

Gas as an integral part of the EU decarbonisation strategy: sources, challenges & perspectives

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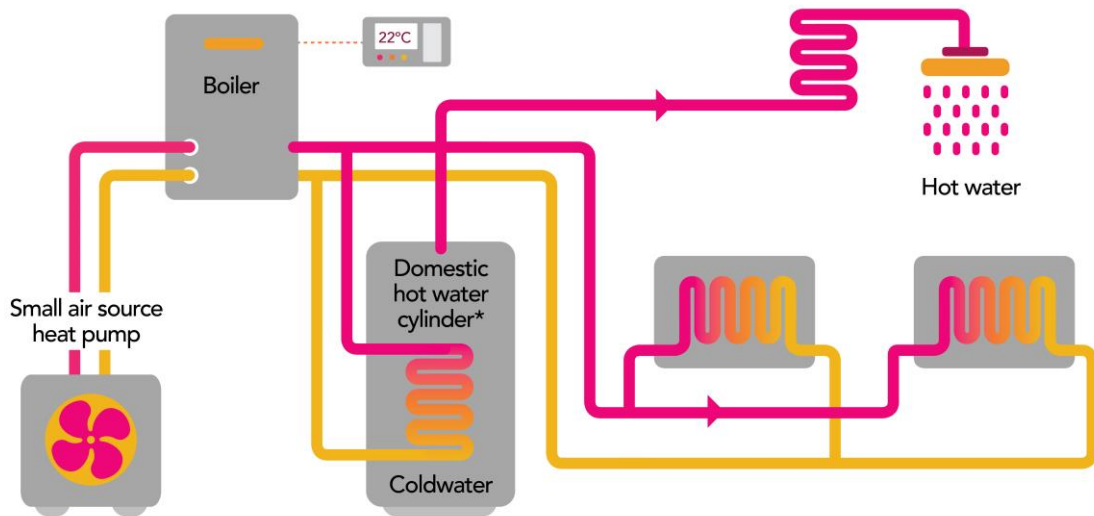
Introduction



£5.2m collaborative project between WPD, Wales & West Utilities, PassivSystems, Imperial College, Delta-ee and City University to evaluate Hybrid Heating Systems

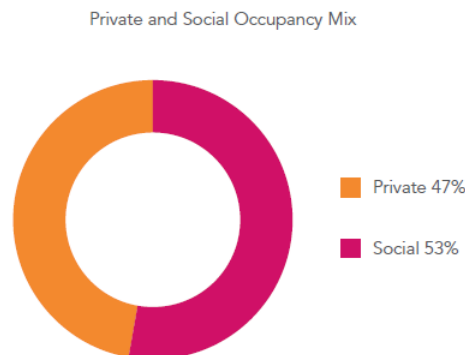
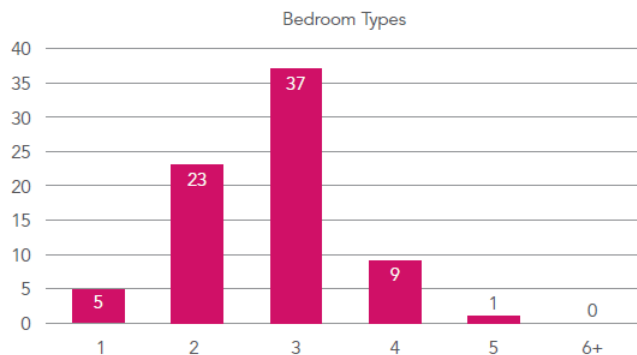
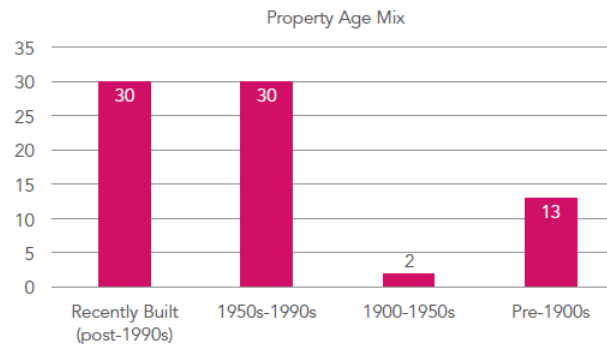
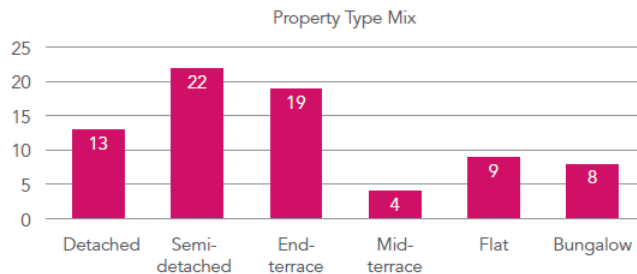
Installed into 75 homes in 2017 in the Bridgend 'Living Heat Lab'

Low cost retrofit to existing wet system with unique smart controller



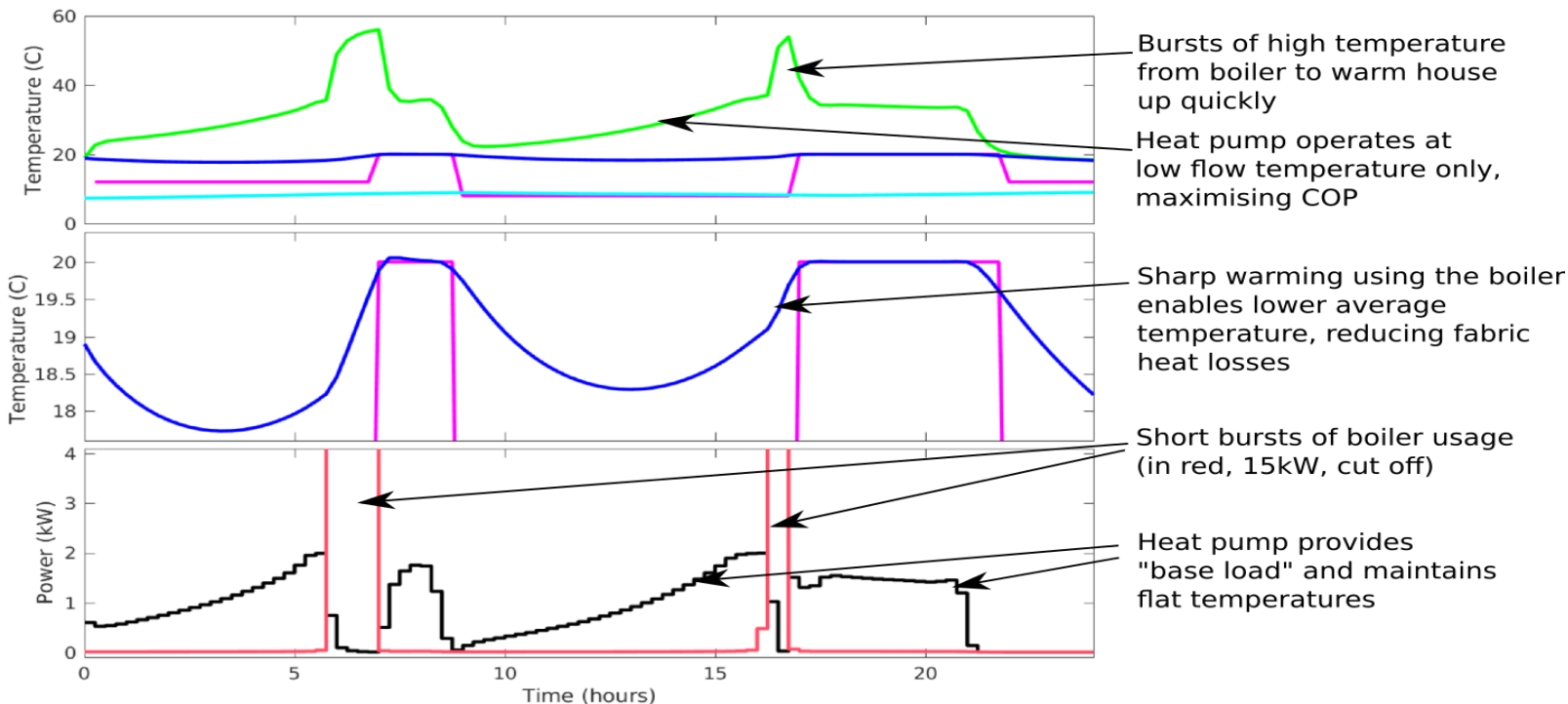
* Optional

Property Information



3x off-gas-grid properties, 3x systems boilers, 1x retrofit to an existing boiler

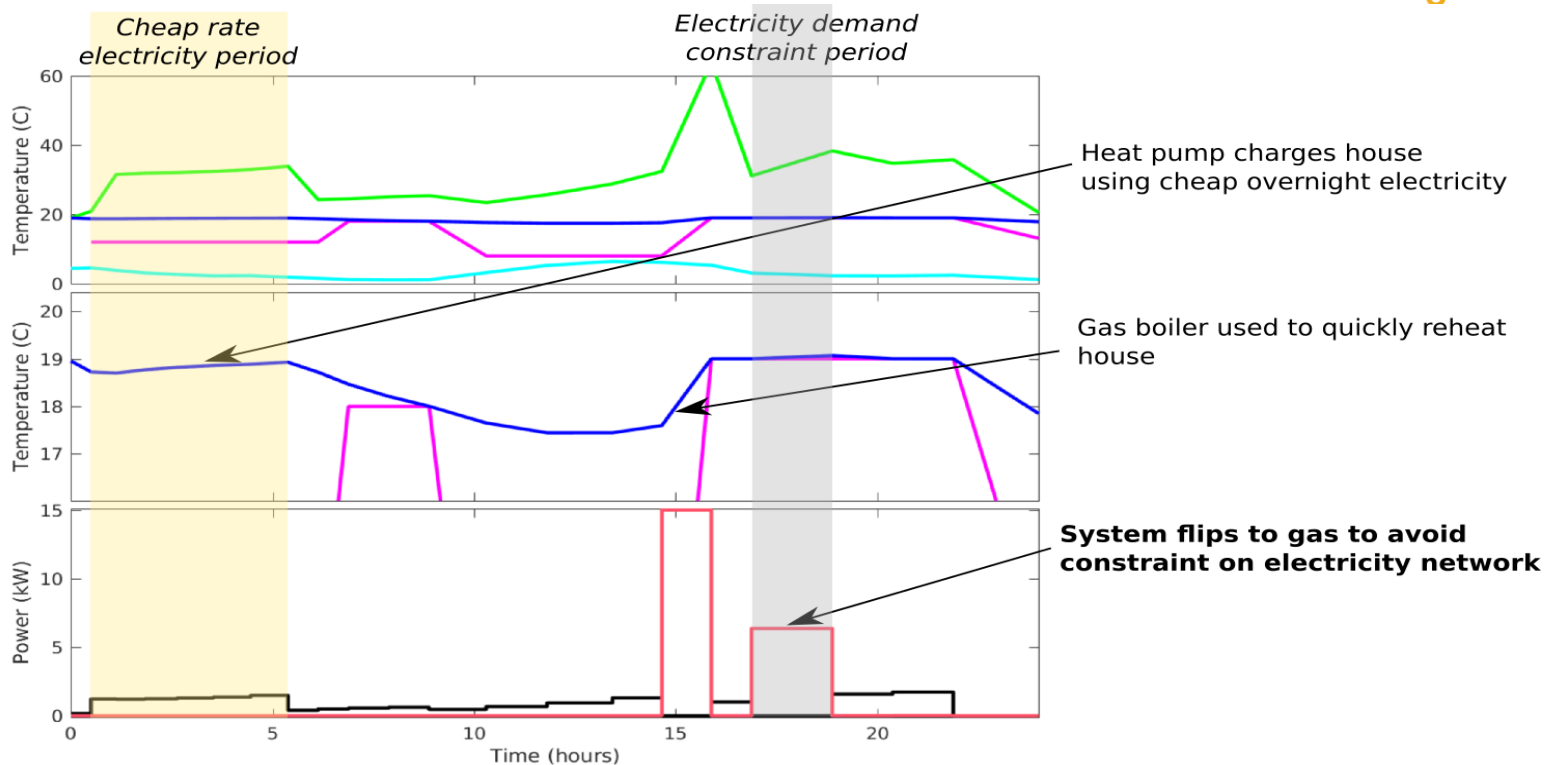
Intro to Hybrid Optimisation



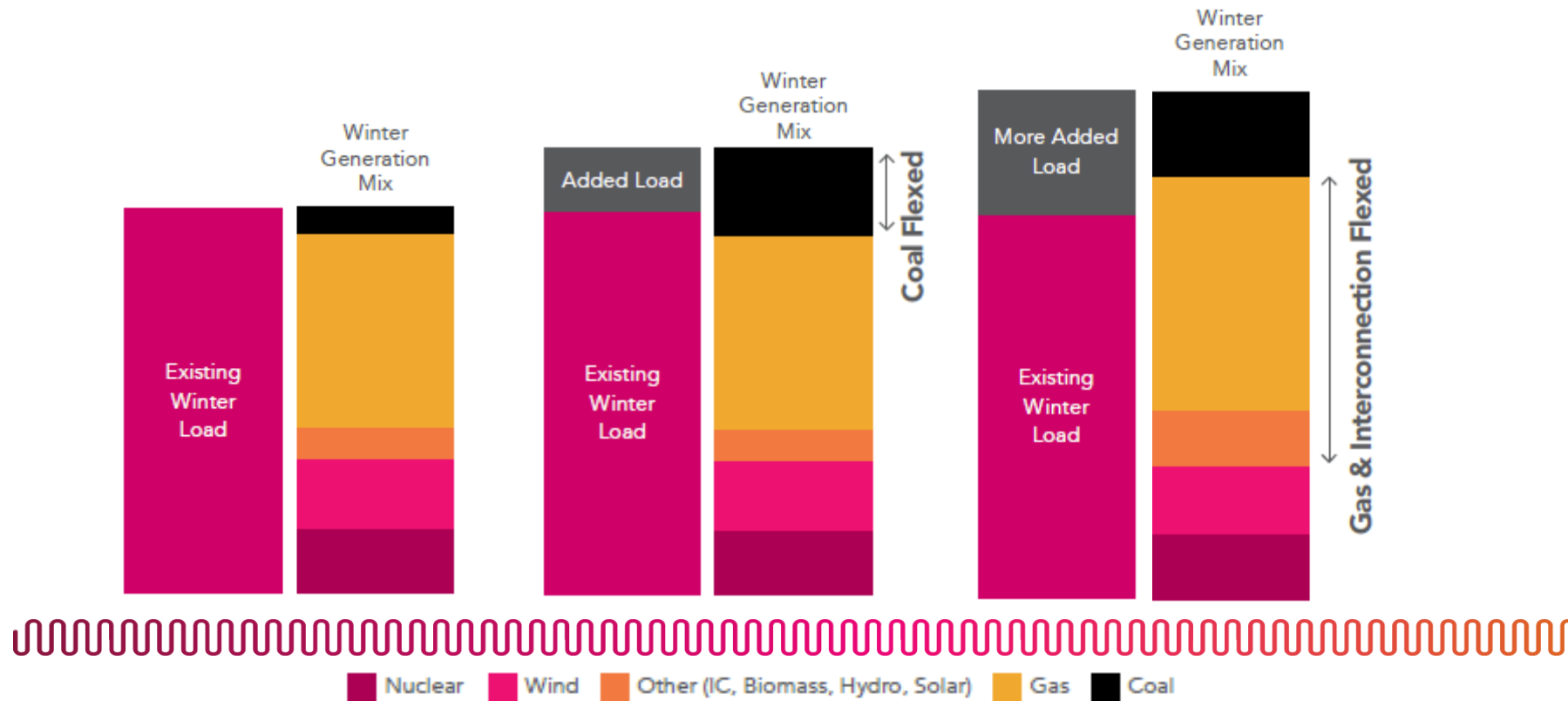
A decorative wavy line in red and orange colors.

Gas:electricity price ratio of **1:3**. Gas usage: **red**, Electricity usage: **black**.

TOUT & Constraint Optimisation



Marginal Generation to Meet Added Load

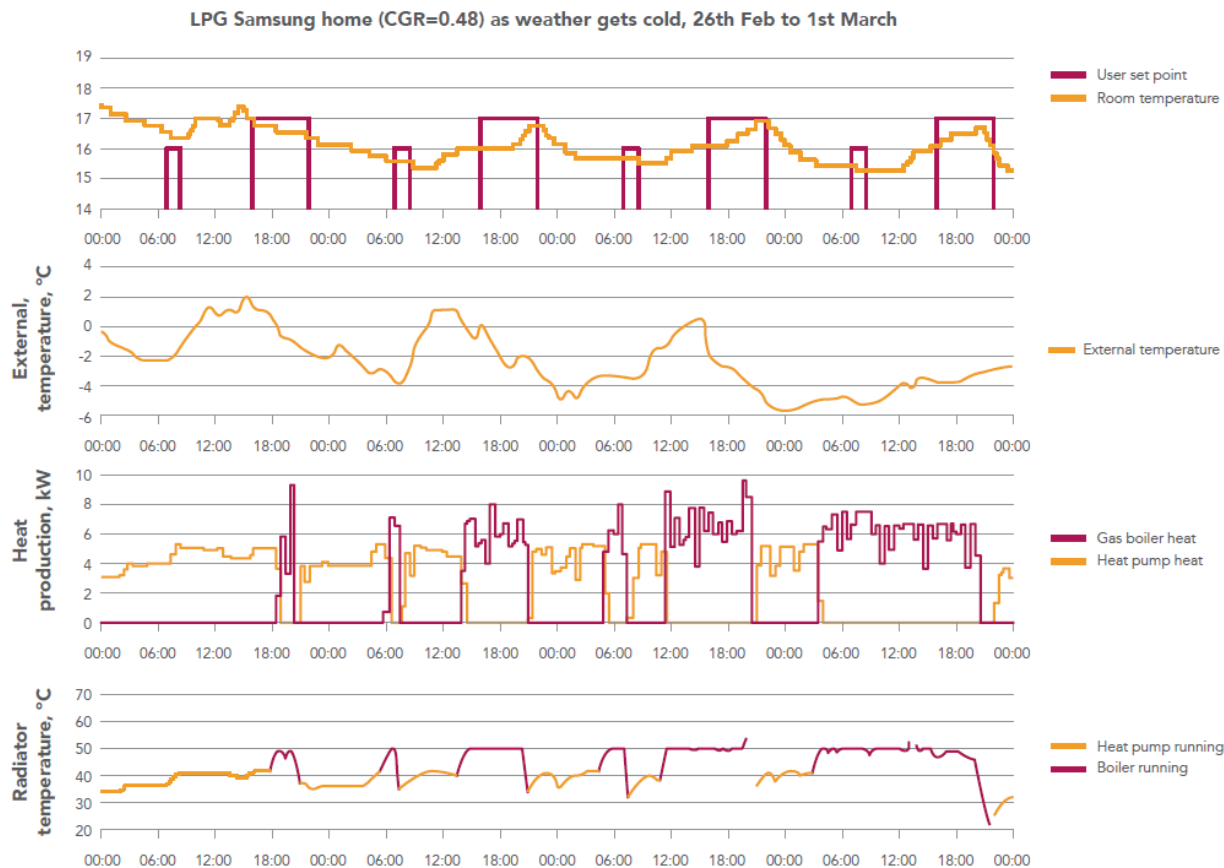


Mild Weather, LPG Home

LPG home (CGR=0.48) in mild weather, 17th to 21st Feb



Beast from the East, LPG Home



Off Gas Grid Home – Case Study



Rural hillside, exposed, farm cottage with no retrofitted insulation for heat pump use

Off Gas Grid Home – Case Study



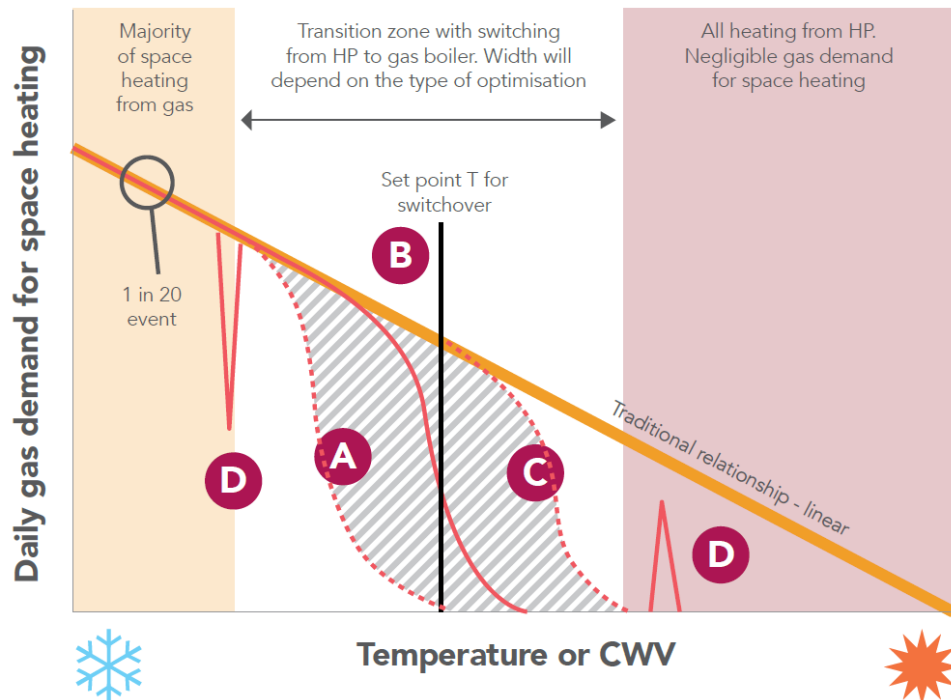
- LPG price for this home simulates a smart hybrid future for on-gas-grid using:
 - biomethane, hydrogen or natural gas with a carbon tax
- The hybrid system delivered 19,887kWh heat from the heat pump and 5,587kWh from the LPG boiler
- The cost to the homeowner was:
 - £657 in electricity
 - £391 in LPG
 - £1,047 total

Using LPG alone would have cost £1,783, therefore delivering a **net cost saving of £736/year**

- The heat pump took **78%** of the load
- A future generation mix with greater renewable capacity could achieve **100% decarbonisation** using:
 - the heat pump with renewable generation (principally wind), and
 - gas boiler with BioLPG during low wind, high electricity cost, cold periods and in response to constraints or flexibility value signals



System Switchover



The availability of lower price electricity, lower marginal carbon emissions of electricity and improvements in system efficiency will result in a lower temperature switchover regime.



With a setpoint switchover, daily demand will still vary slightly depending on daily heat profiles and the need to use gas boilers for initial boost.



Higher electricity prices, higher marginal carbon emissions of electricity and lower heat pump system efficiency (perhaps with a cold morning start-up) will result in greater gas demand at higher temperatures.



Spikes in heat pump or boiler output may occur outside of the transition area due to extremes in stimuli such as extreme price or carbon events. These could be triggered by variable rate tariffs.



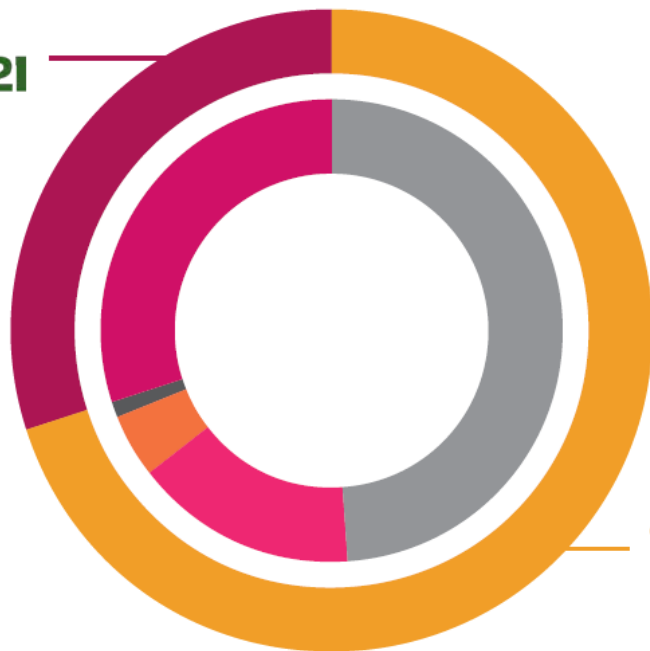
Summary Project Findings



- Smart switching decision 17,520 times a year driven by:
 - Market prices and fuel price ratio, linked to renewable generation
 - Marginal carbon intensity of electricity
 - Electricity network capacity constraints & flexibility revenue opportunities
 - Heat pump efficiencies with cold weather demand
- Gas networks provide the storage and flexibility to the smart hybrid system, moving to low carbon gas
- Hybrids using natural gas offer lower cost and lower carbon heat compared to using a heat pump alone
- Imperial has identified:
 - Up to £15.2b gross savings/year
 - Flexible consumers' heat bills will be around 50% lower than their inflexible peers
- Smart hybrids:
 - Avoid investing in overbuilding of generation assets and power grid reinforcement
 - Offer the opportunity to divert that investment into flexible domestic assets for consumers



So What?



2050 Domestic Heating Fuel Supply

- Wind 49%
- H₂ 30%
- BioGas 16%
- Other 5%
- H₂ blend 1%

2050 Future of Domestic Heat Technology Approaches

- 17 Hydrogen Cities 30%
- On-Gas & Off-Gas Smart Hybrids 70%



What Next?



Customer Propositions

B-Snug

Funded ASHP in delivering heating-assets-as-a-service

B-Snug + ECO3

Potential to fully fund hybrid LPG central heating

UK-Canada Export

Freedom controls to optimise an asset service

UK-Netherlands Export

Applying smart control to emerging hybrid rollout

Other Properties

Freedom

Freedom controls in non-domestics (needs demo)

Smooth Networks

Retrofit heat network with optimised CHP & HIUs

HyRise Project

Hybridisation of Smooth Networks plant room

FreeNet Project

Hybrid heat network in Bridgend or Cardiff

Whole House Benefits

Offset Project

Integrating controllable appliances into hybrids

FreeEV

Integrating smart EV charging into hybrids

No Regrets

Hybrid tariff to support access of aggregated DSR

SMETER Project

Optimisation of thermal performance & home health

Wider Applications

FlexiCell

Smart hybrid with heat pump & domestic CHP

HyHy Project

Introducing hydrogen into an established hybrid city

