



# Heat Pumps & DSR

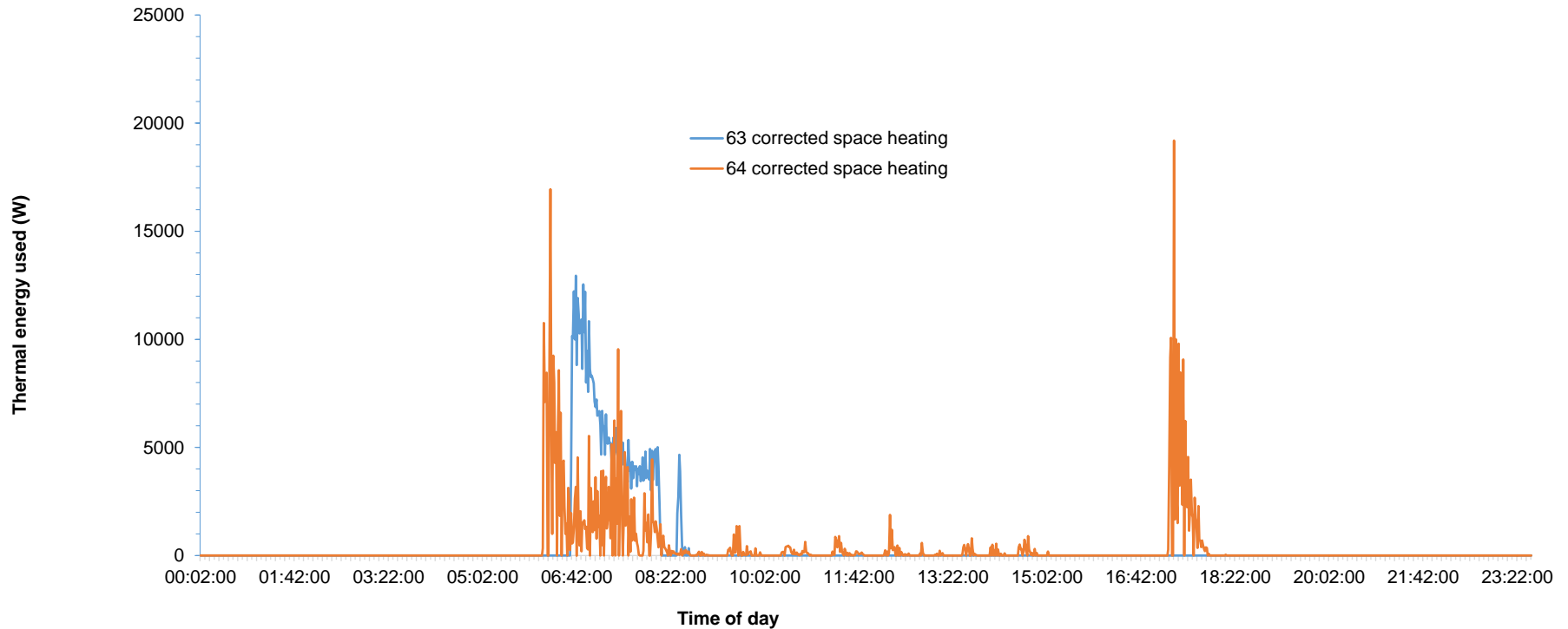
Professor Neil J Hewitt  
University of Ulster

# Heat Pumps – Retrofit

## - Domestic Heat Pumps

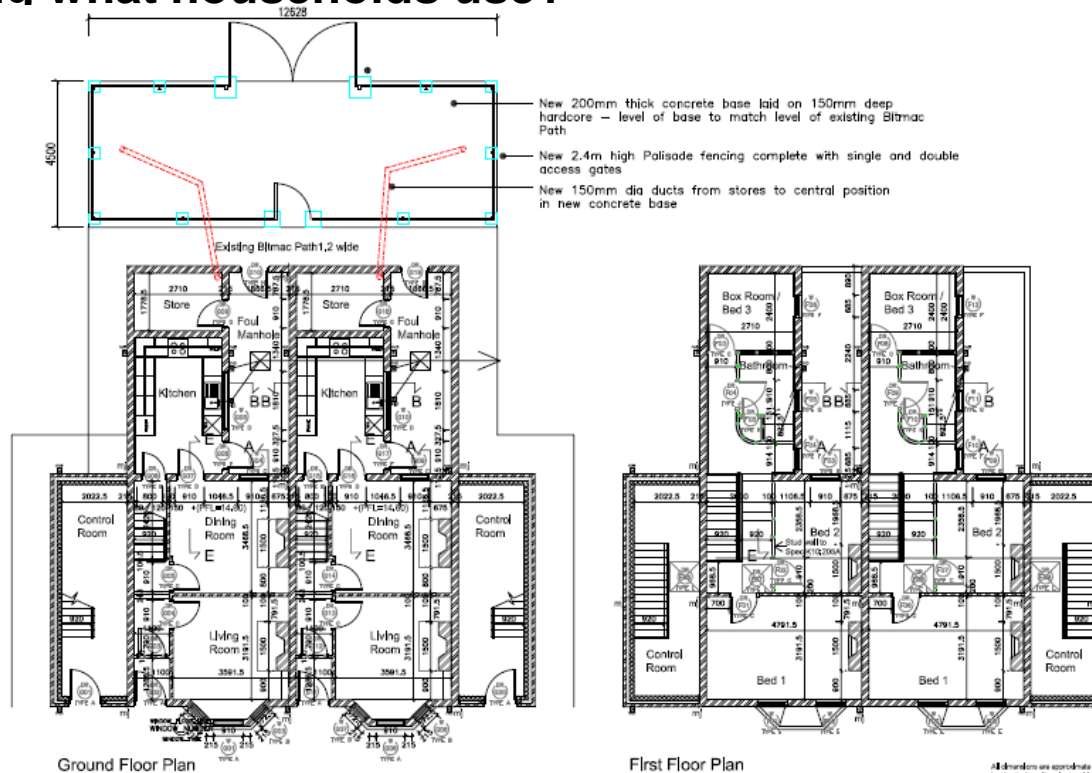


### Understanding what households use?



# Heat Pumps – Retrofit

## - Domestic Heat Pumps Understanding what households use?



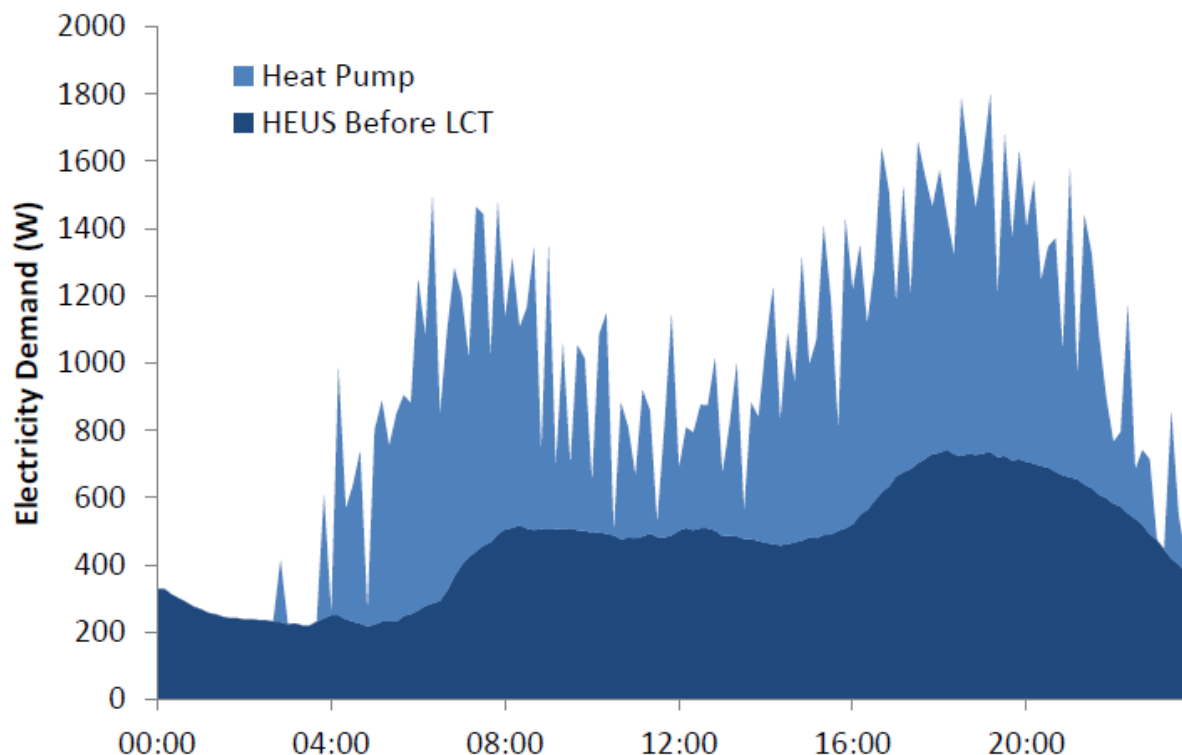
All dimensions are approximate and should be checked on site prior to pricing, fabrication or works commencing.

<b>Project Name</b>	
New Concrete Base to store of Blimac Blimac, Jordanstown Campus	
<b>Project No.</b>	
11/18014	
<b>Project Name (Detail)</b>	
Proposed New Path Details	
<b>Drawn by</b>	<b>Scale</b>
8897401	1:100
<b>Date</b>	<b>Issue No.</b>
1/10	1/1 (Rev 1)

# Heat Pumps – Retrofit

## - Domestic Small Heat Pumps

What are the electricity network limitations?

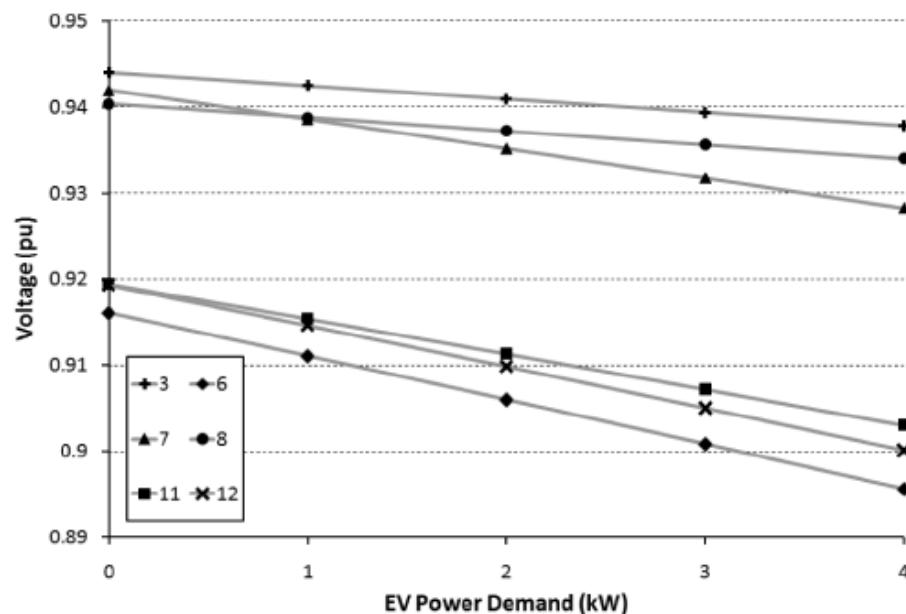
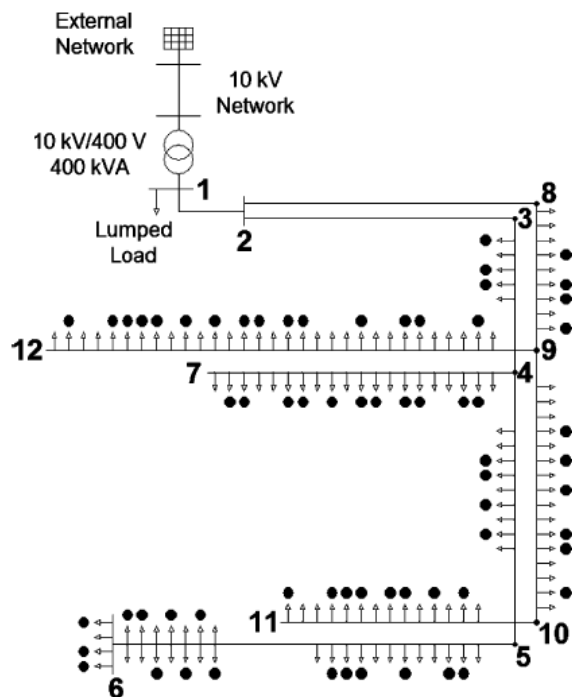


Further Analysis of Data from the Household Electricity Usage Study: Correlation of Consumption with Low Carbon Technologies – Element Energy, 2014

# Heat Pumps – Retrofit

## - Domestic Small Heat Pumps

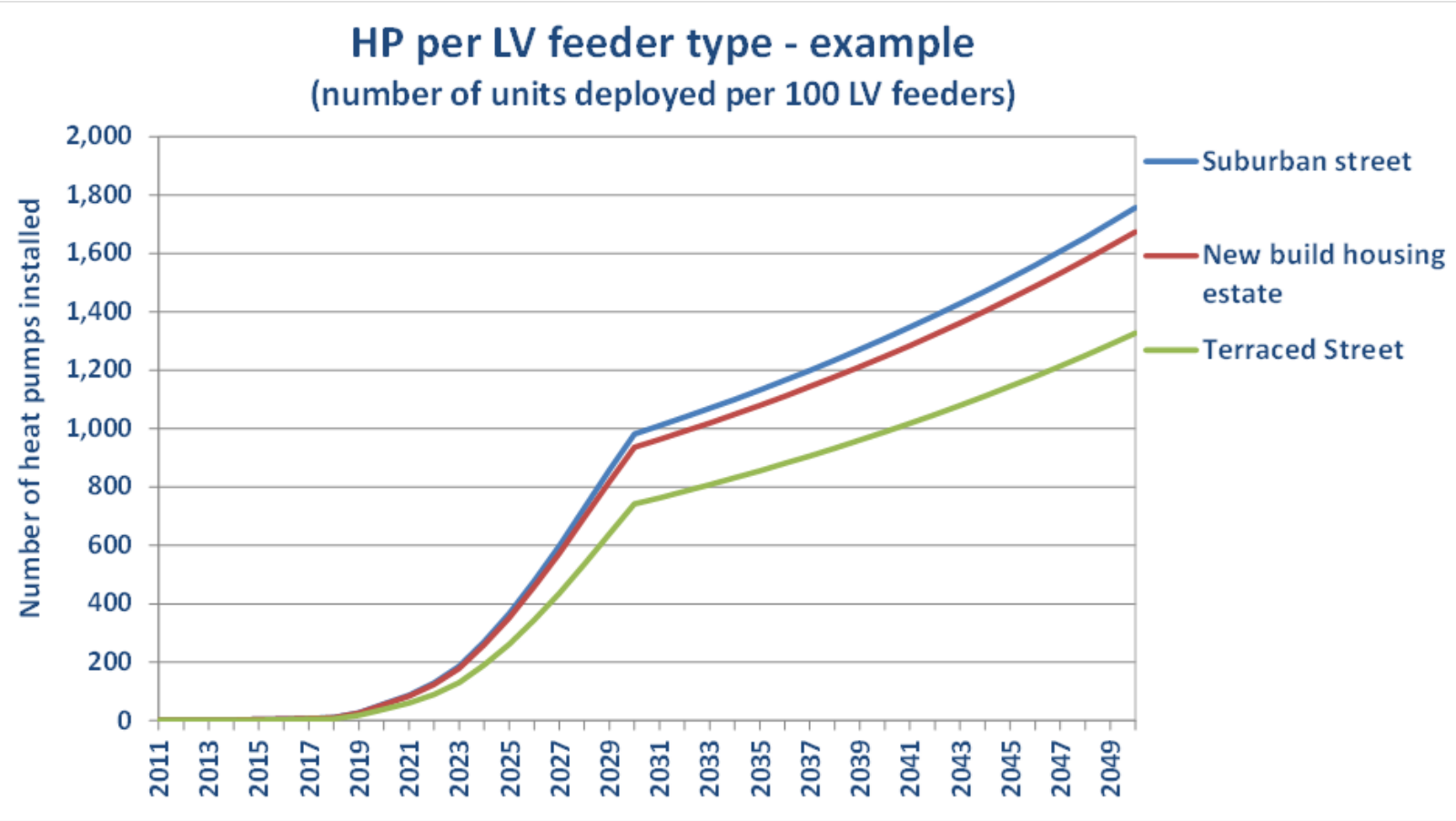
What are the electricity network limitations?



IEEE TRANSACTIONS ON POWER SYSTEMS, VOL. 27, NO. 1, FEBRUARY 2012 Optimal Charging of Electric Vehicles in Low-Voltage Distribution Systems Peter Richardson, Damian Flynn and Andrew Keane,

# Heat Pumps – Retrofit

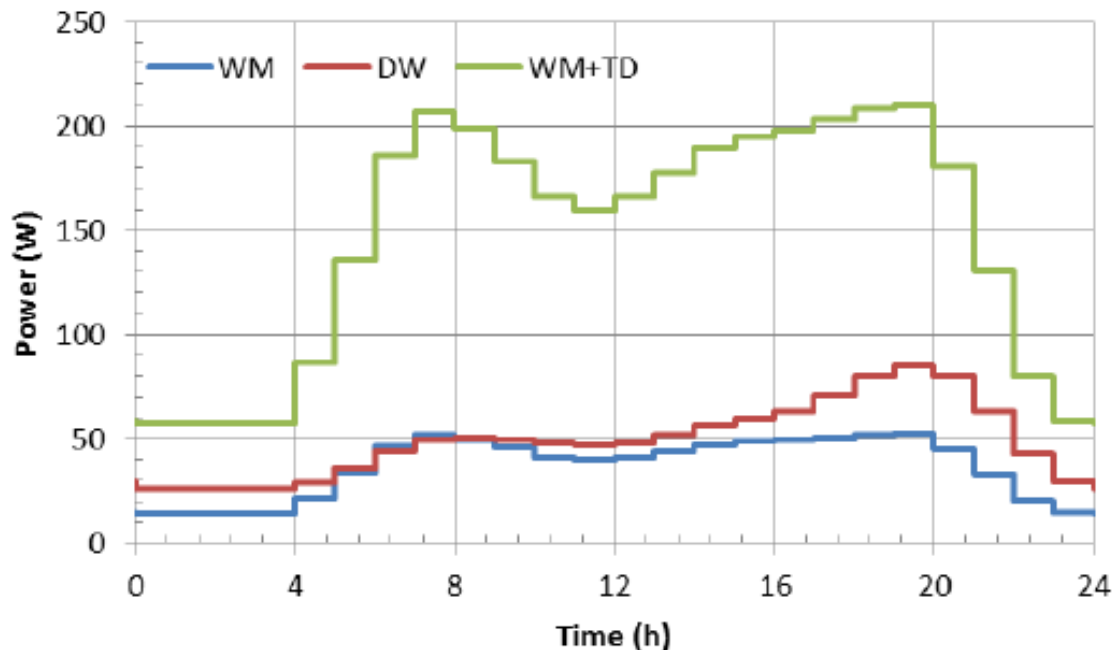
## - Domestic Small Heat Pumps



Assessing the Impact of Low Carbon Technologies on Great Britain's Power Distribution Networks

# Heat Pumps – Retrofit

## - Domestic Heat Pumps – Competing Loads



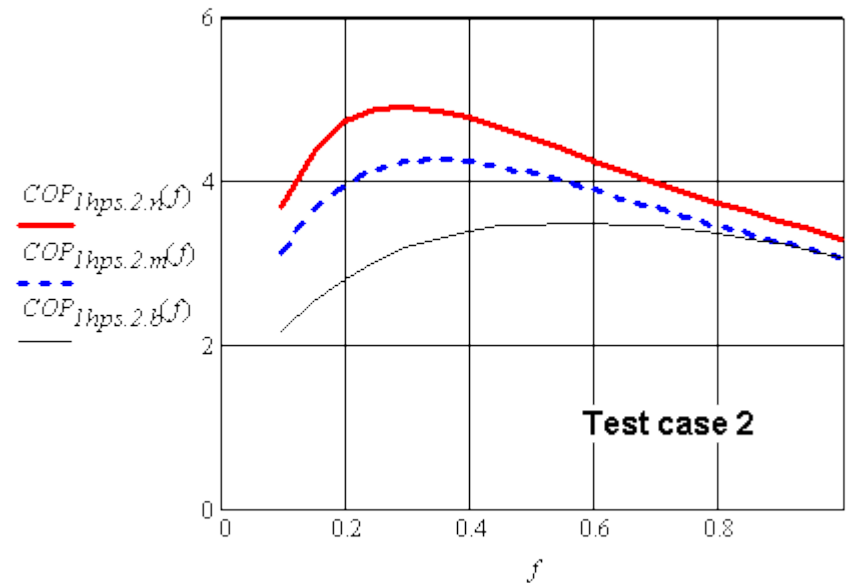
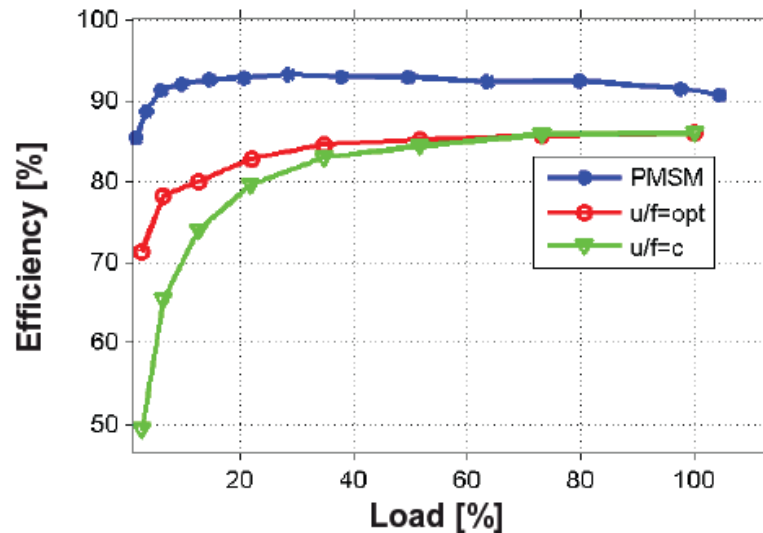
Diversified profiles for washing machines (WM), dishwashers (DW) and washing machines with tumble dryers (WM+TD)

Understanding the Balancing Challenge For the Department of Energy and Climate Change August 2012

# Heat Pumps – Retrofit

## - Domestic Heat Pumps

### Capacity Management of Compressors



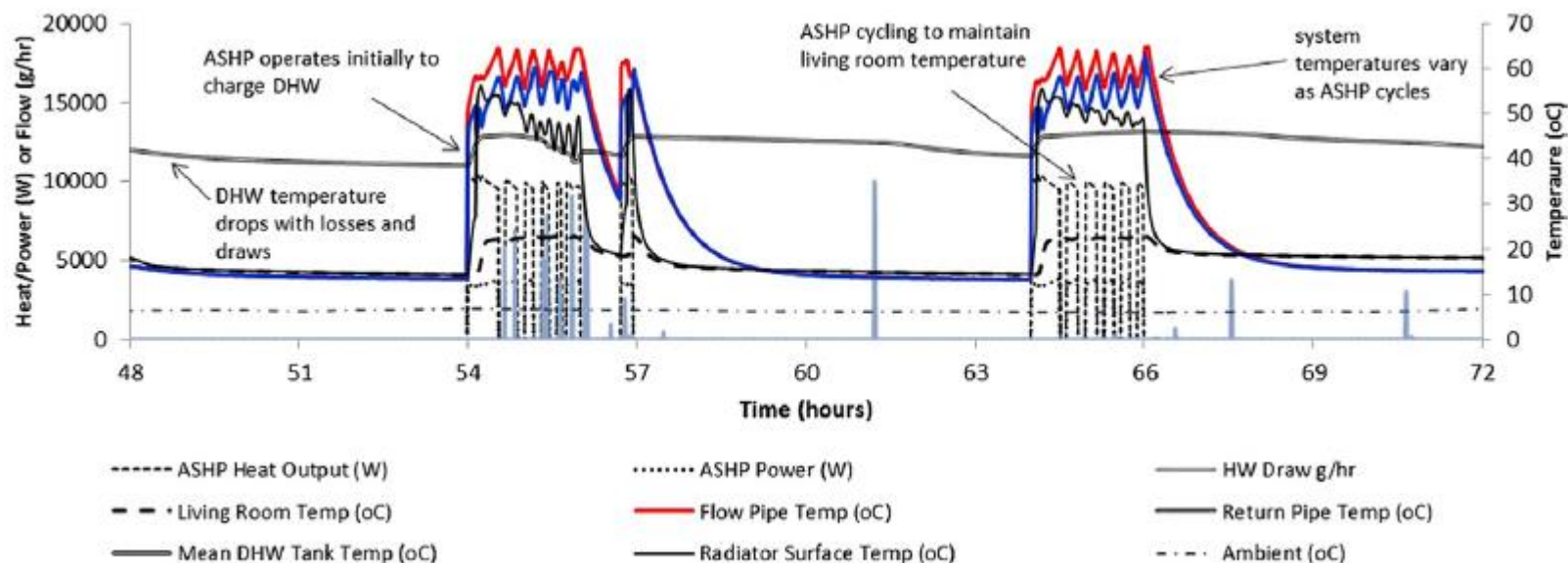
Capacity control of heat pumps, Per Fahlén, REHVA Journal – October 2012



# Heat Pumps – Retrofit

## - Domestic Small Heat Pumps

### Demand Side Response (Modelled)



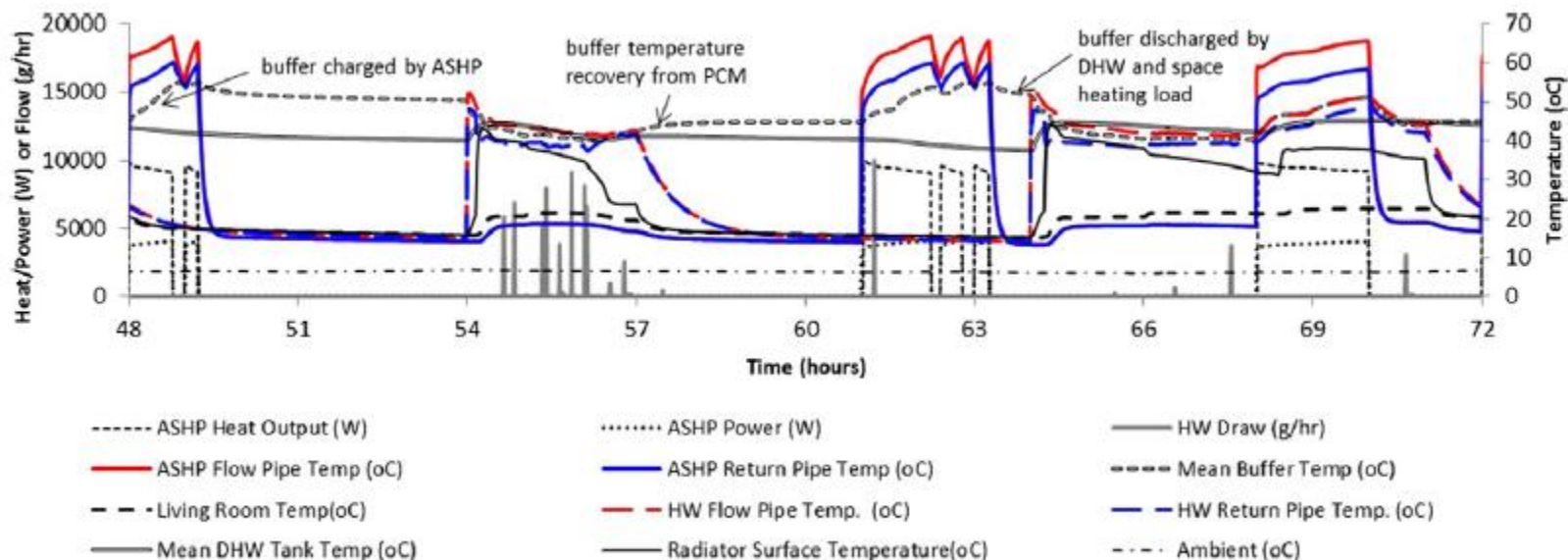
### Heat Pump without Buffering or DSR

N.J. Kelly, et al., Performance assessment of tariff-based air source heat pump load shifting in a UK detached dwelling featuring phase change-enhanced buffering, Applied Thermal Engineering (2013),

# Heat Pumps – Retrofit

## - Domestic Small Heat Pumps

### Demand Side Response (Modelled)



### Heat Pump with Buffering and DSR

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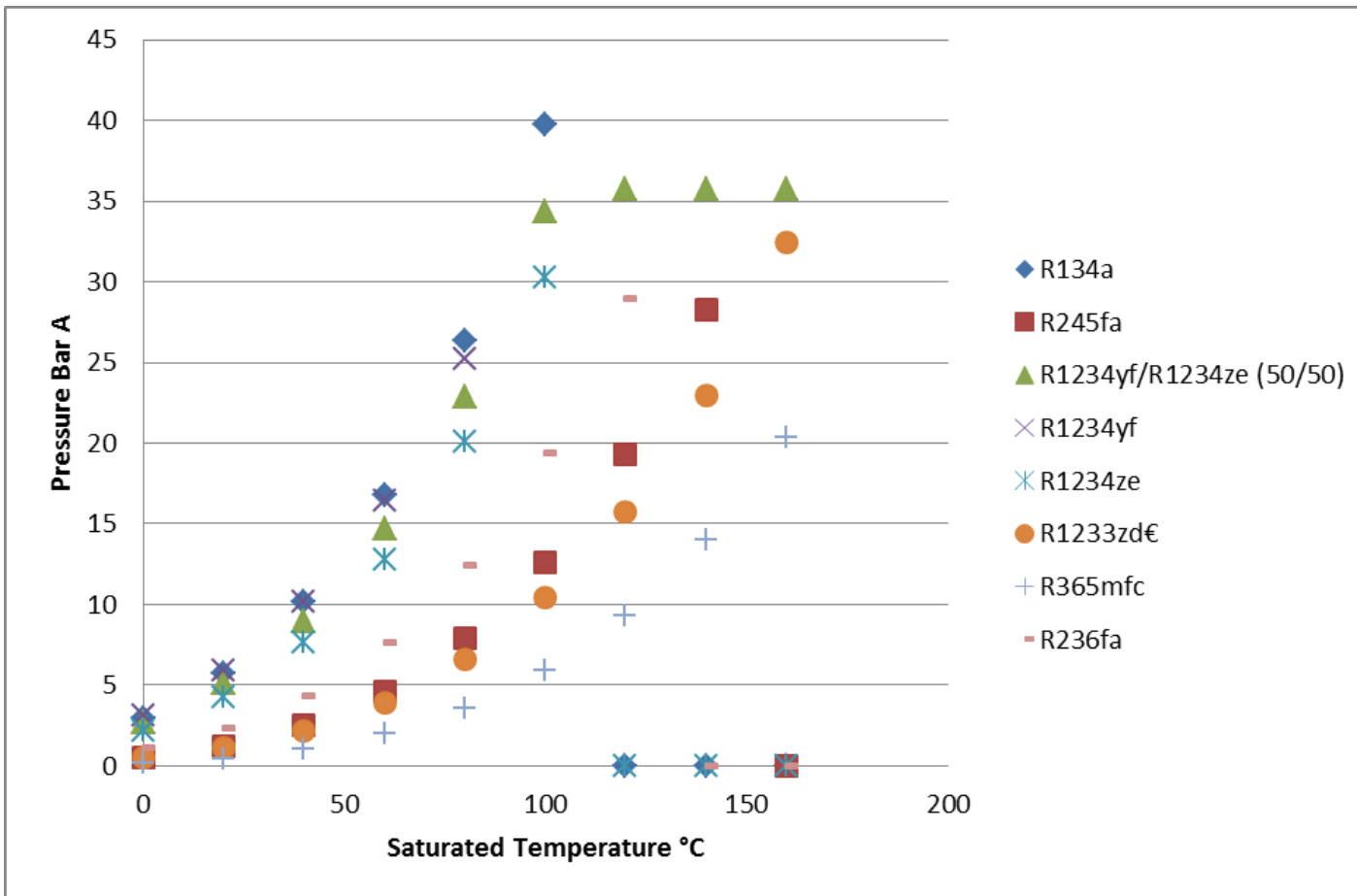
# High Temperature Heat Pump

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# Heat Pumps – High Temperature

## - Industrial/Solar Heat Pumps

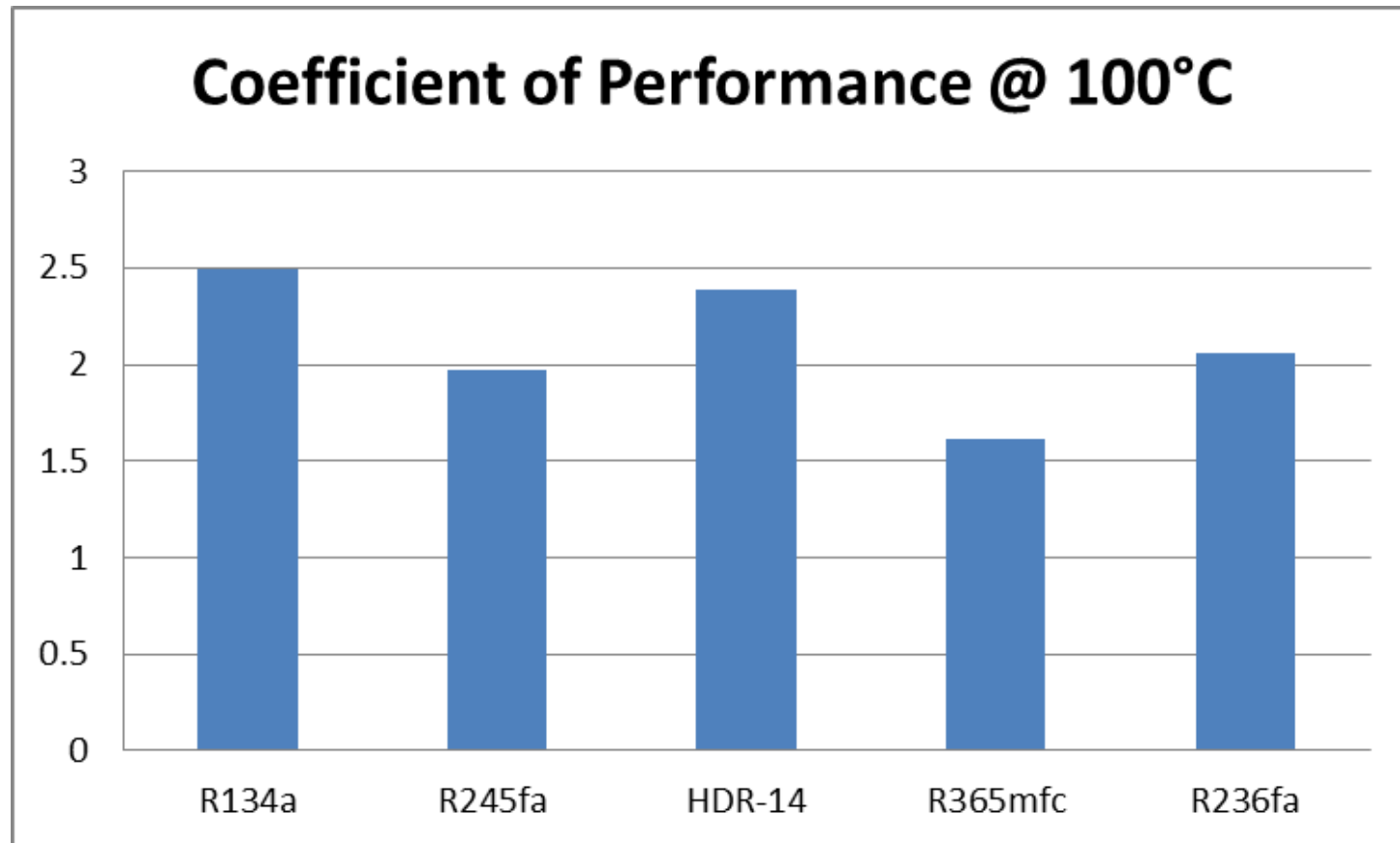
Understanding what fluids might be suitable?



# Heat Pumps – High Temperature

## - Industrial/Solar Heat Pumps

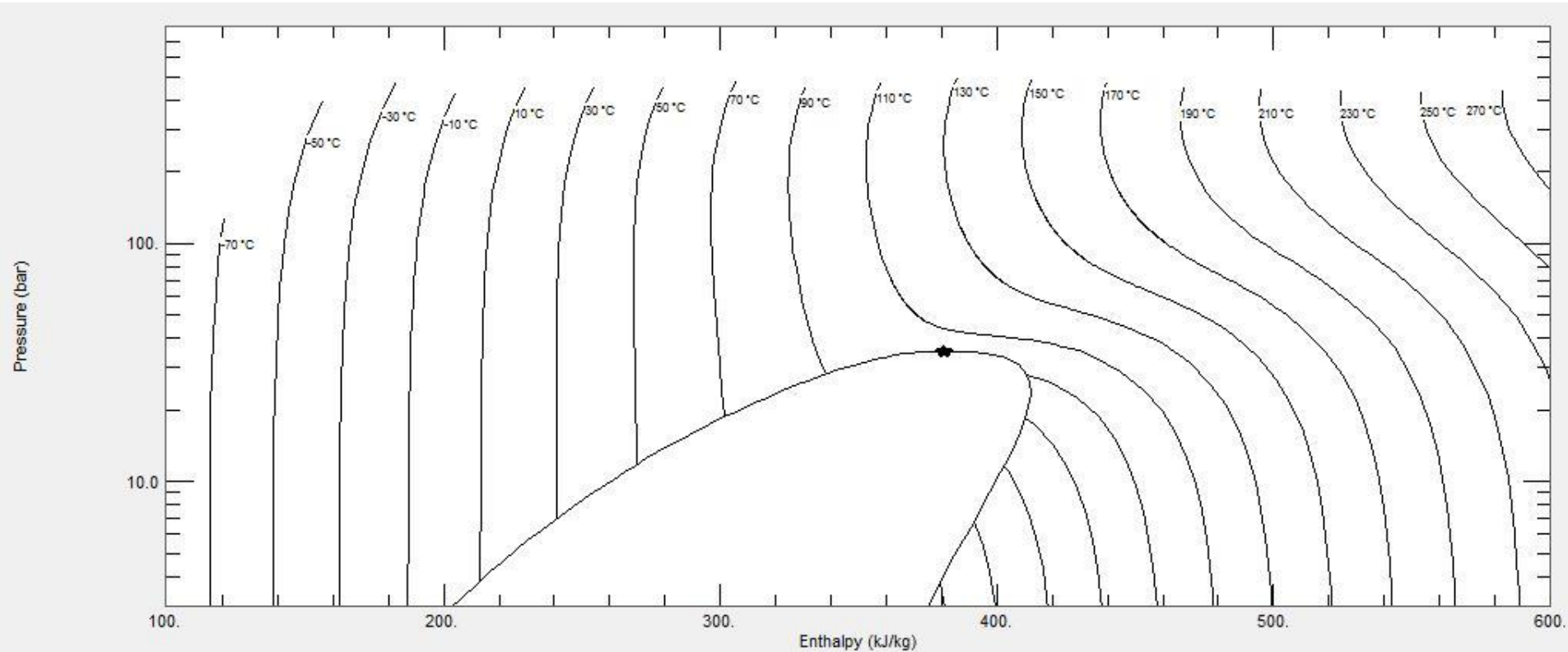
Understanding what fluids might be suitable?



# Heat Pumps – High Temperature

## - Industrial/Solar Heat Pumps

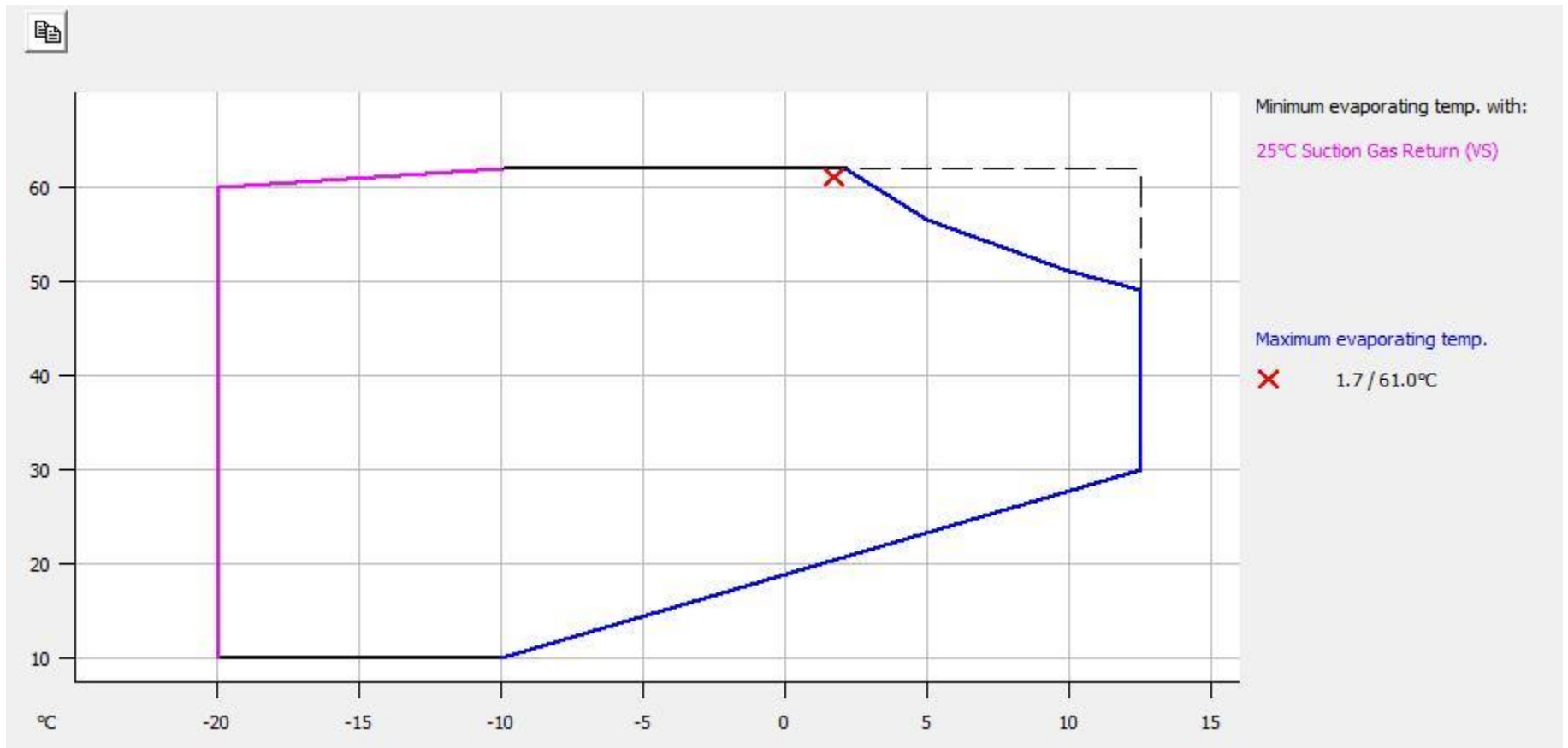
Understanding what fluids might be suitable? HDR-14?



# Heat Pumps – High Temperature

## - Industrial/Solar Heat Pumps

Understanding what equipment might be suitable? R134a equipment?



# Heat Pumps – High Temperature

## - Industrial/Solar Heat Pumps

Understanding what equipment might be suitable?

Fluids are not common

Is R134a equipment the best choice?

Retain pressure characteristics and temperature tolerances?