Electrification of Brownfield Commercial Buildings
- A Practical Guide

Presented at:

CIBSE ANZ Seminar Series
THE NEED FOR SPEED
- Tools to engineer a net zero future

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ELECTRIFICATION

What does it mean for me and my assets…..?

Electrification is about **‘shifting’ Scope 1 emissions to Scope 2**

Scope1; generally, ‘difficult’ to abate fuel sources, must be offset (ie. Gas)

- Scope 2; relatively straightforward to address with Renewable electricity PPA or similar (ie, LGC purchase)

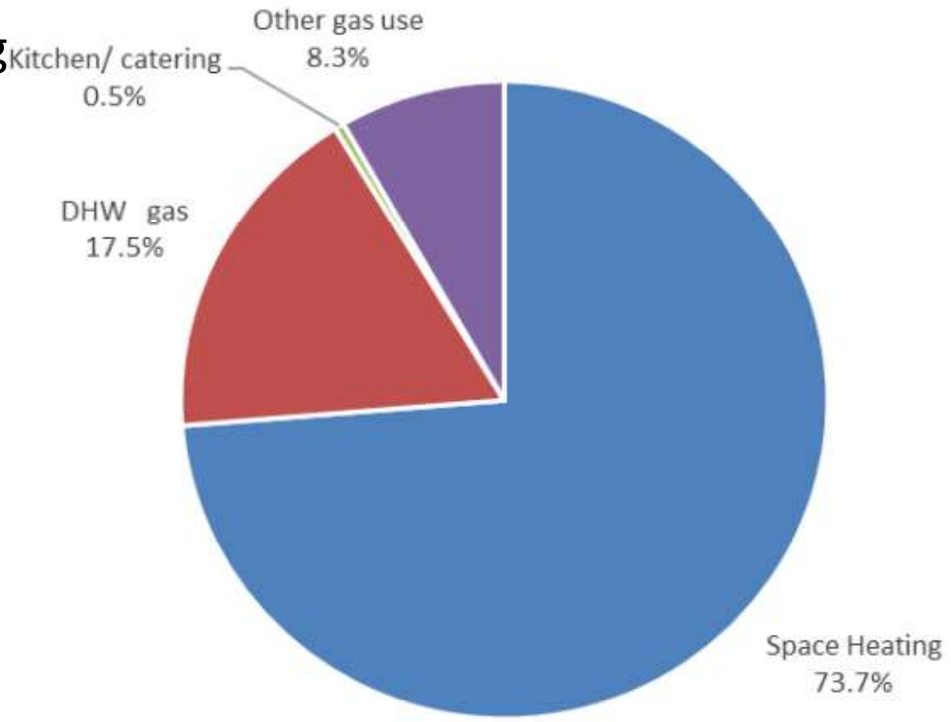
What assets do you have that require electrification and which ones are most important?

CHALLENGES

- LACK OF DATA
- POOR HISTORIC DOCUMENT MANAGEMENT
- TECHNICAL INCOMPATIBILITIES
- IMMATURE INDUSTRY
- RISK APPORTIONMENT
- SENSITIVE STAKEHOLDERS/AREAS

1: CONSIDER LOADS FOR MATERIAL BENEFIT

- Generally speaking, the largest loads are in space heating – especially in Victoria!
- Within space heating;
  - Replacement of Gas boilers that provide Heating Hot Water (HHW) is where the main impact lies
  - Unfortunately, this is also very challenging.
- DHW service replacement, and replacement of other gas heaters (ie, ducted) is also necessary
  - but this is relatively straight forward, has a reasonable business case and should be programmed based on your organization priorities.

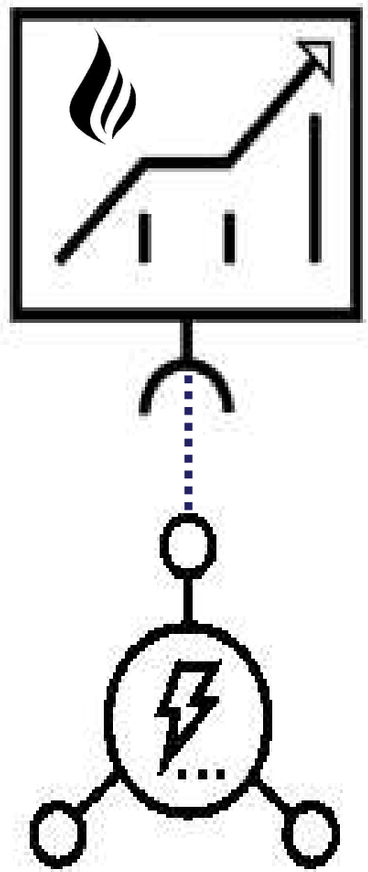


Ref: Fig 74; Gas End-Use shares, Offices, Australia (FY2008 – FY2017) page 117 – Commercial building baseline study 2022, final report, DCCEEW, Aug 2022

We will focus on **Gas Boilers / HHW systems** for the remainder of this discussion

2: GATHER LOADS BASED ON ACTUAL USE
(MODELS ARE OFTEN TOO CONSERVATIVE)

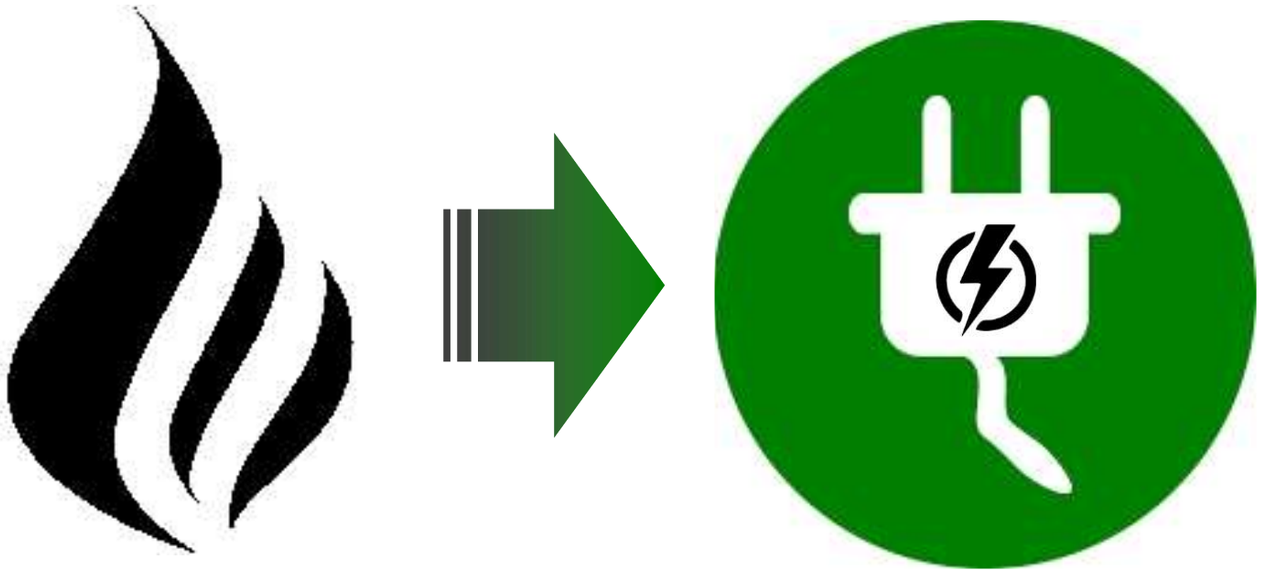
- Consider actual observed peak loads
  - Not what capacity may be installed currently
- You need electrical, thermal heating and thermal cooling
  - Typical day / month / annual profile
  - An understanding of coincident and related loads is critical in design optimisation
  - If not known (or logged) you can model, but verify key assumptions with check measurements to ensure model calibration
- Note; Consider - low hanging fruit to reduce loads at this point.
  - Air tightness, occupancy vs BMS schedule etc.



3: CONSIDER SUITABLE TECHNOLOGIES

Electrification of natural gas HHW space heating in large brownfield, commercial sites is not easy!

There are no ‘cookie cutter’ solutions and numerous technical considerations must be worked through.



Thermal energy from electricity:

- Heal Pumps
- Induction
- Infrared
- Microwave
- Electrical Resistance
- Electrical Arc
- Renewable hydrogen
- Renewable Gases (SNG, Bio, etc)

We will focus on **heat pumps** for the remainder of this discussion.

HEAT PUMPS WILL DELIVER A CARBON NEUTRAL FUTURE!

Responses to this proposition are;

- Correct – its true; and,
- Yes, but in large brownfield site, we don't really know how yet. Its tricky!

COMMON CHALLENGES WITH HEAT PUMPS

- Existing Flow / Return Temperatures
- Lack of Local Experience
- Electrical infrastructure
- Space and Structural requirements
- Peak Loads (Thermal and Electrical)
- Cost to implement…….

Understand which challenges will likely be most relevant to the site

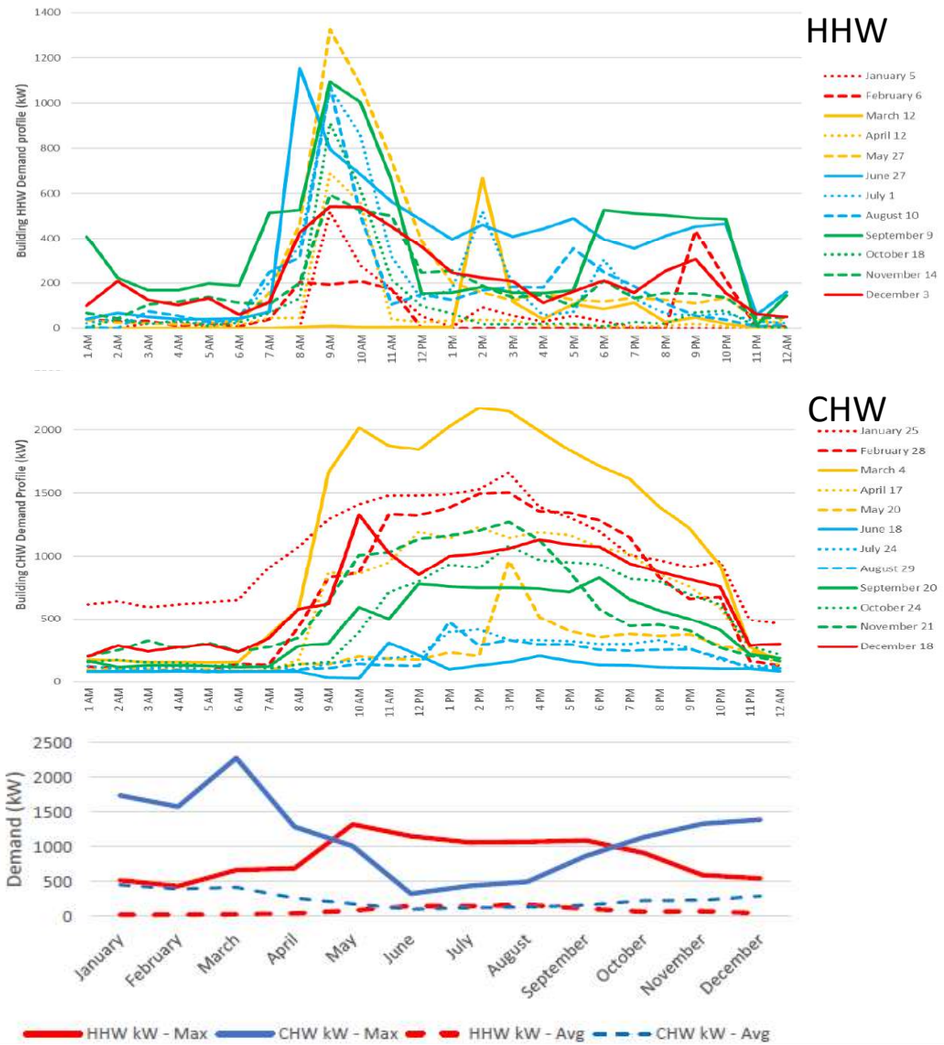
A FEW COMMENTS ABOUT LOADS

Building loads, electrical constraints

- Peak loads are the main concern relating to;
  - Heat pump(s) size and site infrastructure requirements
- Heat pumps probably won't increase site peak loads (elec);
  - Buildings have larger cooling loads generally, and will not be running CHW & HHW at peak capacities simultaneously
- 4 pipe Heat Pumps can service simulations loads.

HHW peak loads, generally occur early morning, for a few hours only

- A lower peak load requirement will reduce the capital investment and minimise infrastructure constraints.
- There are strategies to reduce or shift these peaks.



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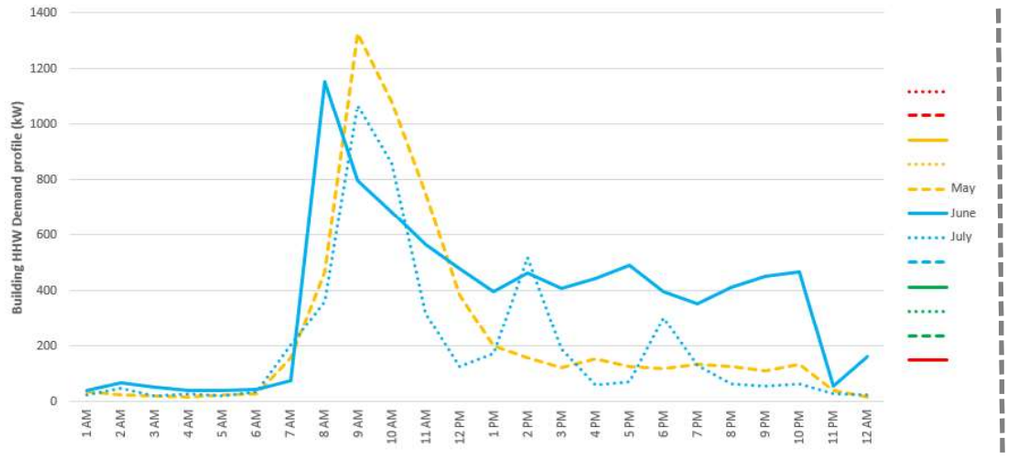
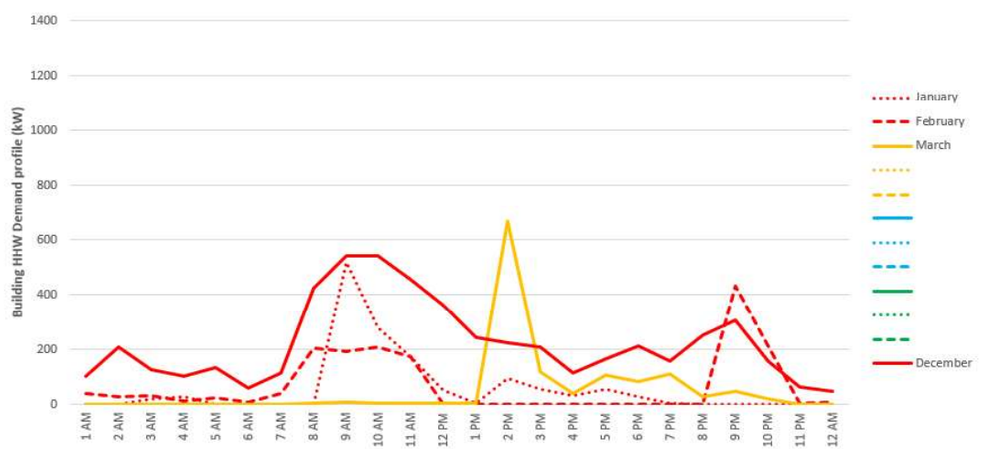
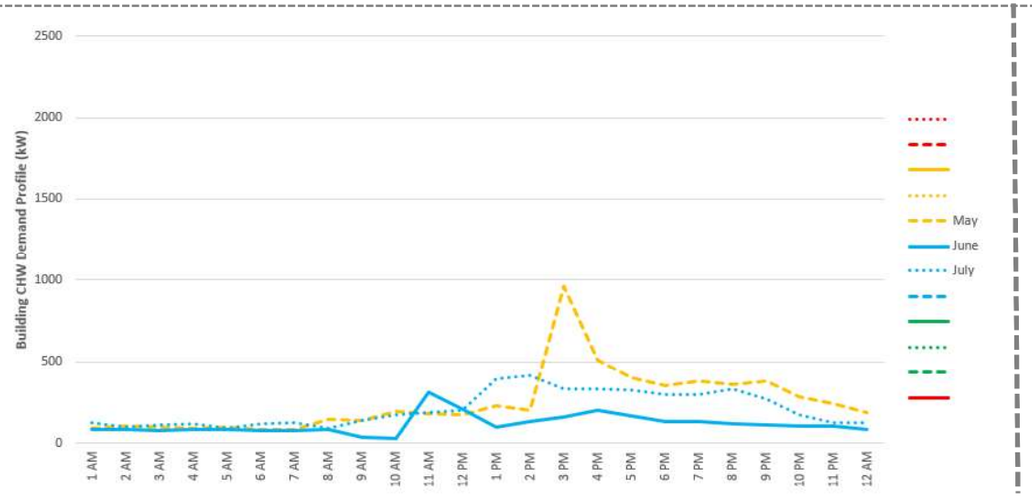
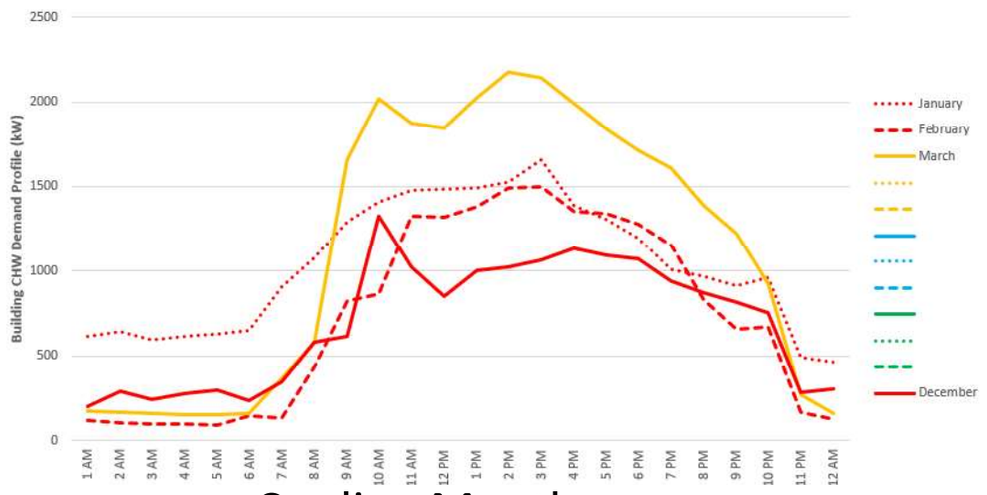




HHW





CHW

Heating Months

Cooling Months

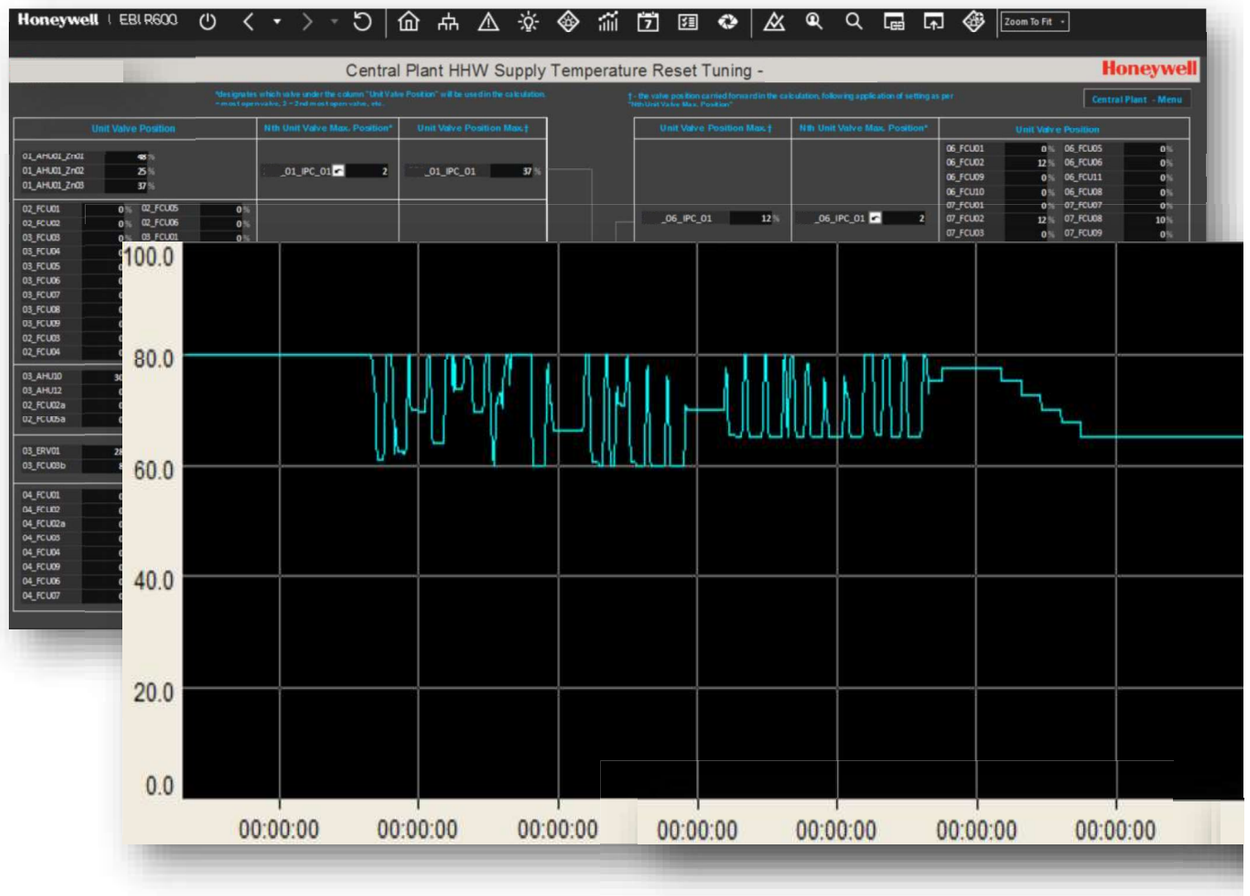
4: STRESS TEST THE EXISTING SYSTEM

SIMULATE A HEAT PUMP

Time to test;

- Define a control strategy that simulates a Heat pump – generally, lower HHW temperatures
- Monitor performance
  - Set up additional alarms in critical spaces
  - Monitor field valve positions
  - Note problems and devise / test strategies to address
  - Include recovery measures

<u>IMPORTANT: COMMUNICATION STRATEGIES ARE CRITICAL</u>



STAKEHOLDER ENGAGEMENT AND COMMUNICATIONS

- Stakeholder communication is critical for buy in / issue discovery
- Consider who needs to be involved in the planning activities and any testing;
  - Facilities Manager
  - BMS user / Controls technician
  - Mechanical Services Contractor
  - Stakeholder representative (leasing coordinator)
  - Others – based on risks/complexity

5: IDENTIFY ANY LIMITATIONS

AND/OR AREAS THAT REQUIRE FURTHER CONSIDERATION

Example: Space temps unable to be maintained in some areas - will cause stakeholder issues

Steady State **and** Peak conditions

Peak conditions only

More detailed consideration of field conditions / infrastructure, coil/pipe size, cleanliness, correct operation, energy leakage etc

Consider design/control strategies to shift, reduce or boost, during peak

PEAK LOAD CONSIDERATIONS

Reduce

- Insulation / Airtightness
- Schedules
- Load aggregation
- Equipment efficiency

Shift

- Schedules and Control
- Thermal Storage
- Load aggregation

Boost

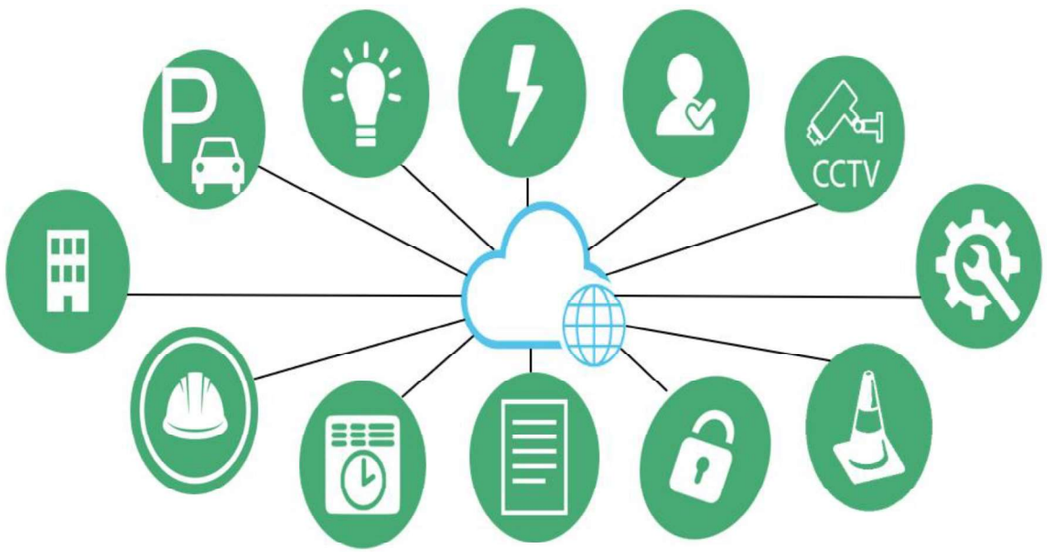
Peaks only occur for a few hours a year - generally.

A low-risk approach may include;

- Maintain gas boilers for extreme peak requirements (<5%)
- Implement a HHW reset strategy to ‘boost’ with gas boilers
- Design with the end goal, complete boiler removal, in mind for the future

SCHEDULED VS ACTUAL OCCUPANCY

LEVERAGING EXISTING OPERATIONAL DATA FOR HIDDEN EFFICIENCY



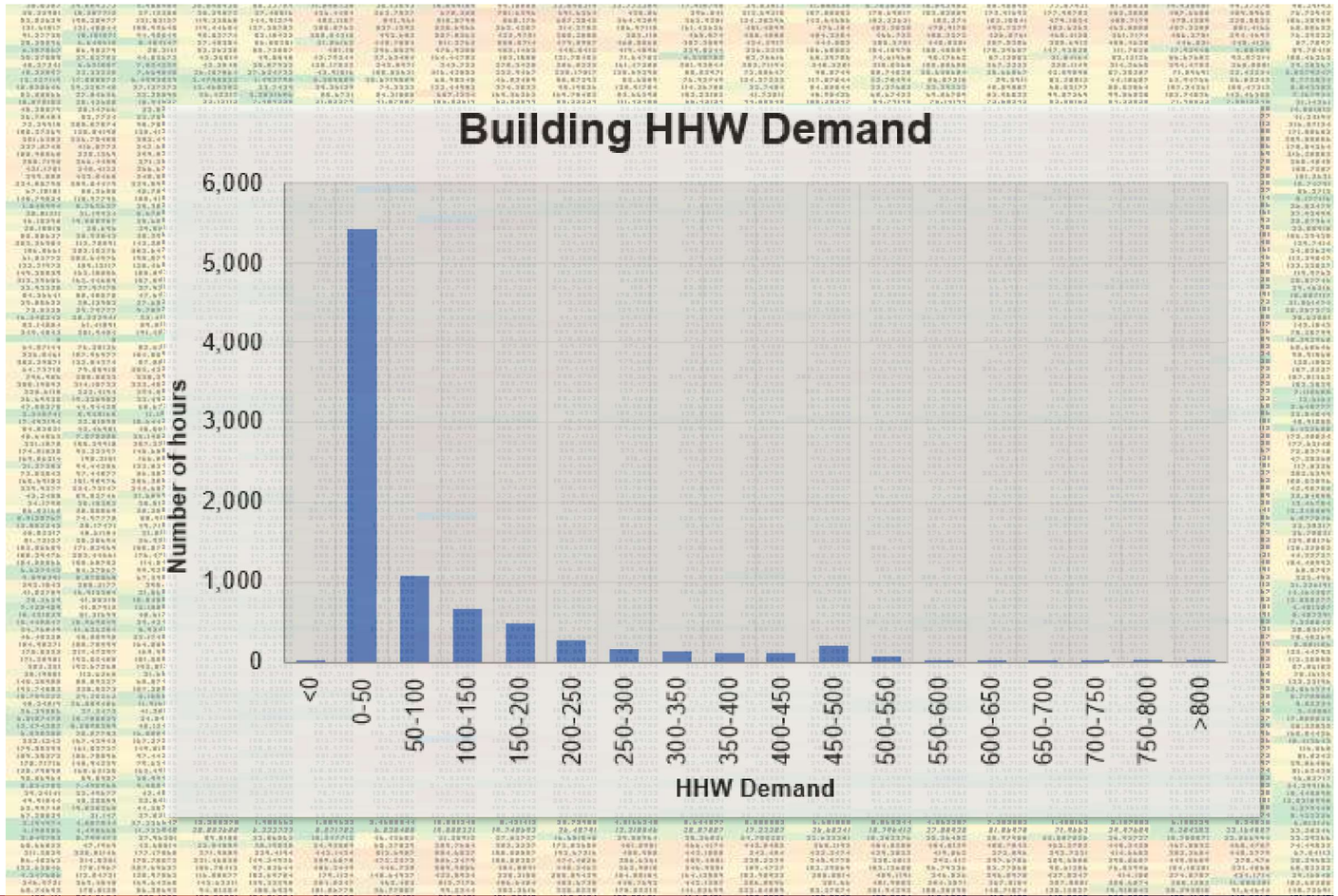
- Systems that interrogate and transform large data sets to form high value, multi-variable insights quickly and prioritise for actioning.
- Potential to Automate operational decision making to maximise efficiency.

6: MODEL HEAT PUMP PERFORMANCE

AGAINST KNOWN LOADS AND RESULTS FROM SYSTEM TESTING

Review limitations and considerations (risk mitigations) from Step 5

- Understand the conditions that might cause concern
  - What can be done to address by design or as part of the implementation works
- Conventional gas boiler – is it still required?
  - What is a suitable portion for boost?
- Load shifting – thermal storage (ideal) or control strategies?
- Assess materiality of any risks



7: FINALISE DESIGN AND IMPLEMENT

Be mindful of contractor experience during procurement

- Apportion risk and be aware of responsibility ‘carve outs’
- Plan implementation over summer if possible
- Include comprehensive tuning programs
- Ensure performance monitoring is in place and routinely reviewed

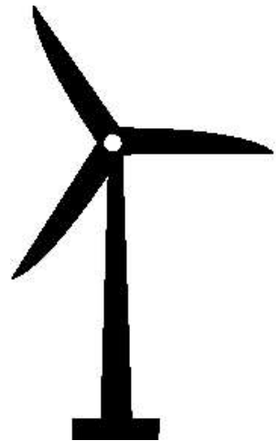
7: FINALISE DESIGN AND IMPLEMENT

8: ‘BAKE IN’ PROCESSES

Lifecycle
Programs

Standards /
Policies

Master planning
processes



Energy Procurement
(Don’t forget Scope 2)

THANK YOU

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