Community heating, heat pumps and test standards

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Heat pumps and community heating

- Electric heat pumps are suitable for individual dwellings as well as community heating (‘heat networks’)
- The UK govt is encouraging the use of electric heat pumps for space and DHW heating but in-use experience has been mixed and field trials have demonstrated poorer performance than anticipated
- This has been compounded by the way the Ecodesign Directive deals with HPs
- Ecodesign treats HPs as a product rather than a system. SCOP for space heating is based on testing to EN14825. DHW heating efficiency is determined separately by testing to EN16147.

Heat pump test standards

- In UK testing is required to provide data for SAP Product Characteristics database (PCDB) and MCS product certification
- SAP requires EN14825 and EN16147 test data
- MCS in addition requires EN14511 safety tests

Heat pump test standards

- EN14825:2016 Testing and rating at part load conditions and calculation of seasonal performance
- EN14511:2018 Part 4 – Requirements (safety tests)
- EN16147:2017 Heat pumps with electrically driven compressors – Testing performance rating and requirements for marking of domestic hot water units
  - Filling and heating up test
  - Standby power test (standing loss)
  - Water draw-offs test – 24 hr tapping cycle
  - Reference hot water (continuous tapping until water is 40C)
  - Calculation of water heating energy efficiency (EU Reg 812/2013)

BRE’s air source heat pump test facility

– - Air source heat pumps can be tested to EN14825 and EN16147

Ecodesign issues(#)

- Ecodesign makes it difficult to predict the performance of a HP system providing space and DHW heating
- Plant size ratio is assumed to be 1 and back-up heating is effectively ignored
- SCOP ignores DHW and assumes continuous 24hrs heating (UK buildings are usually heated intermittently)
- SCOP uses European average weather data which is less accurate for UK and assumes compensation control
- Only 2 options for water flow T (35/55^{o}C)
- Doesn't allow for different modulation rates

see WGriffiths, CIBSE Journal January 2018

UK Building Regulations

- Compliance with Building Regulations Part F for dwellings is through SAP
- SAP is the UK's National Calculation Methodology for energy rating of dwellings based on annual energy
- BRE has produced a revised SAP calculation method for HPs based on the Ecodesign HP test data (EN14825 and EN16147) and the EN15316-4-2 calculation method
- The SAP HP calculation and test data requirements are published in CALCM:01
  - provides an estimate of the HP annual energy consumption for space and hot water taking into account all auxiliary components (pumps & backup heating etc)

Domestic Annual Heat Pump System Efficiency (DAHPSE) Estimator

- BRE has developed DAHPSE to show the annual efficiency of a heat pump (uses CALCM:01) – similar to SEDBUK for boilers
- The DAHPSE Estimator is on online tool that shows DAHSE for any heat pump listed in the product Characteristics Database (PCDB) https:/www.bre.co.uk/heatpumpefficiency
- The DAHPSE Estimator allows the annual efficiency of real heat pumps to be compared on a graph

DAHPSE – estimator – BETA

bre Domestic Annual Heat Pump System Efficiency (DAHPSE) - Estimator - BETA

Efficiency estimator | Background | Dwelling heat loss | Hot water consumption

Annual efficiency estimates

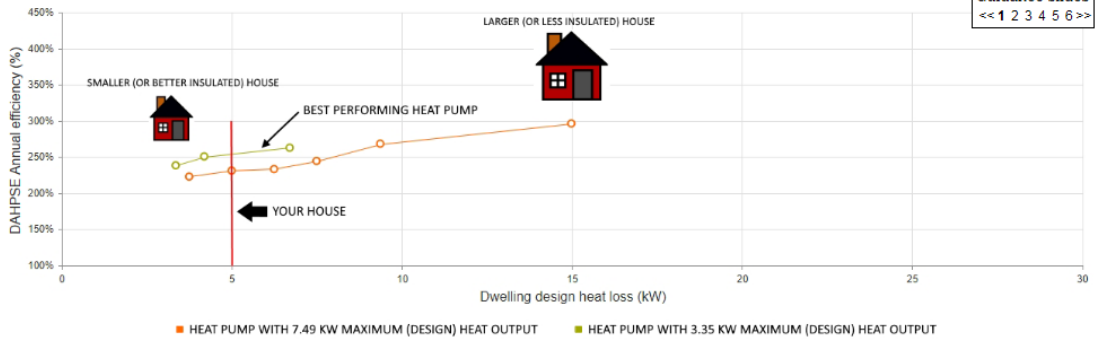
The chart below provides Domestic Annual **Heat Pump** System **Efficiency** (DAHPSE) estimates based on data held in the **Product Characteristics Database (PCDB)** and demonstrates their variation with **heat source, dwelling heat loss, emitter design flow temperature** and presence of weather compensation. See **here** for more details.

The chart can be populated by selecting from the table **"Heat pump input options"**. Filter options can be applied as required.

Domestic Annual Heat Pump System Efficiency (DAHPSE) - Estimator chart

Example 1 - Two different size heat pumps at **same** design flow temperature

Guidance slides
<< 1 2 3 4 5 6 >>



X-axis: Dwelling design heat loss - This is taken from a BAP assessment as 'Heat transfer coefficient (W/K)' - Box (39) - multiplied by 24.2K
Y-axis: DAHPSE Annual efficiency - This is also known as SPF_H4, but is provided in percentage terms, so multiplied by 100. The Seasonal Performance Factor (SPF) is provided in accordance with the SEPEMO H4 system boundary, so includes all auxiliary electrical energy, including back-up heating and circulation pump

NOTE: The graphs, images and performance estimates on this website are BRE's interpretation of publicly accessible data, which are in part based on data submitted by product manufacturers and accepted in good faith. Some of the data supplied by product manufacturers is also used for the purposes of showing compliance with the European Union's Ecodesign regulations (No 811/2013 and 813/2013) and therefore may be subject to market surveillance rules. BRE Group Limited and its subsidiaries, including but not limited to, Building Research Establishment Limited, make no representation or warranty as to the content of this website, its suitability for any use, or that it constitutes accurate data and/or advice.

⇩ Select & compare real heat pumps below ⇩

Heat pump input options

Brand name, Model name, Model qualifier	Heat source	Emitter design flow temperature	Maximum output	Weather compensation	
Select	Select	Select	Select	Select	
Daikin Altherma, ERLQ004CAV3 + EHVH04SU18CB6W	air	Flow temperature = 55°C	3.350 kW	On	Add to graph
Daikin Altherma, ERLQ004CAV3 + EHVH04SU18CB6W	air	Flow temperature = 45°C	3.680 kW	On	Add to graph
Daikin Altherma, ERLQ004CAV3 + EHVH04SU18CB6W	air	Flow temperature = 35°C	4.070 kW	On	Add to graph

Community Heating / Heat Networks

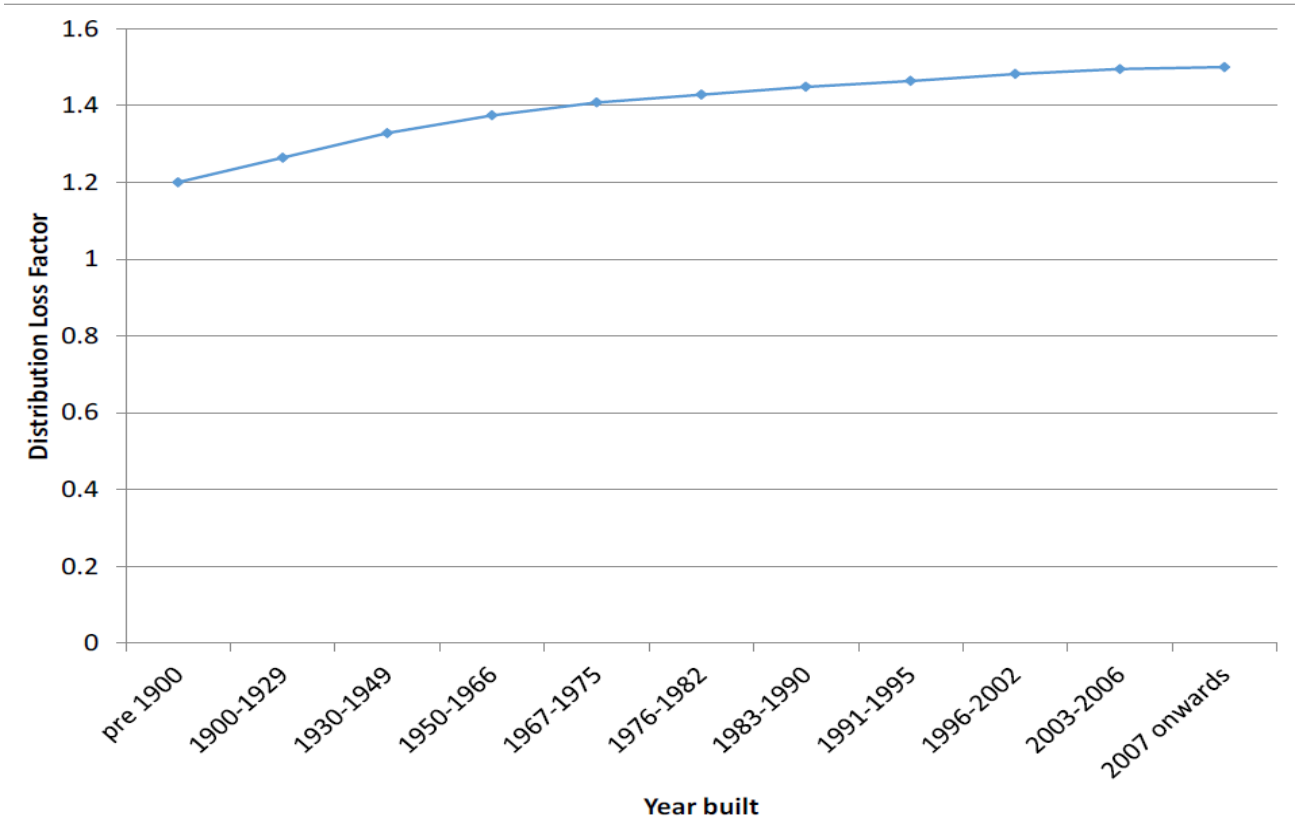
- Heat pumps are not widely used in the UK for community heating (or cooling)
- At present SAP (2012 version) requires the HP seasonal efficiency as an input and would also evaluate the ‘distribution loss factor’ (DLF)
- A major issue is that the newest dwellings have lower space heating requirements and DHW is a larger proportion of the total heat demand – this increases distribution heat losses…..

Community Heating / Heat Networks - DLF

- Total heat demand from heat network is multiplied by DLF to account for distribution losses
- Existing default DLF values in SAP 2012 for new heat networks range between 1.05 and 1.10 depending on water temperature
- However, actual heat losses derived from monitored data show DLF ranges from 1.3 to 3.0 (66% distribution losses) *see SAP consultation paper CONSP:04*

Distribution Loss factor (DLF) – proposed SAP default values

Ref: CONSP:04



Proposed changes to SAP to account for realistic DLF values

- New heat networks designed & commissioned to CIBSE/ADE ‘Heat Networks: Code of Practice for the UK’: DLF = 1.5
- New heat networks NOT designed & commissioned to CIBSE/ADE ‘Heat Networks: Code of Practice for the UK’: DLF = 2.0
- Where monitored in-use consumption data is available DLF can be determined from the in-use energy consumption
- Proposed changes can be seen in SAP 2016 draft for consultation#

ADE = Association for Decentralised Energy

#https://www.bre.co.uk/sap2016/page.jsp?id=3618