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Stephen Procter, Strategic Delivery Manager, Sustainability Programs
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Re: Energy Savings Scheme 2020-2021 rule change

Dear Mr Procter

We thank the DPIE for the opportunity to provide our feedback on the consultation paper for the proposed 2020-2021 Rule changes to the ESS, which includes potential new activities for solar and heat pump water heaters for domestic, commercial and industrial applications.
It is about these activities that our submission focuses on.

We recently provided a submission to the VEU proposed new activities regarding heat pumps for commercial and industrial applications. Since this appears near-identical to the ESS initiative, most of our observations, comments, recommendations, and concerns in that regard will be the same.

STIEBEL ELTRON Australia has been operating since 1995 and is a subsidiary of STIEBEL ELTRON International - a German company established in 1924 and a world leader in thermal comfort solutions for water heating, space heating & cooling and ventilation. For over 44 years we have been at the forefront of heat pump design and innovation and are the leading manufacturer in Germany in this industry, making us one of the top companies in Europe for building services based on renewables. Our domestic and commercial heat pumps are among the best in the market, from performance testing and validation in the field.

In Australia we provide off-the-shelf heat pump packages for space heating & cooling and hot water for domestic (including pool & spa heating) and non-domestic applications. Our systems offer local and remote monitoring and control, suitable for connection to smart energy management systems, some of which use on-site PV energy generation to provide optimal savings for end-users.

STIEBEL ELTRON has made a large investment in Australia over the last 26 years, both financially and in the development and training of staff, transferring years of experience in R&D and knowledge of established performance standards from the EU into the local market. We are aligned with various national and international associations and companies, with the purpose of facilitating the exchange of ideas, information and progress involving sustainability and innovation, including smart energy

management. Through our involvement in industry groups, we have been contributing to and supporting Australian standards for over 15 years. Of relevant mention for the purpose of this consultation, is our ongoing participation in the CS-028 committee, tasked with the drafting and advancement of all standards relating to the design, construction and performance assessment of solar and heat pump water heaters, which include AS/NZS 4234 and AS/NZS 5125.

STIEBEL ELTRON is an internationally recognised manufacturer of quality thermal comfort systems.

Questions for Stakeholder Feedback

2.1 Commencement date and transitional arrangements

- **Q1: Do you agree with the proposed transitional arrangements?**

Yes

- **Q2: Can you foresee any part of the new ESS Rule for which it will be difficult to get 'business-ready' within the proposed timeframes?**

The difficulty will be in the (high) cost of doing business for an entirely new application process of new systems, where applicants have to comply with a series of technical and administrative requirements. Product testing and performance assessment will be particularly resource intensive as it will require external consultancy services for most applicants.

There are specific barriers in this regard for both businesses and the ESS team that we have indicated in our reply to **Q44**.

2.3 Renewable Energy Target exclusions

- **Q3: Do you agree with the proposed changes to clause 5.4(g)?**

We agree with this change, being in line with the same approach as the VEU activities for the installation of solar and heat pump water heaters.

2.5 Define Electricity and Gas Savings for NABERS

- **Q4: Do you agree with the proposed updates to the definitions of Electricity Savings and Gas Savings for the NABERS method?**

Yes

3.2.1 Potential new Activity Definitions D17, D18, D19, D20, D21, D22 – Heat Pump and Solar Water Heaters (HEER)

- **Q26: Do you agree with the inclusion of new Activity Definitions to incentivise heat pump and solar water heaters in the ESS?**

Yes.

- **Q27: Do you agree with the calculation approach and requirements we are proposing for Activity Definitions D17-D22?**

Yes. It is ideal to harmonise with similar VEU activities as much as possible.

- **Q28: Do you have any concerns that these activities could drive bad design or behaviour in the industry, for example, the installation of oversized systems?**

Yes.

It appears that the installation of oversized products is currently a risk when complying with BASIX requirements for a new project dwelling, as the higher the STC value of a product is, the higher the rating score that the project achieves.

For a proposed project in the BASIX tool, when indicating the STC value of a prospective solar or heat pump water heater, there does not seem to be any additional qualification or condition as to the suitability of the selected product in meeting expected building hot water demand. Therefore, it appears that a medium or large load size solar water heater, or medium load size heat pump water heater, could be selected when the actual requirements for the project under consideration would be better served by a system providing a small load (for example, retired couple in a new build).

We therefore see a risk of something similar being allowed to happen in the proposed new ESS activities, unless additional conditions or requirements are placed on the activity, to prevent oversizing.

- **Q29: Do you think there are situations where a customer could face higher energy bills when switching from a controlled load or off-peak electricity tariff to a time of use or single rate tariff for the installation of a heat pump or solar water heater?**

We believe this is unlikely.

Solar and heat pump water heaters eligible for this program will provide minimum savings of 60% as per AS/NZS 4234, when compared to conventional electric water heaters providing the same standardised load.

This means their consumption would be 40% of what is expected for the electric water heater.

For a change of tariff to increase running costs of the new solar/heat pump system, it would mean an increase in tariff cost of more than 2.5 times the previous value.
It appears unlikely that current NSW tariffs would vary by this much when changing to a flat rate or ToU tariff.

If replacing a gas water heater and getting rid of the gas supply, there will be a large saving as the service charge for gas is eliminated, which is typically between $200-$300 per year.

- **Q30: Some heat pump hot water systems include a resistive electric element to automatically operate when ambient temperatures are higher than the heat pump can operate in. What percentage of systems aimed at the residential and small business market do you think have this functionality?**

We are aware of domestic heat pumps including heating elements, which appear to be mainly for load-assistance (air-temperature dependent or not) and could also be for legionella breeding control.

It is unclear whether some of them require this on an ongoing basis, or in situations outside the normal operating range of those heat pump products of high or low ambient temperatures (and what 'low' and 'high' actually mean).

The proportion of available HPWH models in the market that incorporate an electric element is high. The proportion of products *installed* that incorporate electrical elements is a different matter as it will depend on the market share of different brands and models, which we believe is lower that that of product availability, but still a significant number.

We are concerned about the operation of these products, where element operation could be impacting overall efficiency and also for C&I HPWH applications using electrical elements for boosting. We have detailed this in our reply to **Q43**.

- **Q31: Would the proposed changes incentivise you to become accredited to undertake these activities using the HEER method?**

It will not incentivise us for the purpose of accreditation, but certainly as a supplier and registrant of suitable HPWH systems, keen to work with accredited providers and other interesting parties, spreading awareness of the availability of this program.

- **Q32: Do you consider there to be any barriers to the uptake of these activities?**

Not for the domestic activities, but certainly for the proposed C&I activities discussed ahead in **Q44**.

3.2.2 Potential new Activity Definitions F16 and F17 Commercial and Industrial Heat Pump Water Heaters (HEAB)

- **Q33: Do you agree for your responses to questions 34 - 44 to be shared with the Department of Environment, Land, Water and Planning in Victoria?**

Yes.

- **Q34: Do you agree that a product-based approach would be appropriate for smaller systems and will provide certainty around deemed energy savings when installing heat pumps in commercial and industrial premises?**

Not totally.

While we support a deemed activity, we are of the belief that their uptake in the market will happen on many occasions in preference to arguably better suited M&V assessments (and if more resource-intensive application-specific modelling is possible), if an overlap of eligibility for what is a suitable activity is allowed.

The reason for this is the incentive of a lower upfront investment and relatively low costs when compared to the other more involved assessment processes, regardless of conservative nature of modelled outcomes, having or not having a close resemblance to what the usage may be on onsite.

Also, since only one modelling profile is considered, the actual energy savings and deemed savings may differ significantly, especially if the influence of factors affecting hot water demand is not considered, such as the ongoing recirculation heating in residential building ring mains. This is discussed further in our answer to **Q43**. This is why some form of verification in the field is essential, in our view, to confirm the goodness of the program. We discuss this in **Q44**.

- **Q35: Do you agree that the same range of heat pumps installed in commercial and industrial premises are also appropriate to be installed in residential apartment buildings?**

Yes, for the most part.

This program is only considering air-source HPWH, initially. We have argued the case in our submission for the VEU proposed program, for extending this to cover liquid-source HPWS (typically regarded as “geothermal” HPWS). These would also be suitable for residential buildings.

They tend to be of larger capacity than air-source HPWH of many of these and could be covered by an application-based activity that does not quite reach the need, or require, M&V assessment.

These units are typically used for space heating (and cooling) of large premises, but also for sanitary hot water production.

If suitable performance data is available and the modelling files, including the weather data files, can be modified by the applicant to account for the variability of the source temperature over a year (usually ground temperature) we would think it should be acceptable. Most of the modelling procedure would remain the same as for air-source HPWH.

The onus here would lie on the applicant to make a case for such devices and applications, providing reasonable modelling files, audited by ESS chosen consultants.

- **Q36: Do you agree with the calculation approach and requirements proposed for these Activity Definitions?**

We agree with the calculation approach proposed for the creation of ESCs. We do not entirely agree with the performance-based energy and emissions assessment deemed approach as explained in **Q43**.

- **Q37: Do you agree that these Activity Definitions adequately cover all of the different commercial and industrial hot water system configurations, e.g. systems with multiple water heaters? If not, what scenarios are not covered?**

It would appear so.

Yet the actual application is a different matter and we make the point in our reply to **Q43** that the "one size fits all" approach of the deeming process is unsuitable with required water temperatures that can be well below 45°C, but also above 60°C for high temperature industrial processes.

- **Q38: Do you agree that the proposed 12-year lifetime deeming period is acceptable for heat pump water heaters installed in a commercial or industrial setting?**

The VEU approach has proposed 15 years and we agree, based on decades of experience in Europe and over 12 years of experience in Australia with these products. We recommend harmonisation here as well.

- **Q39: Do you have any concerns that these activities could drive bad design or behaviour in the industry, for example, the installation of oversized systems? If yes, how can this be prevented?**

Yes, we are concerned, for both existing systems being replaced with HPWH solutions and new systems being installed. Not just bad design, but also poor outcomes in general.

Our concerns are both product and application related. Product performance needs to be assured and the suitability of the model for the application also needs to be verified.

Product performance and characterisation requires evidentiary documentation that should carry the endorsement of an independent, knowledgeable, certifier/assessor that has been qualified as such by the ESS team. This is necessary in order to assure technical rigour and the validity of purported performance.

If this is not assessed properly, there is a grave risk to this program from manufacturers and distributors of poor performing products taking advantage of what could be, effectively, an unchecked self-verification exercise, with the whole process failing because of HPWH of poor quality not just failing to provide the expected energy and emissions savings, but not able to satisfy the heating requirements in the first place.

Suitability of the application model regarding savings and alleged hot water usage is also something that requires assessment, as it appears this has not been applied in a real-life situation before and so its accuracy and effectiveness is not yet verified.

Programs such as these have the ability to raise the bar and foster healthy competition of what should be expected from products and services, in this case HPWH, by requiring and incentivising manufacturers to invest in R&D for product testing and improvement. They can serve as a starting point for performance standards development and adoption and grow over time and become very complete, useful, well-regarded, and widely adopted in the building industry.

There are HPWH schemes overseas that have developed this way, for example in Switzerland, and are now trusted and used for all matters of heating, cooling and hot water generation for many different applications. We expand more on this in our answer to **Q44** when addressing alternate assessment procedures.

We believe it is necessary for at least every first installation of every HPWH model (or range of models) to be subject to independent, simplified M&V type of check.

It is understood that actual M&V processes are quite resource-intensive, so the proposal is to create a simplified procedure with minimal equipment, yet capable of providing an indication of the goodness of the model, as far as hot water and energy usage goes. This investment helps to create a strong, robust HPWH market for the future. More on this in our answer to **Q44**.

The effectiveness of a HPWH system for low and medium temperature applications is also a matter of concern for us. It appears that both the ESS and VEU programs are considering allowing such HPWH applications, despite the system having to be modelled for higher temperatures. The use of multiple residential HPWH for larger applications is also allowed, so it stands to reason that multiple of these systems would/could be used also for low-medium temperature applications in C&I settings.

This is inappropriate for a couple of reasons:

- The first one is that even if selected HPWH are able to perform at low-medium temperatures, the modelling at the higher temperatures would penalise their performance and underestimate the savings. If a HPWH is capable of doing such work, the modelling should reflect this and at the very least model the realistic water temperature output (even if leaving the draw-off profile unchanged). This is addressed in our reply to **Q43**.

- The more serious reason is that some heat pumps, notably those using CO_2 (R744) refrigerant, are not designed for low-medium temperature applications and perform poorly in such cases. We can refer to a couple of documents in the literature where this is discussed, one a report and guide for heat pumps for aquatic centres[1] and another a comparison between CO_2 and conventional refrigerant HPWH for domestic applications[2]. We have first-hand experience replacing a system of three CO_2 DHW HPWH, installed for underfloor hydronic heating, which was not only failing to provide the necessary thermal comfort, but was expensive to run. The HPWH that was used is a product that has gone through the relevant assessments involving AS/NZS 5125 testing and modelling to AS/NZS 4234 and is regarded as having a high performance. This, however, is only for DHW applications, which is why the system failed to satisfy. As a matter of information, this will be the case for all CO_2 HPWH in the market, so any such products willing to participate in this new activities program that are rated as per the current recommended modelling must not be allowed for use at low temperatures unless compelling evidentiary documentation is provided showing they are able to do so in an appropriate way.

The use of electric or gas boosting with HPWH is another area that requires consideration. The majority of HPWH systems proposed for residential apartment buildings use some form of load-assisted boosting. This is further discussed in our answer to **Q41**.

Part of our answer to **Q43** addresses the issue of ring main building reticulation heat losses not appropriately considered in the modelling, which may overestimate the outcomes of what could be poor performance of a HPWH system.

Another area of concern is the need to load-match HPWH to the specific application and for that to be reasonably accurate. This process needs to be done by competent, knowledgeable assessor, that will look at a given application for heating and determine what is actually required.

In the case of existing systems being replaced, the load-matching must not simply be determined by looking at the specifications label of currently installed product for power consumption/delivery. It needs to consider the type of product and the efficiency of the product. Also, some form of audit/assessment should be performed of the actual hot water needs for the building as it may well be the that the original heating system was under- or over-sized, and/or the buildings carry high heat losses, totally unrelated to hot water loads required.
Therefore, activities must have conditions/requirements for the above to proceed with the necessary attention to detail and best engineering practices.

If this is not done, the risk of oversizing systems is high, where the savings will not be realised and it will jeopardise the effectiveness and usefulness of the program.

[1] https://www.smartconsult.com.au/wp-content/uploads/2020/07/Heat-Pumps-for-Aquatic-Centres-V1.pdf
[2] https://www.mdpi.com/1996-1073/12/3/479/pdf-vor

- **Q40: Do you consider that an application-based method would result in significant uptake?**

Not at the moment.

The main reason for this is the amount of resources required due to the complexity of using the assessment methodology that involves TRNSYS modelling and simulation.

If simpler and equally appropriate assessment tools are allowed, then the uptake of an application-based method could be considerable.
We go into extensive detail of one such assessment tool used in Europe that we believe could be adapted for Australia in our answer to **Q44**.

- **Q41: Some heat pump hot water systems include a resistive electric element to automatically operate when ambient temperatures are higher than the heat pump can operate in. What percentage of systems aimed at the commercial and industrial market do you think have this functionality?**

For assistance when temperatures are outside the operating conditions of the product, we wouldn't know and would rather not speculate about at this time.

However, for the purpose of aiding in load delivery, where the HPHW system is not providing the entire hot water load, we believe the proportion of HPWH systems that use either electric or gas backup for this purpose is very high, over 95% probably and this is an important matter that must be accounted for in this program.

The ESS incentives should most definitely account for the use of any auxiliary heating; electric, gas or other, for whatever purpose it is intended.

There are many HPWH systems that include boosting stages (primarily electric, but also gas) to what is effectively preheated stored water, for the purpose of increasing load provision. It is crucial that any HPWH system presented as a solution for a particular application be assessed with this in mind and modelled appropriately, as indicated as part of our reply to **Q43.**

- **Q42: Would the proposed changes incentivise you to become accredited to undertake these activities using the HEAB method?**

Our answer is the same as for **Q31**. It will not incentivise us for this purpose, but surely in the efforts to promote and incentivise others for the uptake of the technology.

- **Q43: If you have downloaded and tested the Commercial and Industrial air source HPWH Application Guide and TRNSYS Application Files which have been developed for the product registration process, please provide feedback here.**

We have not yet tested the modelling files but have gone over their structure and have observations and general concerns related to the modelling.

Firstly, these new activities are clearly for water temperature applications above 45°C and for one specific hot water draw-off profile over a week.

Low or medium temperature hydronic heating for space conditioning and agricultural use, for example, where temperatures from 28-38°C would be required, is not an eligible application, yet its outcome is as useful as that of a high temperature space heating HPWH system using radiators and fan coil units to achieve similar outcomes.
In fact, of the two, the former one is the *better* option is many ways, as the comfort is better, their efficiency (COP) is higher and so their energy consumption is lower, resulting in higher operational savings and the strain on the heat pumps is much lower, increasing their longevity.

It is easy to argue the case of it being the better overall solution and when presented with the need for hydronic heating in a new building, for it to be the go-to solution, yet it seems as if it would receive no reward or credits as the modelling allows for one single temperature application, which is for water delivery over 45°C at all times.

It appears simple to allow in the modelling **1)** low temperature HPWH applications for when this is needed with **2)** a suitable draw-off profile. The system would obviously need to be capable of this, having acceptable performance data at the temperatures required.
The proponent of the system would modify the modelling files to suit this application in agreement with ESS consultants.

From a processing and administrative point of view it does reduce the simplicity of the program as there would need to be a clear indication in the registration of the working water temperature capabilities of HPWH systems. Also, there would need to be a way of allowing certificates to be issued for the same system, but under a 'high' or 'low' temperature application (for example).

We can appreciate that complexity is undesired, even if the applicant/registrant is willing to have their product modelled in both ways. This is, however, pertinent to the reality of our market and specifically to our company, as most of the applications for our stand-alone HPWH is for low-medium heating purposes (domestic and non-domestic).

We therefore request that a pathway be afforded to HPWH for low-medium temperature heating and would welcome further participation in future discussions on this matter.

The proposed VEU new activities for HPWH C&I, in principle will allow the use of registered products for low temperature applications. We would expect the proposed new ESS HP C&I activities to also allow this as part of the harmonisation efforts between both programs/initiatives.

This, at least, allows products like ours to be used in those cases, even though the modelling at the required higher temperature delivery will underestimate the savings and emissions reductions.
Notwithstanding this fact, this cannot simply be allowed without further assessment or qualification of products' capabilities as it has the potential for poor outcomes, which was discussed in our answer to **Q39.**

However, even for high temperature applications, this condition of the modelling of a minimum delivery of water at 45°C, appears to be in breach of heated water services installation standard AS/NZS 3500.4, which requires water heating systems in forced circulation heated water reticulation installations to deliver temperatures 'not less than 60°C'.
This is clearly not a problem for a domestic setting where there is no recirculation occurring, or for small commercial applications, yet will be an issue for larger installations.

This would mean that unless some other measures are taken to assure the requirement of no less than 60°C is met, HPWH on their own, complying with this proposed new C&I activity, will not be suitable for the task.

A revision of the modelling appears necessary, where it may be the case that two different minimum water temperature compliance conditions are required now:
-The current 45°C value, for systems installed in buildings without recirculating hot water
-A new value at 60°C, for systems in building with recirculating hot water.

Or, have also a third, higher temperature condition requirement for high-temperature industrial processes where a range of 45°C-60°C water would be too low.

Secondly, building recirculation losses have not been considered in the modelling.

The reason for this seems to be the complexity and limitation of being quite application-specific, since different buildings and premises will have different heat loss characteristics.
The consultancy group (EnergyAE) pointed out during the VEU online public consultation session that since the draw-off profile of the modelling considers ongoing consumption throughout the day, this would conveniently cover the energy expense of recirculation losses.

We see a problem by not properly including heat loss recirculation in the modelling of HPWH systems, as it could overestimate the savings and underestimate emissions, especially for applications such as residential apartment buildings where the hot water demand does not seem represented by the draw-off profile proposed in the modelling.

Residential buildings usually have two hot water demand peaks per day, morning and afternoon, with the off-peak load being delivered during the day and very little hot water drawn off overnight (between 11 pm and 5 am).
Many HPWH systems providing residential building hot water do recirculation heat losses recovery continuously. For periods of low or no use, these systems (including any auxiliary heating) could be topping up the building reticulation hot water volume by as little as 5°±2°, with hot water being delivered into the building at no less than 60°C and the recirculation return being no lower than 55°C, in compliance with the requirements for circulatory heated water reticulation (as just mentioned).

We have witnessed heat pump systems in residential buildings working at idle times of the day when no hot water is in demand, raising the temperature of the recirculation return water by this much (or this little, rather).

If a HPWH system is working exclusively to recover such low temperature drop at delivery values around 60°C, its efficiency will suffer greatly.

It is not clear if this would be captured by the modelling as it stands at the moment, given that during the lowest demand times in the day, the modelling is assuming draw-off is taking place with cold water entering the heating system and displacing hot water. This is clearly not the case with recirculation heat loss recovery.

For CO_2 HPWH systems without auxiliary heating, this scenario is not easy to manage as they appear uncapable of raising the temperature by these small amounts and would have to resort to much larger temperature drops, which is not what traditionally occurs in these reticulation scenarios.

Having said the above, we can appreciate it is not easy to quantify the effect of an event for which there is scant or no knowledge beforehand, however, this highlights the need for more work in order to produce modelling that better accounts for what is surely to be experienced in many (maybe most) cases.

What should not happen is this matter being postponed for further review and then modelling proceeds from the beginning with this handicap and with diminished confidence from stakeholders on its effectiveness.

We are ready to provide information and resources on this specific matter in whichever way may assist. We have good knowledge of how recirculation hot water systems work and what to expect, specifically for residential apartment buildings.

There are also HPWH systems in buildings and commercial premises that only recover the load demand, while an electric bypass-boosting tank takes care of recirculation heat losses exclusively. This scenario would be a lot easier to model and the performance of the heat pump would be more accurately described.

The matter of electric boosting to complement HPWH load delivery is also important and is already considered in the modelling, yet the control of auxiliary heating and how it is implemented in operation is something that needs to be very carefully assessed. Whatever heating control is modelled is what must be recommended by the provider of the system and applied in the real world.

In the domestic market there are HPWH devices that include electric elements in their tanks. The modelling and simulation done for those, for the purpose of eligibility for the SRES or the current VEU activities, do not consider the multiple ways in which the providers of these units allow and encourage end-users to use the element functionality. This has the potential to reduce the alleged product efficiency and increase operational costs.

This type of distortion from deemed HPWH performance to real-life application is something that could happen in the proposed C&I HPWH activities unless risk-mitigating measures and procedures are taken and enforced as part of the conditions of the activity.

Another issue, which is not strictly about the proposed modelling files, is the use of existing tanks in a retrofit. If this will be considered under this program, the physical characteristics of those tanks need to be very well documented and presented to the ESS team, as well as those engaged in the modelling and simulation of the system. The generic modelling files **1)** will need to be modified to reflect the specifics of equipment used, including pre-existing tanks and **2)** the ESS assessment team will need to conduct proper auditing to make sure this is satisfactory.

- **Q44: Do you consider there to be any barriers to the uptake of these activities?**

Yes.

Costs (time and resources) will be the main barrier for distributors and manufacturers to meet the eligibility requirements of the activity, who will need to:
1) First test their HPWH
2) Then have them assessed, but with only one assessment platform, TRNSYS
3) Finally, submit through the application and auditing procedure outlined by the ESS program
Also, **4)** additional costs will be incurred if a simplified M&V for first-time product installation is implemented, which we believe is necessary.

Ideally, all these four points can be managed to reduce the resource impact on applicants, while providing as much flexibility as possible, but without sacrificing the integrity of what should be a robust program that delivers quality results.

Costs are an inevitability of participating in this process, in a similar way as it is currently for manufacturers and distributors having solar and heat pump water heaters eligible under the SRES and for the existing VEU activities for domestic applications.
The upshot of this, of course, is the financial benefit the end-user will receive, which will incentivise these activities, bolster the use of energy efficient and sustainable heating solutions with electric heat pumps (as has been the case with the SRES) and ultimately achieve the objective of the program which is emissions reductions.

We believe the key to managing this is *flexibility*.

1) Testing of HPWH

This is inevitable as there is no other way of characterising HPWH performance. We agree with the requirements of testing to either AS/NZS 5125 or EN 14511 (and EN 14825). There may be other international standards providing testing regimes appropriate, for example, for the construction of data performance maps. We would like to see the option given in such cases for applicants wishing

to use other test processes or standards better suited to their circumstances, to “prove” these are comparable to those required by the program.

We will not support the allowance of performance test data obtained without a guarantee that the necessary technical stringency has been followed for an accurate representation of the capabilities of the device.

This program’s success will be largely dependent on its technical merits, so it is crucial that all aspects related to performance assessment and modelling/simulation are carefully considered, are collected/applied , where applicable, with the utmost regard for technical rigour and with the intent of capturing as much as possible the expected behaviour of HPWH systems in C&I heating applications.

2) Using TRNSYS

A barrier, no doubt, is the requirement of a single assessment tool/platform, especially one that is expensive and hard to use and understand.

Despite its utility and well-earned reputation over decades of use, improvement and validation of its modelling and simulation capabilities in real-life scenarios, and considered by many in Academia as the gold standard for assessment of thermal processes, in practice TRNSYS remains mostly in the domain of academic circles, R&D centres and highly specialised consultants.

It is not simply the case that any manufacturer, or any interested party, with capable technical staff can purchase it and in a short period be able to use it competently. It is a very specialised tool requiring specialised knowledge of heat transfer and thermodynamic theory. Companies wishing to do so will require a high upfront investment and then train suitably qualified staff over time, who will experience quite a steep learning curve.

The vast majority of those wishing to partake in this program will need to seek consultancy services in order to have their products assessed and this will come at a high cost. It also means total dependency on an external entity for something that arguably should be able to be done ‘in-house’, so to speak, as is the case in other C&I situations in the building industry, for example with building rating and similar tools for the assessment of thermal performance and sustainability practices.

It may appear at first glance that this is not such a problem as after all the deemed activity for every HPWH is likely a one-off process. However, this essentially limits participants in the program to that option only and for every change to a product, for improvement or added features, a re-assessment will be necessary, again by the external entity (and we note that there are not many in Australia that can provide this service).

This means that to be able to assess the suitability of a product for a particular application, which is precisely the option of a site-specific modelling approach, the amount of work required and the cost, if outsourced, would likely make it an unfeasible option in practice. The M&V method would equally

be too onerous and impractical as well, plus the fact that it would not greatly assist with the development of the modelling and simulation process as it is mostly about measured outcomes.

In a way, as good as TRNSYS may be, ironically it seems its applicability is limited by its own complexity.

This assessment process is therefore not flexible and discourages the more comprehensive and site-specific modelling scenarios that are ideal for the improvement, the enrichment and advancement of a program like this one.

Without allowing a pathway for attainable performance-based solutions, it is difficult to imagine the program growing out from the proposed simple deemed activity, always providing a conservative incentive level.

These options are afforded to other areas of industry, where other than de-facto assessment and rating tools can be used, as long as they are deemed suitable for the task at hand.

In fact, this is actually the case with the latest publication of AS/NZS 4234:2021, where the modelling and simulation of heated water systems can be carried out by any program, or calculation platform, as long as it is able to make use of suitable mathematical models to assess the energy consumption and performance of water heating systems. There is a validation procedure in the document to determine whether a program is capable of this.
Even though TRNSYS has always been used for this purpose and will most likely continue to be used for the foreseeable future, it is not mandatory to do so.

We would expect that for a HPWH program, or scheme, such as this one, being built up from the very beginning, different options for assessment be allowed if their suitability can be reasonably demonstrated. This is regardless of the way this is achieved and whether a numerical simulation approach, as described in AS/NZS 4234, is used or not.

There are, indeed, other HPWH performance rating and assessment tools already, as the result of decades of experience and development of HPWH technology in Europe.

A standout from these is a Swiss tool and calculation method (also adopted in Austria) known as **WPesti**[3], used to determine energy costs and savings of HPWH for thermal comfort applications. This tool is an elaborate spreadsheet and is currently made available in German, French and Italian with an explanatory handbook that also provides some historical insight into its development (also in those languages).

The calculation and determination of the relevant quantities (heating loads, seasonal savings) is based on Swiss standards for thermal performance assessment (SIA 380.1 and SIA 384.3). The performance data used for HPWH is the result of testing to EN 14511. Many air-source and geothermal HPWH systems can be selected from drop-down menus that contain a vast range of products available in the European market. The selection of heating applications, or categories, (single family home, restaurant, school, etc) is also done via drop-down menu.

[3]https://www.energie-zentralschweiz.ch/fileadmin/user_upload/Downloads/Planungshilfen/13_WPesti_Modellbeschrieb.pdf

It first was released in 2004, followed a period of modest improvements and has been used mostly in its current form (with incremental changes) over 11 years now, after having been subject of multiple field-testing validation and is used by government and industry schemes for allocation of financial benefits associated with energy savings.

This tool considers 32 Swiss climate zones and follows an assessment procedure (climate BIN approach) that is similar to, but more in depth than, the procedure for air conditioning energy efficiency rating as per AS/NZS 3823 standards, which considers 3 climates zones for Australia.

The great advantage about this tool is that it already provides:

- A tried and tested methodology for determining energy costs and savings for heating, cooling and sanitary hot water
- Assessment for 12 different applications, such as schools, restaurants, sports centres, hospitals, etc.
- Product performance from a selection of over 1000 commercially available heat pump solutions from 32 different manufacturers.

On top of all this, by comparison with TRNSYS, it is very easy to use requiring no specialised skills and is provided free of charge.

Such a tool appears to be an ideal template for an alternative HPWH assessment in C&I applications that could be adopted and modified to suit Australian conditions. It would provide performance results for many application-specific cases that could also be revised and changed to suit our needs.

We believe that being able to propose and have access to options such as these -and particularly this one- is something that will greatly assist the development of this HPWH program, allowing it to expand into the best that it can be.

Therefore, we request also that a pathway be given for the above, for the proposal of alternate solutions to HPWH assessment, for applicants that are keen to do so and are prepared to invest resources in a reasonable validation and acceptance process.

3) ESS submission process

A potential barrier is the actual application process; submission of informative and evidentiary documentation in support of HPWH systems proposed, followed by auditing.

The draft application guide developed for the proposed VEU and ESS new activities that details most of this process appears straightforward to follow and flexible enough to allow applications for multiple products and clarifications via manufacturer's declarations, if necessary. In principle, it would appear this would pose no difficulty to an applicant.

It's application should be as straightforward and clear as possible, flexible enough to also allow applications for multiple system configurations (for example, for rating product performance at low-

medium and high temperature applications, as mentioned in previous answers and detailed in **Q43**) and clarifications via manufacturer's declarations, if necessary.
If it unduly burdens the applicant by making it painstakingly hard and costly, it will discourage participation in the program.

The auditing process, particularly, must be very clear in its requests, where auditors must be knowledgeable and capable of assessing all sorts of technical data, including modelling results and be confident in making judgement calls that are sensible, that don't burden applicants unnecessarily, yet do not ignore matters that ultimately preserve the integrity of the program.

4) Mandatory one-off, simplified, M&V

We believe it is necessary for the modelling and simulation results for energy consumption, savings and emissions reductions to be checked as much as practically possible, against measured outcomes for at least every first installation of every eligible HPWH system/package (or range of systems) registered with the program.

The generic C&I hot water demand profile of the modelling will differ from actual hot water consumption of C&I applications (especially residential building hot water demand), therefore it should not be expected for modelled results to match those obtained from an actual installation.

Our position and the reason for doing this is to assess the goodness of the entire program:
a) If installed products are performing as expected in a broad sense and **b)** if the program is ultimately meeting expectations.

This will provide insight on matters such HPWH average COP values, matching of HPWH systems with building loads and determine from the savings achieved how worthwhile this program is.

Feedback gained from this can then be used to re-shape and steer the program in better ways; perhaps modify modelling and simulation, introduce new requirements and processes to account for unforeseen difficulties or problematic consequences (for example, not complying with certain requirements of installation and other standards), potentially assist with the use of other assessment tools, as mentioned in our reply in point **2)** above.

It is understood that actual M&V practices are quite resource-intensive, so our proposal is for the ESS team to create a simplified procedure with minimal equipment, yet capable of providing useful information regarding three main aspects:

a) Hot water volume usage and demand profile
b) HPWH system energy consumption
c) HPWH system energy delivery as hot water

This would entail:

- Electrical energy metering equipment
- Heat metering equipment
- Flow meter for recirculation of heated water
- Data collection and logging facility

Monitoring and logging capabilities, if available as part of the control systems of HPWH, could be allowed to further simplify these tasks and reduce costs.

The assessment process; collection and analysis of the data, would also require simplification and could be a shared task between the applicant and the ESS assessment team, where the applicant is in charge of the collection of the data and the ESS, via preconfigured spreadsheet macros for example, would analyse it for an indication, and estimation, of measured outcomes.

Doing this will give a lot more credence to the process and make for a more trusted program that will improve over time.

We believe that manufacturers and distributors need to be prepared to invest in matters such as these, for their own benefit and the benefit of the program in the long run.

Therefore, rather than a "barrier" we see this as a welcomed opportunity to participate in the making of a great HPWH reward program, an opportunity that should be met with enthusiasm and a desire to showcase how good HPWH products and solutions are.

- **Q45: Do you agree the ESS should harmonise with the VEU and consider adopting or closely aligning with their modelling procedure, product approval process and product registry to calculate energy savings for residential and small business heat pump and solar water heaters under the HEER method of the ESS?**

Yes

- **Q46: Do you agree that the energy performance of heat pump products should be tested in climate zones 3 and 5 to represent energy savings more accurately for NSW?**

With some exceptions, as described earlier, we support testing and assessment of products as per the proposed draft application guide for all zones under installation, which includes zones 3 and 5 for NSW.

- **Q47: Do you agree that the NSW Government should harmonise with the VEU to develop a joint modelling procedure, product approval process and product registry to calculate energy savings for commercial and industrial heat pump water heaters under the HEAB method of the ESS?**

Most definitely**.**

- **Q48: Do you have any alternative solutions the NSW Government should consider?**

There is no drop-in alternative solution we can propose other than consider expanding this program as was suggested for the VEU initiative, by allowing other assessment methods to be considered. Our reply to **Q44**, item **2)** goes into an alternative assessment method that due to its simplicity and affordability we believe would greatly benefit this program and that could be ported to Australia if resources were made available.

- **Q49: Do you consider there to be any barriers the NSW Government should be aware of?**

The barriers we see were mentioned in our reply to **Q44**.

We believe this is a fantastic initiative, as conveyed in our submission to the VEU program.

We want to see this expand and be a wholesome program that does justice to HPWH systems and their applications and encourages participation and incentivizes the use of the technology for C&I applications.

We remain committed to contribute and assist in its development and growth.

Kind regards,

Dr. Raniero Guarnieri
Technical Manager