

HEADLINE SPONSOR



LOW-CARBON HEAT CONFERENCE 30 APRIL 2019 GLASGOW





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Inclusive growth and low-carbon heat

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Richard Long Business Development Director ENGIE

engie

District Energy - Markets and Commercial Structures

Scottish Renewables Low Carbon Heat Conference 30th April 2019

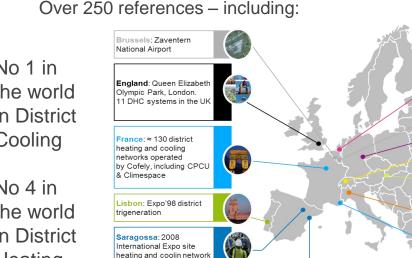
ENGIE Worldwide

ENGIE is one of the world's largest utility companies.

Operating in €70 billion 155,000 70 **Employees Revenues in 2017** worldwide countries **Decarbonisation Decentralisation** Digitalisation Working towards low carbon Focus on energy that is Digital technologies are a generated, stored and powerful accelerator or zero carbon energy generation, homes and places consumed closer to demand within of progress in creating connected the home and community

communities

ENGIE – European District Heating & Cooling References



• No 1 in the world in District Cooling

• No 4 in the world in District Heating

Expansion outside of the Europe:

Network

Barcelona: District

Heating and Cooling

- Acquisition of 40% of Tabreed a district cooling company in the Middle East
- 50 year contract with Ohio State University >\$1bn contract

Amsterdam: Heating and Cooling networks for 3 main districts (Mahler 4, Oosterdokseiland

Liège: Heating Network

for University Campus

Magdeburg: Heating network

Zurich,(Bussigny):

Slovakia: Cofely operates

Italy: Cofely operates

on 24 district heating

and cooling networks

network trigeneration

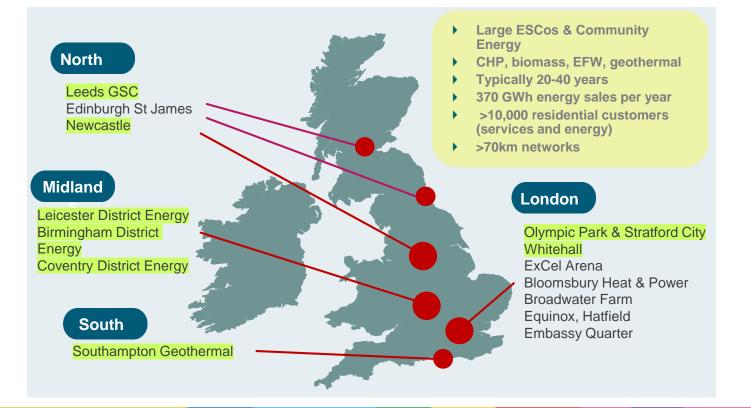
Monaco: Principality DHC

Heating network

5 DHC networks (2 in Bratislava)

and Overhoeks)

ENGIE Urban Energy District energy schemes in the UK



The UK District Energy Market

- Segmented regionally:
 - London
 - Scotland
 - Rest of UK
- Segmented type of scheme:
 - Block Schemes (small scheme serving one residential block)
 - Community Energy supplying several residential blocks (typically discrete legacy Local Authority/Social Housing schemes)
 - Education and Healthcare campus based schemes
 - Residential Development based schemes (on new build)
 - City Centre/Large Schemes supplying energy to a mix of customers across a network

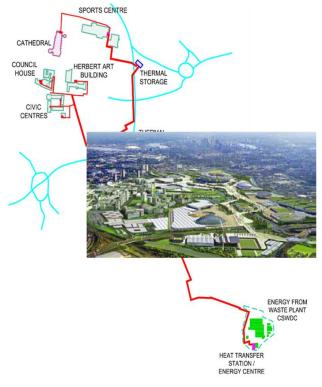
District Energy – Market Potential

Deployment

- Retrofit to existing buildings
- New build developments
- Extensions to existing networks
- Repowering of existing networks
- Heat from energy-from-waste, biomass and other heat producers

Funding and operation

- Public Sector
- Private Sector
- Partnerships



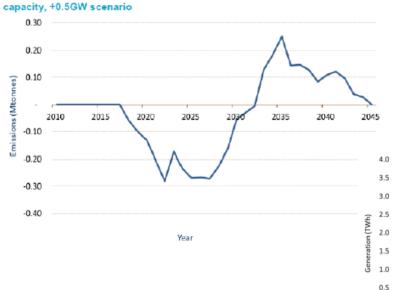
District Energy – Key Challenges

- Widely available gas network
- Upfront costs to fund
- Installing in dense urban areas
- Customer uptake and perception
- Uncertain heat loads/growth
- Operational performance
- Viability challenge
- Planning consent
- Long-term carbon sustainability





"Gas CHP delivers carbon savings throughout the 2020s but additional gas CHP increases carbon emissions from 2032"

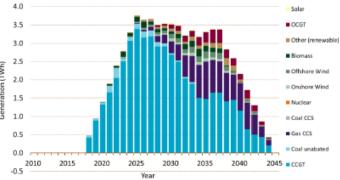


Net Annual CO2 emissions from the generation displaced by additional Gas CHP

See: Bespoke Natural Gas Analysis 2014

"there is a significant amount of uncertainty in these results"

Alternative analysis indicates this happening much sooner.



Decarbonisation of District Energy

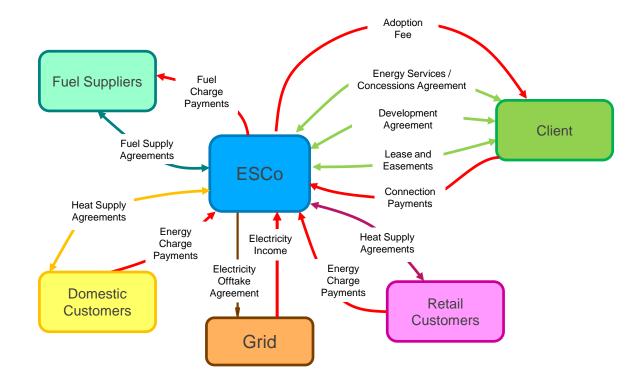
- Long-life networks
- New District Heating Projects
 - Consider alternatives to gas CHP now
 - Long-life modelling
 - Adaptability
 - Policy support
- Existing District Heating Schemes
 - Future-proofing
 - Options appraisal
 - Ease of retrofit
 - Customer requirements/constraints



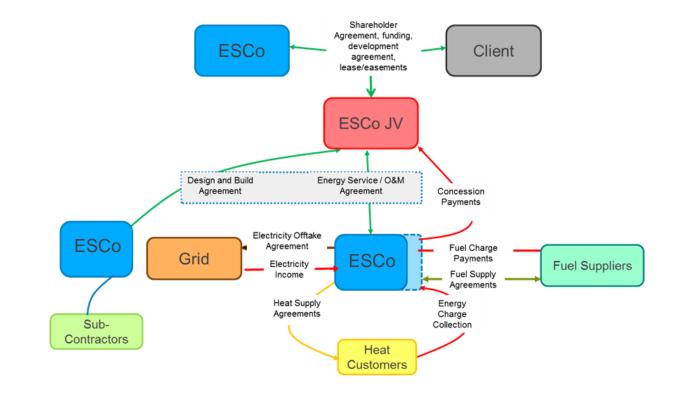
Partnership or Contracting Structures for District Energy

- Numerous potential structures, such as:
 - Do-It-Yourself or Partial Outsourcing
 - Outsource design & build (potential adoption/lease by an ESCo)
 - Separation of Heat generation and distribution
 - Contract out operation and maintenance (medium / long-term)
 - Short-term O&M and metering and billing
 - Collaboration Partnership
 - Appoint ESCo to DBOM (and grow) for defined term
 - Joint Ventures: single or multiple entities not always 50/50
 - Long-term concession including obligations to connection within the concession area

Typical ESCo Structure – long-term contract with adoption



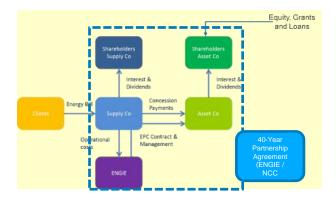
A JV Structure



Newcastle – Example of a JV with the Public Sector

- 40 year "Regenerate" Partnership with Newcastle City Council (NCC) – joint development of District Energy (and other energy related opportunities) in the City
- Competitive Dialogue commenced June 2015; contract signed Aug 2018.
- Complex contract structure: overriding Partnership Agreement, with separate Asset and Supply JV companies related to the operating assets.
- Initial project: Newcastle Helix; a highprofile new mixed-use development.
 Grant funding was obtained. Scheme is in construction; Energy Centre completion Q4 2019.





Olympic Park – Example of a Long-Term Concession

ENGIE was awarded a 40-year concession by the ODA to design, finance and build the Energy Centres and deliver Energy Services to the Olympic Park.

- ENGIE has invested over £120m in two energy centres and over 20km of network on the back of the concession
- The concession obligates all consumers with the park boundary to connect – "quasi regulation", through agreements ensures standard pricing and contract terms.
- Since the Olympics, the energy load has more than doubles; including over 6,000 residential customers
- The scheme has also to new networks and neighbourhoods that have developed outside of the concession area, but on aligned terms.

Concessions, with obligations to connect, are most easily implemented on new developments



Richard Long

Business Development Director

ENGIE Urban Energy

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Councillor Anna Richardson City Convener for Sustainability and Carbon Reduction Glasgow City Council Paul Farrell Director West Whitlawburn Housing Co-operative

Paul Farrell Director West Whitlawburn Housing Co-operative

West Whitlawburn Housing Co-operative Biomass Energy Fuel Poverty Project

The future is warm and bright at WWHC



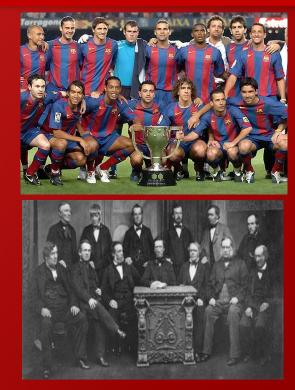
West Whitlawburn Housing Co-operative

- A not-for-profit Housing Co-operative RSL (Registered Social Landlord) with Charitable Status
- Formed in 1989. Houses bought from GCC
- We have 644 houses for rent
- 67% of stock is Multi storey
- 5th largest Housing Co-operative in UK
- We have 41 Staff
- We have a Community Resource Centre for Economic, Health, Social, Educational and Recreational projects

West Whitlawburn Housing Co-operative

- We are proud to be a Voluntary Tenant Controlled Housing Co-operative
- Only 11 Housing Co-operatives in Scotland
- We are Social Accountants: We put people first
- We measure value: Quality not quantity

Worldwide Co-ops: The International Co-operative Alliance







WWHC Systems Built: Problems and Challenges

- Flat Roofs
- Exposed Panel Joints
- Dampness and Water penetration
- Poor quality single glazed windows
- Very poor and expensive heating systems
- No Gas in properties due to Structural issues
- Ugly and Unattractive



Before



After



Befores and Afters









MSF Before and After



WWHC: Refurb and New build



West Whitlawburn Fuel Poverty

- Most expensive form of heating systems:
- Electric, white meter, centrally controlled
- Most tenants either on State Benefit or in low paid employment
- Benefit dependency rate 68%
- Income deprivation level 58% against a national average of 17%
- Heating costs 72% above the national average

Who is fuel poverty most likely to strike?



Anyone who relies on electricity for heating their homes are twice as likely to be affected than others on the gas grid.

West Whitlawburn Fuel Poverty Biomass Energy Project

- To introduce a retrofit Biomass District Heating Scheme for 544 properties
- WWHC becomes the Energy Supply Co-operative
- NPower CESP and ECO partners
- Estimated Cap-ex Cost circa £6.9m
- Circa £12.7k per unit

Capital Funding Sources

Source	Value
Community Energy Savings Programme/Energy Company obligations	£2.965m
European Regional Development Funding (ERDF)	£2.366m
Warm Homes Scottish Govt LOAN	£1.42m
National Lottery	£0.186m
TOTAL	£6.937m

Work in progress



Contract Delivery Problems

- Utility company as Principle Contractor
- Principle Contractor and sub-contractors initial performance woeful
- Completion 4 years overdue
- 4 full revisits to all homes
- Considerable initial tenant dissatisfaction
- Contractor paid compensation to tenants
- Retentions still held

Current situation

- Front end services working very well
- Very high levels of tenant satisfaction
- Heat loss calculations still awaited which could possibly result in more savings to tenants

Wood chip delivery



Energy Savings Trust

- Very helpful with advice and support
- Easy to deal with
- ... had a bucket of dosh



Scottish Government Warm Homes

- Circa £1.5 m Loan facility
- 3.5% interest over 15 years
- CPI currently 2.3%
- Government net yield p/a over 15 years
- A nice wee Government earner????
- Addressing Fuel Poverty?????

ERDF Funding



European Regional Development Funding

- WWHC Date of Application: December 2010
- WWHC Date of Offer of Grant: October 2012
- Audit after audit after audit after audit....

ERDF: Bursts yer heid



To obtain ERDF Funding you need

Plenty of Energy and Stamina





Revenue and Savings

- Renewable Heat Incentive subsidy
- Tenants Tariffs: Estimated savings circa 20% on average
- 1600 tonnes of CO2 per annum
- WWHC ESCO: All Energy Prices frozen since inception

WWHC ESCO charges

- Frozen for the past 5 years
- Big 6 utility companies: double figure % rises over that same period
- WWHC average savings to tenants based on comparisons with Economy 7 is 14%
- WWHC system far more controllable and efficient than previous system
- A community controlled ESCO delivers

Things we wish we had known

- Utility companies are not necessarily capable of delivering a contract
- The Scottish Government would make a profit out of fuel poverty
- European funding would be so difficult to obtain and difficult to deal with
- How relatively easy it is to become an ESCO

Before



After



The Future

• Is Warmer With WWHC



Claire Mack

Chief Executive, Scottish Renewables

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Councillor Anna Richardson

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Paul Farrell

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Planning a clean future for heat

Tweet @ScotRenew



James Hemphill Head of Heat Regulation Scottish Government

Local Heat and Energy Efficiency Strategies (LHEES)

James Hemphill The Scottish Government james.hemphill@gov.scot



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Overview

- Energy Efficient Scotland context
- Local Heat and Energy Efficiency Strategies (LHEES)
- Next Steps







23%

REMOVING POOR ENERGY EFFICIENCY AS A DRIVER OF FUEL POVERTY

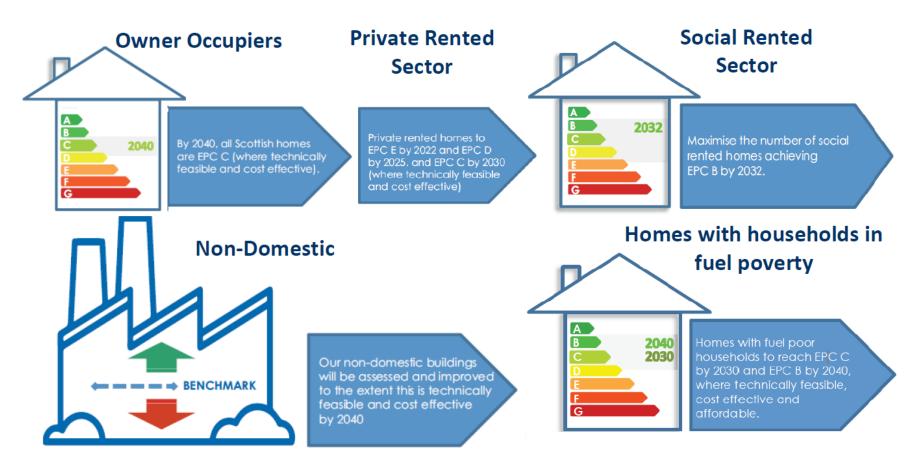
- 20 year programme to make Scotland's existing buildings near zero carbon wherever feasible by 2040
- Dual focus:
 - Energy efficiency in all buildings
 - Low carbon heat where it is appropriate

EMISSION REDUCTIONS IN THE DOMESTIC SECTOR BY 2032 ON 2015 LEVELS



59% EMISSIONS REDUCTION IN THE NON-DOMESTIC SECTOR BY 2032 ON 2015 LEVELS



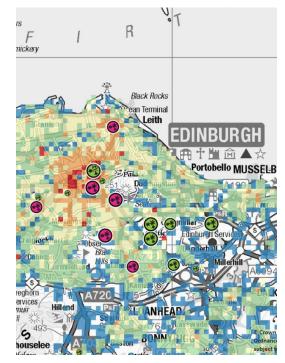


- Proposing local authorities offer a facilitated, integrated service covering:
 - advice, support and assessment for domestic and non-domestic buildings
 - tackling fuel poverty
 - domestic and non-domestic able-to-pay energy efficiency (with loan funding provided by national loan schemes)
 - public sector energy efficiency
- Take a lead role in helping to identify and plan for the delivery of low regrets heat decarbonisation



Local Heat & Energy Efficiency Strategies

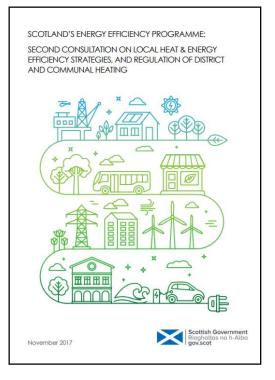
- Proposed that local authorities would have a statutory duty to develop Local Heat & Energy Efficiency Strategies (LHEES), which would:
 - cover a 15-20 year period
 - set out an authority-wide overall energy efficiency and heat decarbonisation strategy
 - designate zones that set out the most appropriate energy efficiency and heat decarbonisation options for the area.
 - These zones would help to phase the operation of area based delivery programmes for energy efficiency
- Prior to commencement of this duty, local authorities would be offered capacity and support to develop LHEES



What are LHEES?

Consultation proposed local authorities (LAs) would have a statutory duty to create region-wide LHEES covering 15-20 year period.

- 1. Assessment of existing local and national strategies / data collation & integration
- 2. Assessment of energy efficiency (EE) and heat supply for current building stock
- 3. Target setting
- 4. Opportunity identification, including **socioeconomic** assessment of potential solutions
- 5. Prioritisation and zoning of areas
- 6. Costing and phasing of delivery programmes

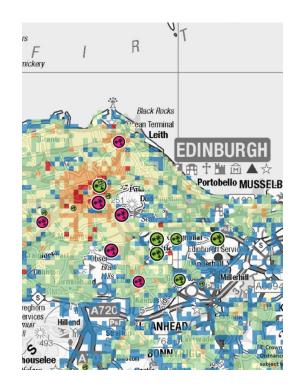


Supporting LHEES

Prior to commencement of this duty, local authorities would be offered capacity and support to develop LHEES:

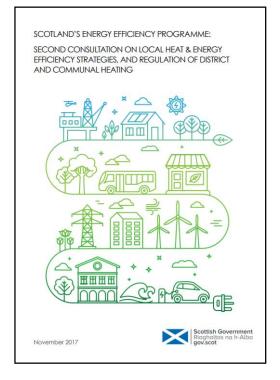
• Pilots

- Consideration of National Delivery Mechanism for Energy Efficient Scotland
- Local Authorities could jointly discharge their duty to produce an LHEES
- LHEES would be developed in consultation with local communities



Pilot Studies & Next Steps

- Pilot studies underway to test approaches & build capacity
- 12 (2017-19) + 11 (Jun 2018-20)
 + 9 more (2019-21)
- Examples
 - LHEES for off-gas grid village in Dumfries and Galloway
 - Socio-economic assessment of decarbonisation scenarios in North Lanarkshire
- Will build the evidence base for legislation.





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Roz Smith Strategic Energy Coordinator Stirling Council



Roz Smith, Strategic Energy Coordinator, Stirling Council

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1. Council Overview

Energy sits across multiple areas within the Council – collaboration key with all stakeholders, including communities and public partners, and knowledge sharing with other Local Authorities. Need for strategic energy masterplanning to identify and optimise opportunities – HERO approach (Heat, Energy & Renewables Opportunities) with community energy at its core



Sustainable Development-Housing-Planning & Building Standards-Assets-Energy-Roads & Transport Planning-Communities-Public Partners-Local Authorities- Sustainable Development-Housing-Planning & Building Standards-

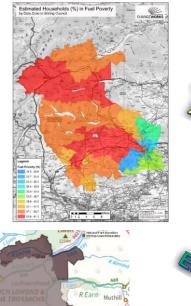


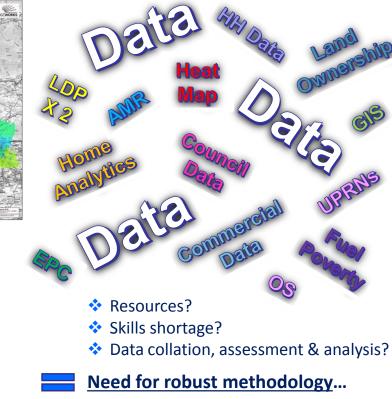
2. Energy Challenges

Some of the challenges we face - by no means specific to Stirling Council:

Challenges:

- Large areas off gas grid lack of fuel choice
- High levels of fuel poverty (38%)
- High levels of pre-1960s Housing stock (90%)
- Grid Constraints
- Geographical Constraints
- Large area within National Park different Planning Authority
- Low Population Density (109/sq. mile)



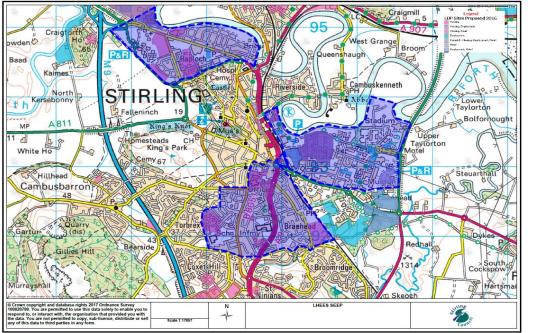


Sustainable Development-Housing-Planning & Building Standards-Assets-Energy-Roads & Transport Planning-Communities-Public Partners-Local Authorities- Sustainable Development-Housing-Planning & Building Standards-



3. LHEES SEEP Pathfinder

LHEES Pilot through Scottish Cities Alliance – 5 of the 7 Cities, all have very different issues and constraints. Stirling LHEES pilot areas urban, mixed use, all on gas grid. Slight change from initial boundaries to fit with data zones:



<u>Raploch</u>: Large areas of social and private housing mixed with commercial

- Major ongoing regeneration and development
- 4 SIMD data zones 2 in most deprived 5%; 1 in most deprived 10%; and 1 in most deprived 15%

- Community Campus; Stirling Fire Station; Primary Schools; Care Homes; Forth Valley College

<u>Braehead</u>: Large areas of social and private housing mixed with commercial

- High levels of social housing and fixed incomes
- High levels of fuel poverty
- PPP school; Care Village; Community Hospital; Police HQ; Primary School

Forthside: Primarily commercial/industrial/business

- Regeneration area new business 'grow on space'
- Stirling Council's first district heating network proposed
- Currently low levels of housing but residential proposed
 - key site requirement to connect?
- PPP school; Leisure Centre; Football Stadium; Homeless Accommodation; new proposed Civic Hub





<u>Raploch</u>: District heating opportunity centred around Raploch Campus. Currently has CHP.

High Heat Demand: Modern new premises - host a diverse range of Council and Community Services including a local Library, Employability and Active Stirling leisure facilities. Also accommodates three primary schools and a nursery; college and community classes; and meeting room facilities. Council Housing stock within the boundary to the north and 50% to the south west

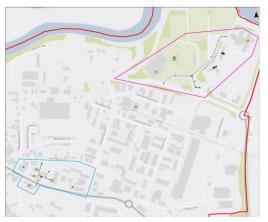
Potential errors in heat demand data pointed out as child buildings had heat data against them as well as parent building – local knowledge of buildings essential to pick up these details
 Network not financially viable at this point, even with RHI

<u>Braehead & Forthside</u>: 2 x district heating opportunities – one of which we're currently installing through LCITP funding.

Network B (bottom LHS) identified network which consisted of a number of current Council buildings and depots. With estate rationalisation unlikely we will still have in 5 years.

- Again, local knowledge of buildings key to picking up these details

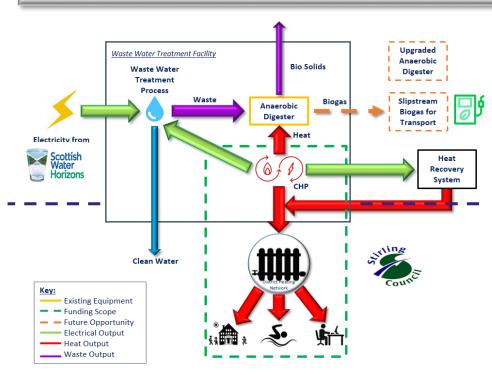
Network not financially viable at this point, even with RHI

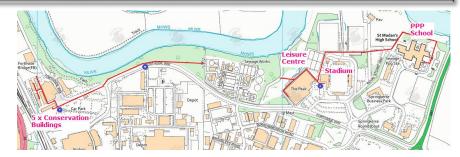




5. Stirling Renewable Heat Project

Collaborative partnership with aligned vision towards decarbonisation of heat and electricity - opportunity identified for LCITP funding: First of a Kind in the UK for technology mix



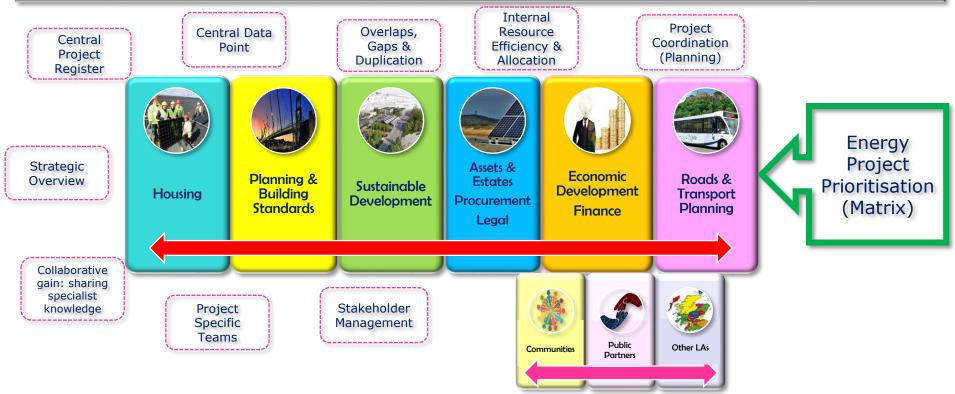


- Initially used Scotland's Heat Map to identify anchor loads
- End users including PPP school; Leisure Centre & Football Stadium; 5 x conservation buildings (4 x non Council)
- Electricity from CHP goes to WWTW; heat goes to network
- 10% savings to end users based on current gas prices
- Potential for expansion to commercial areas
- Key site requirement for MOD site earmarked for closure



6. Achievements & Future Opportunities

Successes already from cross-departmental working - a structured, integrated approach to data collation; knowing what we hold and who holds it – gaps, overlaps and duplication. Key: Not an onerous process – collating data already produced as part of our current functions, not additional data being asked for. Gives ability to cross-reference projects for increased resource efficiency and additional opportunities



Sustainable Development-Housing-Planning & Building Standards-Assets-Energy-Roads & Transport Planning-Communities-Public Partners-Local Authorities- Sustainable Development-Housing-Planning & Building Standards-



Final Thoughts

Pilots were an opportunity to test, from first principles, development of an LHEES looking at various methodologies in recognition this is not a one size fits all solution – collaboration and knowledge sharing will continue to be key



- Data: Councils have access to comprehensive data sets (incl. Scotland's Heat Map; Home Analytics)
- issues with commercial energy data, buildings which could be anchor loads
- key to success for Councils can be how this is presented: training opportunities run centrally? e.g. ArcGIS; Heat Map



Resources: At a time of constrained resources in Local Authorities – centralised/external resources?

- need for local knowledge of area and buildings combined with specialist technical expertise
- working collaboratively key to success: couldn't have done this without external help
- changes in priorities of different political administrations/differences in departmental priorities



- District Heating: Difficult without funding, even with incentives
- off gas grid areas easier to stack up? Small scale?
- energy templates for new developments? Key site requirements?



- Additional: Behaviour change/incentivising will also play a key role
- energy efficiency measures: owner occupiers/private rented; rented commercial spaces
- focusing on local area based solutions key to addressing fuel poverty and meeting targets: solution not one size fits all
 - \rightarrow

Will help prioritise and deliver projects responding to local needs

Sustainable Development-Housing-Planning & Building Standards-Assets-Energy-Roads & Transport Planning-Communities-Public Partners-Local Authorities- Sustainable Development-Housing-Planning & Building Standards-



Fiona Boyd Sustainability Officer The Highland Council



The Highland Council LHEES Pilot

🔆 energyandsustainability

The Highland Council

Fiona Boyd Sustainability Officer

Pilot Background

- Inverness east of the river
- 21,904 domestic properties 88% privately owned
- Includes Longman Industrial Estate, Raigmore Hospital and University of Highlands and Islands campus
- Significant new development for domestic and non-domestic
- Opportunity for homes to have energy efficiency and/or low carbon heat upgrades.
- 6 district heat networks identified
- Piloting the process



Low Carbon Heating Upgrades

Non-Domestic

Only 15% of non-domestic buildings could be analysed due to lack of data.

Technologies considered: water source heat pump, ground source heat pump, air source heat pump and biomass

Domestic

Opportunity for 13,000 homes could have low carbon heat upgrades. Homes in mainly gas areas

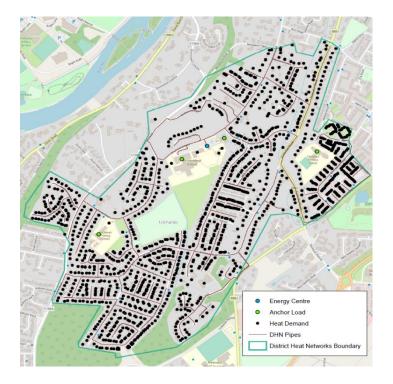
Technologies considered: solar thermal, air source heat pump or high heat retention heaters

Generation

LHEES does not include electrical generation which means no consideration in the pilot for photovoltaic panels.

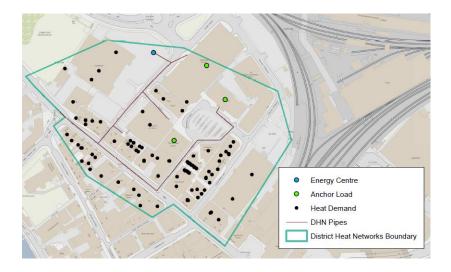
The Highland Council would include this in a full LHEES as generation and storage would be important for rural areas.

District Heat Network A – Drummond School



- 1,612 buildings with network peak of 17,072 kW
- Biomass or air source heat pump
- Mains gas area so lower fuel poverty levels
- Energy centre proposed at Drummond School. This school is for pupils with additional needs.
- Public perception of converting gas area to district heat

District Heat Network C – Inverness Bus Station



- 95 buildings with network peak of 4,541 kW
- Only ground source heat pump and biomass financially feasibly. GSHP not suitable for Inverness and network close to air quality monitoring area
- Academy Street recently under gone major renovation and road works
- Bus Station is major transport hub
- Rose Street Car Park has high electricity demand but no heat demand

District Heat Network D – Harbour Road



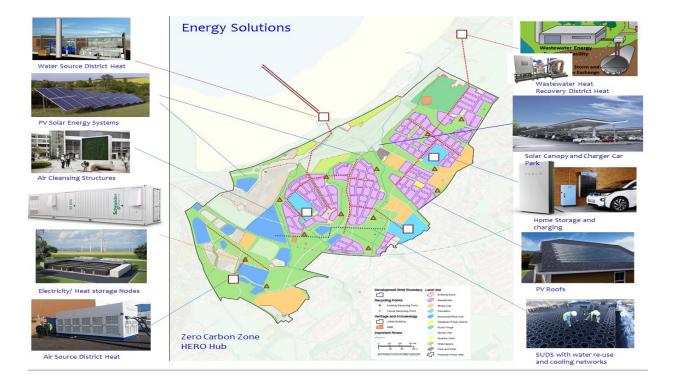
- 78 buildings with network peak of 5,084 kW
- Only ground source heat pump and biomass financially feasibly. GSHP not suitable for Inverness
- Industrial estate with depots
- One of the anchor points used is now demolished
- Lack of data on private nondomestic

District Heat Network E – Smithton Primary School

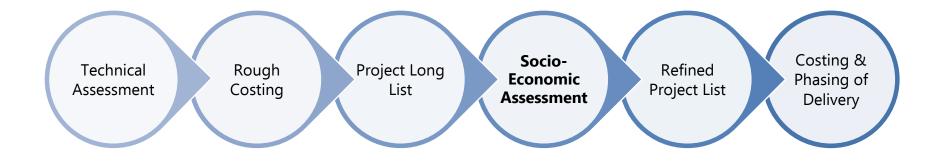


- 347 buildings with network peak 8,380 kW
- No technology financially viable
- Fuel mix: 50% gas, 29% electricity
- Due to fuel poverty levels the area could benefit from district heating

New Development – Inverness East



The Highland Council LHEES Process



Lessons Learned

Pilot was consultant driven – need more local knowledge

Not considering new development areas means missed opportunities

Socio-economic assessment was useful for flagging up issues

Consider more technology types

Public perception of district heating will need to be tackled

Funding and resources required

Lack of data on non-domestic



Thank you

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🔆 energyandsustainability

The Highland Council

Fiona Boyd | Sustainability Officer

Dr Graeme Hawker Research Associate University of Strathclyde





Zoning in LHEES

Graeme Hawker, Research Associate Institute for Energy and Environment, University of Strathclyde



LHEES summary



- 15-20 year period
- Authority-wide strategy for energy efficiency and heat decarbonisation
- Designate zones that set out the most appropriate options to help in phasing delivery programmes
- Socio-economic assessment of solutions
 - Net improvement in social welfare





Spatial variance



Technical

- Network availability/capacity
- Housing density
- Demand level / density
- Housing efficiency
- Technology characteristics
- Supply-side evolution / access

Economic

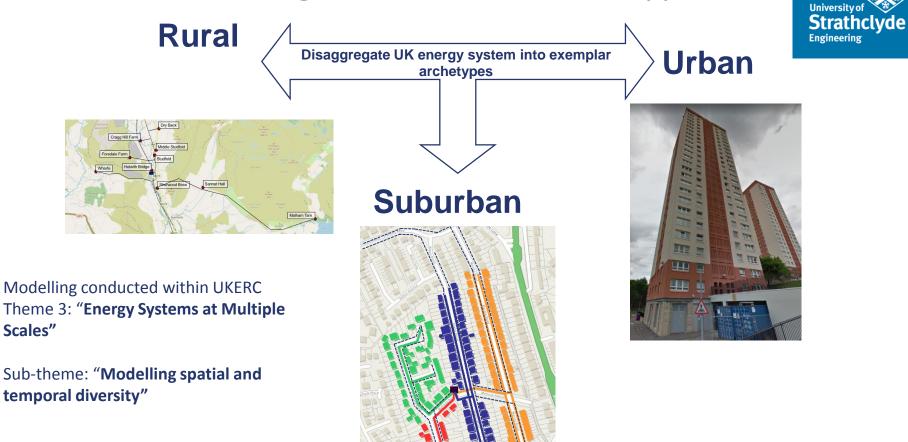
- Technology costs
- Access to capital
- Ownership models
- Commercial actors

- Social/behavioural
 - Demographics
 - Fuel poverty
 - Rebound effects
 - Acceptance

Zonal definition & prioritisation



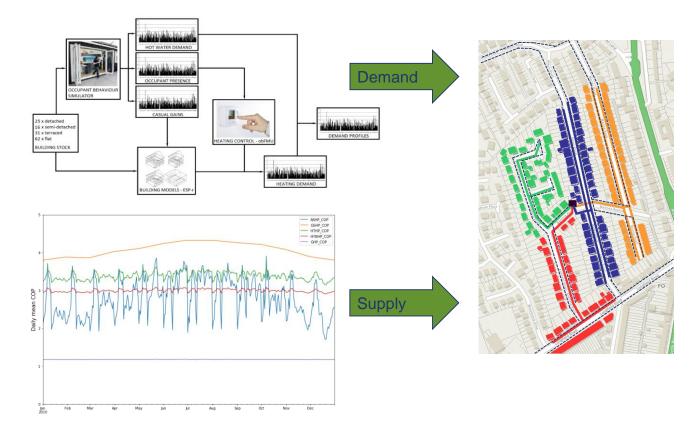
Examining future local archetypes





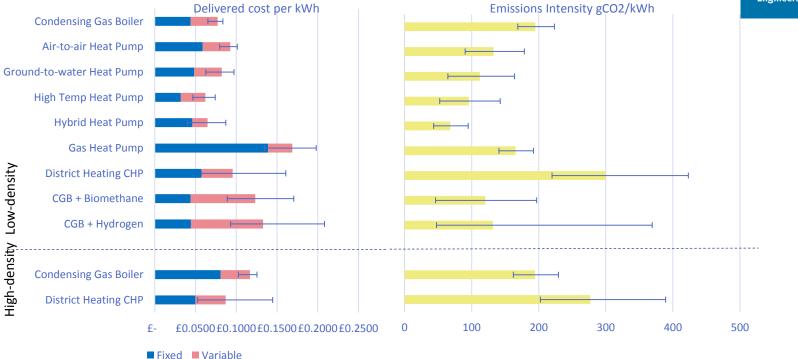
Demand and technology modelling







Evidence for costs and abatement



O. Broad, G. Hawker, P. Dodds, (2019) Decarbonising the UK residential sector: the dependence of national abatement on flexible and local views of the future

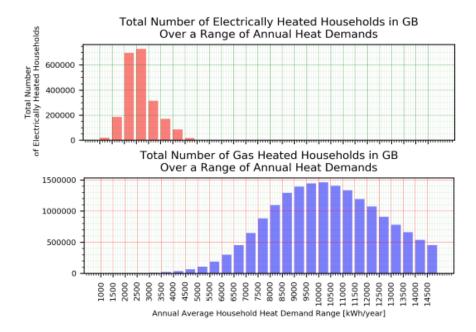


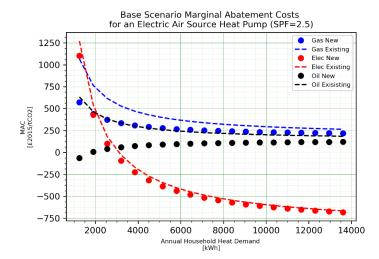
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UK Energy Research Centre

The impact of demand rebound







Sources: [1] England, Northern Ireland, Scotland and Wales 2011 Census: Office for National Statistics ; National Records of Scotland ; Northern Ireland Statistics and Research Agency (2017): 2011 Census aggregate data. UK Data Service (Edition: February 2017). DOI: <u>http://dx.doi.org/10.5257/census/aggregate-2011-2</u>; [2] UK GOV, Sub-national electricity and gas consumption data 2015

University of Strathclyde IPPI blog October 2018 - Reducing emissions from heating our homes – does one size fit all? J. Flower, G. Hawker, K. Bell, (2019) Heterogeneity of UK Residential Heat Demand and its Impact on the Value Case for Heat Pumps



Near-term LHEES goals



- Achievable policies and business models which incrementally decarbonise real-world systems at a local scale
- Within the context of uncertain evolution of regional/national-scale systems
 - 'Bridging' solutions and long-term sustainable options
 - Unclear coordination for non-incremental change
- A clear picture of the likely technical performance and efficiency of lowcarbon options
- Breakdown of discrete responsibilities between homeowners/housing associations, local authorities, network owners/operators and national bodies
- Danger of near-term small-scale efforts undermining the business case for more transformative change?
 - A need to consider the first, middle and last thousand homes

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Head of Heat Regulation, Scottish Government

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Strategic Energy Coordinator, Stirling Council

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Consultancy Director, Locogen





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Hydrogen: the future's hybrid?

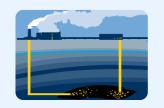


Ian Walker Director Element Energy

















Heat decarbonization pathways: Hydrogen – the future's hybrid?

SR Low Carbon Heat Conference 2019

30th April 2019

Element Energy Ltd

Ian Walker (ian.walker@element-energy.co.uk)

elementenergy

Element Energy, a consultancy focused on the low carbon energy sector

- Element Energy is a specialist energy consultancy, with an excellent ٠ reputation for rigorous and insightful analysis in the area of low carbon energy
- We consult on both technical and strategic issues our technical ٠ and engineering understanding of the real-world challenges support our strategic work and vice versa
- Element Energy covers all major low carbon energy sectors: ٠







Hydrogen



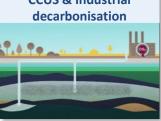


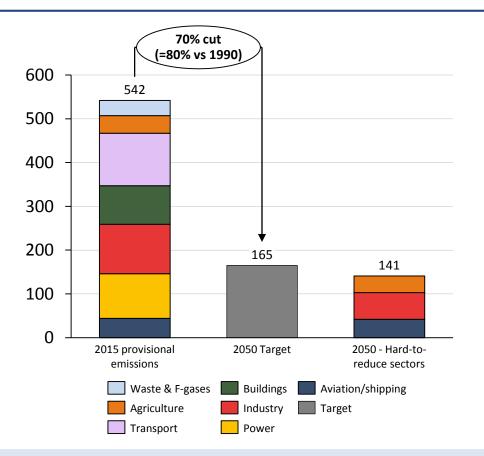
Energy for generations

Built Environment









Possible formulations of the CO₂ target

- Committee on Climate Change's 5th Carbon Budget identifies the 2050 target of an 80% reduction in emissions economy-wide versus 1990 as 165 MtCO₂
- The same analysis suggests that an 80% reduction in emissions from heat may not be sufficient, given the presence of "hard-to-reduce" sectors which could account for 141 MtCO₂ in 2050
- This means that near-complete decarbonisation of heat may be required
- Considering the remaining 24 MtCO₂ as an indicative "budget" for the Buildings, Transport, Power and Waste sectors suggests it may be necessary for remaining emissions from the heat sector to fall **below 10 MtCO₂**

Low regrets actions to address decarbonization of segments of the stock can be identified, but there remains uncertainty around the approach for a large segment of existing buildings

Illustration of low regrets measures and the remaining challenge for existing on-gas buildings High energy efficiency and low carbon heating standards in new build New build **Existing buildings** Main off-gas options: Electrification and Biomass heating **Off-gas grid** Low carbon heat networks in denser areas Energy Multiple pathway options for on-gas segments not efficiency **Biomethane grid Existing buildings** connected to heat networks: retrofits **On-gas grid** injection Flectrification **Hybrid Gas-Electric** Hydrogen

Adapted from Committee on Climate Change, Next steps for UK heat policy (2016)

High electrification:

- Heat electrified using pure electric heat pumps
- District heating (DH) with heat pumps

Hybrid approach:

- Electrification using hybrid heat pumps
- Boilers fueled by methane (including biomethane) or H₂ to meet peak heat demands

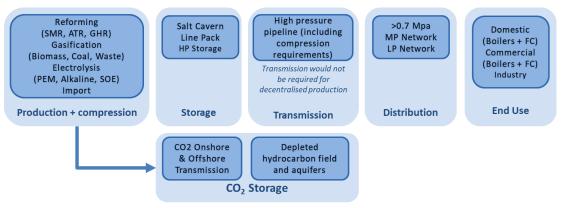
Decarbonised gas:

- Supply H₂ via a repurposed gas network
- DH using H₂ or biofuel CHP

- In each pathway, cost-effective energy efficiency is a low regrets action
- These pathways have been compared on whole system cost and carbon grounds
- Important questions around consumer acceptance & technical feasibility
- Potential for regional differences in preferred approach

There are a number of low carbon gases that could play a role in a Decarbonised Gas pathway (and potentially also in other pathway options)





• Two principal production routes for Hydrogen:

- Blue hydrogen H₂ produced by reforming natural gas with carbon capture and storage
- Green hydrogen Water electrolysis using renewable electricity
- Most studies to-date assume hydrogen for heat will rely on blue hydrogen to meet the bulk of heat demand cost-effectively
- Requirement for gas distribution network repurposing and potential build of new H₂ transmission system

Biofuels and synthetic hydrocarbons

Biomethane:

- Produced by Anaerobic Digestion
- Feedstocks include biodegradable waste, sewage sludge, manure / litter, some biomass
- Upgrade of biogas to methane for grid injection

Bio-SNG:

- Themochemical treatment of wastes and biomass feedstocks
- Larger resource potential than biomethane by AD
- May require CCS to achieve very low emissions

Power-to-methane (E-gas):

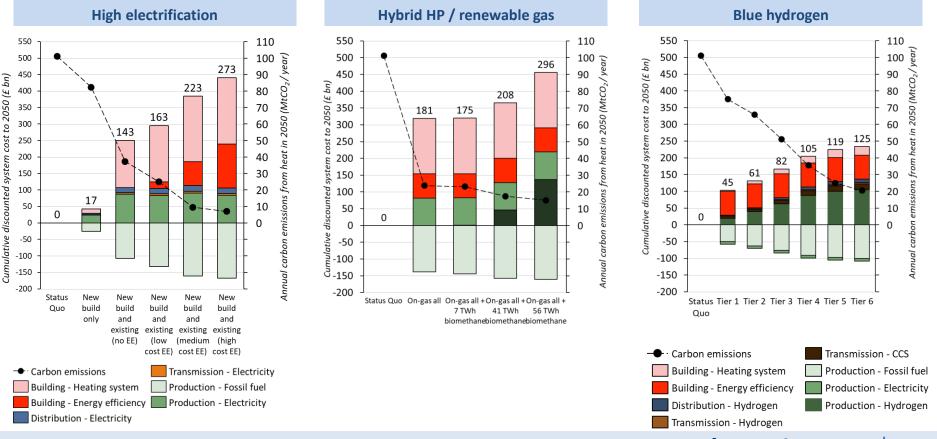
- Combination of renewable H₂ (electrolytic) with CO₂ to produce synthetic methane
- Not yet proven commercially at scale

elementenergy 107

The heat decarbonization pathway choices each have implications for the power sector and network infrastructure, which are important considerations in the whole system costs

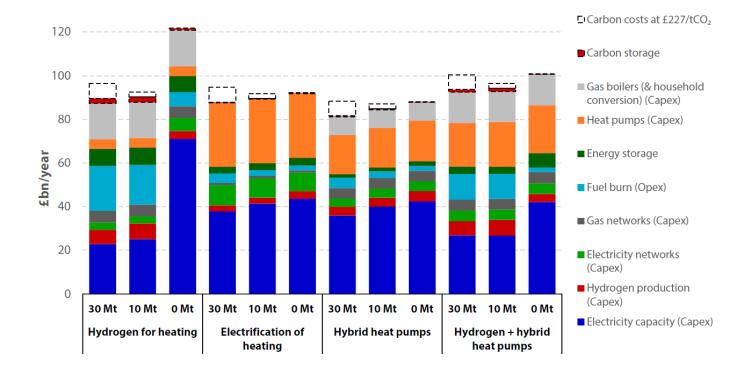
Pathway	Power generation	Electricity transmission & distribution
High electrification	 Large additional generation capacity required to meet peak heat demands Battery storage or flexible power plants (e.g. biomass, gas & CCS) needed for low wind periods 	 Investment needed to reinforce both low voltage distribution networks and transmission lines to meet increased demands Potential for demand side response and storage to mitigate to some extent
Decarbonised gas	 Assuming 'blue' hydrogen – lower requirement for additional capacity for heat Significant green H₂ production – increased requirement for renewables capacity Potential for H₂ / biomethane plant to provide flexible generation capacity 	 Reduced requirement for investment in transmission and distribution infrastructure compared to high electrification scenario
Hybrid gas-electric	 Substantial electrification of heat increases requirement for renewable electricity generation Lower peak capacity than high electrification case Potential for H₂ / biomethane to provide flexible capacity 	 Use of gas to meet peak heat demands reduces additional peak loads on networks, hence lower reinforcement requirement than in High electrification pathway.

Analysis of the additional cost of heat decarbonization by different pathways, taken from Element Energy analysis for the National Infrastructure Commission



The CCC also undertook an analysis of the cost of heat decarbonization options, provided by Imperial College, which informs their recommendations of a hybrid gas-electric approach

• The figure below is taken from 'Hydrogen in a low carbon economy', Committee on Climate Change (November 2018)



The choice of heat decarbonization pathway, in particular the role of the gas network, will have implications for decarbonization in other sectors

Pathway	Industry – process heat and feedstocks	Road transport
High electrification	 Electrification of lower temperature process heat Onsite H₂ production by SMR & CCS or electrolysis for high temp heat & feedstocks Substantial increase in industrial electricity load 	 Passenger cars and light commercial vehicles battery electric Freight and buses – mix of battery electric vehicles and biofuels
Decarbonised gas	 Electrification of lower temperature process heat H₂ supplied by network infrastructure for high temp processes and feedstocks 	 Passenger cars and light commercial vehicles – Battery electric vehicles with potential for H₂ fuel cell vehicles Freight and buses – increasing potential for H2FCEV in the transport mix
Hybrid gas-electric	 Electrification of lower temperature process heat H₂ supplied by network infrastructure for high temp processes and feedstocks 	Similar to the Decarbonised gas case

Low regrets actions

- Cost-effective energy efficiency is a low regrets action across all pathways higher levels of energy efficiency improvement may be required in higher electrification scenarios
- District heating is a low regrets solution across all pathways, particularly where waste heat or environmental heat sources are available
- Carbon capture and storage is key to a hydrogen pathway, but is likely to have a role in all pathways, hence developing and demonstrating the viability of CCS should be a strategic priority
- Biomethane produced from low cost feedstocks (biodegradable waste, food waste, sewage sludge) is a near term means of decarbonizing gas supplies and can play a long-term role in all pathways

Remaining uncertainties

- Various analyses have shown similar pathway costs to achieve comparable levels of residual emissions from heating (<10MtCO₂) – within the range of uncertainty of the analyses
- There is uncertainty around the technical feasibility and practicality of widespread hydrogen use for heating in buildings and uncertainty concerning the building level costs across the pathways
- The degree to which heat can be electrified in a hybrid heat pump pathway is uncertain and has important implications for decarbonisation of the residual gas use.
- The degree to which demand flexibility can mitigate electricity system costs in high electrification scenarios

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Dave Pearson Director, Star Renewable Energy

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Sticks, carrots and chasing clean growth



Gareth Fenney Head of Heat & Energy Efficiency Scottish Government

Sticks, Carrots and Chasing Clean Growth

Decarbonising Scotland's Heat Supply Gareth Fenney 30 April 2019

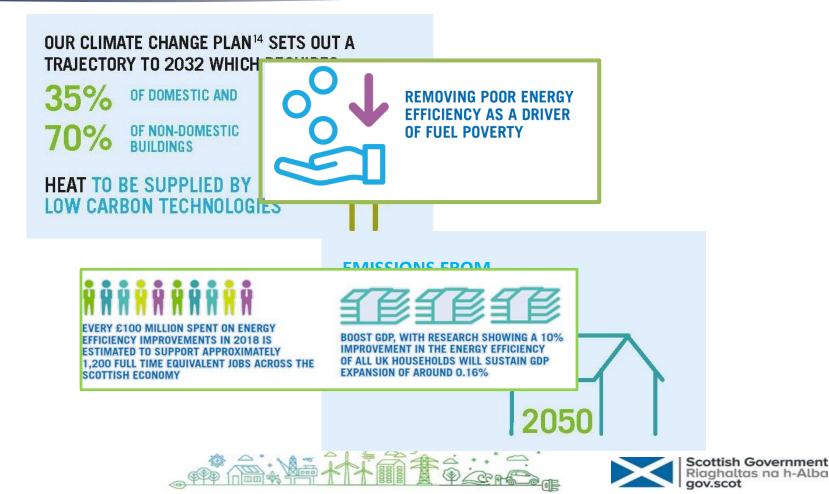




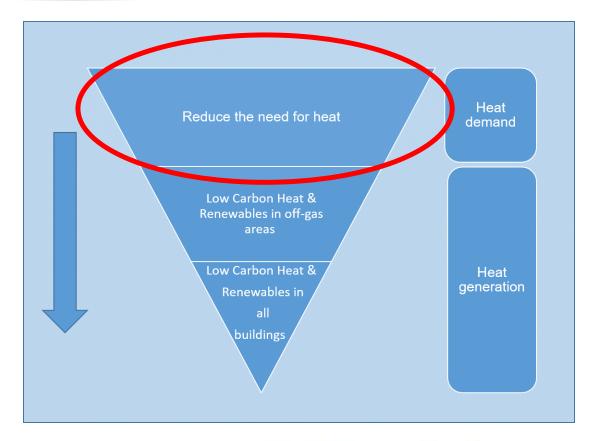


Headline Targets

	Fuel Poverty (Target, Definition and Strategy) (Scotland) Bill [AS INTRODUCED]	
Climate Change (Scotland) Act 2009 (asp 12)	CONTENTS Section Fuel poverty target 1 The 2040 target 2 Meaning of fuel poverty Fuel poverty strategy	
Climate Change (Scotland) Act 2009 2009 asp 12 CONTENTS Section	Climate Change (Emissions Reduction Targets) (Scotland) Bill [AS INTRODUCED]	
PART 1 EMISSIONS REDUCTION TARGETS The 2050 target 1 The 2050 target	CONTENTS	
2 The interim target 2 The interim target 3 Annual targets	PART 1 EMISSIONS REDUCTION TARGETS The net-zero emissions target 1 The net-zero emissions target	
	The 2050 target The interim targets Modification of the 2050 and interim targets	
	Scottish Governm Riaghaltas na h- gov.scot	nent Albo

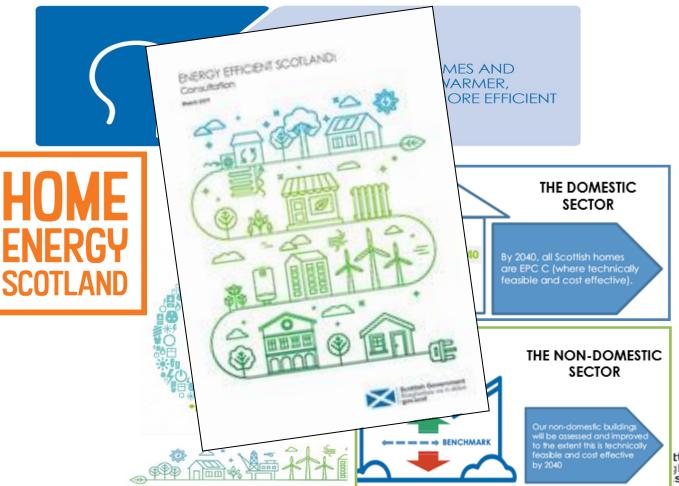


Our Approach



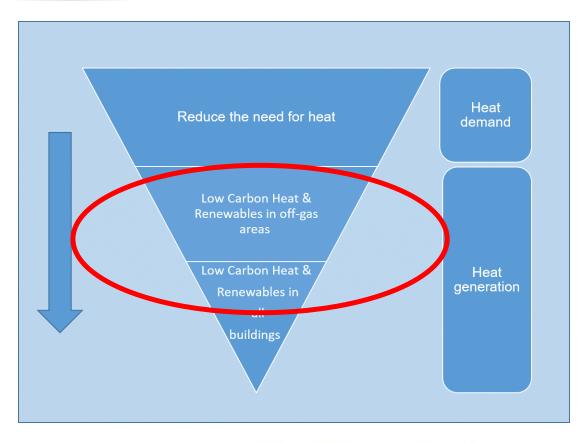






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Our Approach







Support for Low Carbon Heat

- Home Energy Scotland Loan Scheme interest free loans up to the value of £38,500 for both energy efficiency measures and renewable technologies
- **SME Loan Scheme** low or no cost loans to business up to £100,000 for the installation of energy efficiency measures and renewable technologies.
- Low Carbon Infrastructure Transition Programme since March 2015 over £40 million of funding offered to 14 low carbon demonstrator projects supporting low carbon energy generation and the co-development of over 30 proof of concept and development proposals.
- **District Heating Loan Fund** since 2011 offered just over £15 million in loans to 46 projects across Scotland
- **Renewable Heat Incentive** Scotland receives an above pro-rata share of the RHI subsidy, with 20% of all accreditations to the scheme located in Scotland





Technological

- Suitability of buildings to maximise efficiency
- Constraints on electricity grids
- Hydrogen not yet proved at scale.

Price

- Higher upfront costs compared to incum
- Can generally have higher running costs particularly natural gas

Engagement

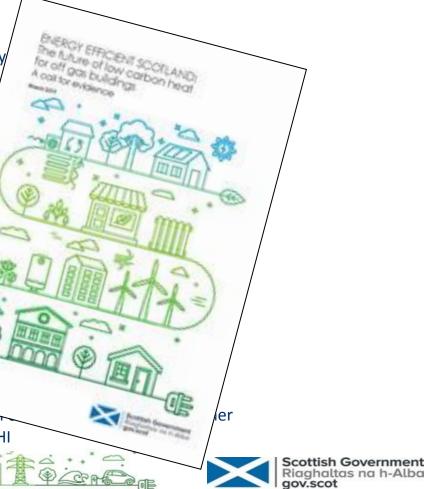
- Can require extensive changes to inte
- Lack of awareness of alternative opti
- Myths, bad experiences, etc. of low/

Replacement cycle

• Heating systems often replaced in

UK reserved powers

• Timescales on UK wide decisions, regulation Protection, Price signals and future of the RHI



A Planned Approach

Local authorities to develop Local Heat & Energy Efficiency Strategies (LHEES).

- set out an authority-wide overall energy efficiency and heat decarbonisation strategy;
- cover a 15-20 year period;
- designate zones that set out the most appropriate energy efficiency and heat decarbonisation options for the area.

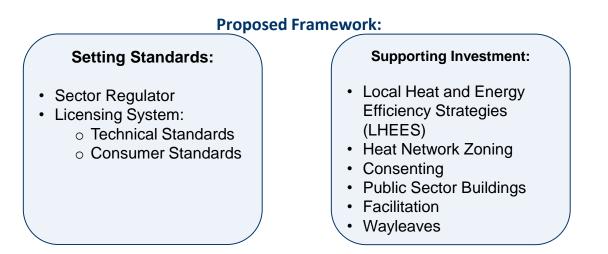






Purpose:

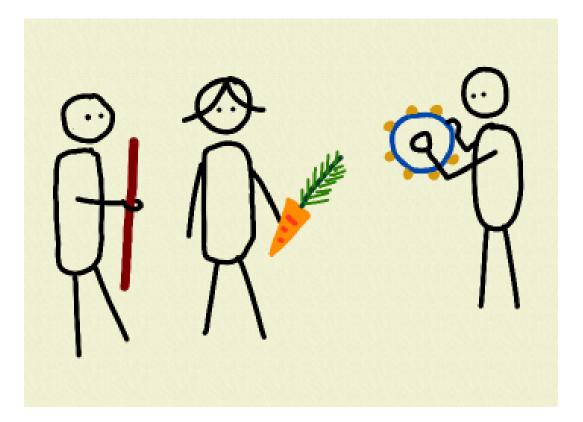
To support heat network development by providing certainty to investors and stakeholders helping to make Scotland a more attractive place to invest in district heating, supporting efforts to eradicate fuel poverty and reduce greenhouse gas emissions.



Development:

- Consultation (March June)
- Working Group (Summer 2019)









Please remember current consultations:

https://consult.gov.scot/better-homesdivision/energy-efficient/

https://consult.gov.scot/better-homesdivision/the-future-of-low-carbon-heat/

Closing date for responses 17 June 2019

Consultation events dates:

Inverness 8 May Stirling 9 May

Dates of any additional events to be confirmed soon.

Please contact LowCarbonFuture@gov.scot if you are interested in being informed of future events







Barbara Garnier Head of Heat in Buildings Department for Business, Energy & Industrial Strategy

The Future Homes Standards

Scottish Renewables low carbon heat conference, 2019

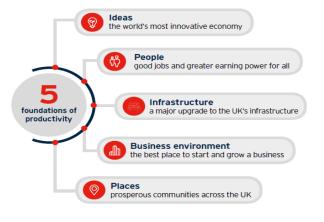
Barbara Garnier, Heat in Buildings BEIS

> Department for Business, Energy & Industrial Strategy

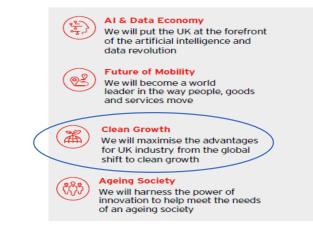
30 April 2019

Industrial Strategy & Clean Growth Grand Challenge

The Industrial Strategy (IS) set out five foundations for creating an economy that boosts productivity and earning power throughout the UK:



IS set Grand Challenges to put the future of the UK at the forefront of the industries of the future, one of which focused on clean growth

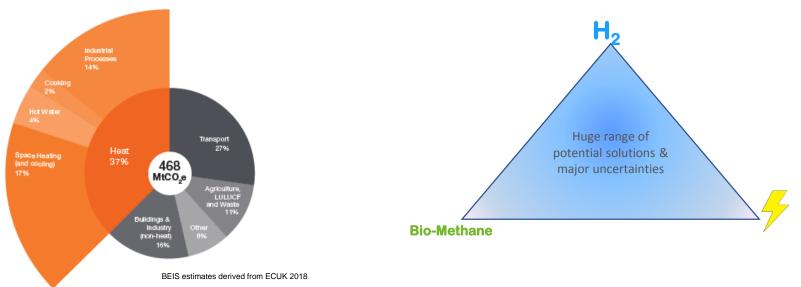


The aim of the Clean Growth Grand Challenge is to maximise the advantages for UK industry of the global shift to clean growth, through leading the world in the development, manufacture and use of low carbon technologies, systems and services that cost less than high carbon alternatives.



The long term challenge: decarbonisation of heat

Estimated UK Emissions Attributable to Heating, 2016





Clean Growth Strategy: key new-build commitments

Phase out high carbon fossil fuel installation

Clean heating / Futureproofing

Addressing the performance gap

Innovation

Consult on energy performance standards (Part L)

Retrofit commitments

Department for Business, Energy & Industrial Strategy

The Future Homes Standards and Buildings Mission

Chancellor's announcement

"A Future Homes Standard, to be introduced by 2025, future-proofing new build homes with low carbon heating and world-leading levels of energy efficiency."

- Builds on the Clean Growth mission to "at least halve the energy use of new buildings by 2030"
- Reflects feedback:
 - Industry is ready to take action
 - but needs a level playing field and long term certainty
 - Specific standards and dates
 - Staged approach
- Delivered through Building Regulations
- Continued engagement with industry



Implementing the Future Homes Standard



Challenges:

- Phasing in the standard
- standardisation of heat pump installation
- Performance gap



Other policy developments

- Buildings mission:
 - A competition to design "The Home of the Future"
 - Building for 2050 research project
 - Transforming construction ISCF
- Consultations following the 'Future Framework for Heat in Buildings' call for evidence
- Installers engagement exercise



Bruno Berardelli Managing Director HW Energy

Low Carbon Heat Conference 30.04.19





HWEnergy



- Formed in 2003 and working exclusively in the design, installation and operation of biomass heating systems.
- Operating approximately 900 biomass systems across UK.
- Circa 25,000 tonnes of wood fuel supplied per annum for heat and fuel contracts in Scotland.
- Part of the AMP Clean Energy group.





Carbon Trust 2010 Report





Preface

In 2005, the Carbon Trust's Biomass Sector Review¹ highlighted the significant potential of biomass heating in the UK. It showed that carbon savings of up to 20 million tonnes of CO_2 per year could be achieved using UK biomass resources alone. It also identified that using biomass for heating typically gives the most cost-effective carbon savings of all uses of biomass and that this is particularly the case for small-to-medium scale applications (100 kW_{th}-3MW_{th}).

In June 2008, the Government's Renewable Energy Strategy consultation proposed that under one possible scenario 14% of the UK's heating may need to come from renewable sources by 2020 for the UK to meet its share of the EU 2020 target for total renewable energy. Given that less than 1% of UK heat demand is currently met by renewable sources, this implies a dramatic and rapid transformation in the way heat is provided over the next decade. To help deliver this step change in renewable heat the Government took powers in the 2008 Energy Act to establish a 'Renewable Heat Incentive' (RHI) to give financial support to those generating renewable heat. An overview of the RHI appears on page 66.



• Bioenergy now provides around 4% of UK heat, up from 1.4% in 2008 .

• Between the RHI's inception and the end of 2018, bioenergy provided more than 96% of the total heat supplied under the Non Domestic RHI.

• As at year end 2018, nearly 87% of accredited Non-Domestic RHI installations were solid biomass boilers and solid biomass CHP. Biomass heat has been a key technology in driving low-carbon and renewable heating forward under this mechanism .

• Bioenergy has stimulated UK supply chains, with domestic supply providing over 3 Mt of wood fuel consumed in heating boilers .

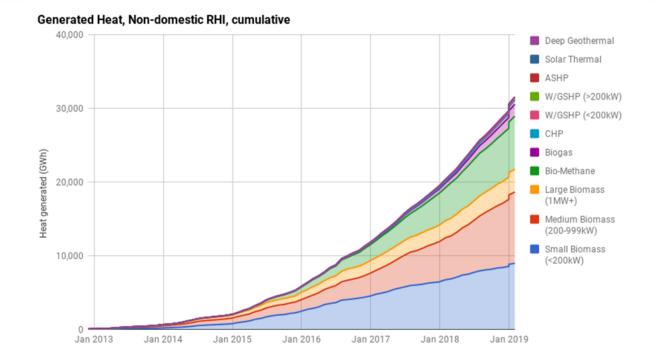
• In 2017, biomass heat produced total emission savings of 6.8 MtCO2e .

• As at 2017, employment from the biomass heat sector alone provided over 6,000 UK jobs and contributes £889 m to the UK economy.

• Biomass use for heating has grown rapidly in the agricultural sector in the last ten years and biomass now makes up 35% of energy use (up from 15%). During this period, biomass heat has therefore stimulated growth in the rural economy as well as the renewable heating sector. In industry more generally, bioenergy use now provides around 5% of heat needs up from just over 1% in 2008), with use concentrated in the paper, printing and minerals sectors .



Biomass contribution to renewable heat





The Biomass heat specialists

Why Biomass in Scotland?

- Cold
- Timber Supply
- Much off gas grid usage
- Circa 3500 commercial biomass systems in use







The Biomass heat specialists

Post RHI / 2021

- Biomass will have to play a part of the low carbon heat mix.
- Opportunities in heating large buildings and district heating, on and off the gas network.
- Continued opportunities in domestic market





Post RHI / 2021

- Review regulation around planning/BREEAM for new build opportunity.
- Government and local authority taking the lead with their own commercial building stock.
- Soft loans, enhanced capital allowances and other incentives for private sector.
- Fuel duties on carbon emitting heat usage. Review climate change level to incentivise switching away from carbon intensive heating and creating a fund for supporting low carbon heating sources.



Carbon Trust 2020 Report

Heat in all its forms presently accounts for nearly half of the UK's carbon emissions². The UK has a legal requirement to reduce carbon emissions by at least 26% by 2020 and 80% by 2050 (against a 1990 baseline) under the Climate Change Act³. Meeting these targets will require a major shift away from fossil fuel heating systems to lower carbon forms of heating.

Of all possible renewable heating solutions, biomass has the potential to deliver some of the most significant and cost-effective carbon savings, particularly for commercial and industrial applications. In addition to carbon savings, biomass heating also offers significant benefits for users, including operational fuel cost savings and reduced fuel price volatility. It can also stimulate local economic activity by creating fuel supply chains and make use of resources that would otherwise be treated as waste and sent to landfill.



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Gareth Fenney

Head of Heat & Energy Efficiency, Scottish Government

Bruno Berardelli

Managing Director, HW Energy

Jody Pittaway

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Marc Overson

Senior Product & Marketing Manager, Mitsubishi Electric

Paul Steen Head of Department, Ramboll

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