



LOW-CARBON HEAT CONFERENCE

24 September, Online

Morag Watson
Director of Policy
Scottish Renewables

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Paul Wheelhouse MSP
Minister for Energy, Connectivity
and the Islands
Scottish Government

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LOW-CARBON HEAT CONFERENCE

24 September, Online

Next session begins at 1200

Realising the potential of efficient, electric heat

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Colin Calder
CEO
PassivSystems

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Realising the potential of cost efficient low carbon heat



Company Details:

- Established in 2008.
- 75 employees including dedicated resource in Edinburgh.
- A market leader in advanced home energy services: delivering 30+ projects since 2018 incl. FREEDOM Project, Smart Energy Islands, NEDO, MADE, SMOOTH, FUSION.

About PassivSystems:

- An award-winning home energy services platform, providing data monitoring, Low Carbon Technology (LCT) controls, smart heating and DSR aggregation services.
- A range of connected sensor devices and equipment integrate data into PassivPro an asset management portal.
- #1 provider of asset backed residential solar monitoring services in the UK.
- Advanced AI optimises home heat, storage and transport assets and unlocks smart grid value.

Extensive experience in developing new energy services:

- Distributed computing
- Radio technologies
- Web and app-based consumer interfaces
- Innovative control algorithms



Our Innovation and Services:

The combination of low carbon technology controls and the PassivPro portal enables PassivSystems to aggregate and demand manage the network loads for superior asset performance:

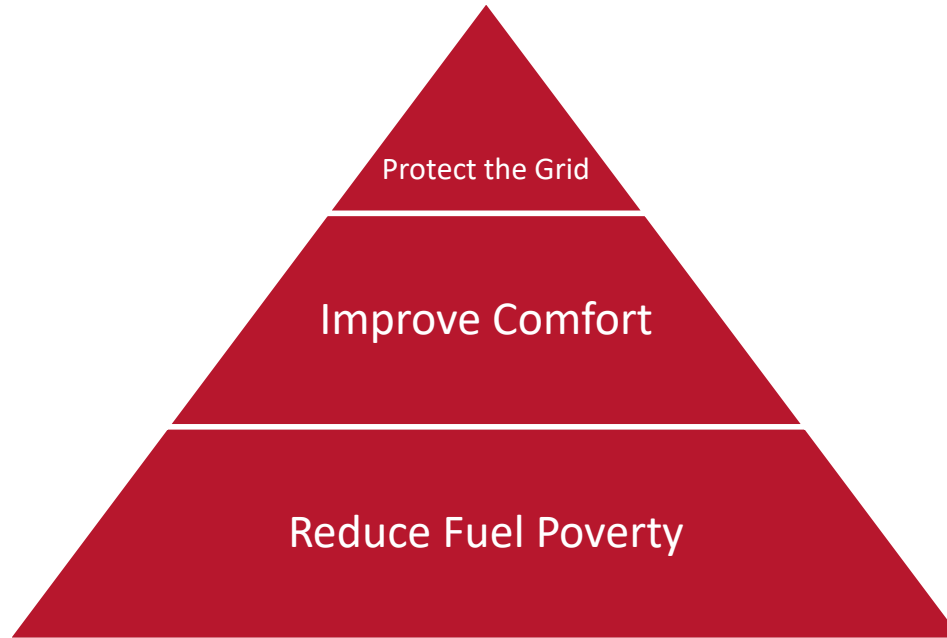
- Every end point can capture minute-by-minute temperature and power data
- Controls can act autonomously after taking into account consumer preferences and optimise energy consumption
- Customer engagement with in-app messaging
- Zero hardware upgrade costs, only remote software upgrades
- Demand can be managed to cut peaks, predict/forecast consumption and support energy procurement.

We deliver commercial and R&D projects to help deliver future energy systems and partner with:

- Energy Suppliers and Distribution Network Operators;
- Policymakers;
- Regulators and;
- Like minded technology providers, consultancies and academics.



The Potential of Efficient Electric Heat & Transport in Scotland



The decarbonisation of heat and transport is now a priority for the UK government.

It is likely that as we transition to reach Net Zero, a large proportion of UK homes will:

- Be heated by a **hybrid heat pump** (HHP), consisting of an electrically powered heat pump together with a fossil-fuel boiler;
- Have **solar photovoltaic (PV) panels** generating electricity to use at home and export to the grid;
- Have a (electric) **battery** installed to store excess solar generation and to take advantage of cheap renewably-generated electricity from the grid;
- Have occupants who drive an **electric vehicle** (EV) which can be charged via an EV charge point at home.

Multi Asset Demand Execution (MADE) Project



In collaboration with Western Power Distribution (West Midlands, South West distribution network operator) a £1.6m innovation project investigates the network, consumer and broader energy system implications of high-volume deployments of the combination of LCTs, including generation and storage.

The MADE project is a trial of smart control technology for integrating and coordinating multiple domestic Low Carbon Technologies (LCTs). Third party controls were integrated to optimise:

- Electric vehicles with smart charging;
- Smart hybrid heat pumps: heat pump with boiler;
- Solar photovoltaic (PV) generation with battery storage.

Project aims:

- provide greater customer value;
- a route towards decarbonisation;
- demonstrate complete flexibility on the electrical load with demand-side management.

Key MADE output: Uncoordinated Vs smart coordinated control

The field trial collected data and carried out interventions over a 1-year period (September 2019 – October 2020).

Real-world overall household demand shape (and balance between the assets) changes depending on:

- Supplier tariff type (including Time-of-Use);
- Level of asset coordination;
- Seasons (winter, spring, summer and autumn).

These factors were tested (with and without coordinated control) alongside a number of local distribution interventions.

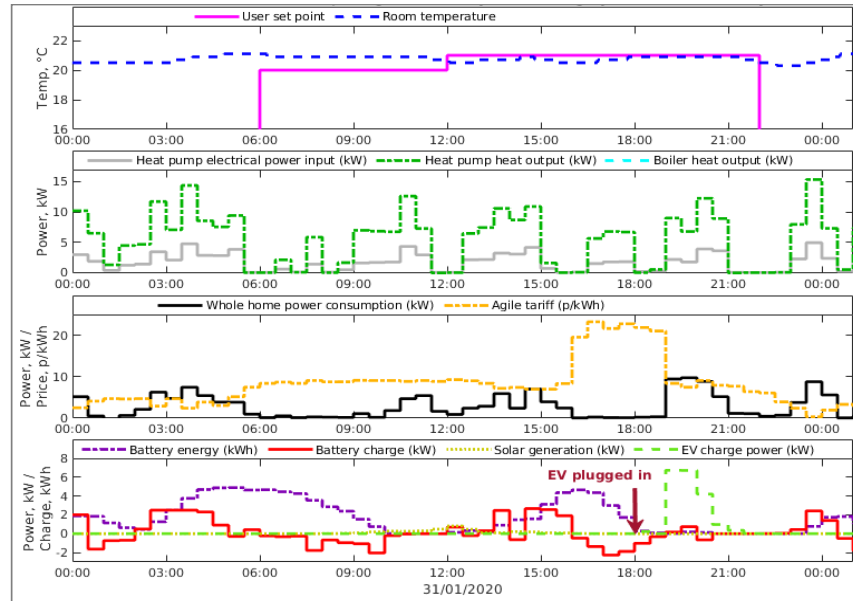


Figure 1: Real world MADE concept home energy demand profile

MADE Impact and Benefits

Customer savings: £260 per annum
(Everoze Consultants).

Peak load shifting between 35 and 40%
(Everoze Consultants).

GB local network savings: £310 per annum
(Imperial College).

GB whole-system savings: 5.6bn per annum
(Imperial College).

Stimulates LCT uptake.

Supports the decarbonisation of domestic heat, power and transport.

Supports Net Zero.

- Funding should be directed towards supporting both on and off gas grid communities in adopting hybrid Air Source Heat Pumps with grid aware smart controls

Delivering material reductions in fuel poverty, improved comfort and reduced carbon emissions

Creating new skilled green jobs in support of the Just Transition

- Local authorities should be incentivised to migrate their gas boiler replacement programmes towards the installation of compact hybrid Air Source Heat Pumps & Hydrogen Ready Boilers being demonstrated by the HyCompact Trial
- Regulated asset owners such as DNO's should be able to finance domestic low carbon heating assets to remove the upfront CAPEX barriers from mass deployment

Our Partners



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Matthew Black
Business Development Manager
Kensa

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GROUND SOURCE HEAT PUMPS AND SHARED GROUND LOOP ARRAYS



The UK's leading ground source heat pump manufacturer and installation contractor

THE KENSA GROUP

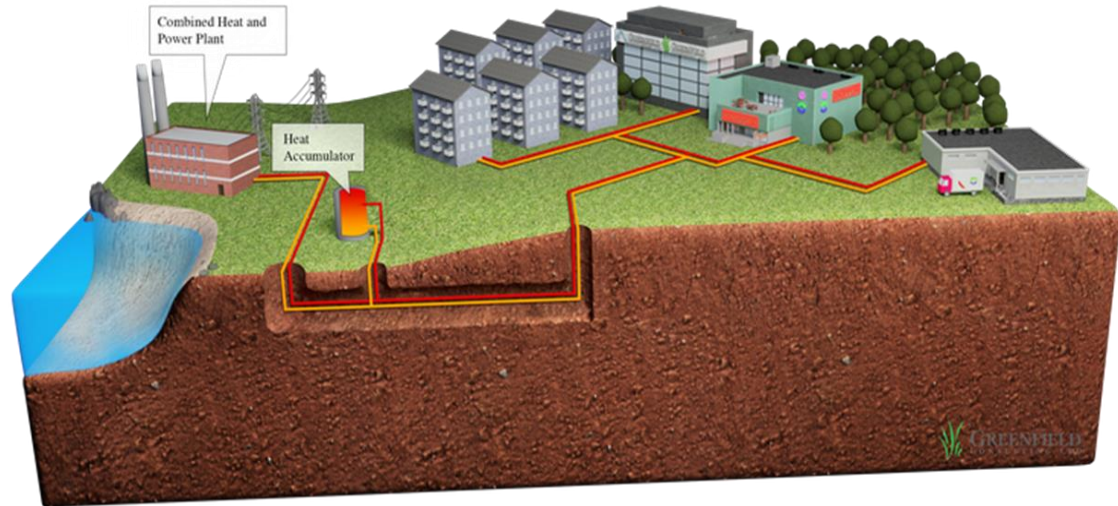
- **Kensa Heat Pumps** remains the UK's only manufacturer of ground source heat pumps since 1999. It provides products and technical support to an extensive network of plumbing contractors.
- **Kensa Contracting** is a specialist ground source heat pump installation business which focusses on large-scale new build and social housing retrofit programmes. It benefits from unrivalled experience and expertise and has delivered the UK's largest installations in the residential sector. Kensa Contracting is the UK's specialist delivery partner for Fifth Generation District Heating networks featuring Ground Source Heat Pumps and Shared Ground Loop Arrays
- **Kensa Utilities** is an infrastructure asset company which funds, owns and maintains shared ground loops that serve ground source heat pump installations. It utilises subsidy support to provide these assets at zero cost to the housebuilder or social landlord.

www.thekensagroup.com



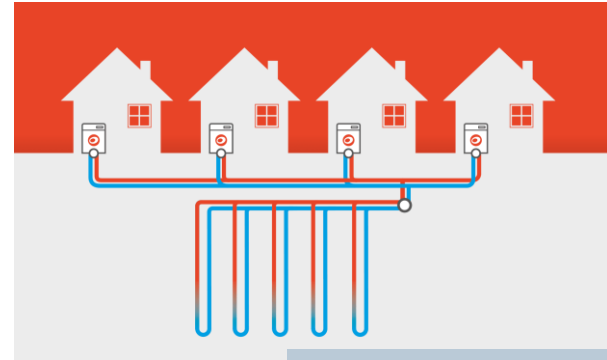
Main disadvantages:

- Central heat plant which requires fossil fuel back up. If offline all end users are without heating or hot water.
- High temp heat network 50-90°C. Heat loss through pipework which reduces efficiency resulting in less CO2 savings and higher operating cost
- Each end user has a Heat Interface Units (HIU) which requires regular servicing and maintenance
- Requires Heat Metering and Heat Billing which is onerous and results in high operating costs and consumer protection issues.



Shared ground loop arrays are a form of ultra-low temperature heat network connecting Kensa ground source heat pumps inside individual dwellings.

- Simple, flexible and infinitely scalable solution for large developments
- Ambient temperature network: -5 - 20°C – no heat losses
- Mimics a traditional gas framework. Boreholes last 75-100 years +
- Individual heat pump in each dwelling – no billing or metering
- No external plant – no visual impact
- No energy centre, central plant or pumps, no pre-insulated pipework or HIUs – low operational requirements
- No sale of heat, no heat metering and no heat billing required. Hassle free low cost operation
- Applicable to all housing and building types.



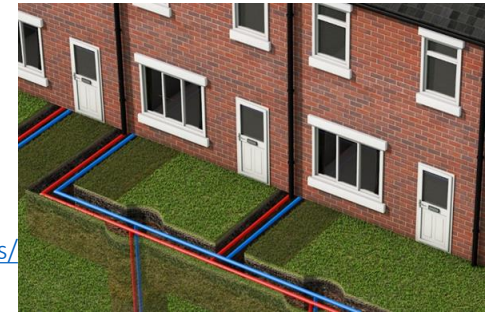
<https://www.kensacontracting.com/services/fifth-generation-district-heating-cooling/shared-ground-loop-arrays/>

FIFTH GENERATION HEAT NETWORKS FEATURING SGLAS

- Due to higher efficiencies, ground/water source heat pumps achieve the highest CO2 savings and end user fuel cost savings comparative to other heat pump types or fuel sources.
- Heat sources are typically closed loop boreholes but could be open loop using aquifers or mine water, water source (closed or open loop in fresh water river, lochs, reservoirs, canals or potentially sea water), Energy from Waste...
- Can easily provide low cost cooling. This energy boosts the heat network further improving heating efficiencies
- Can be integrated with a “smart” programmable thermostat and dynamic pricing tariffs to mitigate heat use during peak times. This has the added benefit of a) reducing end user running costs by an additional 25-30% b) stabilise local and regional grid issues during peak demand – currently trialled at Energy Superhub Oxford (see link below)

Useful links

- <https://www.kensacontracting.com/services/fifth-generation-district-heating-cooling/>
- <https://www.kensacontracting.com/services/fifth-generation-district-heating-cooling/shared-ground-loop-arrays/>
- <https://www.kensacontracting.com/energy-superhub-oxford-eso/>
- <https://www.kensacontracting.com/community-heating-district-heating-with-ground-source-heat-pumps/>



CHALLENGES FOR DEPLOYMENT

- Low price of Mains Gas
- Out of date Standard Assessment Procedure (SAP): We still use SAP2012 to assess carbon in buildings. SAP2012 CO2 intensity of electricity is 519g/kWh. Reality in Scotland is about 10% of that figure meaning that in the real world Ground Source Heat Pumps in on-gas areas will reduce CO2 by 80%+. SAP needs to be updated more frequently to reflect the changing landscape.
- Uncertainty in the market place due to the closure of Non-Domestic RHI: A Scottish RHI?
- Tight grant funding deadlines
- More certainty required around banning of fossil fuel appliances in new and existing buildings moving forward.

Useful links

- <https://www.kensacontracting.com/the-uks-largest-gas-replacement-programme-with-ground-source-heat-pumps/> - open loop gas replacement in seven tower blocks in Sunderland
- <https://www.kensacontracting.com/meeting-grid-demand-with-heat-pump-innovations/>
- <https://www.kensacontracting.com/croydon-council-responds-to-climate-emergency-with-kensa-contracting-gshp-pilot-scheme/>

CONTACT DETAILS

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<https://www.kensacontracting.com/>



Shoebox Ground Source Heat Pump

The Kensa **Shoebox Ground Source Heat Pump** Series features the quietest, smallest and most innovative ground source heat pump on the market.

Available in 3kW single compressor models and 6kW twin compressor models, the award-winning Kensa Shoebox Series is an efficient, practical and affordable heating solution engineered to provide both heating and hot water in new build and retrofit multi-dwellings and starter homes.

Explore example Shoebox **ground source heat pump costs** in our new Solution Centre.



Accreditations



Danny Ball

Business Development Manager

Engie

Tweet @ScotRenew

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RESTRICTED

INTERNAL

SECRET

ENGIE - URBAN ENERGY

The UK leader in city centre district energy

~70km networks ~340GWh heat ~135GWh electricity ~70GWh cooling ~90% gas ~50% CHP ~30 years experience

33-40 years



North & Scotland

- Leeds
- Liverpool
- Newcastle
- Edinburgh St. James

25 years

MIDLANDS 30+km

- Birmingham District Energy (BDEC)
- Leicester District Energy (LDEC)
- Coventry District Energy (CDEC)

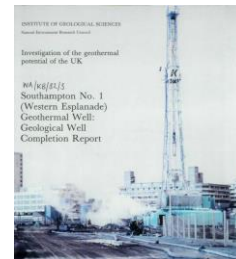


44MW EFW

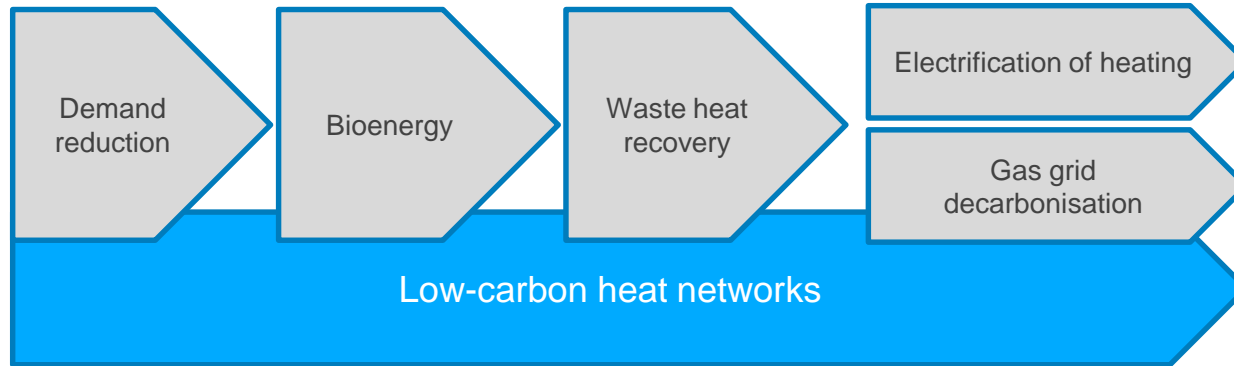
London & South 30+km

25-40 years

- East London Energy (ELE)
- ExCel District Energy (EDEC)
- Pimlico District Heating Undertaking (PDHU)
- Southampton Geothermal Heating Company (SGHC)
- Bloomsbury Heat and Power (BHP)
- Battersea DH Scheme
- Embassy Quarter DH Scheme



Heat Decarbonisation



Proposed Scottish Heat Networks Bill is supportive of this position.

Heat Decarbonisation: Pipes Or Pylons?

Long term options for decarbonising heat

A number of technologies hold potential, but there is no consensus on which approach will work best at the scale needed – for consumers and for minimising costs.

Electrification

- conversion to electric heat pumps or other electric technologies
- particularly useful for buildings not on the gas grid



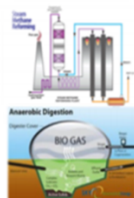
District heat networks

- cost effective where there is sufficient density of heat demand
- likely to be an important part of the mix in the long term



Decarbonising the gas grid

- using hydrogen or biogas
- more work is needed to assess cost and feasibility



Hybrid solutions

- two different heating technologies and energy sources working together



Electric Heating

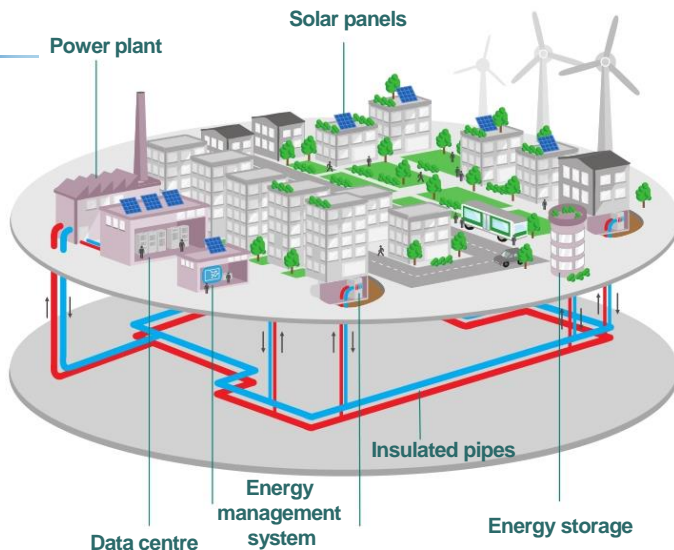
- Resistive electric heating has very low capex, but high customer energy costs. Offers low carbon as grid has decarbonised – especially in Scotland.
- Heat Pumps – offer higher efficiency and lower unit energy costs, but high capex. Require financial support to be competitive with counterfactual.
- Retrofit challenge on existing schemes – temperatures (network and customers)

District Heating and Cooling – the backbone of zero carbon transitions



Consuming less resources

- Best available technologies for boilers, chillers, heat pumps, energy transfer stations, storage, distribution ...
- Energy management system, digital monitoring and intelligence optimizing consumptions
- Reduction of energy losses (LTHW Low Temperature Hot Water)
- Reduction of water leakages
- Guaranteed energy performance and savings



Shifting to green energy

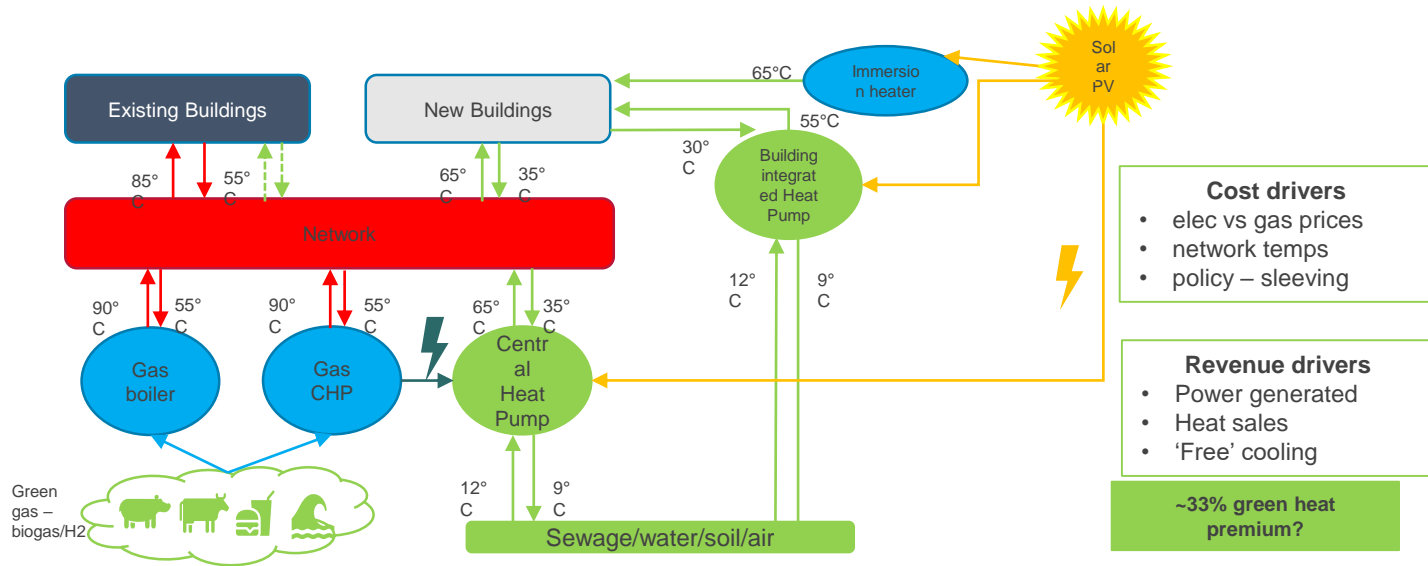
- On-site energy production: combined heat & power, cogeneration, biomass, biogas, solar thermal, geothermal, hydrogen ...
- Green Power Purchase Agreement
- Re-use of local excess heat (industry, data centres...) not otherwise usable
- Waste recycling to energy
- Energy storage increasing renewables penetration and reducing intermittency



Contributing to better urban spaces

- Urban planning
- Green roofs, greenery urban islands
- Protection of biodiversity
- Guaranteed availability
- Safety of installations, security for people
- Reduction of the number of points of emissions and better control
- End-users' satisfaction surveys
- Visitors centres

Existing Heat Networks - Phased Decarbonisation





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