



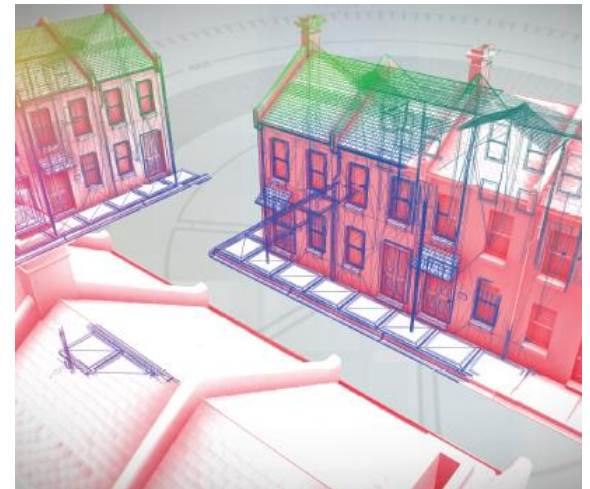
[www.eti.co.uk](http://www.eti.co.uk)

# Decarbonising Heat for UK Homes

Energy Institute

19 May 2015

Jeff Douglas



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# What is the ETI?

- The ETI is a public-private partnership between global energy and engineering companies and the UK Government.
- Targeted development, demonstration and de-risking of new technologies for affordable and secure energy
- Shared risk

## ETI members



**CATERPILLAR®**



**EPSRC**  
Pioneering research  
and skills



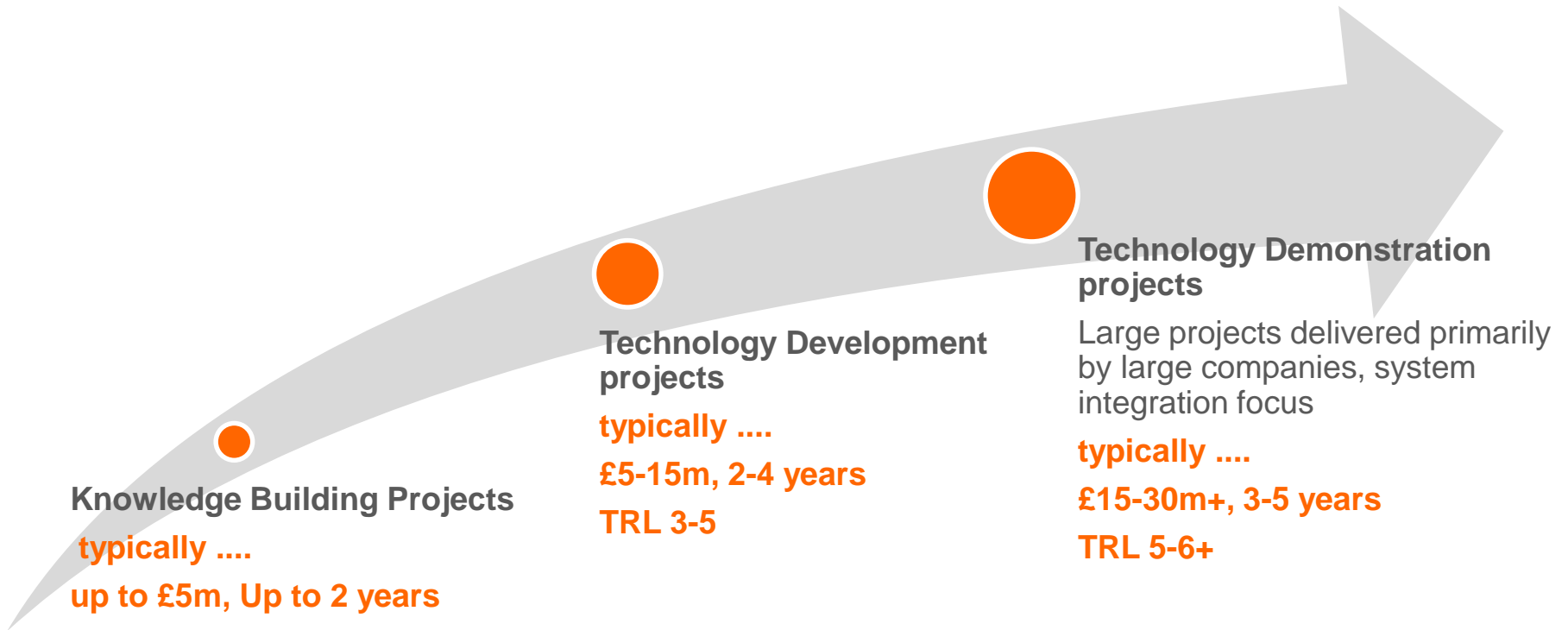
**Innovate UK**  
Technology Strategy Board

## ETI programme associate

**HITACHI**  
Inspire the Next

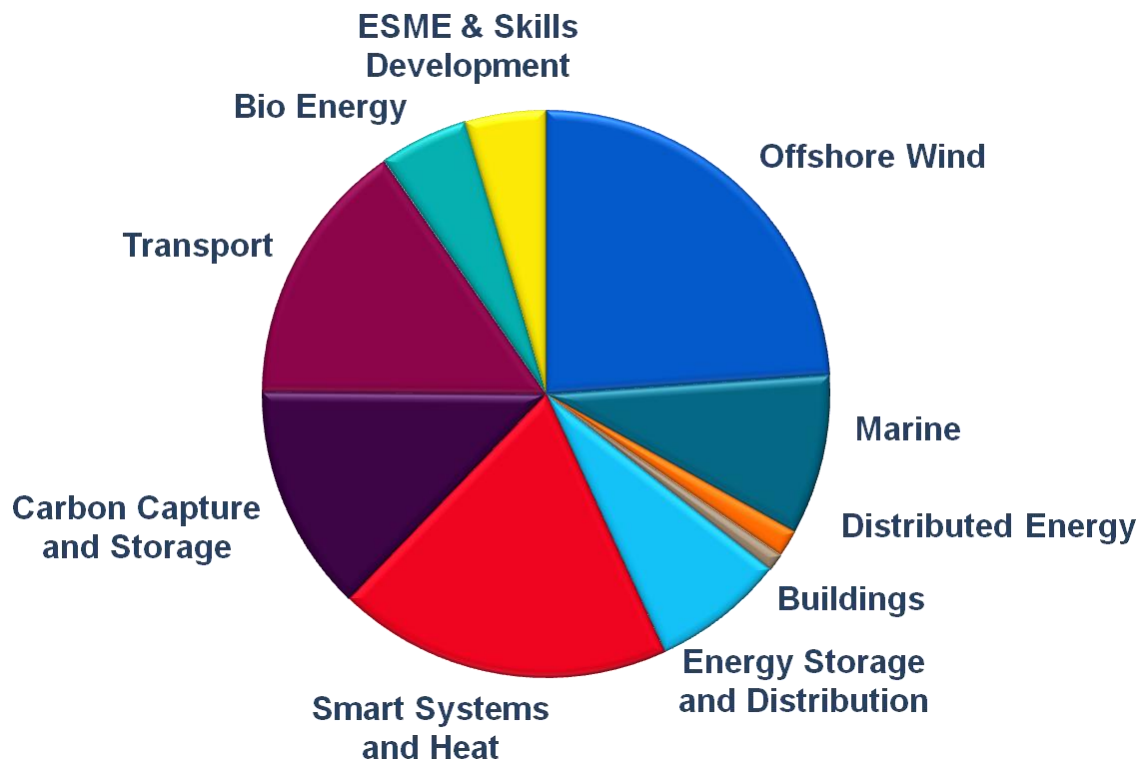


## ETI Invests in projects at 3 levels





## ETI Invests in projects at 3 levels



### 9 Technology Programme areas

Delivering...  
New knowledge  
Technology development  
Technology demonstration  
Reduced risk



10 YEARS  
TO PREPARE  
for a low  
carbon transition

Systems  
Approach

£100<sub>bn</sub>  


Eliminating emissions from buildings is more cost effective than deeper cuts in other sectors

Consumer  
Requirements



Few consumers are engaged to change their heating systems to combat emissions

Transition  
Pathways



There are two principal pathways for decarbonising domestic space and water heating

Business  
Models

20,000  
homes per week

the equivalent of  
10 Milton Keynes  
each year

Between 2025 and 2050 – 26 million homes will require new low carbon installations

Leadership

Next decade is critical

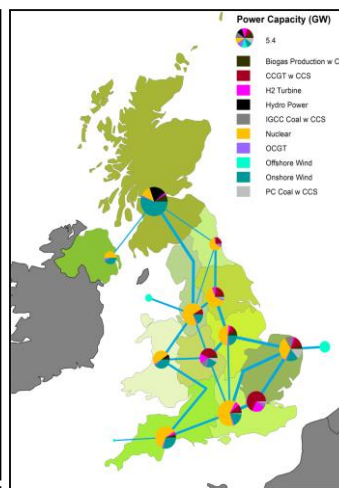
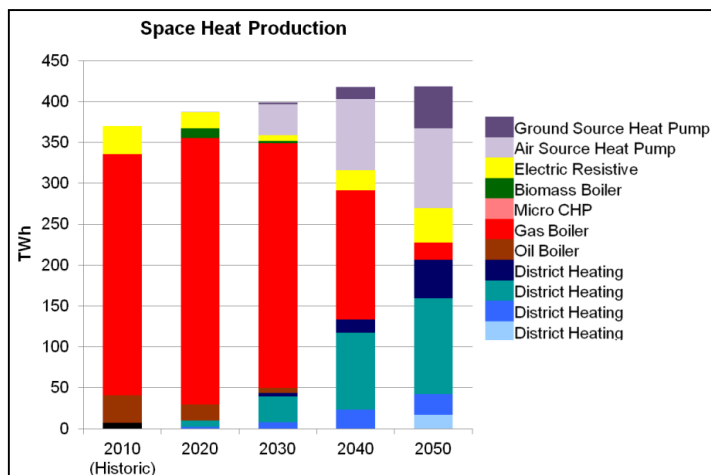
10<sub>Years</sub>



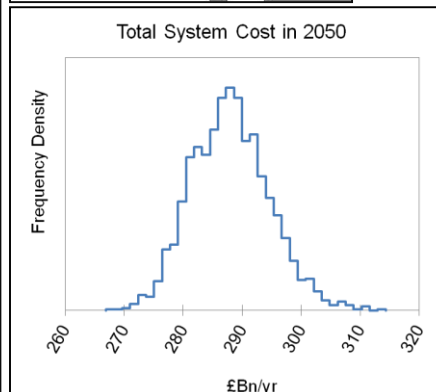
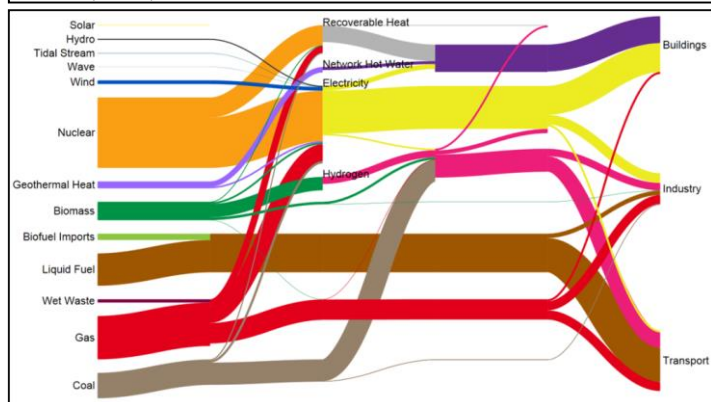
Preparing for transition – rapid implementation required from 2025



# Energy System Overview - Energy System Modelling

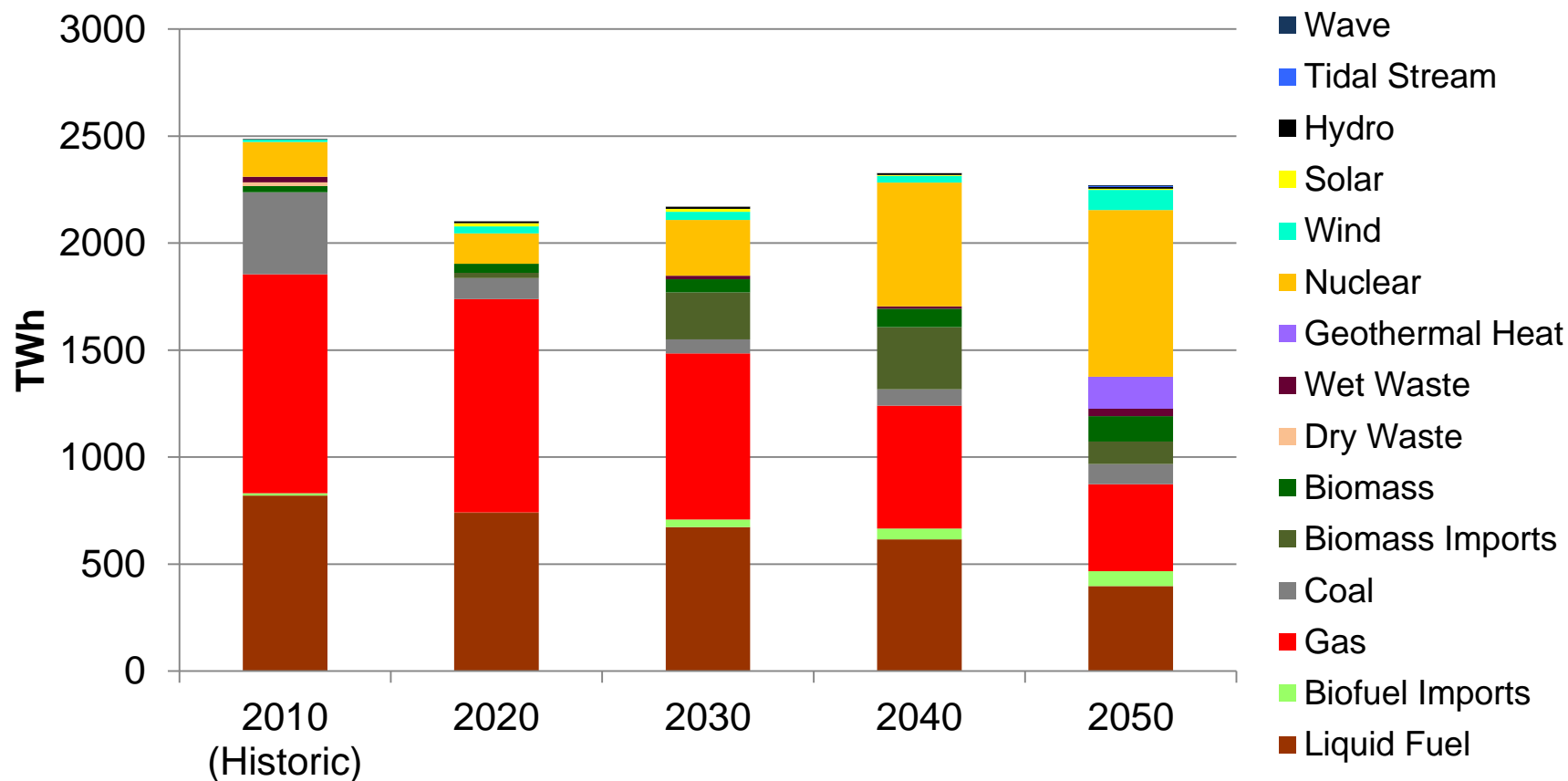


- Least cost optimisation (policy neutral)
- 2050 pathway and back-casting
- Probabilistic treatment of uncertainty
- Spatial & temporal factors





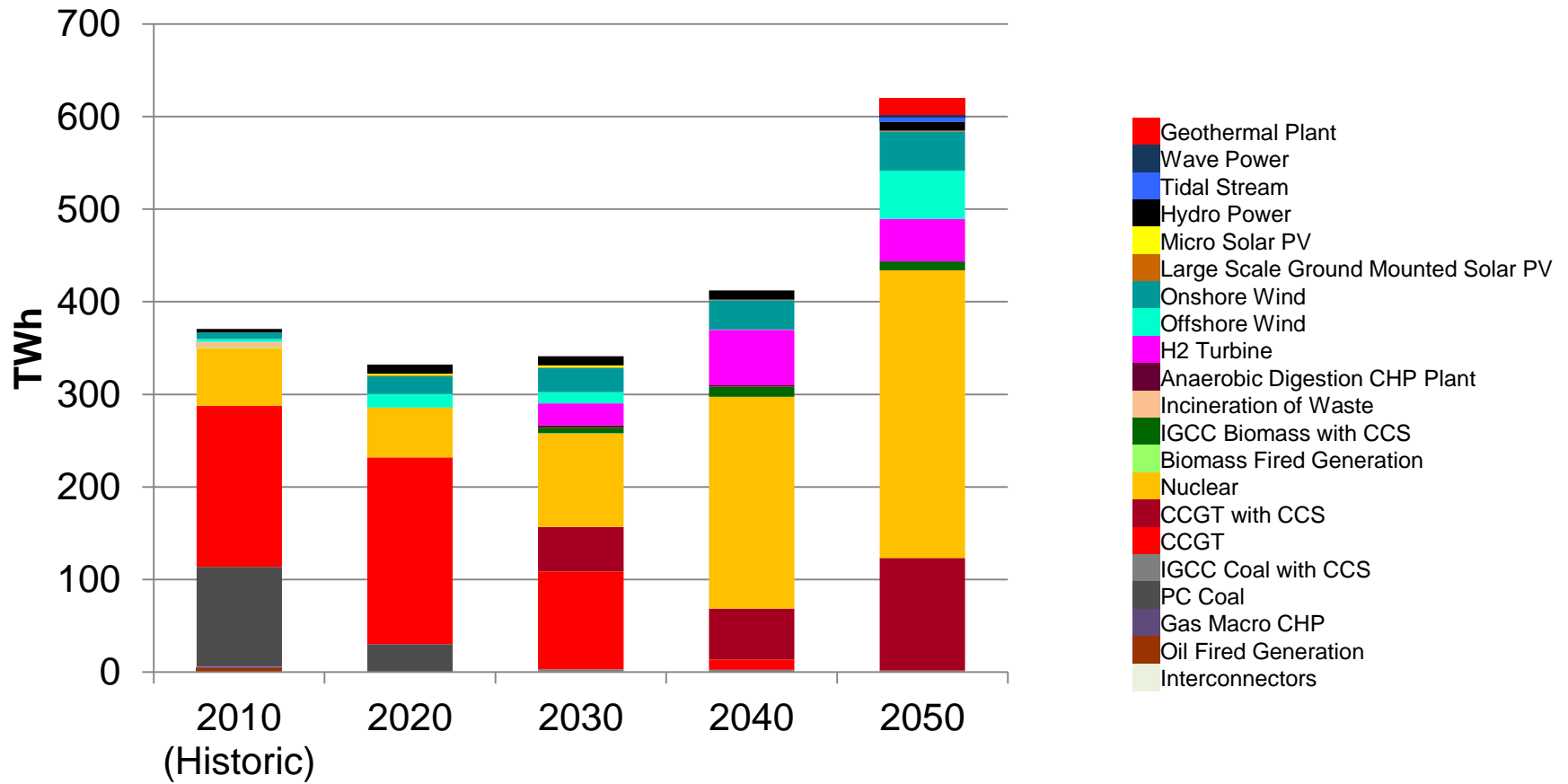
## Primary Resource Consumption



DB v3.4 / Optimiser v3.4



# Electricity Generation

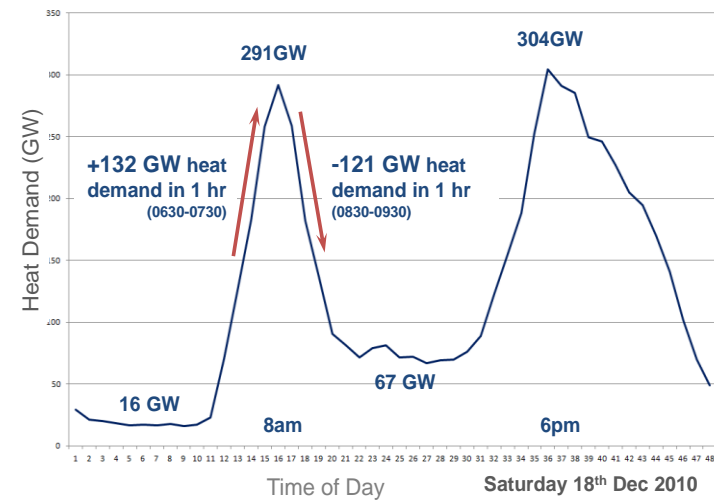
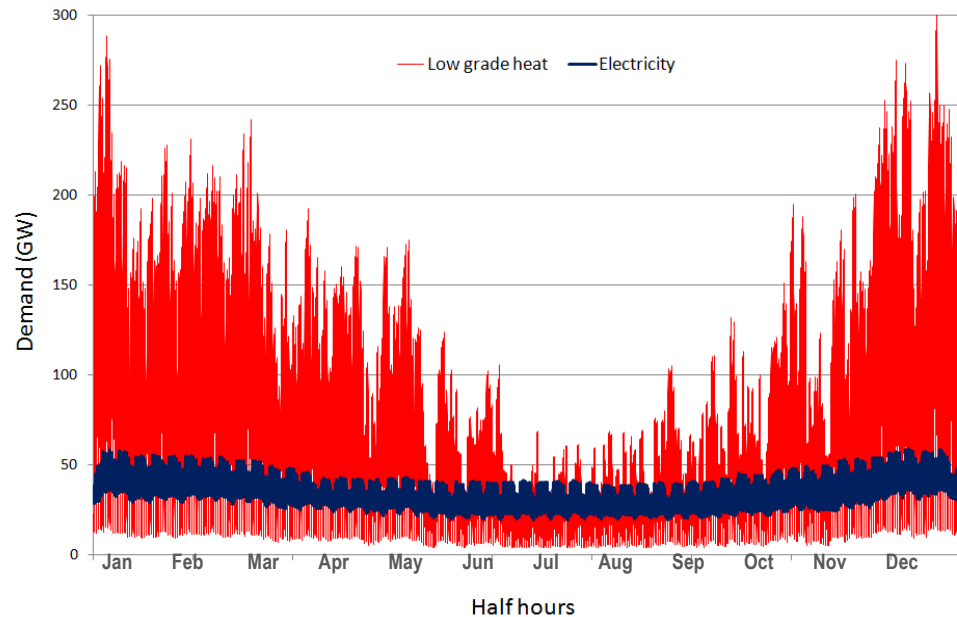


DB v3.4 / Optimiser v3.4





# The Heat Challenge



132GW/hr = 36MW/s  
Dinorwig = 108MW/s  
and 1.32GW total

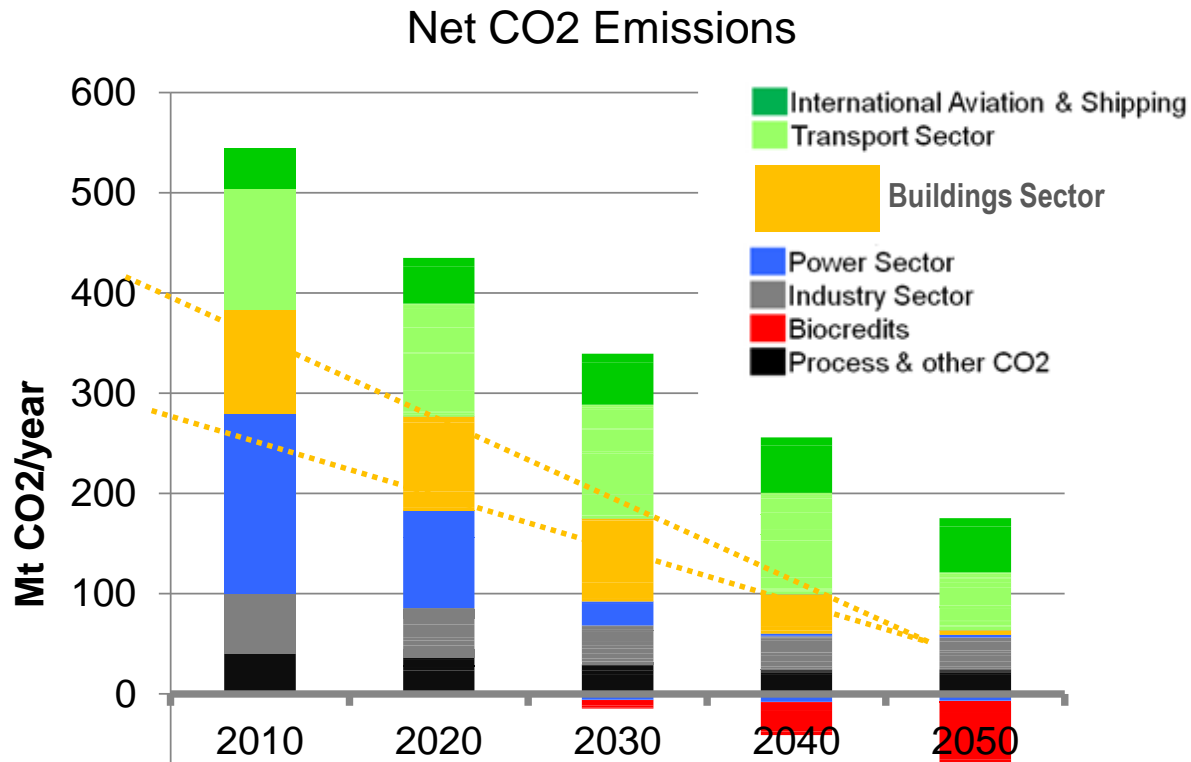
Source: Robert Sansom, Imperial College (2011)

*'Heating within the domestic sector currently accounts for 23% of UK energy demand'*



# Meeting National Emissions Targets

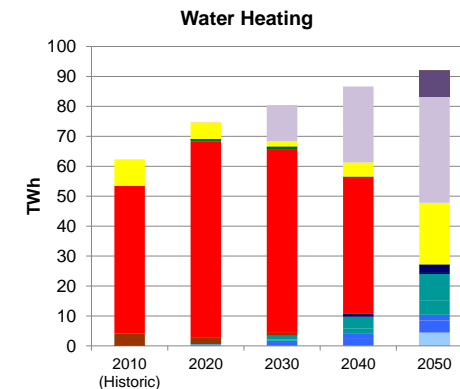
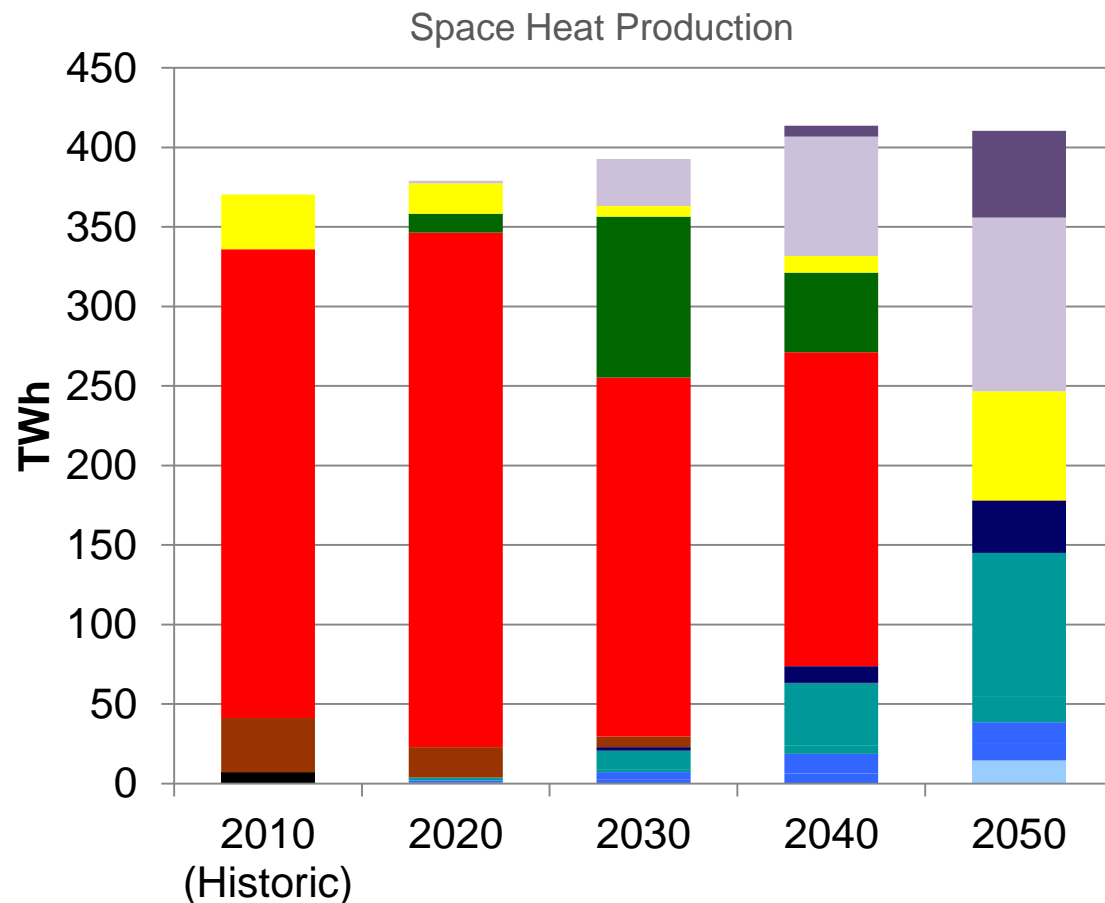
'Systems' view shows the need to decarbonise buildings



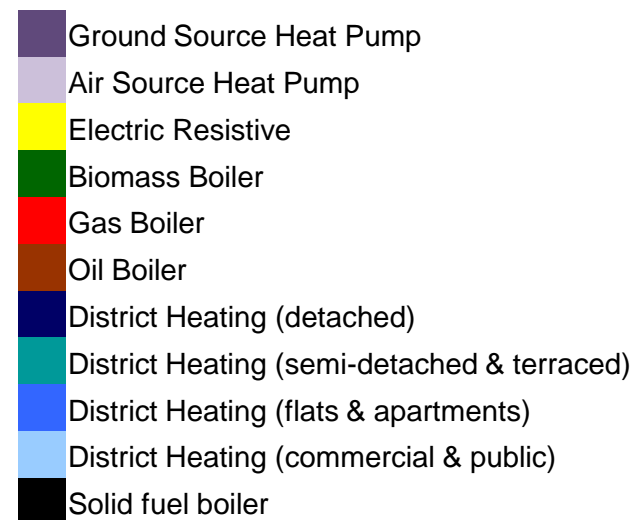
*Challenge is establishing new heating solutions that substantially remove natural gas from homes*



# Space and Water Heating



DB v3.4 / Optimiser v3.4

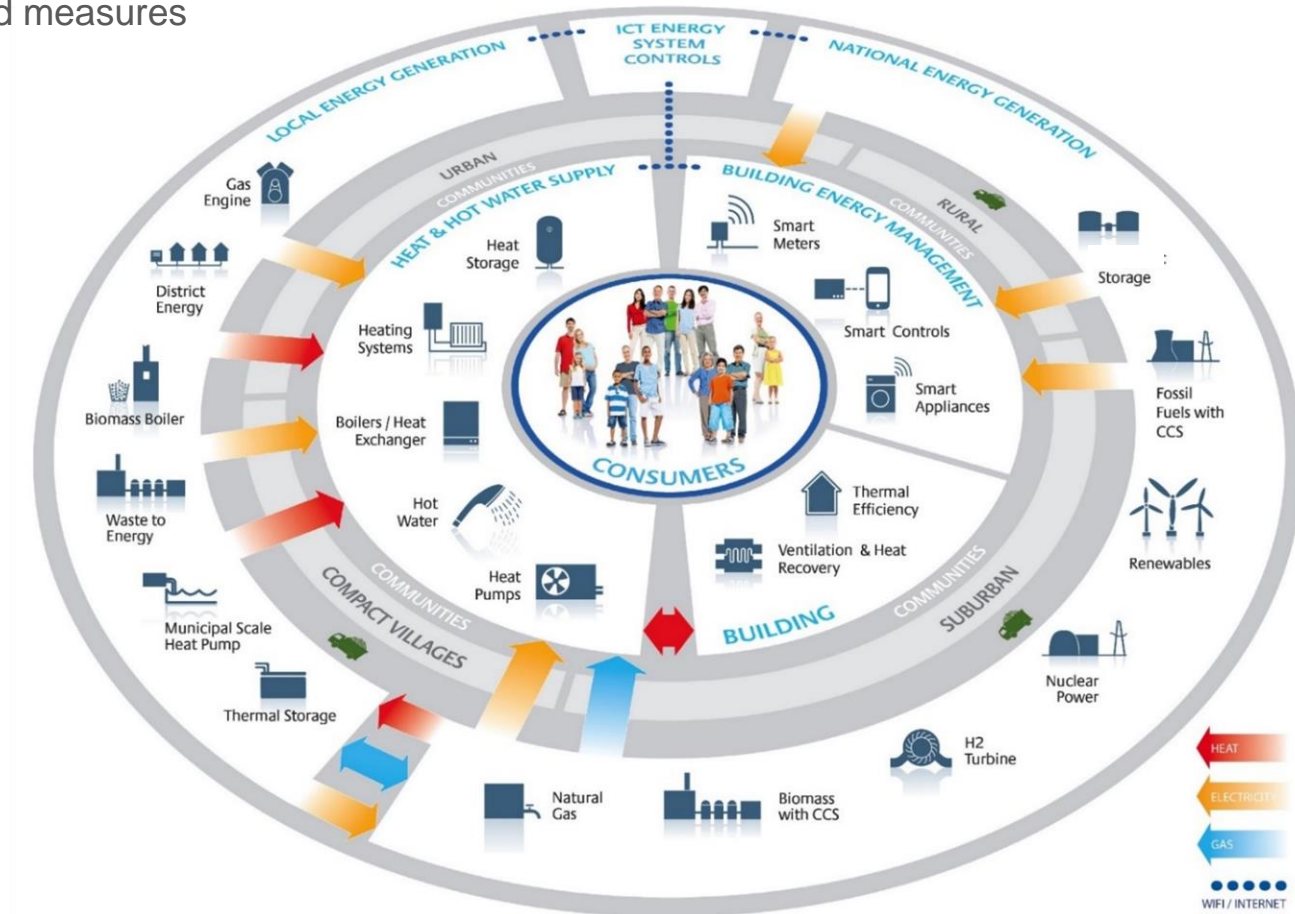


DB v3.4 / Optimiser v3.4



# UK heat challenge

...Meeting local residents needs while cost-effectively balancing supply and demand measures





# Meeting Consumer Needs

- Vital to understand the needs consumers seek to meet when using energy
- Incumbent boiler based solution is generally attractive to consumers

## Consumer Appeal

Solutions must appeal to consumers if the UK is to meet its emissions targets

## Costs

People want better control of the time, effort and money - not simply minimise their running costs

## Complexity

No simple relationship between the occupants, their property and what they need

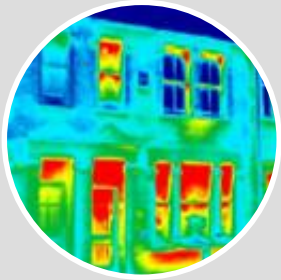
## Simplicity

Major obstacles discourage those few who might want to upgrade to lower carbon heating





# Technologies



## Heat Demand Reduction

Energy efficiency measures that help meet consumer needs with reduced energy input



## Heat Production

Technologies that convert an energy source to useful heat



## Energy Storage

Technologies that help break the link between demand and supply



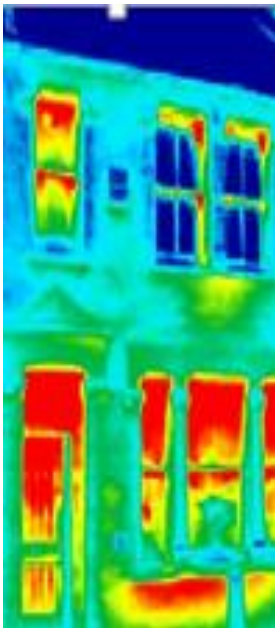
## Energy System Management

System wide measures, including home energy management






# Technologies – Heat Demand Reduction




Carbon Reduction Package	% CO2 Saving	Cost per Dwelling
Retrofix	33%	£7,500 - £21,000
Retrofix Plus	45%	£15,000 - £31,000

➔ = £b x 00,s for 26 million homes...  
and not meet the emissions target

  
**Pre 1919 Detached**  
780,000 homes  
13,940,000 tCO<sub>2</sub>

  
**1945-1965 Semi Detached**  
2,040,000 homes  
12,850,000 tCO<sub>2</sub>

  
**1965-80 Detached**  
1,050,000 homes  
9,360,000 tCO<sub>2</sub>





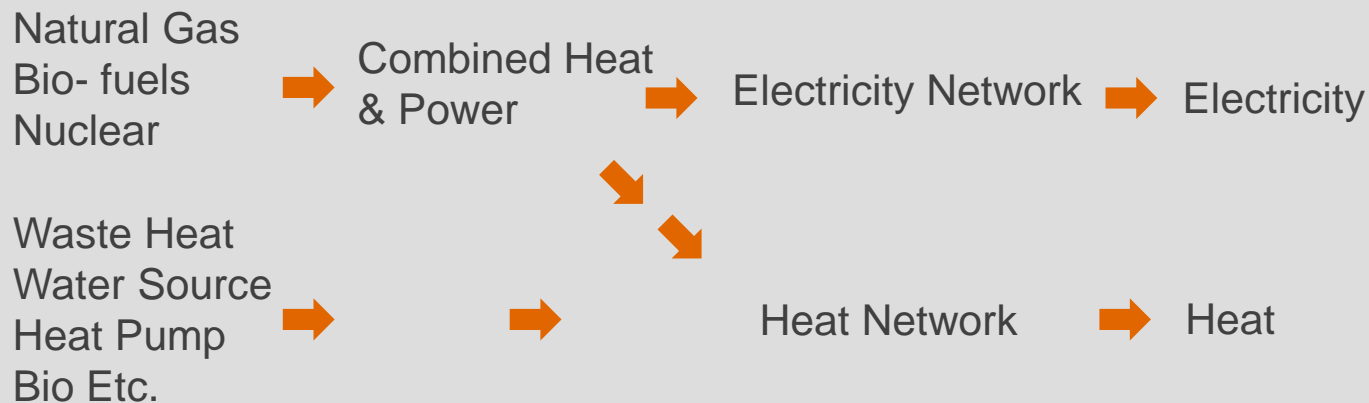
# Technologies - Heat Production

## Individual Solutions

Natural gas	➔	Gas / Oil Boiler	➔	Heat
Natural gas	➔	Gas Absorption Heat Pump	➔	Heat
Electricity	➔	Electric Heat Pump	➔	Heat
Electricity	➔	Direct Resistance Heater	➔	Heat
Electricity + Natural gas	➔	Hybrid Heat Pump	➔	Heat



## Shared Solutions



UK Heat Network Installation  
Cardiff City





# Technology Options

## Retrofit

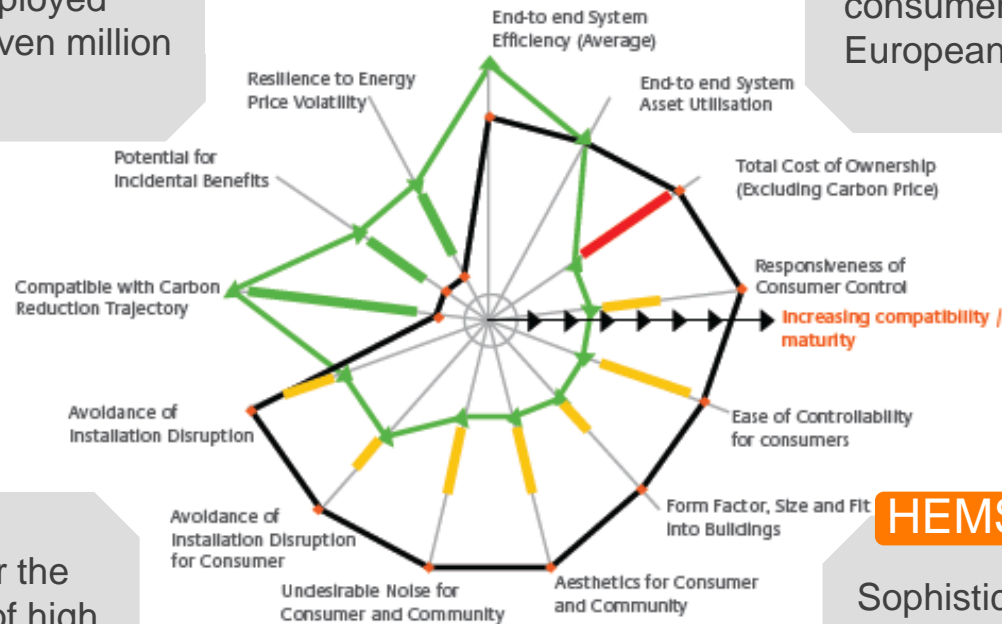
Comprehensive retrofitted efficiency measures deployed selectively – around seven million homes / £100billion

## Heat Networks

Heat networks could become the system of choice for many UK consumers as many Western European cities

## Energy Storage

Opportunities exist for the further development of high density thermal storage media for domestic situations



## HEMS

Sophisticated Home Energy Management System could support the design of heating solutions + tailored services



# Energy System View

## Resilience

Opportunity to build in resilience and flexibility around future energy sources

## Biomass

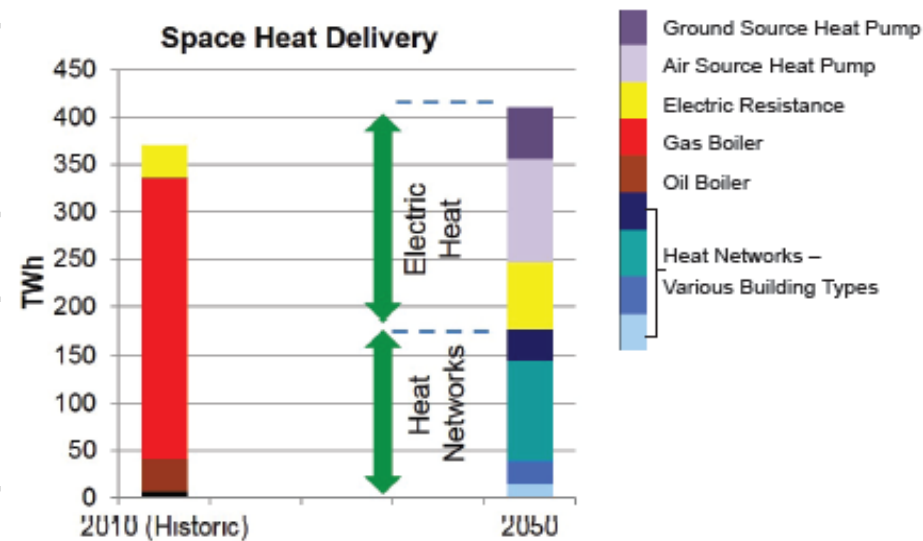
Biomass resources - most valuable when used to generate hydrogen. Heat from biomass can play a transition role, and help to establish a market for domestically produced feedstock

## Gas Networks

A consequence of a low carbon transition - significant reduction in the flexibility of supply provided by gas heating systems

## System Architect

There is currently no owner for the holistic view of integrated electricity, gas and heat systems





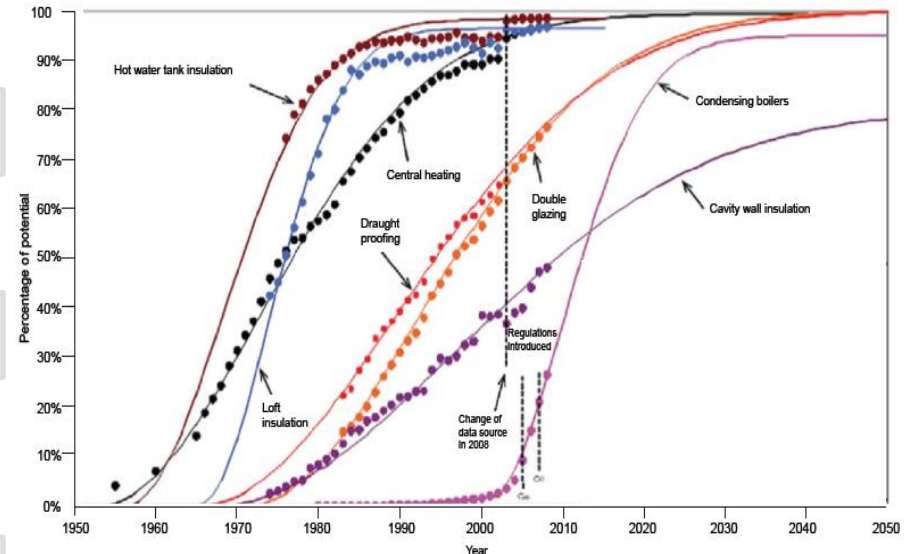
# Consumer Propositions and Business Models

More consumer led and costly changes can be seen to take effect over a period of decades

Previous rapid transitions have been driven by strong policy requirements

Solutions lie in the development of a true and segmented understanding of consumer needs

Cost of heating is important – but cost alone is not necessarily the prime determinant of satisfaction



“An understanding of the consumer’s willingness to pay for the new service offerings will emerge, along with a greater understanding of the barriers to change, and the costs and welfare benefits of new solutions”

“The rate of adoption varies greatly depending on the cost of the measures, the scale of their intrusion, the value delivered to consumers and importantly the extent to which they are optional”

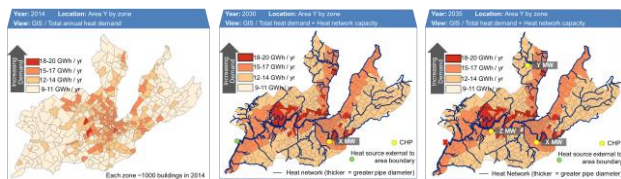


# National Targets to Local Strategies

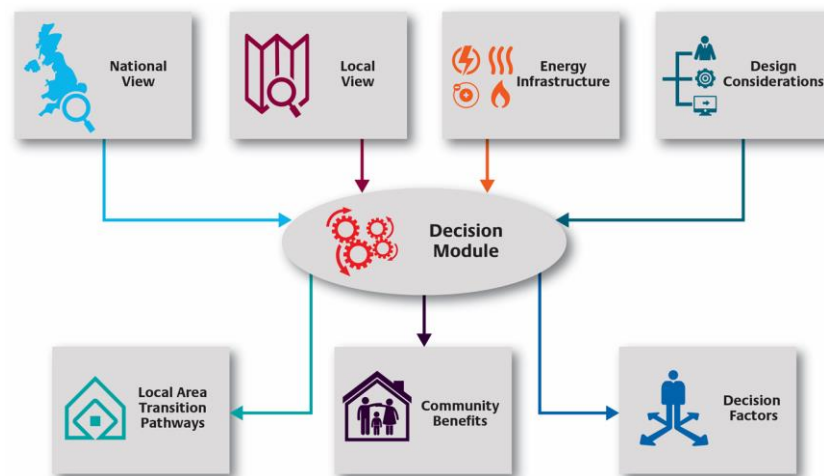
Future local energy infrastructure requirements are quite different. There is a real need to develop local energy strategies that identify the key inherent characteristics of the area

Strategies need to consider the geographical layout, house types, individual consumer preferences, availability of local energy resources, natural features and constraints

“ More systematic analysis of these wider economic benefits that can help build the investment case in local areas ”

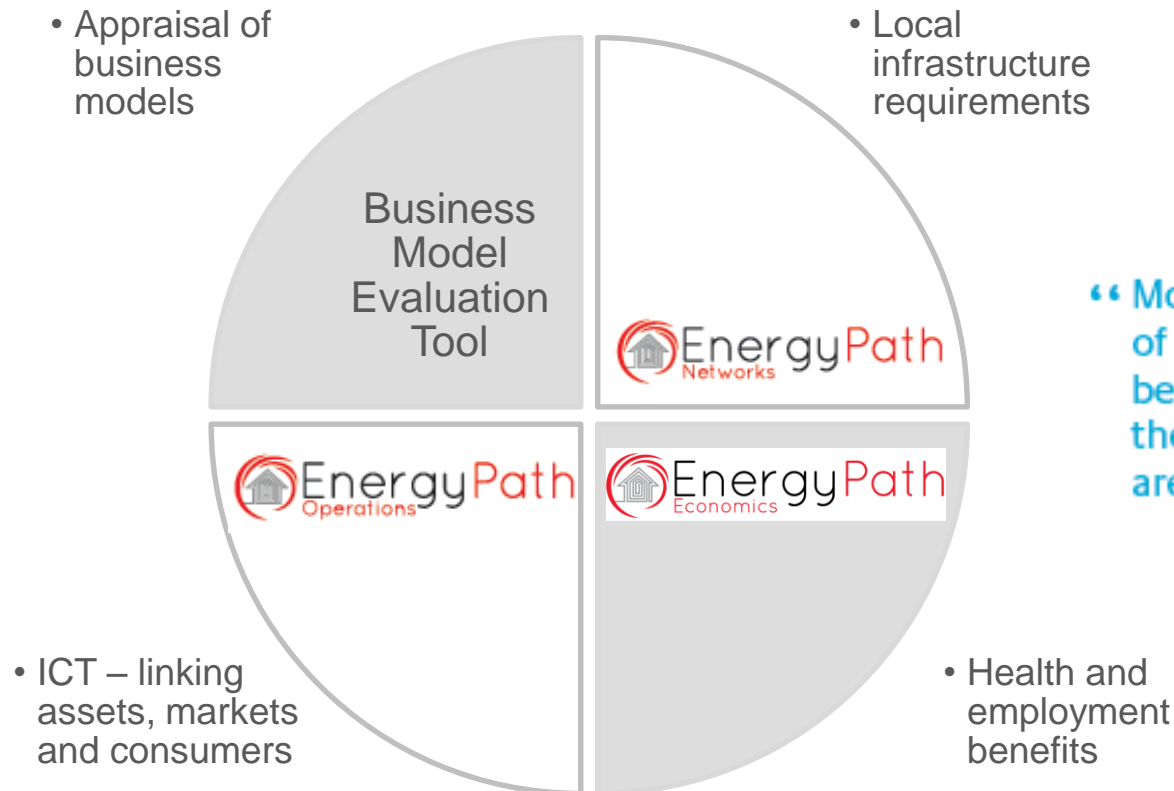


time





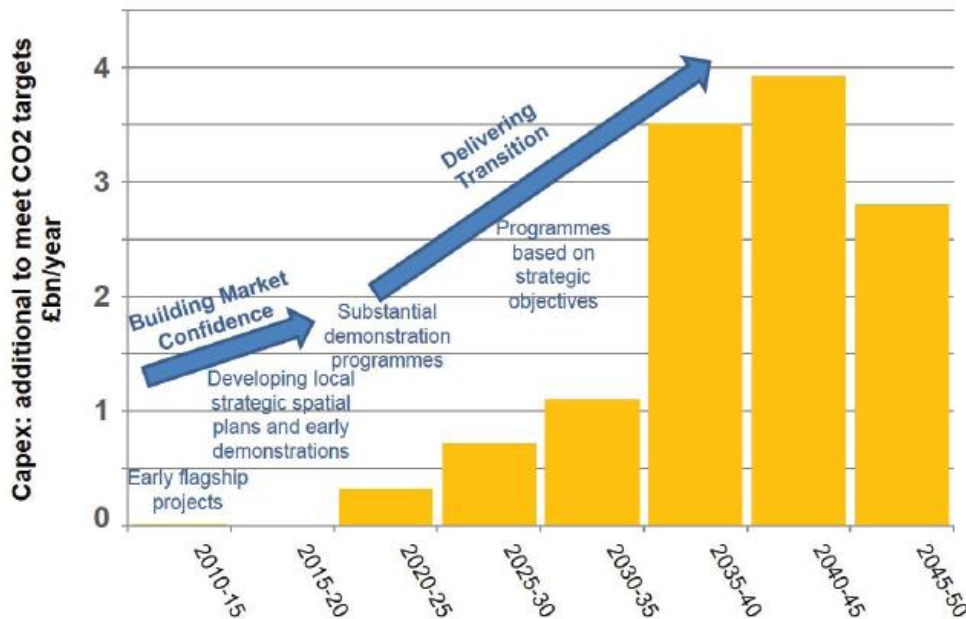
# National Targets to Local Strategies



“ More systematic analysis of these wider economic benefits that can help build the investment case in local areas ”



# Preparedness, Policy and Leadership



“A lack of market confidence and delay in building the necessary momentum will inevitably lead to harder pressed resources and higher costs, along with missed targets and business opportunities”

## Leadership

- Markets cannot be expected to engage without the essential foundations of leadership, clear strategic direction, effective policy and proven business models

## Preparation

- “Preparedness phase” to translate overall targets into plans for action, deciding on policy needs and building supply chain

## Consensus

- Challenges are not so much technology based, but around gaining public consensus and trust

## Local Responsibility

- Essential to lay the foundations of transition by defining the necessary local responsibility and leadership expectation through a national policy framework



# 10 YEARS TO PREPARE

## for a low carbon transition

Between 2025 and 2050 - 26 million  
homes will require new low carbon  
installations

# 20,000

homes per week



the equivalent of  
**10 Milton Keynes**  
each year

Few consumers are presently engaged to change their heating  
systems to combat emission reductions



Time



Effort



Money

our consumer research highlights people want better control of time, effort  
and money

There are two principal pathways for decarbonising domestic  
space and water heating



local area schemes using heat networks and individual home systems using  
electric heat

Eliminating emissions from buildings is more  
cost-effective than making deeper cuts in other  
sectors

# £100<sub>bn</sub>



likely cost of comprehensively retrofitting seven million  
homes

Carbon abatement costs  
increase around

# 30%

if electric heat systems are not  
used in any transition

Next decade is critical

# 10 Years



in preparing for transition as rapid implementation is  
required from 2025 to meet 2050 targets



# 90%

of the UK's housing stock  
will still be in use in 2050



# 20%

contribution of household  
heating to national carbon  
emissions



# 2,500

Consumers



involved in ETI research around heating  
use and needs

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