yr.)	8812	8672	8655	46/43, 46/43, 46/43
Decentralised				
Heat Pump (kWh/yr.)	771			
Electric Instant (kWh/yr.)	10312			
Gas storage (MJ/yr.)	6860			
Gas Instant (MJ/yr.)	1427			

Table 3 - Canberra

	Low-rise	Mid-rise	High-rise	Whole of Home rating (decentralised/centralised, low-rise, mid-rise, high- rise)
Heat Pump (kWh/yr.)	1019	888	868	60/72, 60/72, 60/72
Electric Instant (kWh/yr.)	2389	2111	2069	69/66, 69/66, 69/66
Gas storage (MJ/yr.)	10142	8983	8809	69/69, 69/70, 69/70
Gas Instant (MJ/yr.)	8864	8727	8707	69/70, 69/70, 69/70
Decentralised				
Heat Pump (kWh/yr.)	885			
Electric Instant (kWh/yr.)	1427			
Gas storage (MJ/yr.)	10312			
Gas Instant (MJ/yr.)	6860			

Table 4 - Heat pump performance decentralised – other capital cities

Location	Decentralised Heat Pump (kWh/yr.)
Adelaide	671
Hobart	885
Perth	671

APPENDIX B: HEATING AND COOLING TESTING RESULTS

Testing specification and limitations

The testing was conducted using the same basic building and SOU design used to test centralised hot water. Centralised HVAC system energy usage is sensitive to many inputs, including SOU thermal performance, duct and piping layout, fan and pump energy, and heating and cooling system components specific efficiency. Given the relative scarcity of these systems in Australia, it was not possible to source a case study for all scenarios. Best attempts have been made to ensure the inputs in this demonstration testing are realistic, and it uses industry heuristics as necessary. Actual performance of specific centralised systems will be sensitive to these; however this allows a building designer to optimise energy performance and is a key advantage of the proposed method.

Testing was conducted in Melbourne (see Table 5), Brisbane (Table 6), as these are the most likely locations for apartment construction, excluding Sydney where a BASIX method is used, and cover a hot and cool climate. Apartment 610, an apartment design detailed in the NatHERS Software Accreditation Protocol, was used for all SOUs. This apartment achieved a 4.1 star thermal rating in Brisbane, and an 8.9 Star rating in Melbourne. The heating and cooling requirement is a key input to the centralised services method.

Other key inputs common to all HVAC systems are summarised as follows:

Input	Low-rise	Mid-rise	High-rise
Number of SOU's	8	80	400
Pipe length conditioned (m)	70	700	3500
Pipe length unconditioned (m)	10	100	500
Duct length conditioned (m)	100	1000	5000
Duct length unconditioned (m)	15	100	700
Duct insulation R-value	1.2 (2 in unconditioned spaces)		
Pipe insulation R-value	1		
Supply temperature cooling °C	15		
Supply temperature heating °C	35		

The choice of decentralised heating and cooling appliance against which to evaluate the performance of centralised systems is highly subjective. We have modelled a non-ducted reverse cycle air conditioner with a ZERL star rating of 3 (COP of 4.5). Changing the technology or the star rating will change the outcome. A non-ducted reverse cycle is the most common heating and cooling system. The 3-star efficiency is a medium efficiency and is used for the Whole of Home benchmark dwelling.

According to the Bridgeford method, the heating and cooling input efficiency should be “derived from tested efficiency values obtained from supplier's technical data” (Table 18: System efficiency input guidelines). There are also default minimum efficiencies specified for each system type (Table 19), and these default efficiencies were used in the current testing. Many systems have the same default efficiencies, therefore only a subset of the possible system types are demonstrated. The details of the tested systems are:

System	Heating efficiency	Cooling Efficiency	Auxiliary energy
Air-cooled chiller	NA ¹	4.05	Heating Hot Water (HHW), Chilled Water (CHW) pumps, and AHUs
Air-cooled packaged air conditioner (PAC)	3.0	3.0	HHW, CHW pumps, and AHUs
Water Cooled Chiller	NA ¹	5.9	HHW, CHW pumps, AHUs, Cooling tower and condensing water pumps.
Air-sourced variable refrigerant flow/variable refrigerant volume system (VRF/VRV)	3.0	3.0	HHW, CHW pumps, and AHUs
Atmospheric boiler	0.86	NA ¹	HHW, CHW pumps, and AHUs
Reverse-cycle air-water 2-pipe heat pump	3.0	3.0	HHW, CHW pumps, and AHUs

1. For Melbourne, when the selected system only supplied heating or cooling, an air-cooled packaged air conditioner (PAC) with COP of 3.0 supplied the other end use.

For Brisbane, as there is an insignificant heating load, only cooling results are provided (Table 5). In Melbourne both heating and cooling were modelled (Table 6).

Testing results

The results of baseline testing are presented in the following tables.

Table 5 – Brisbane – 4.1 Star shell – Cooling only

	Low-rise (kWh/yr.)	Mid-rise (kWh/yr.)	High-rise (kWh/yr.)	Whole of Home rating (decentralised/centralised, low-rise, mid-rise, high-rise)
Air-cooled chiller	490	473	472	50/53, 50/53, 50/53
Air-cooled PAC	655	638	637	53/48, 53/48, 53/48
Water-cooled chiller	344	327	326	53/53, 53/53, 53/53

Table 6 – Melbourne – 8.9 Star – Heating and Cooling

Cooling				
	Low-rise (kWh/yr.)	Mid-rise (kWh/yr.)	High-rise (kWh/yr.)	Whole of Home rating (decentralised/centralised, low-rise, mid-rise, high-rise)
Air-cooled chiller	145	129	127	54/41, 54/42, 54/42
Air-cooled PAC	172	172	172	54/40, 54/40, 54/40
Water-cooled chiller	106	89	88	54/42, 54/43, 54/43
Heating				
Air-cooled PAC	249	249	249	54/40, 54/40, 54/40
Atmospheric boiler	871	870	870	54/45, 54/46, 54/46

To demonstrate the response of the current method to design choices related to pipe, duct and auxiliary components, a number of scenarios are presented below for an apartment building in Melbourne with a centralised air-cooled PAC (COP 3.0 for heating and cooling).

Table 7 – Melbourne – 8.9 Star – Scenarios

Cooling				
	Low-rise (cooling/heating) (kWh/yr.)	Mid-rise (cooling/heating) (kWh/yr.)	High-rise (cooling/heating) (kWh/yr.)	Whole of Home rating (centralised ¹ , low-rise, mid-rise, high-rise)
Baseline	172/249	172/249	172/249	40/40/40
1- Pipe length halved from baseline	159/203	158/202	158/202	43, 43,43
2 – 1 + pipe insulation doubled.	156/179	156/178	156/178	44,44,44
3 – 2 + duct length halved	124/157	124/156	124/156	46,47,47
4 – 3 + Duct insulation doubled	152/97	152/97	151/96	48,48,48

1. The decentralised rating is 54 for all scenarios.

Attachment 1: How to provide feedback

How to provide feedback

Feedback may range from a short paragraph outlining your views on a particular topic to much more substantial feedback covering a range of issues. Where possible, please provide evidence, such as relevant data and documentation, to support your views.

Generally

- Feedback, except for anything supplied in confidence, may be used and attributed to you in the final report.
- The department reserves the right to not use your material particularly if it is offensive, potentially defamatory, or clearly out of scope for the consultation.

In confidence material

- The final report will be public, and all feedback should be provided so it can be used by the department for others to read. However, information which is of a confidential nature, or which is submitted in confidence can be treated as such by the department, provided the cause for such treatment is shown.
- We may also request a non-confidential summary of the confidential material it is given, or the reasons why a summary cannot be provided.
- Material supplied in confidence should be clearly marked 'IN CONFIDENCE'.
- You are encouraged to contact us for further information and advice before submitting such material.

Privacy

You may wish to remain anonymous. Please note that, if you choose to remain anonymous, the Secretariat may place less weight on your feedback.

How to lodge feedback

- Feedback should be lodged via email to admin@nathers.gov.au and with the subject line **Apartment Centralised Services Consultation Feedback**
- Please do not send password protected documents.

If you do not receive notification of receipt of your feedback, please contact the NatHERS team via email at admin@nathers.gov.au

Due date for feedback on proposals in this consultation paper:

COB 18th July 2024.