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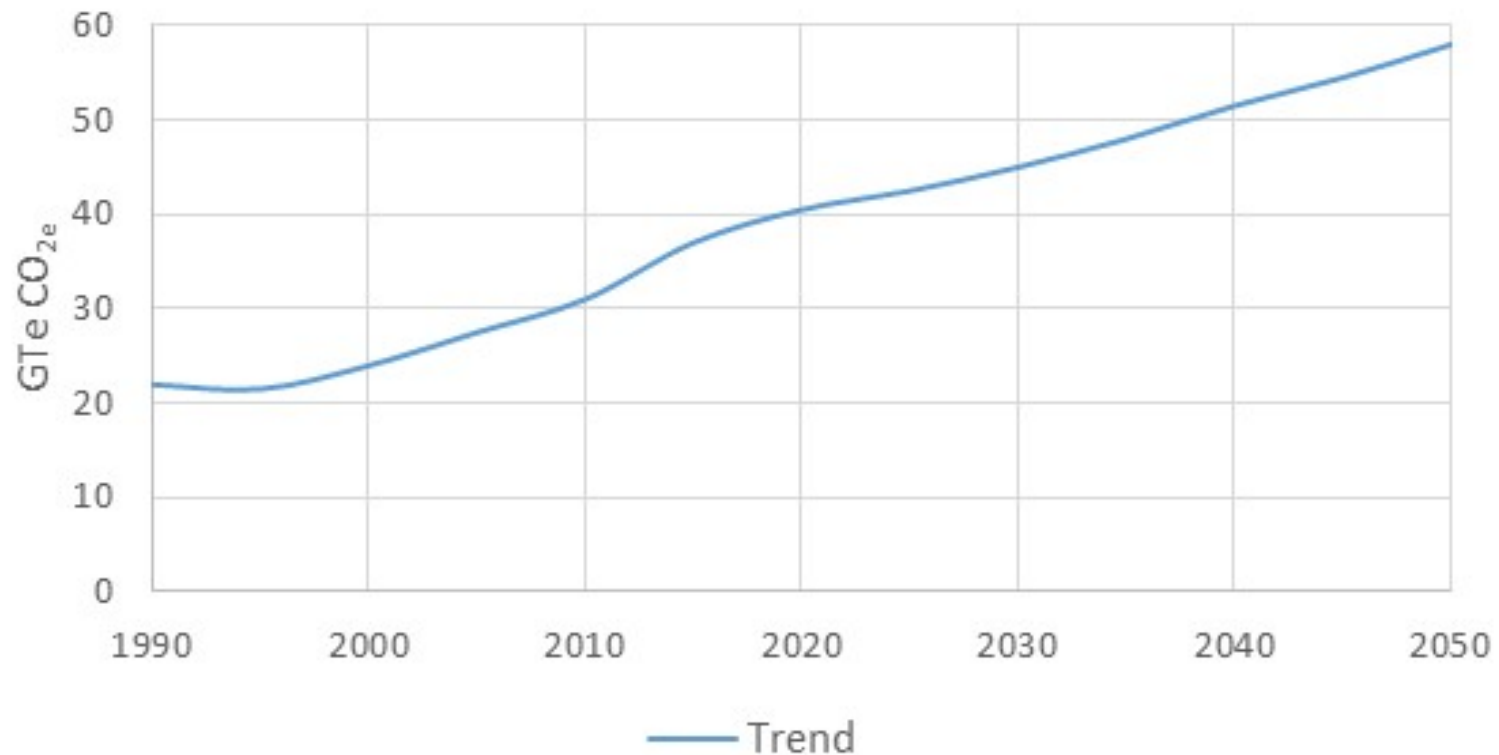
How can the UK transition to an affordable, secure and sustainable energy system?

Andrew Haslett FREng, Chief Engineer



When do we need to be ready?

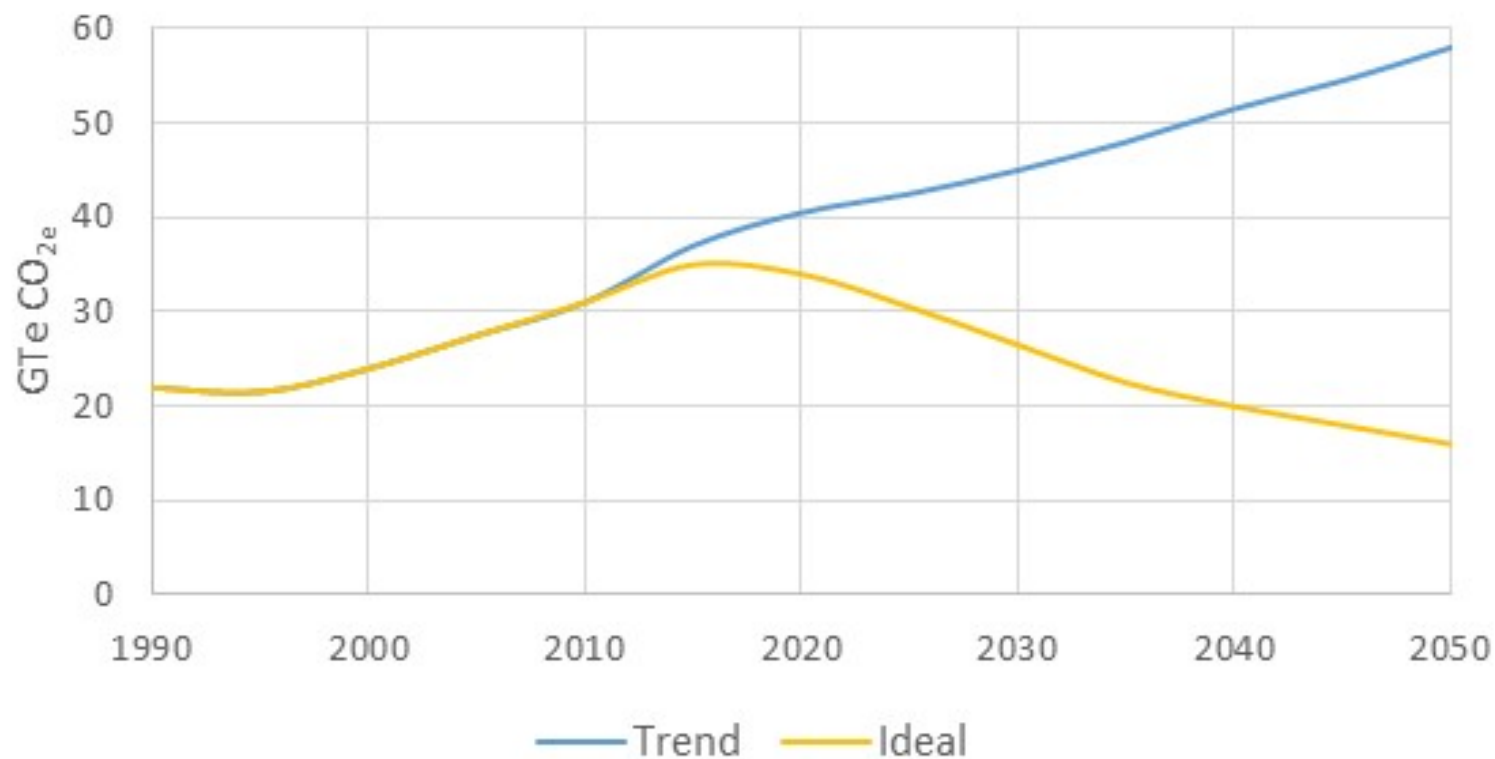
Global Greenhouse Gas Emissions





When do we need to be ready?

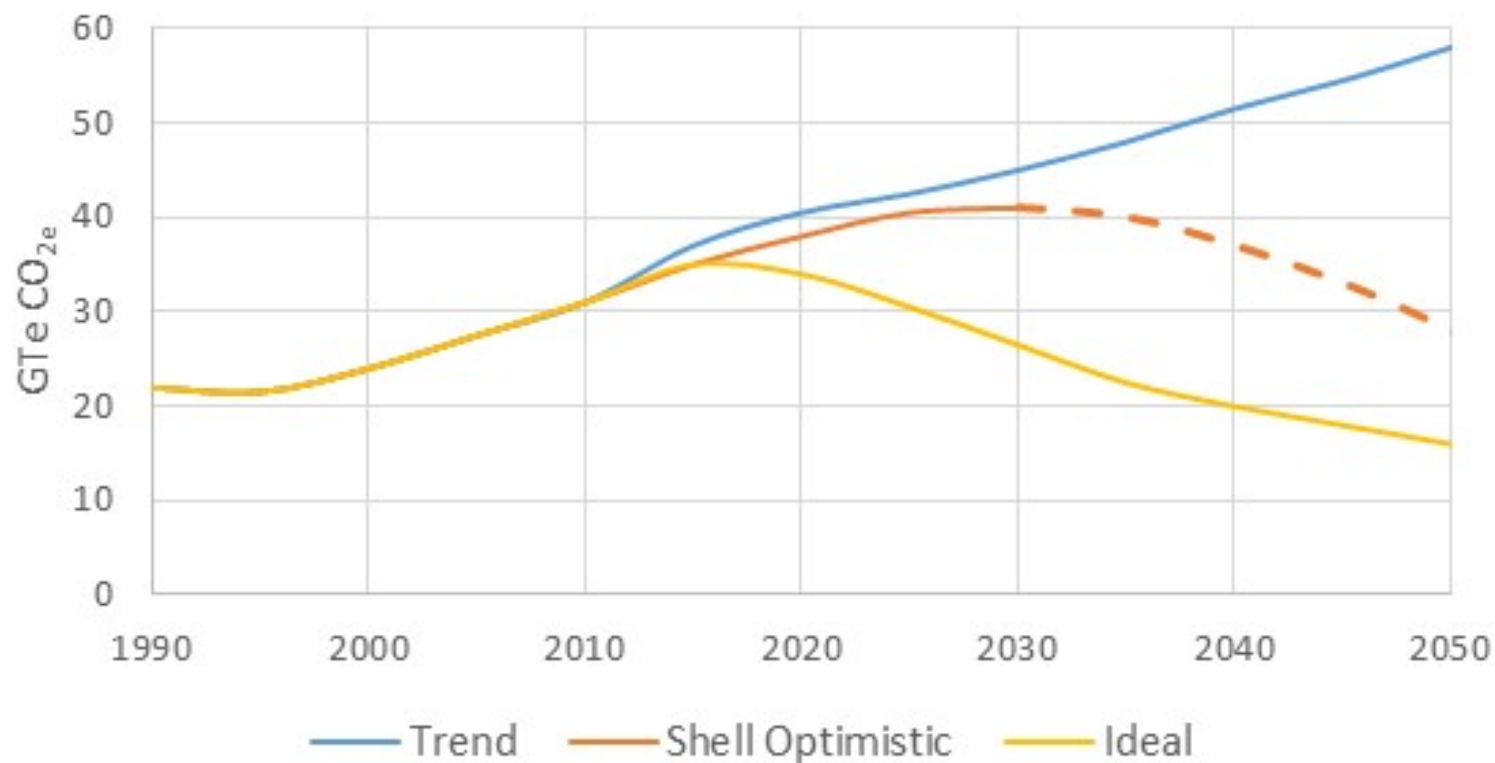
Global Greenhouse Gas Emissions





When do we need to be ready?

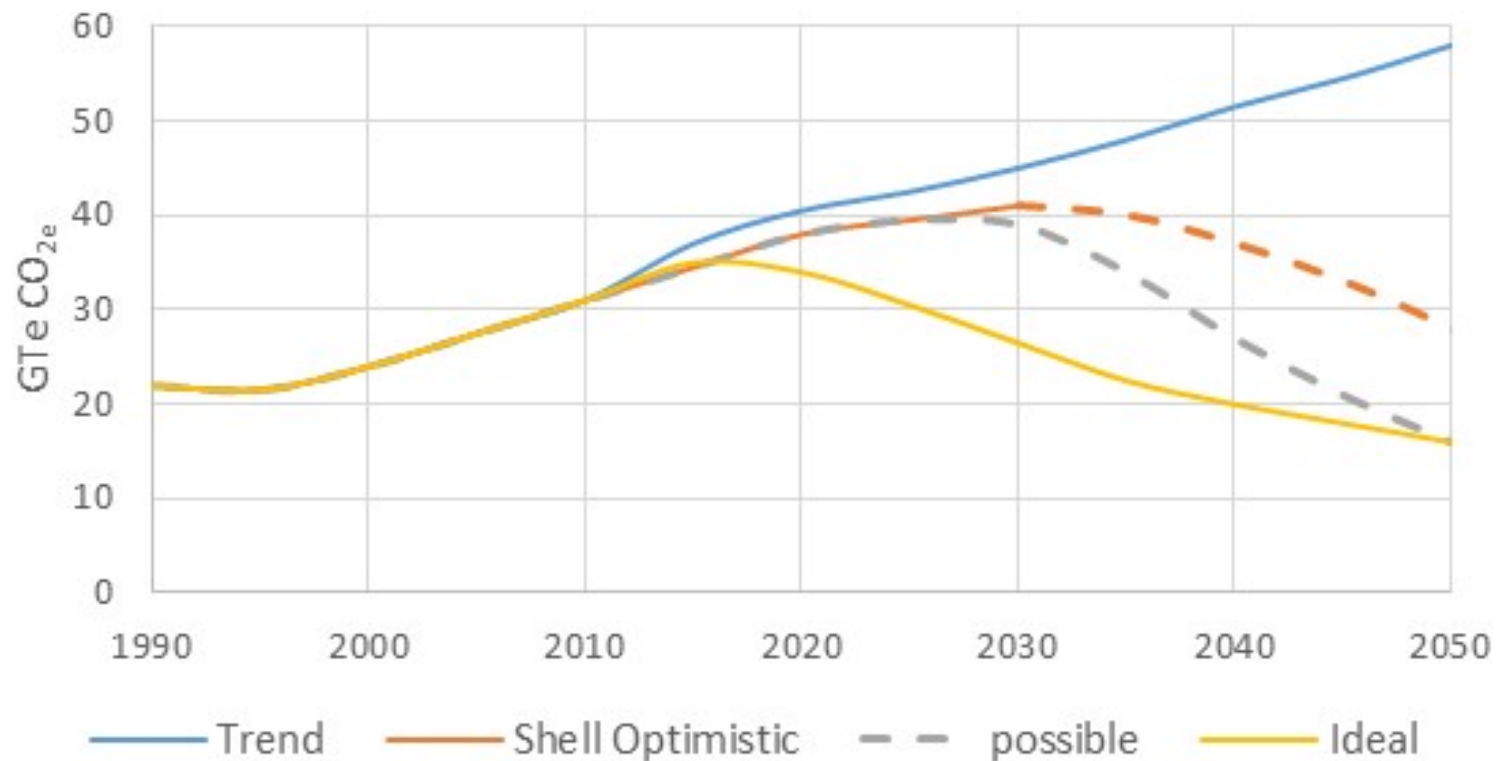
Global Greenhouse Gas Emissions





When do we need to be ready?

Global Greenhouse Gas Emissions





Delivering innovation: Strategic planning and technology demonstration



A national energy system design tool

Integrating heat, power, transport and infrastructure

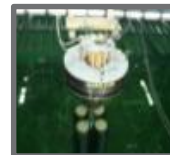
Searching for the lowest cost solution

Knowledge Building <£5m, 6-24 months



Bioenergy

Multi-site field trial to study impact of bioenergy crops on soil carbonisation and greenhouse gas emissions



Marine

Optimising wave and tidal array yields



Carbon Capture & Storage

First comprehensive UK CO2 storage database

Developing Technology £5-15m, 2-4 years



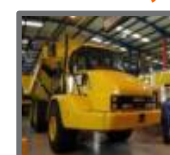
Energy Storage & Distribution

New approach to storing electricity at scale



Marine

3 phase 11kv wet-mate connector with integrated communications



Transport

Increasing efficiencies of HDV land and marine vehicles by up to 30%

Demonstrating technology and system solutions



Offshore Wind

New designs for Floating turbine platforms reducing generating costs



Offshore Wind

World leading facility to increase reliability of new turbines



Marine

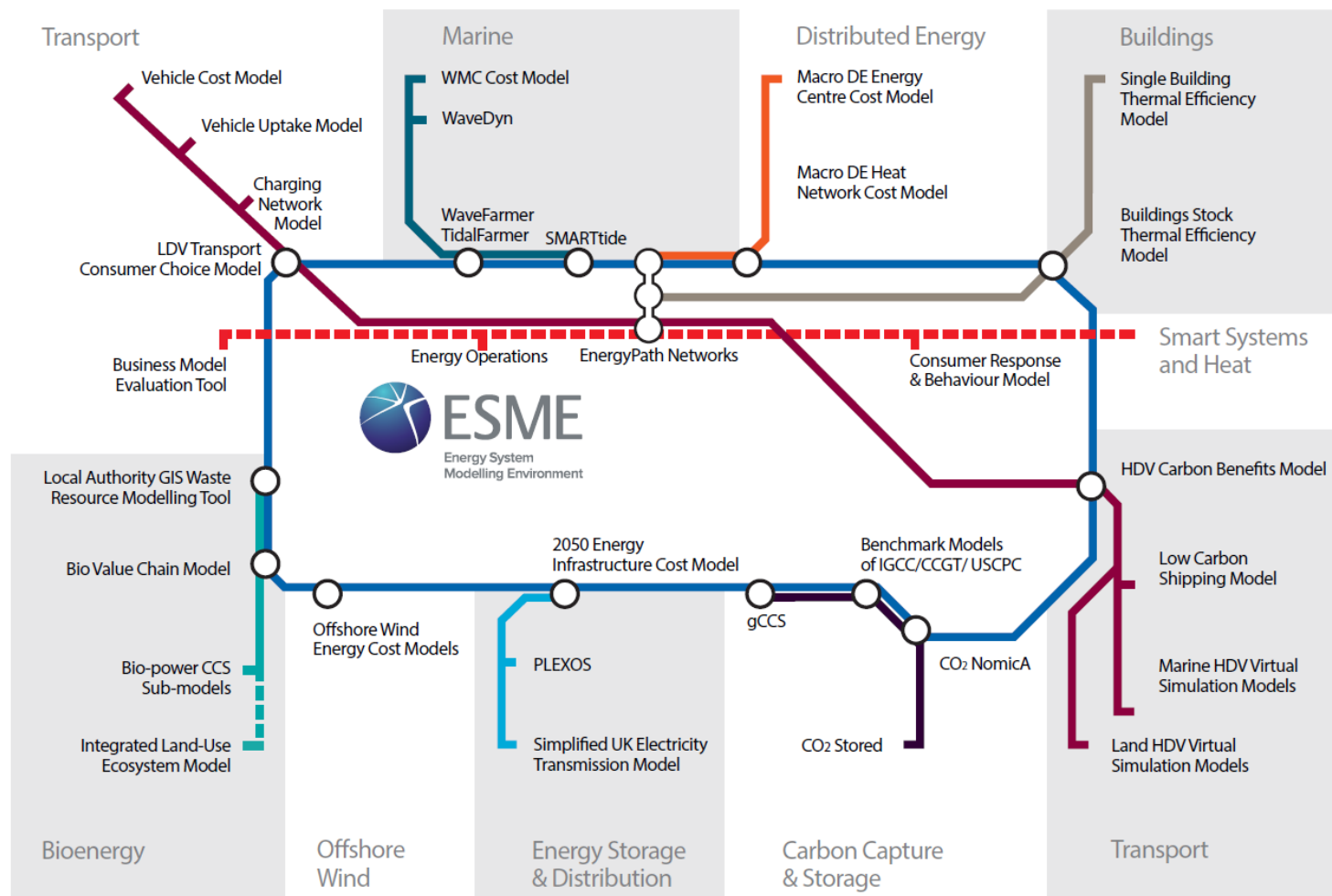
1MW tidal generator providing environmental impact and performance

£15-30m+,
3-5 years



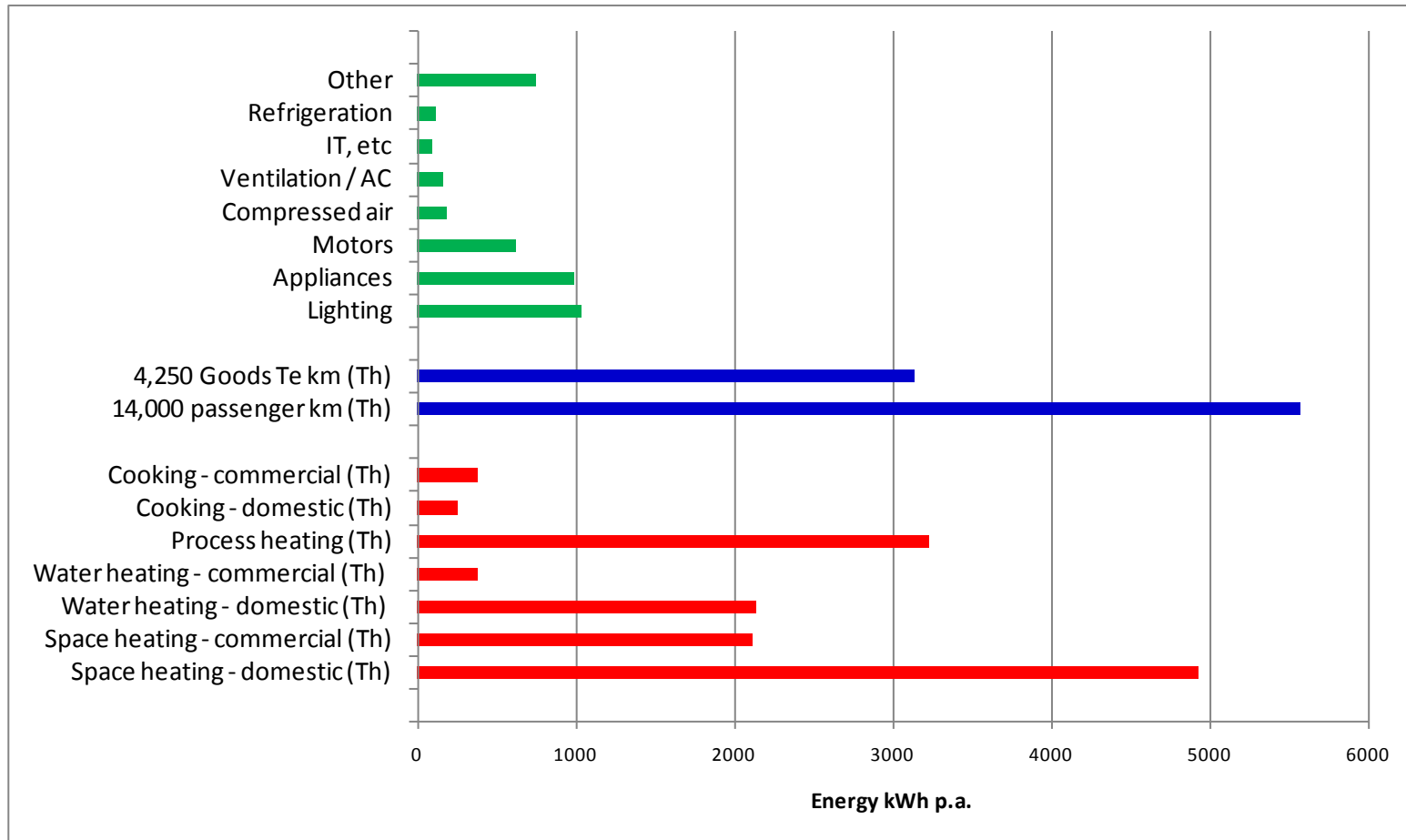
Whole system analysis based on sector specific detail

ESME - On track to 2050





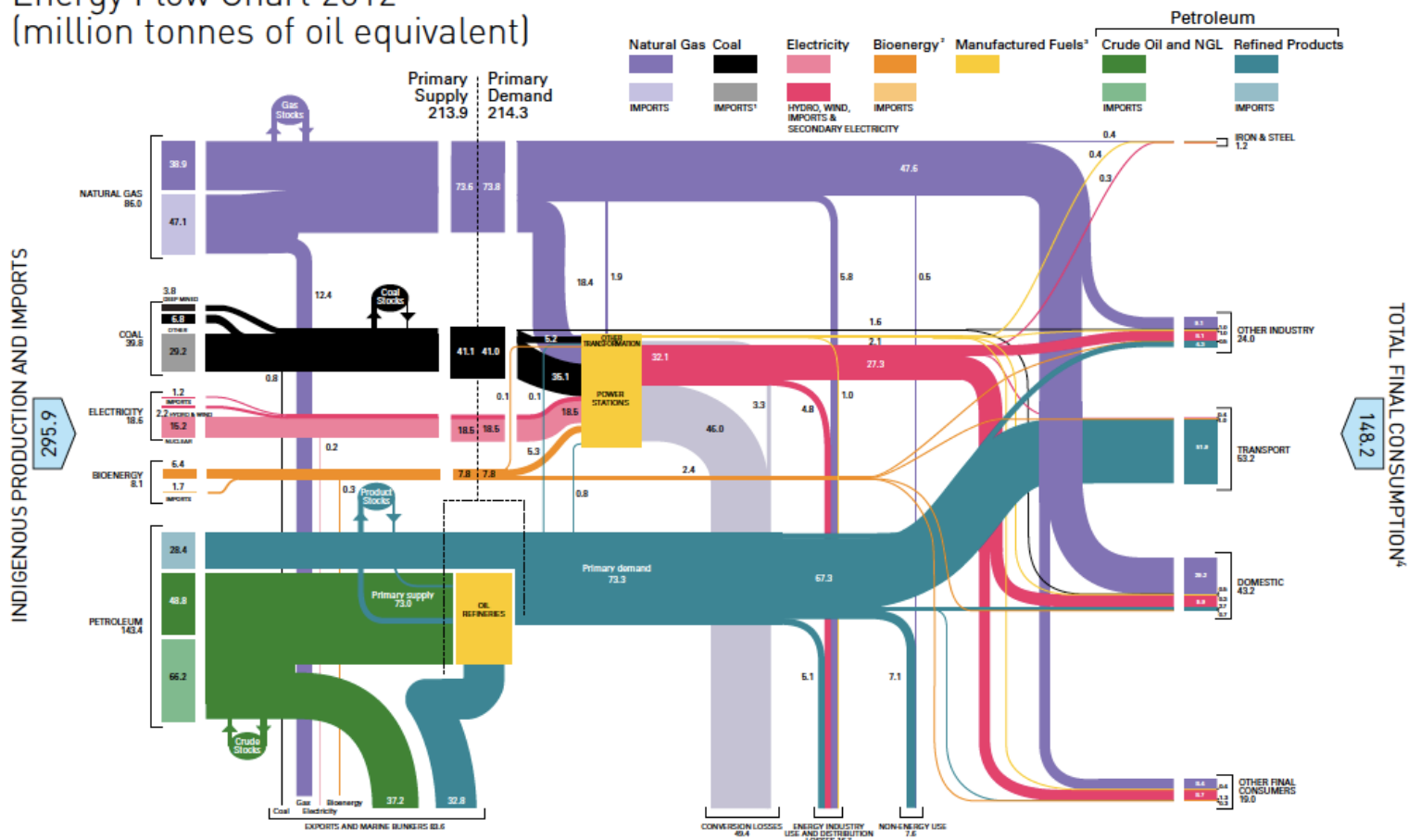
Annual energy use per person in UK (2010)





Digest of UK Energy Statistics 2013

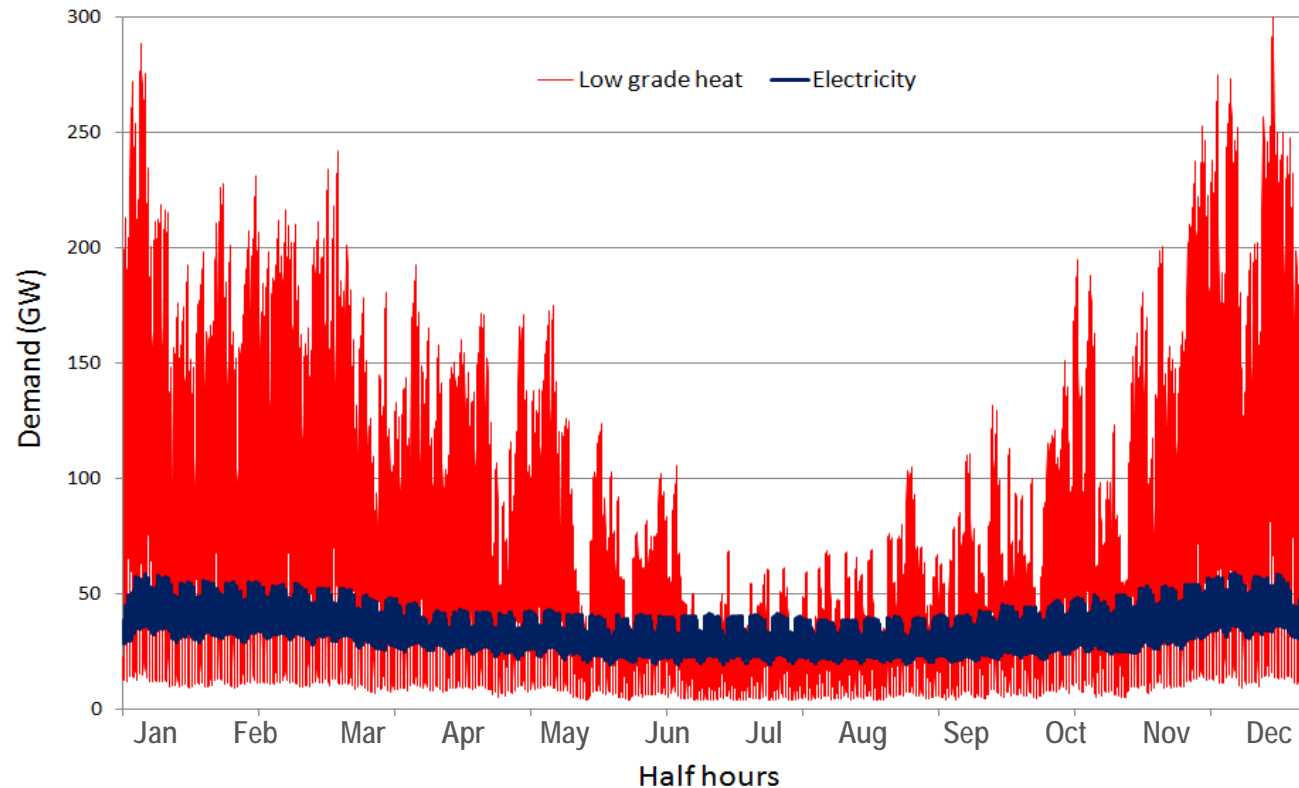
Energy Flow Chart 2012
(million tonnes of oil equivalent)



FOOTNOTES:
1. Coal imports include imports of manufactured fuels, which accounted for 0.1 million tonnes of oil equivalent in 2012.
2. Bioenergy is renewable energy made from material of recent biological origin derived from plant or animal matter, known as biomass.
3. Includes fuel sold.
4. Includes non-energy use.
This flowchart has been produced using the style of balance and figures in the 2013 Digest of UK Energy Statistics, Table 1.1.



Variability (Duty Cycle) is very important

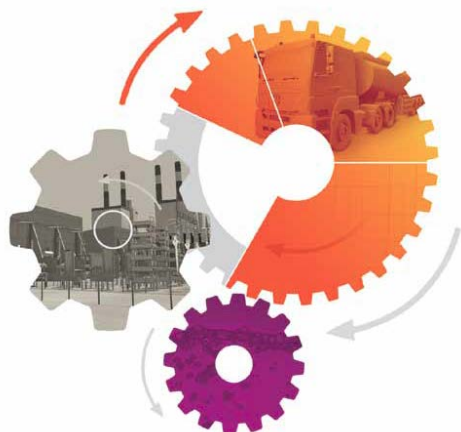


By kind permission of UKERC: 2011



A range of social, demographic, industrial, economic, policy and consumer possibilities

CLOCKWORK



PATCHWORK





CLOCKWORK

Institutional Mandate

Clear leadership and a national planning capability provide a framework for energy system decision-making with strong regional participation.

Large Scale Infrastructure

A focus is placed on national co-ordination of supply-side generation and shared national, regional and local infrastructures.

Carbon Offsetting

Realising the system-wide value of CCS and biomass in generating negative emissions.

Phased Decarbonisation

Emissions reduction is led by action in the power sector, followed by buildings and finally transport. All vehicles have dramatic efficiency improvements, driven by regulations. Cars and vans are mostly hybrids.





PATCHWORK

Societal Engagement

Alongside decarbonisation, popular perceptions over other social and environmental factors (eg land use) influence decisions strongly. Energy prices are used to reinforce progress.

Multi-Scale Infrastructure

A mixture of national, regional and local initiatives deliver a patchwork of low-carbon energy infrastructures.

Renewables Optimism

A focus on renewables drives offshore wind at large scale, supported by significant capacity of smaller-scale technologies.

Parallel Decarbonisation

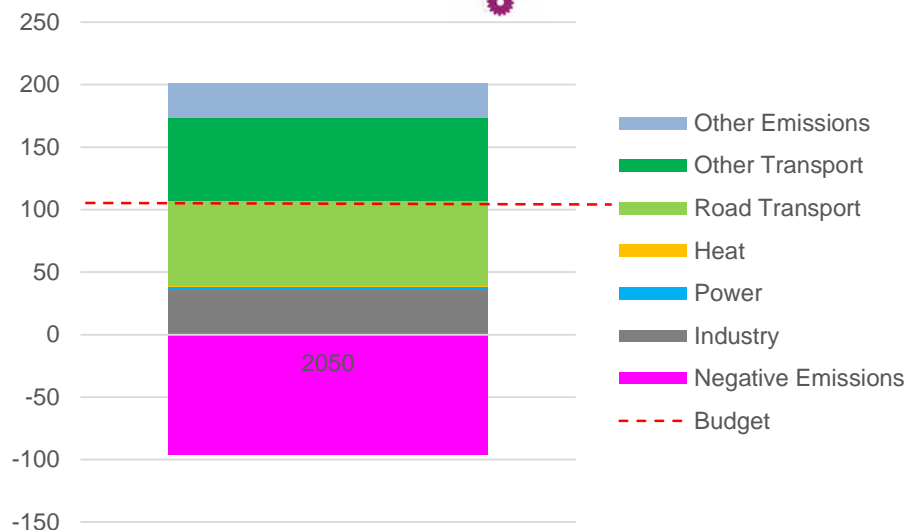
Transformation of the power sector is followed by deep, parallel abatement action across buildings and transportation.



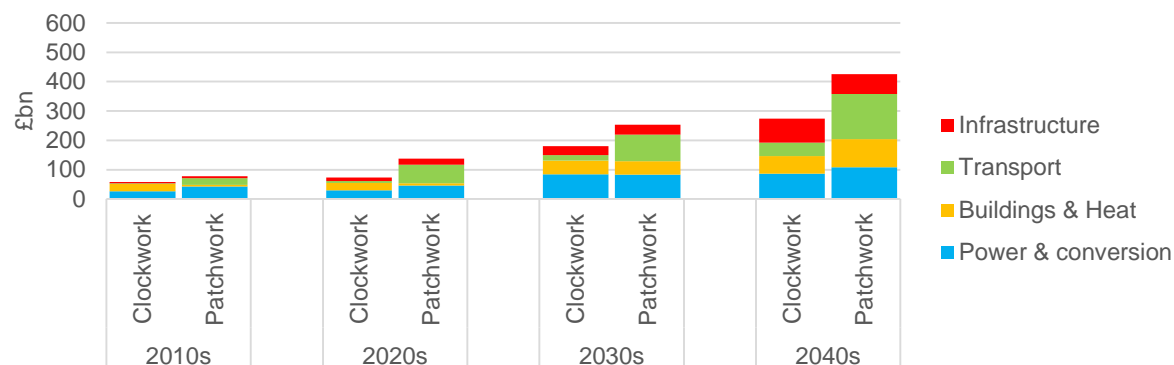
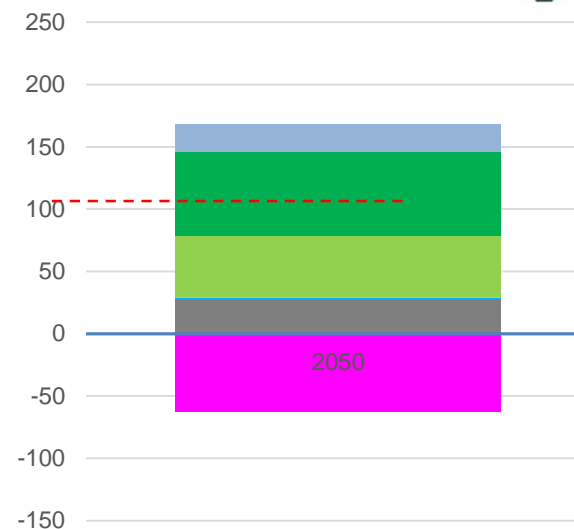


Carbon pricing across the economy?

Clockwork

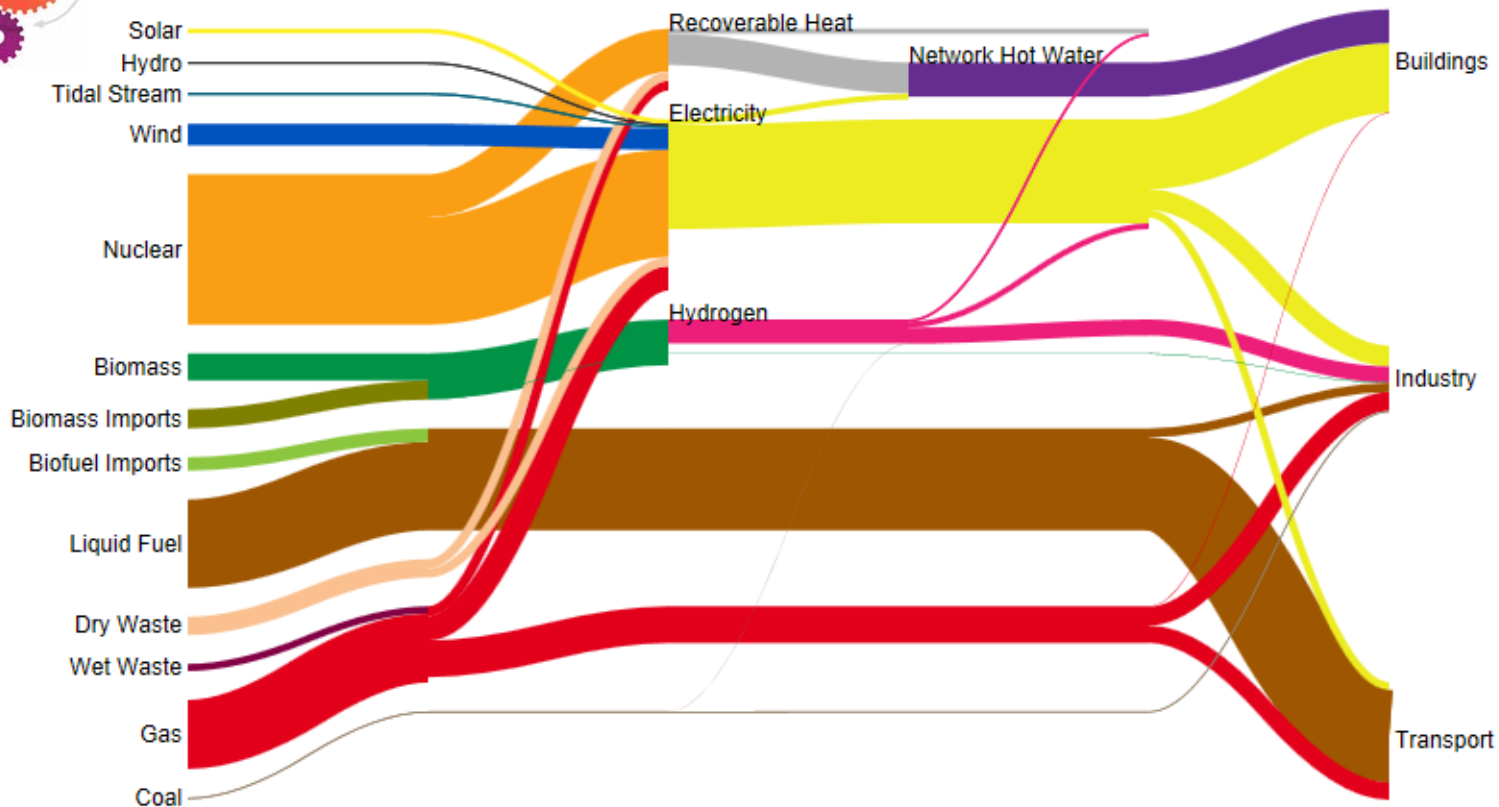


Patchwork



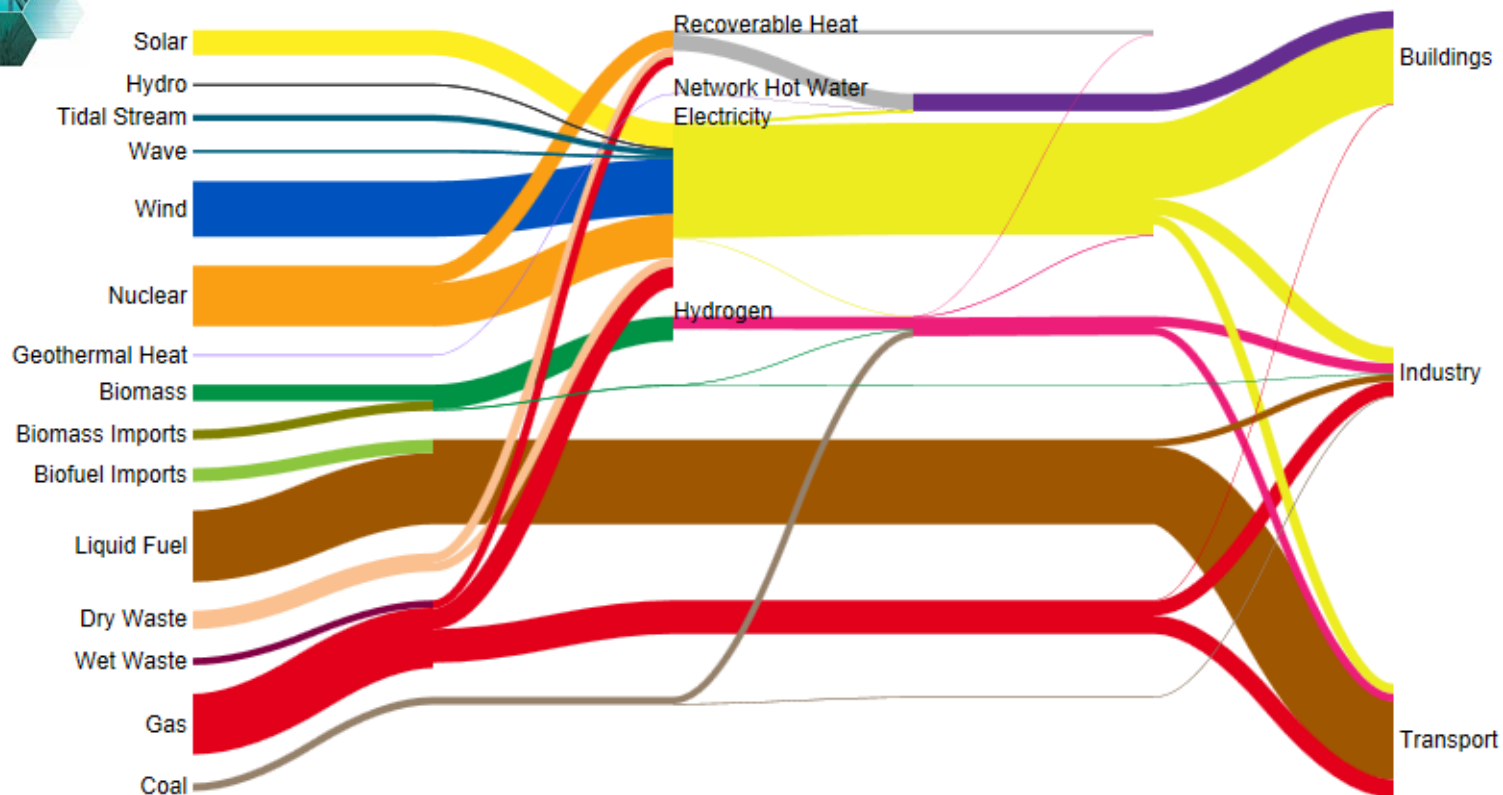


Clockwork





Patchwork





Impact on daily life

Energy costs and carbon taxes are rising

- Cars and vans
 - You will be offered incentives to buy battery vehicles, hybrid fuel/electric vehicles and hydrogen vehicles with different fuel, charging and hydrogen availability in different places and different approaches to congestion charges etc but hydrogen vehicles are likely to become the accepted solution
- Heating
 - Your Local Authority may have a plan or not and you will have to decide on investments in fabric efficiency, new heating systems and controls, given what is on offer from local suppliers and government schemes
- Financial and policy risk
 - You will have to decide whether you are buying the wrong car, wrong house or wrong heating system and make sure you access incentives that are available



Impact on daily life

Energy costs and carbon taxes are rising

- Cars and vans
 - After 2025 you are likely to see a national plan to adopt battery vehicles and hybrid vehicles over twenty years. [Possibly the answer might be hydrogen vehicles]
- Heating
 - Your community will have an infrastructure plan developed with the support of regional and national government and suppliers will be offering you solutions with government support
- Financial and policy risk
 - There should appear to be a joined-up plan, with widespread support, and actions match words, but...



Techno-economic strategic perspective

EXECUTIVE SUMMARY

CORE FUNDAMENTAL ARGUMENTS

1

The UK can implement an affordable 35-year transition to a low carbon energy system. Our modelling shows 2050 abatement costs can range from 1-2% of GDP if planned effectively

2

We are not yet able to recommend a single detailed blueprint. The UK must focus on developing and proving capability across a basket of the most attractive supply and demand technologies

3

Priorities for the UK energy system include: efficiency of vehicles and buildings, nuclear, carbon capture and storage (CCS), bioenergy, offshore wind and hydrogen systems

4

It is critical that these options are developed over the next decade to prepare the UK for transition. By 2025, crucial decisions must be made regarding infrastructure design for the long-term

5

CCS and bioenergy are especially valuable. The most cost-effective system designs require zero or even "negative" emissions in sectors where decarbonisation is easiest, alleviating pressure in more difficult sectors

6

Effective choices of storage technologies, especially heat, hydrogen and natural gas, can accommodate high levels of renewables cost-effectively and also mitigate large swings in demand for electricity

7

Hydrogen is an important low carbon fuel in industry and the power sector – providing the flexible capacity essential for meeting peak demand and acting as backup for intermittent sources such as wind



Registered Office
Energy Technologies Institute
Holywell Building
Holywell Park
Loughborough
LE11 3UZ



For all general enquiries
telephone the ETI on
01509 202020.



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about the ETI visit
www.eti.co.uk



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