Introduction of Whole of Home Energy Efficiency Standards into the Australian National Construction Code

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What this paper is about

Subject: Australia's "Whole of Home" (WoH) minimum energy performance regulations for residential buildings

What we will look at:

- The context surrounding the new regulations
- The scope of the regulations
- The metrics used and stringency levels adopted
- The main pathways available for achieving compliance
- The basis for modelling of performance
- The important role of on-site renewables (PVs) and batteries
- Some key challenges faced and conclusions

Context 1: Regulatory Environment

- Residential Energy Efficiency standards in Australia are formulated at a national level in**:** **The National Construction Code of Australia(NCC)** but enacted at State level
- The NCC is a performance-based code that sets minimum required levels for safety, health , amenity, accessibility and **sustainability**
- Effectively 9 Governments (Commonwealth + 8 states/territories) of different persuasions have to agree on a path forward - so some degree of compromise is usually a feature

Context 2: History -The Course of EE Regulation

< 2022 WOH performance standards

< 1990 Insulation standards in some states

2011More Stringent T/P Standards >

2003-5 Min. Thermal Performance Standards ^

The long and winding road ……..

Context 3: The Case for Regulation

How regulation of WoH performance was justified:

- Market Failures
  - Unpriced externalities (primarily carbon cost)
  - Information asymmetry (impacts the consumer's capacity to make informed choice)
  - Split incentives (builder is not usually the owner, doesn't bear the operational cost)
- Policy Drivers
  - Paris Climate Agreement: 26-28% reduction on 2005 emissions by 2030, Net Zero 2050
  - National Energy **Productivity** Plan (NEEPP): 40% improvement on 2015 by 2030
- Cost Effectiveness
  - Analysis showed that the proposed regulations would deliver a B/C ratio = 1.3

Whole of Home - what it covers

- The performance of the building fabric (now 7 star minimum)
- New - The efficiency of fixed energy-using equipment
  - Heating and cooling equipment
  - Water heating
  - Lighting
  - Pool and spa pumps
- New - On-site renewable energy generating systems, such as rooftop solar panels – offsetting and exporting electricity
- New - Batteries (offer increased offsetting of grid supplied electricity)
- New - Accounting for time of use impacts on energy costs

The Metric Adopted

- The old metric (heating and cooling loads) no longer suitable:- so a new "Societal Cost" (SC) metric was developed. It encompasses:
  - $ energy costs to the building user
  - CO_2 costs to the environment in terms of greenhouse gas emissions
  - time-of-use cost impact on energy networks (relates to electricity).

- All 3 components of SC are resolved into a $ cost so they can be combined.
- The new WoH requirements allow trading between the efficiency of energy-using equipment, as well as offsetting through energy generated onsite

Setting the Stringency

7 Star building shell performance (e.g. Heat/Cool Load 100 MJ/m^2/annum in Melbourne)

Heating = ducted heat pump with COP = 4.5 (GEMS 3 star)

Cooling = ducted heat pump with EER = 4.5 (GEMS 3 star)

Hot Water = Gas instantaneous (≈80% burner efficiency) (5 star)

Lighting = 4 W / m^2 power density

Benchmark Set

According to House Size and Climate Zone

Example: Assume Benchmark SC = $1000 (given floor area and climate)

- Apartment buildings must meet the benchmark (i.e. ≤ $1000 SC)
- Detached dwellings must meet 70% of the benchmark (i.e. ≤ $700 SC)

Main Compliance Pathways

1. ENERGY RATING OPTION (Simulation)

(Nationwide Home Energy Rating Scheme)

Thermal Performance Star Rating

7 Star Min

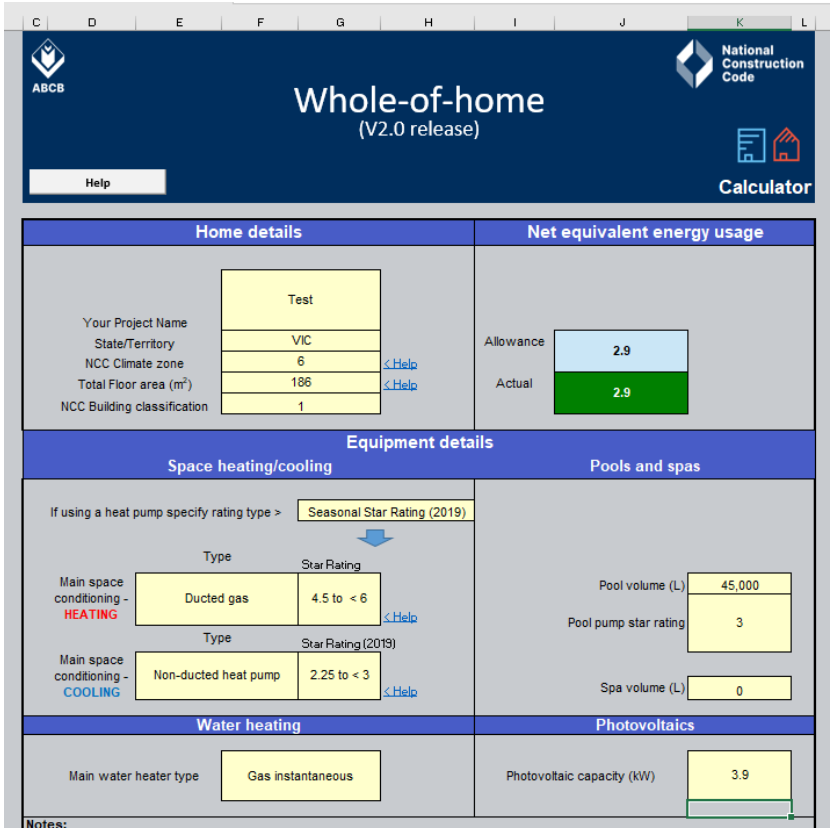
Whole of Home Performance Rating

Detached = 60

Flats = 50

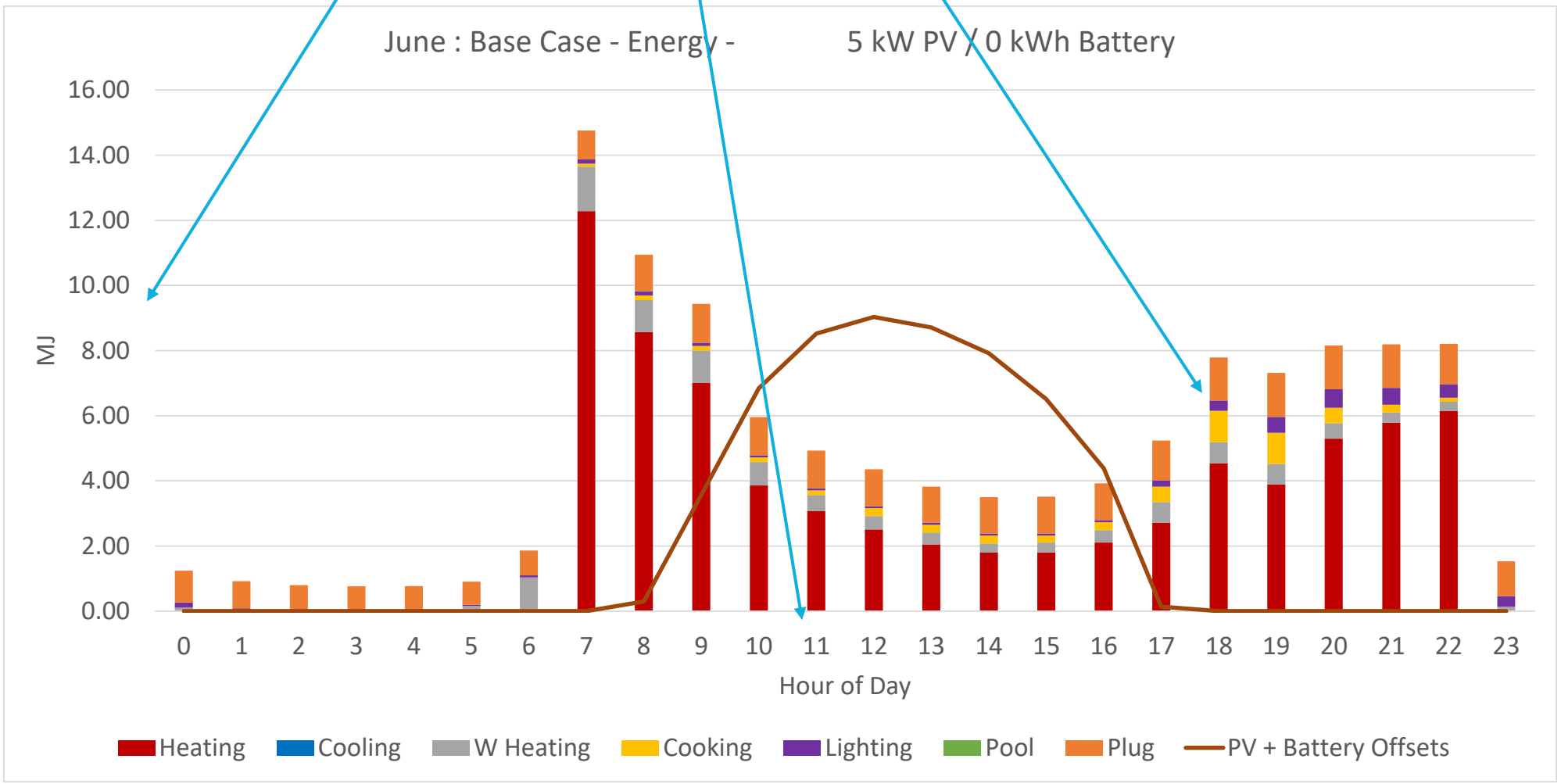
2. ELEMENTAL DTS OPTION

(simple on-line calculator)

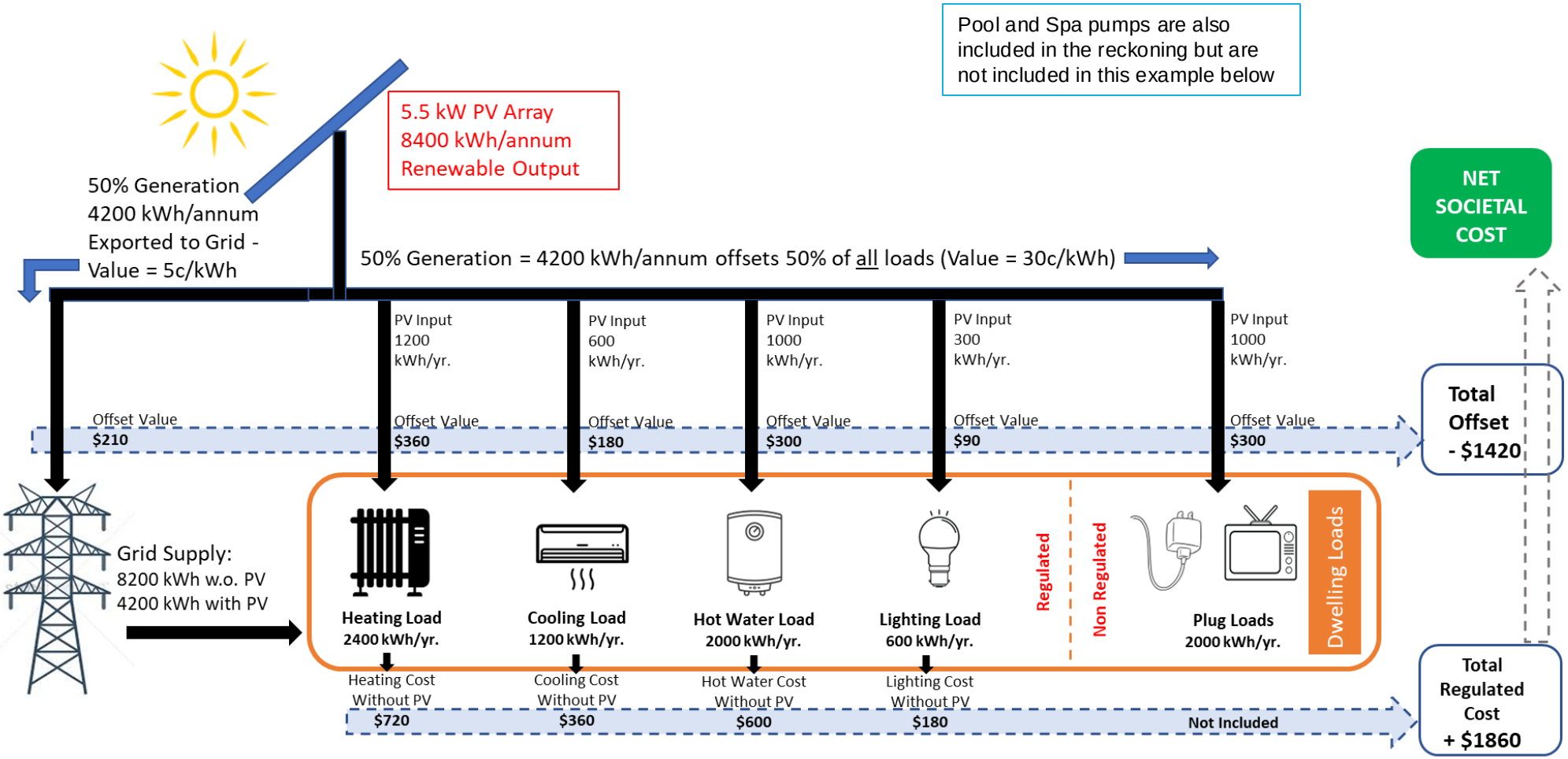


Basis for Modelling 1: Hourly assessment

Model uses Energy (MJ), Hour of operation and fuel type to determine societal cost



Basis for Modelling 2: Societal Cost Accounting



Basis for Modelling 3: PVs and Batteries

- Theoretical PV hourly output calculated taking into account:
  - Climate data in location (hourly) – direct and indirect radiation, azimuth and altitude of the sun, ambient temperature
  - Tilt and orientation of the PV array
  - Rated output of the array (kW)
  - Losses
    - Ambient temperature
    - Soiling
    - DC wiring losses
    - Conversion losses
  - Capacity limits of the inverter
  - Capacity limits of the grid connection
- Batteries modelled as simple energy storage tanks with a basic control system (not responsive to expected future load profiles or network price signals)

Role of On-site Renewables & Batteries

PVs (main form of renewables)

- Australia has one of the highest PV ownership levels in the world (1 in 3).
- PVs offer an easy compliance solution that is appealing to consumers
- PVs can help to offset “extras” such as pools and spas
- PVs will be increasingly important as stringency standards are increased

Batteries

- Batteries consume energy but a $SC based metric allows for batteries to realise credits (Excess PV generation stored then used to offset on-site demand (30 c/kWh), rather than be exported to the grid (5 c/kWh)
- Batteries will become a more important solution as:
  - Battery costs decline
  - The value of exported PV generation (the feed-in tariff) declines further
  - When the stringency of the regulations are increased in the future
- PV diverters to hot water systems can also gain credits

Some of the Challenges

- Australia had no accredited WoH rating software to facilitate modelling
- Societal cost metric is dynamic (fuel costs, carbon value, feed in tariffs..)

Pros	Cons
• More accurately reflects policy objectives • As the metric settings change over time, it sends the right signals to the market • Incentivises battery technologies	• Relatively complex / not well understood • Change in settings over time could prove challenging for industry

- SC Calculations are complex – not well suited to an Elemental DTS method
- Apartment buildings:
  - PVs present challenges: limited roof space, more costly to install, complicates metering arrangements, can create common property ownership issues (but not insurmountable)
  - Use of stand-alone heat pump technologies present challenges: Outdoor units of split systems may be difficult to site. (but can be designed for in a new development)

Conclusions

- New standards have been successfully adopted by more than half the jurisdictions in Australia with most of the remaining states and territories to adopt by mid 2025 – Success!
- The stringency of the standard as currently codified is relatively modest but the required regulatory framework is now in place to pave the way to regulate for net zero (cost/emissions) dwellings in Australia
- Full evaluation of the regulations is warranted in the coming years incl. :
  - Actual compliance costs versus modelled
  - Actual savings in energy costs and emissions compared to modelled
  - Levels of non-compliance
  - Preferred compliance pathways / uptake of PVs in new housing
  - Review of the societal cost metric settings
  - Consideration of the use of a national societal cost value rather than individual jurisdictions
  - Comparison of outcomes between elemental method and simulation method

THE END