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How much insulation do you need to fit a heat pump?

How much insulation do you need to fit a heat pump?
Heat Pump Challenge dissemination webinar
28th April 2022
Jonathan

www.carbon.coop / @carboncoop

Welcome to the webinar

- Say hello in the chat!
- The webinar will be technical and some prior knowledge of retrofit and heat pumps will be required.
- This webinar is suitable for **practitioners**, **installers, engineers, architects, policy makers, Community Energy groups** and **householders** with high levels of technical knowledge.
- The session will be recorded and made available after the event.
- Questions = Q&A

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One-stop-shop for retrofit

Background to the webinar

Carbon Co-op

MCS CHARITABLE FOUNDATION

nesta

PEOPLE POWERED RETROFIT

Quantum

electricity northwest

Practitioner questions

- Should we not worry about fabric and just fit as many heat pumps as we can? Or, should we not fit any heat pumps until we've improved the fabric of a home?
- What principles should we be consider in evaluating what level of fabric upgrade a home might require to accommodate a new heat pump?
- Are there any rules of thumb we can use in understanding the relationship between fabric upgrades and heat pumps?
- Are EPC ratings a good indicator of heat pump readiness of a home?
- How should we think about hot water supply in a home with a heat pump?
- What challenges are there in retrofitting a home with fabric upgrades AND a heat pump at the same time?

Policy Maker Questions

- What incentives, standards and regulatory tools should policy makers seek to use in delivering effective heat pump programmes that include fabric upgrades?
- What are the approaches policy makers might use to understand the actual impact of fabric improvements and heat pump installations and what are the tools/components we need to put in place to make these effective?

How much insulation is required for a heat pump?

- 'It depends'. Mainly on the **householder's priorities** vs the **existing condition** of the property.
- It will reduce **carbon emissions** pretty immediately vs a gas boiler; BUT:
  - If they want to **save money on bills**, then they need to do some fabric work.
  - If they want to be **more comfortable** they need to do some fabric work.
  - If they want to **reduce embodied emissions**, they need to do some fabric work so they can have a smaller bit of kit (M+E kit is on a 10-15 year replacement schedule, so the embodied impacts multiply exponentially!).
  - If they want to have a **system that's quiet to run and easy to maintain**, they'll prob need to do some fabric work so that a smaller/quieter/simpler bit of kit can be fitted.

How much insulation do you need to fit a heat pump?

It’s complicated!

A question that can only really be answered with another set of questions....

Need to understand aims and priorities.

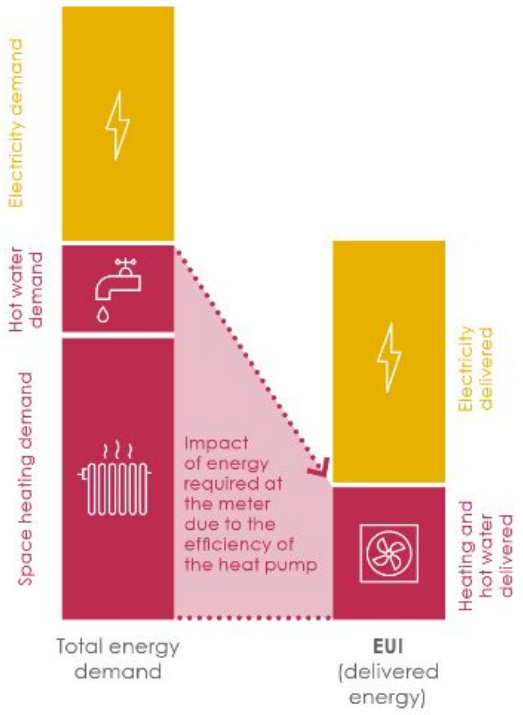
What do you want to achieve?

Carbon dioxide emissions reductions?

Fitting a heat pump in a home will immediately reduce the carbon emissions from heating.* This is both because electricity is now less carbon intensive than fossil gas, and because a heat pump is a lot more efficient than a boiler**.

*Assuming current UK grid carbon emissions and a competent install that runs efficiently.

**Reduces 'Energy Use Intensity' significantly.



Graph from the LETI Retrofit Guide - www.leti.london

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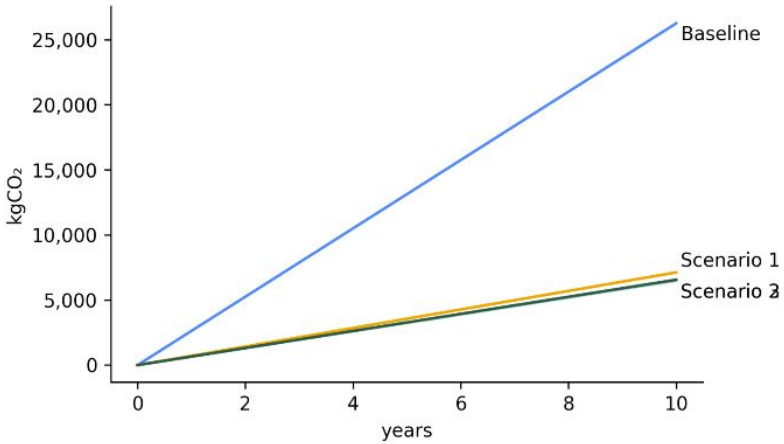
Figure 7: Cumulative carbon dioxide emissions



Graph from Home Retrofit Planner

Affordability?

Fitting a heat pump, if nothing else changes, will probably cost about the same to run* as existing fossil gas system**. A bit less if very efficient. Insulation improves affordability - but that's also true for boilers!

*Assuming current UK energy pricing and a competently fitted system.

**Depending on efficiency of existing system and whether can remove standing charge for gas.

Figure 1.7 - Annual fuel bills of average band D household in fuel poverty and with 50% reduction in heating demand.

Graph from the LETI Retrofit Guide - www.leti.london

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Comfort and health?

A heat pump can help improve comfort*. But it can't solve comfort problems caused by poor building fabric, e.g. draughts or cold surface temperatures in winter - or overheating in summer**. Insulation and fabric work is needed to address this.

*If done well as part of a whole heating system - by maintaining steadier internal temperatures.

**Some heatpumps can do cooling, but treating symptom not cause - shading and ventilation also important.

Internal disruption?

To work efficiently a heat pump needs to run at a flow temp of less than 45oC - the lower the better*. To do this need appropriately sized emitters (radiators) and pipework. If you insulate, greater chance that existing radiators can do the job - so less disruption**.

*If it runs hotter than this, won't achieve good efficiency, so running costs will go up!

**Should also reduce capital cost.

Image credit: Dom McCann (twitter @Zapaman)

External disruption?

Air source heat pumps require an external unit. This has to go somewhere and it does make (a small amount) of noise*. If you have limited space or close neighbours, a bigger unit more likely to be a problem. Insulating can reduce size of unit needed**.

*MCS and planning regulations on noise apply.

**This should also reduce capital cost of system.

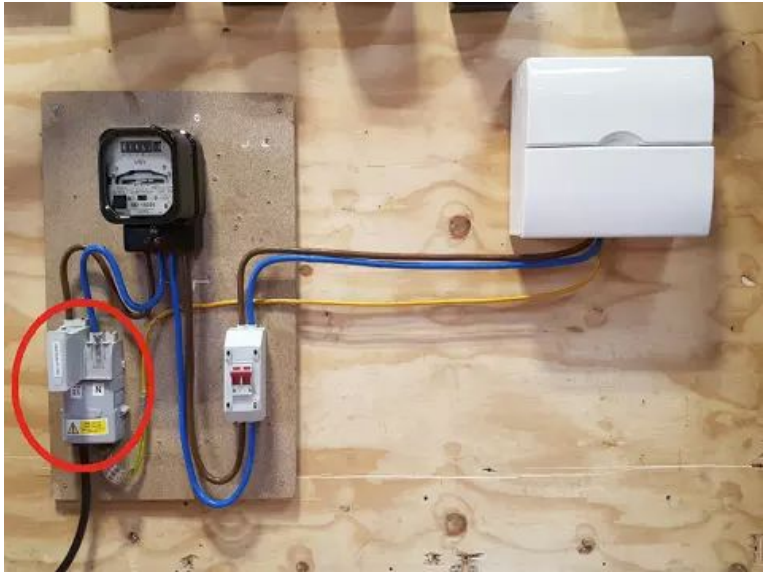
https://www.star-ref.co.uk/news/uks-largest-air-source-heat-pump-for-residential-use-to-showcase-at-all-energy-event/

https://tippenergy.ie/

Grid connection?

Small air source heat pumps can run on a standard domestic single-phase electricity supply. Larger units might need the connection to be upgraded to a three phase supply. Adding insulation can help eliminate this need.

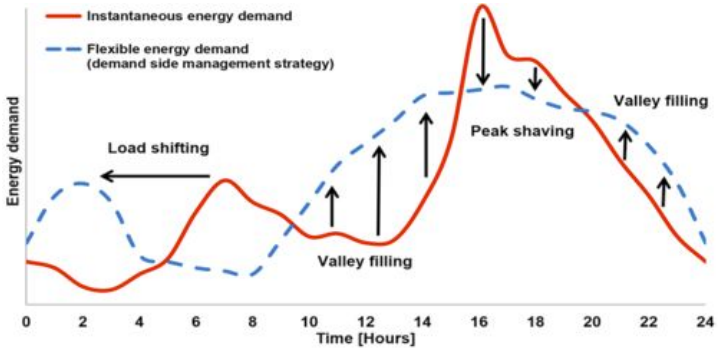
*Need for connection upgrade may also be affected by other uses like cooking (large ovens/hobs/stoves), electric vehicles, solar panels etc. Or by location and capacity of local grid.



Demand response?

The better insulated your home, the less it matters when heat for space heating goes into it - because it retains heat for longer.

With a well insulated home, can treat it like a big battery. Very useful for responding to grid carbon intensity or pricing.



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System effects?

Reducing UK's carbon emissions means considering the whole energy system, not just individual homes.

The more we reduce demand, the less we have to expand generation capacity - and the quicker we'll get to a decarbonised grid.

*Arguments about exactly how much demand reduction is optimal - but just need to do as much as we can, as fast as we can!

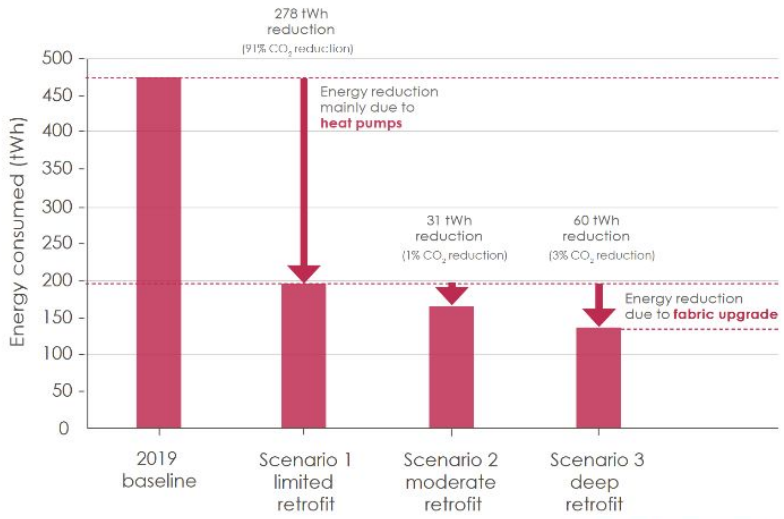
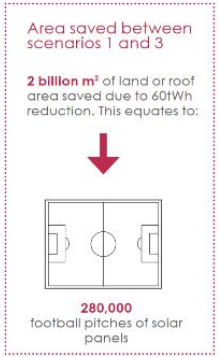


Figure 3.20 - Scenario comparison of energy consumed

Graph from the LETI Retrofit Guide - www.leti.london



Bringing it all together....

How much insulation you should fit depends on what you're trying to achieve - and how concerned you are about each of the above factors.

From looking at lots of different houses, we've come to some conclusions about roughly where we should be heading - but each house and client is different!

Each has a different budget and different priorities that need to be met with that budget.

Using the right metrics

We look at Space Heating Demand* and Peak Load** as two key metrics to inform decision making.

We do not use EPC ratings!***

*Affects comfort and running cost
**Affects size and cost of unit and likelihood of changes to emitters.
***EPC ratings are a measure of running cost, not energy efficiency! Have some questionable assumptions at moment on carbon intensity of grid and on heat pumps. (Do state SHD though, which can be a start).

Figure 3. Space heating demand (kWh/m²·year)

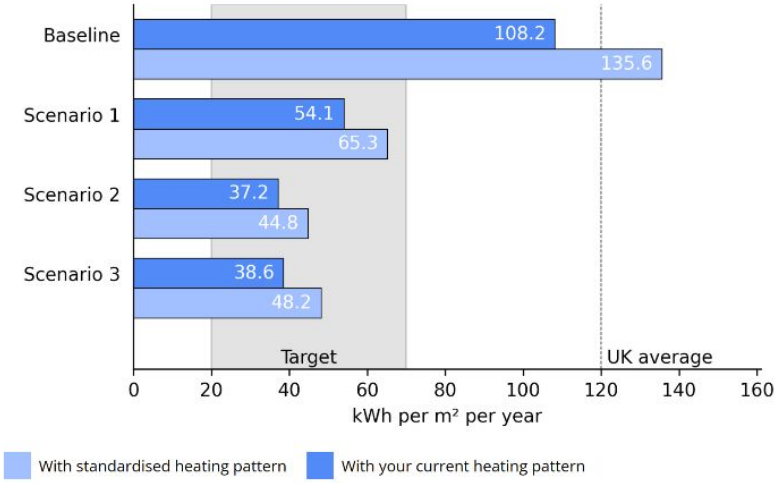
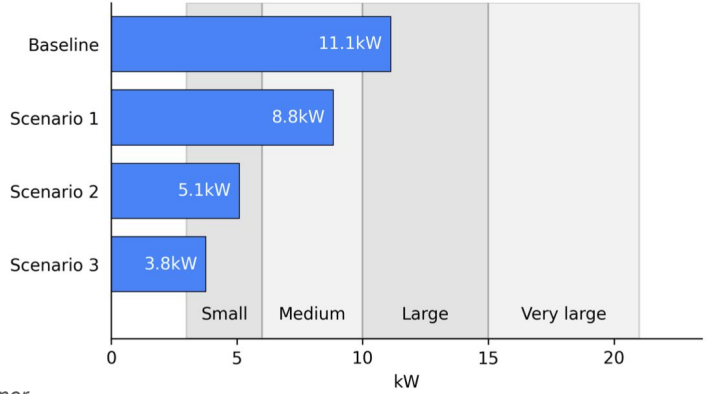


Figure 4. Peak heat load



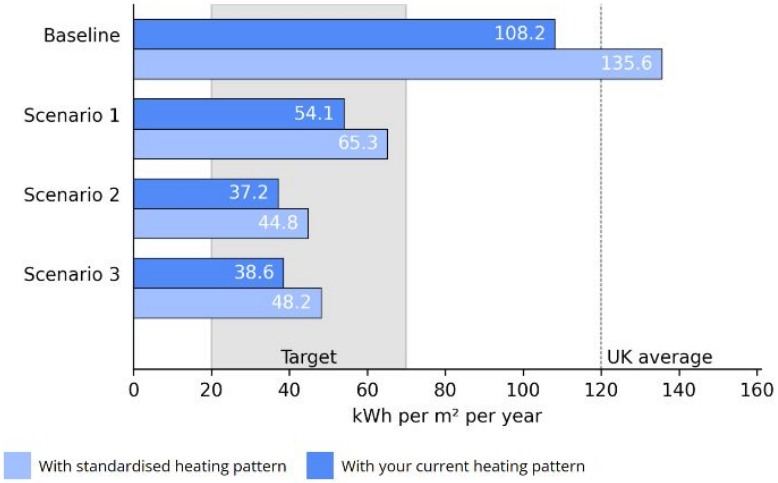
Graphs from Home Retrofit Planner

Rules of thumb

- Peak load <10kW or ideally <5kW in urban areas*
- Space Heating Demand <70kWh, ideally <50kWh**
- No major comfort or building health issues.

*Because of likely noise and space issues.
**For affordability and comfort. Note that AECB, LETI, SHDF, TippEA and others all landing in similar range. About what makes a difference and is achievable.

Figure 3. Space heating demand (kWh/m²·year)



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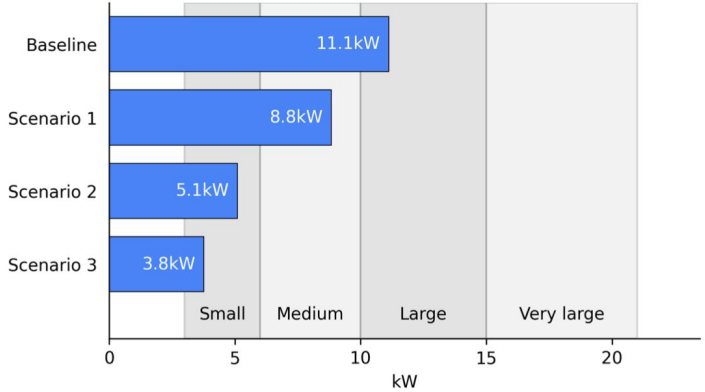


No one answer!

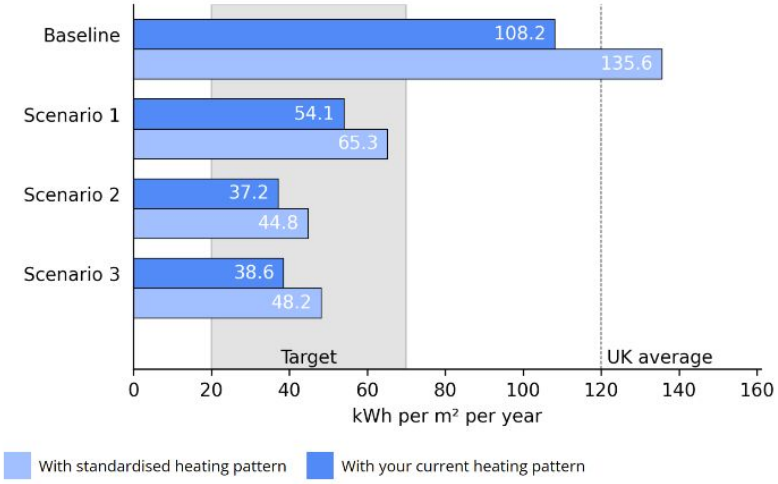
What this means in each home will vary:

- If your home is already well insulated and comfortable, and you don't mind your current running costs, you could fit a heat pump now and save carbon.

- If you home is cold and draughty, or if you want to save more money on bills, or you want to engage with demand response and systems issues, at least some insulation is likely to be beneficial.

Being clear about your aims and constraints can help you decide.

Figure 3. Space heating demand (kWh/m²·year)



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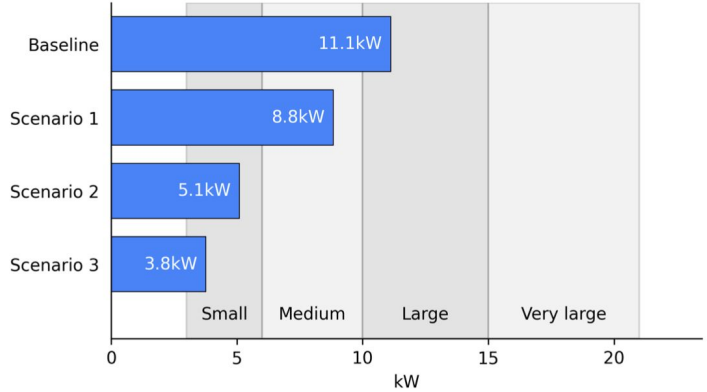

How much insulation is required for a heat pump?

- A lot of ASHP instatlled are prob **oversized**.
- Worse performing the fabric, the bigger risk the install will go wrong.
  - Assume the error margin might be 20%. 20% on a 5kWp is 1kWp, 20% on 15kW system is 3kW out - so more likely to be a problem).
- Often that is to do with **hot water demand** and margins added on to the calcs.
- https://www.eventbrite.co.uk/e/317623649887

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How data to help us enhance design and optimisation.

Heat Pump Challenge learning
Update on Carbon Co-op's research
28th April 2022
Matt

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Limitations of modelling

- We know that in a UK context consumer value case is extremely sensitive to heat pump performance
- Only a small subset of UK installations were subject to ‘metering for payment’ performance monitoring, but in these cases there are concerns (Meek, 2021). **Ofgem dataset of 2200** installations.
  - More than a quarter had an SPF of under 2.5.
  - **"No correlation between the installer performance forecasts and the actual performance was found in the main sample”**
- This has potentially serious implications for ambitions to rapidly expand heat pump installation rates.

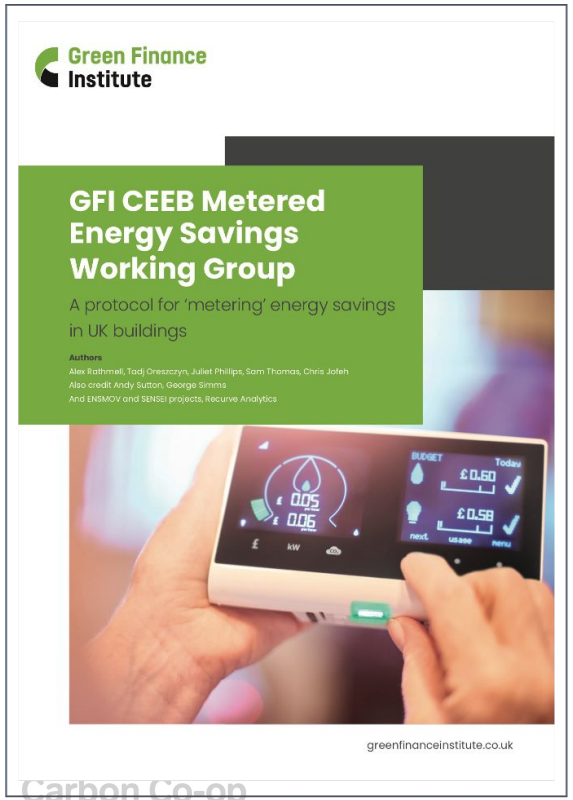
Limitations of ‘fit and forget’

- Performance gap between estimated energy consumption and actual is extremely varied
- We’ve seen some very impressive SPF results from domestic consumers who are engaged with monitoring their heat pumps and optimising performance
- Yet consumers are often discouraged from engaging with (or even touching) their heat pumps. Even where a level monitoring is provided by default by the manufacturer, this rarely seems to be part of the onboarding process.
- Post installation follow-up vs. performance optimization

Monitoring options after end of Metering & Monitoring Service Package

- The additional **MMSP** payment as part of RHI was very welcome, but sadly now ended. Hopefully the results will be made available as an open, anonymised dataset for analysis.
- Some excellent initiatives such as the Heat Pump Monitor project which not only provide complete systems, but help users to understand their heat pumps - BUT they are very technical.
- We are currently investigating data provided by various **manufacturer APIs** & online dashboards - keen for more participants, especially those with an MMSP package.

Is there an alternative for assessment, impact analysis and subsidy?



CALTRACK

RECURVE
SHAPE THE FUTURE OF ENERGY

LF ENERGY

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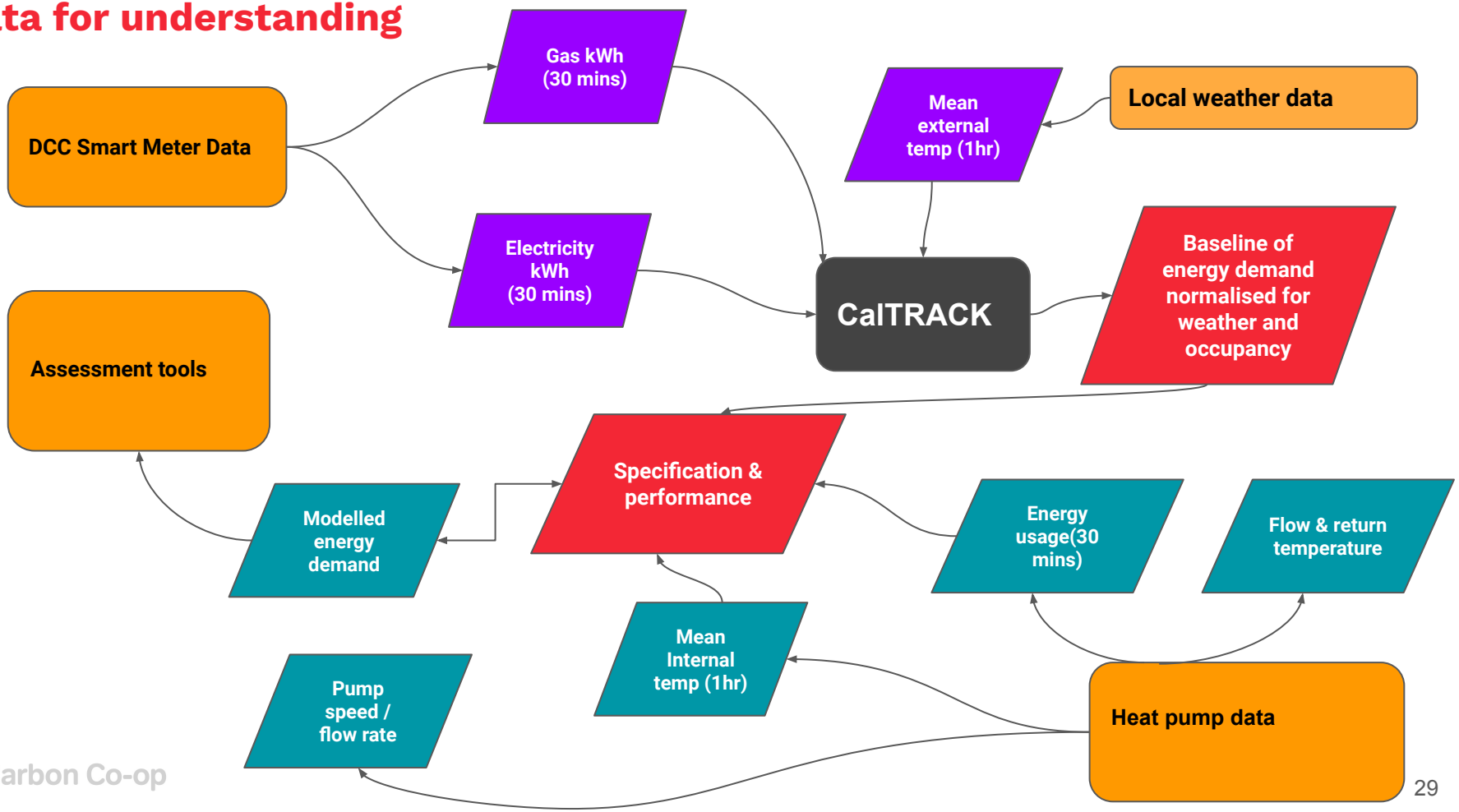
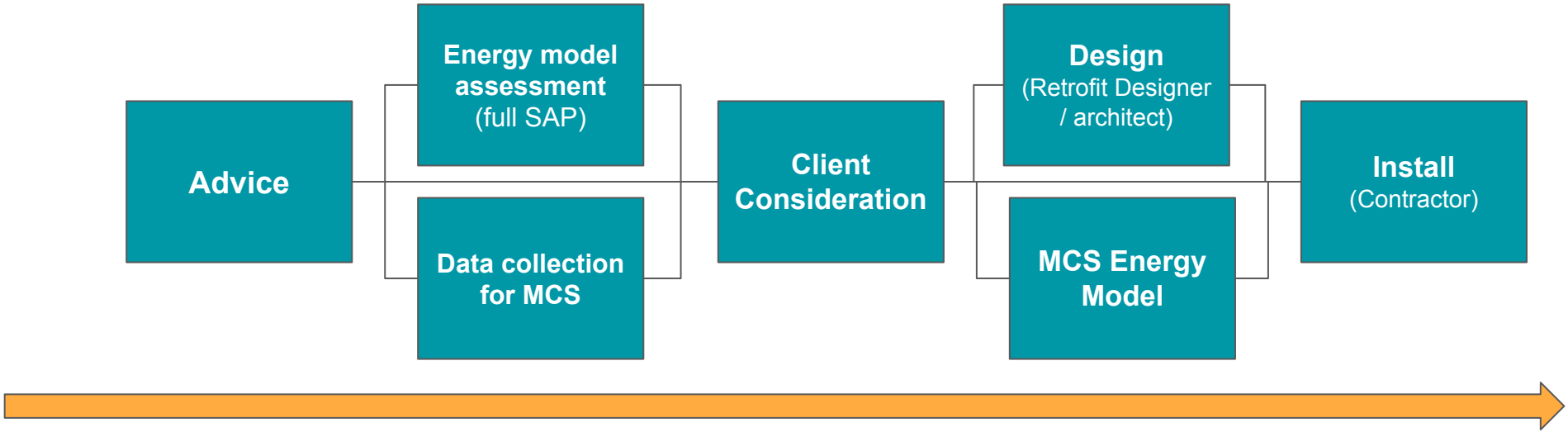
Data for understanding



Coming next....



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