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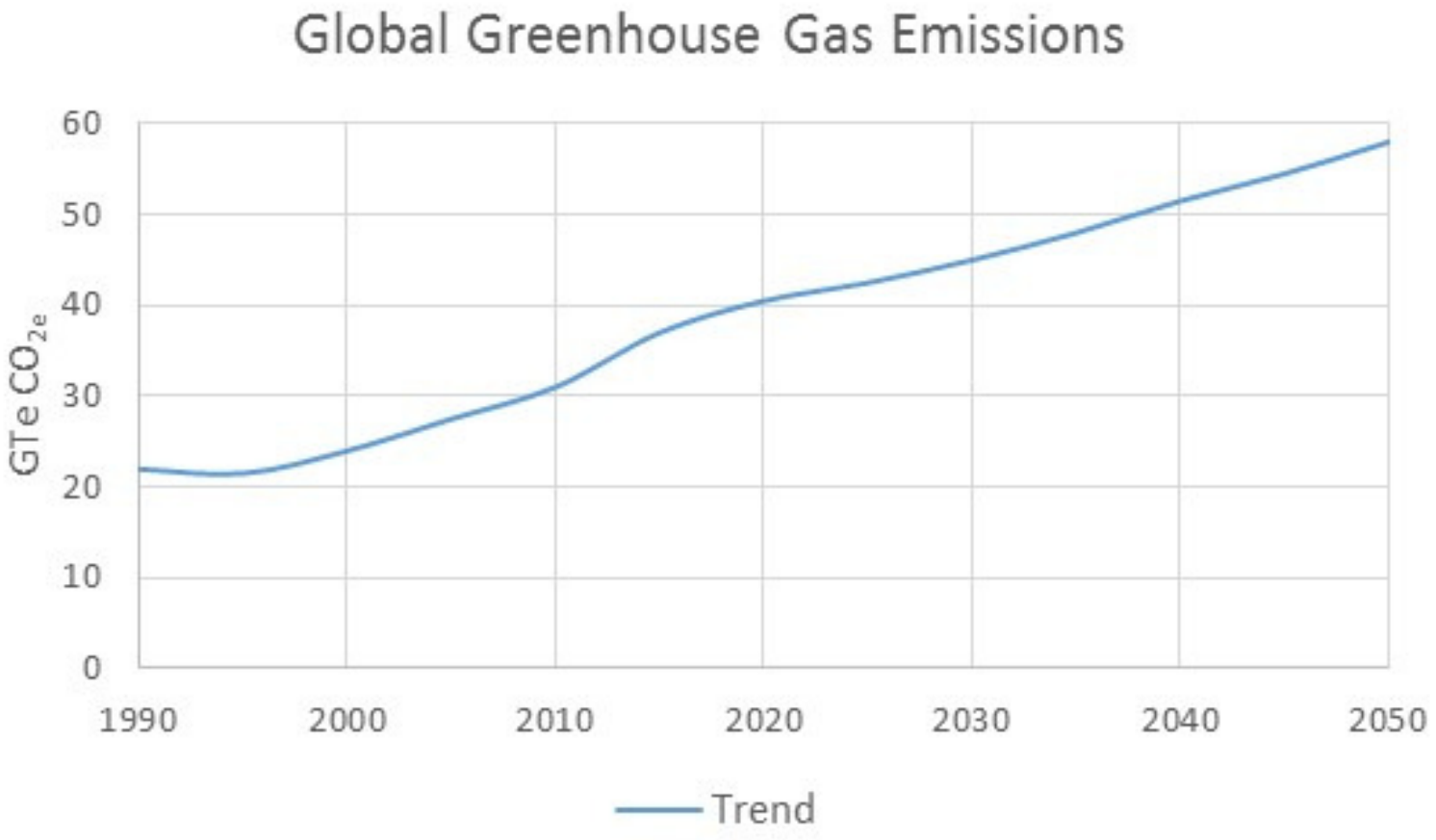
How can the UK transition to an affordable, secure and sustainable energy system?

Andrew Haslett FREng, Chief Engineer

When do we need to be ready?



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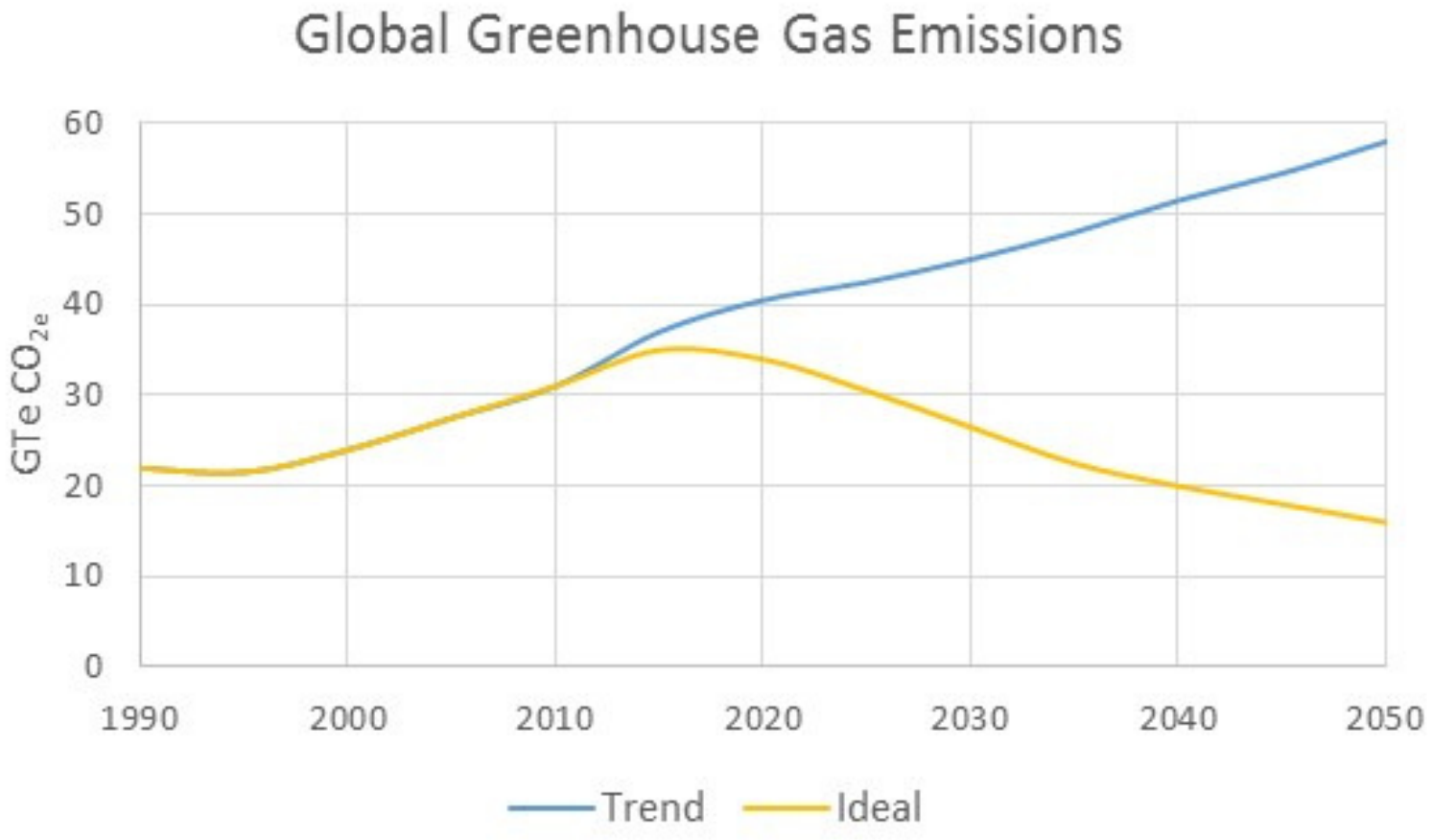

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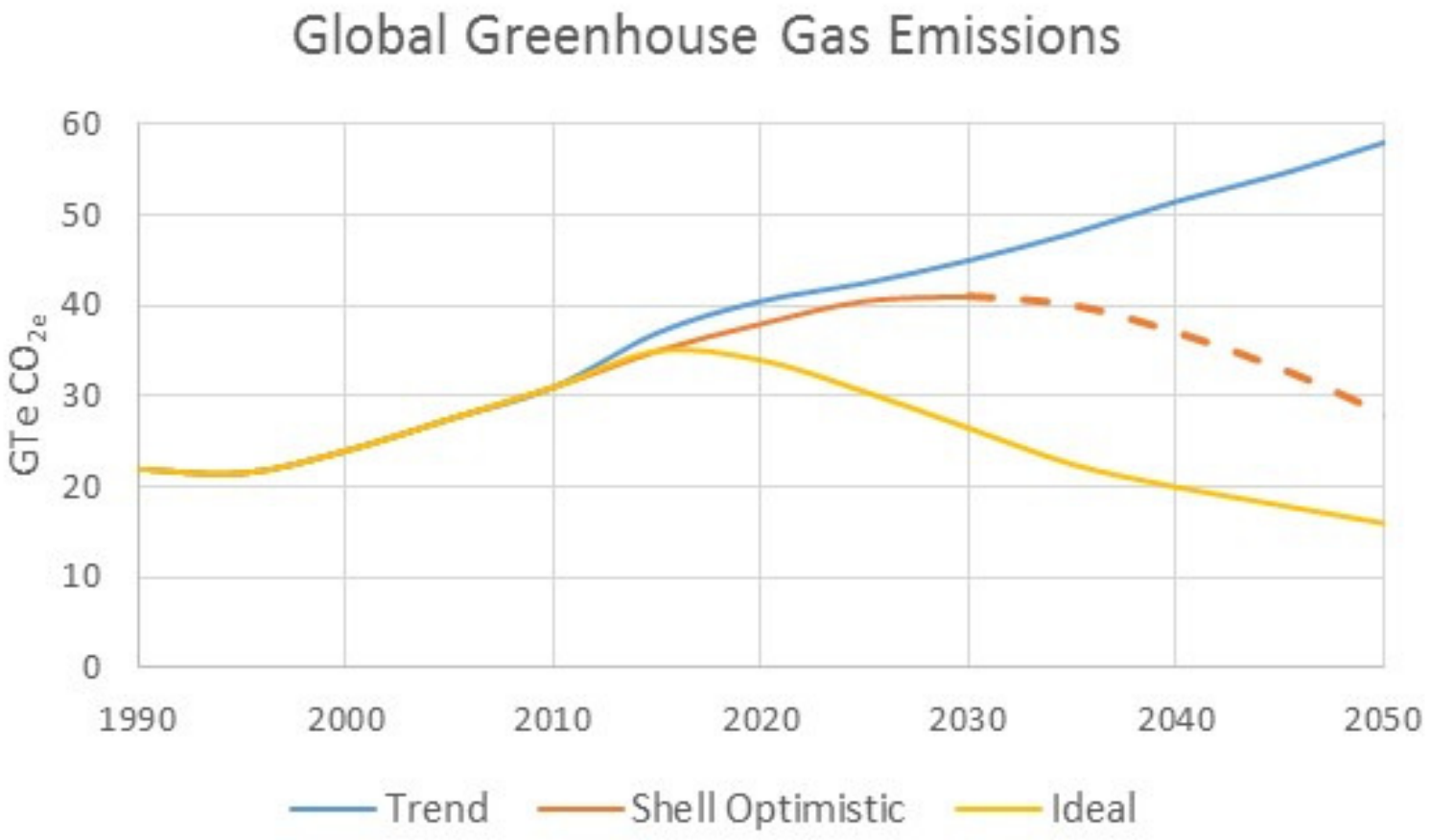

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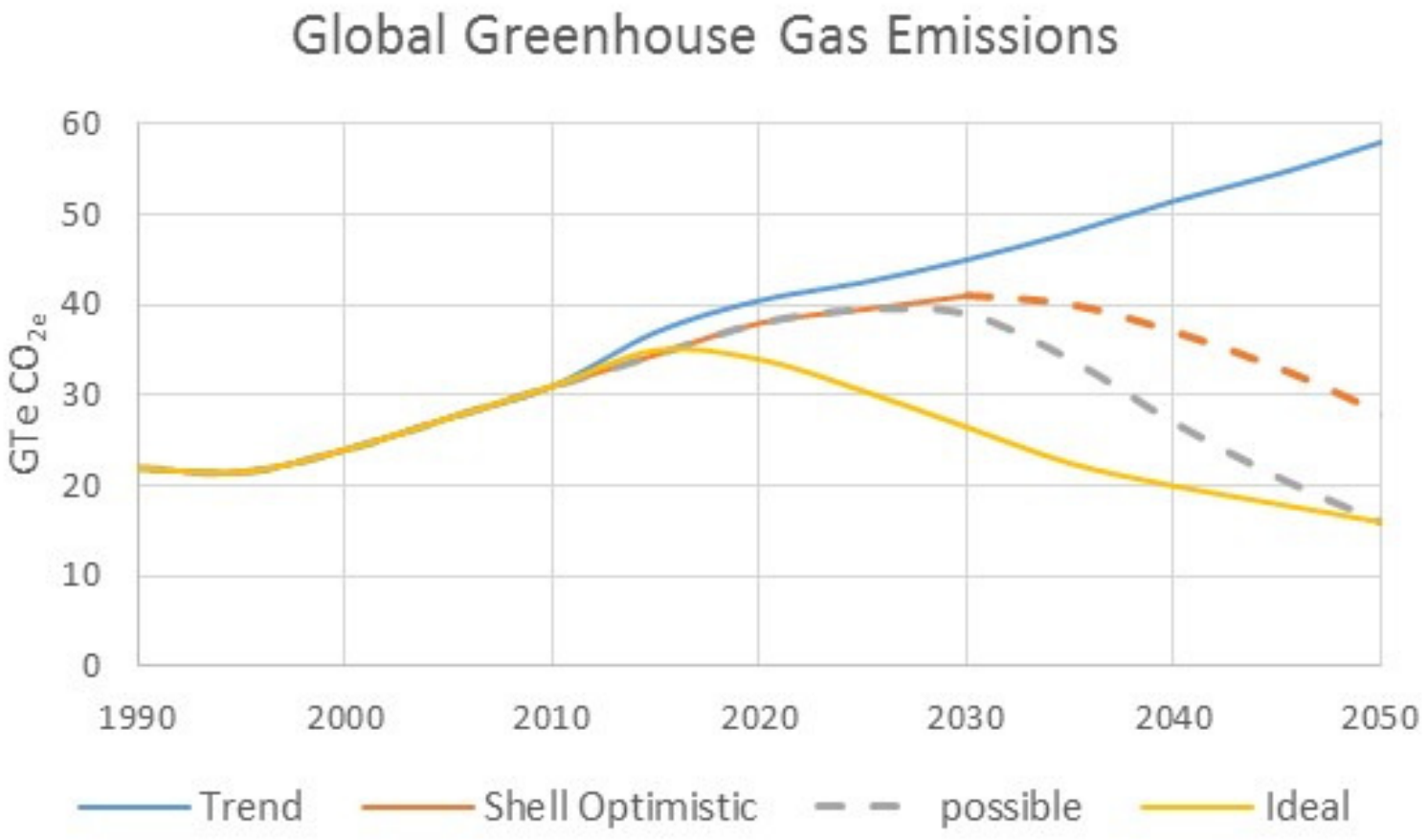


Delivering innovation: Strategic planning and technology demonstration

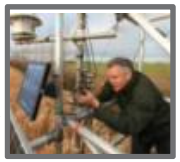
ESME
Energy System Modelling Environment

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 CO_2 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

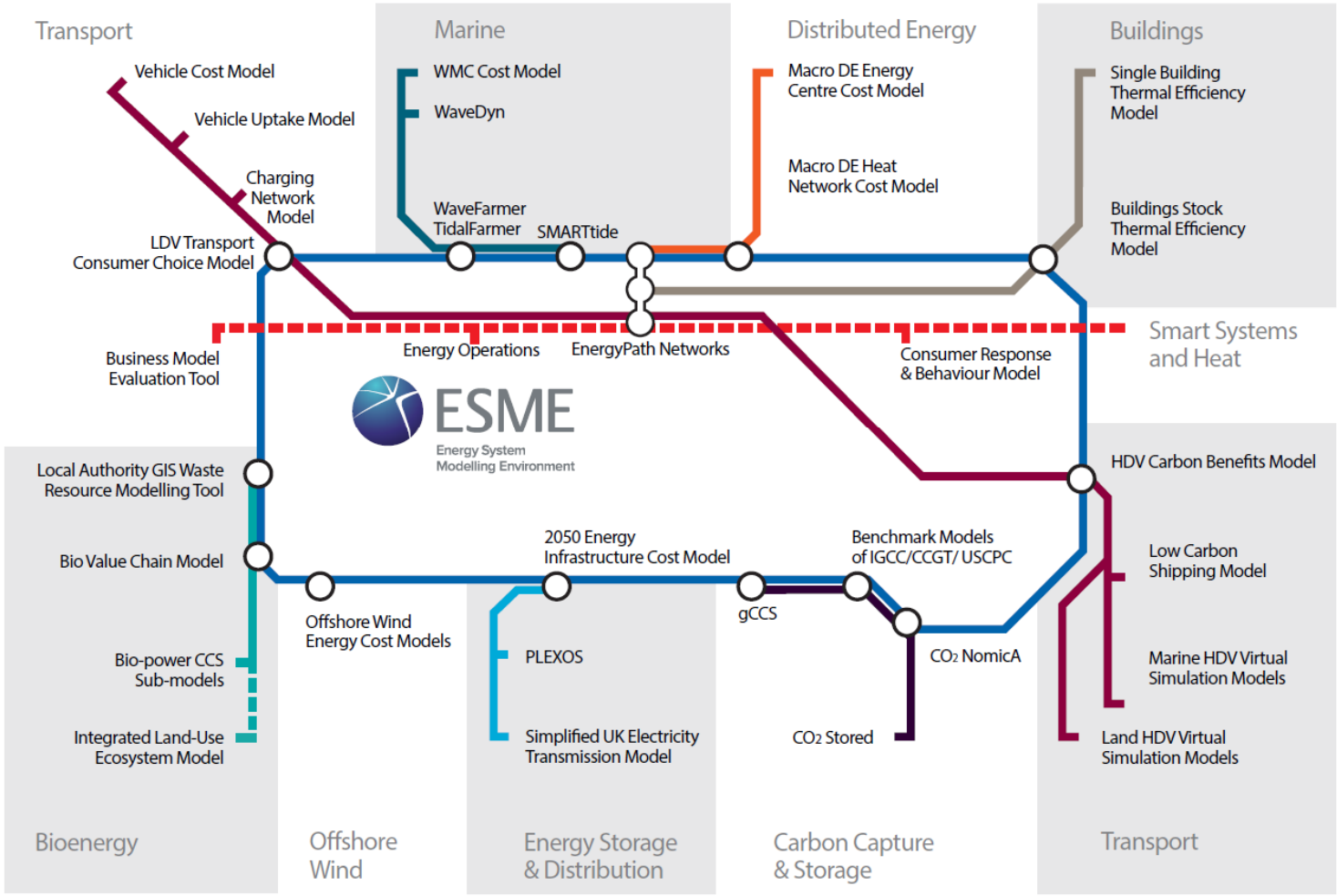
Offshore Wind
World leading facility to increase reliability of new turbines

Marine
1MW tidal generator providing environmental impact and performance

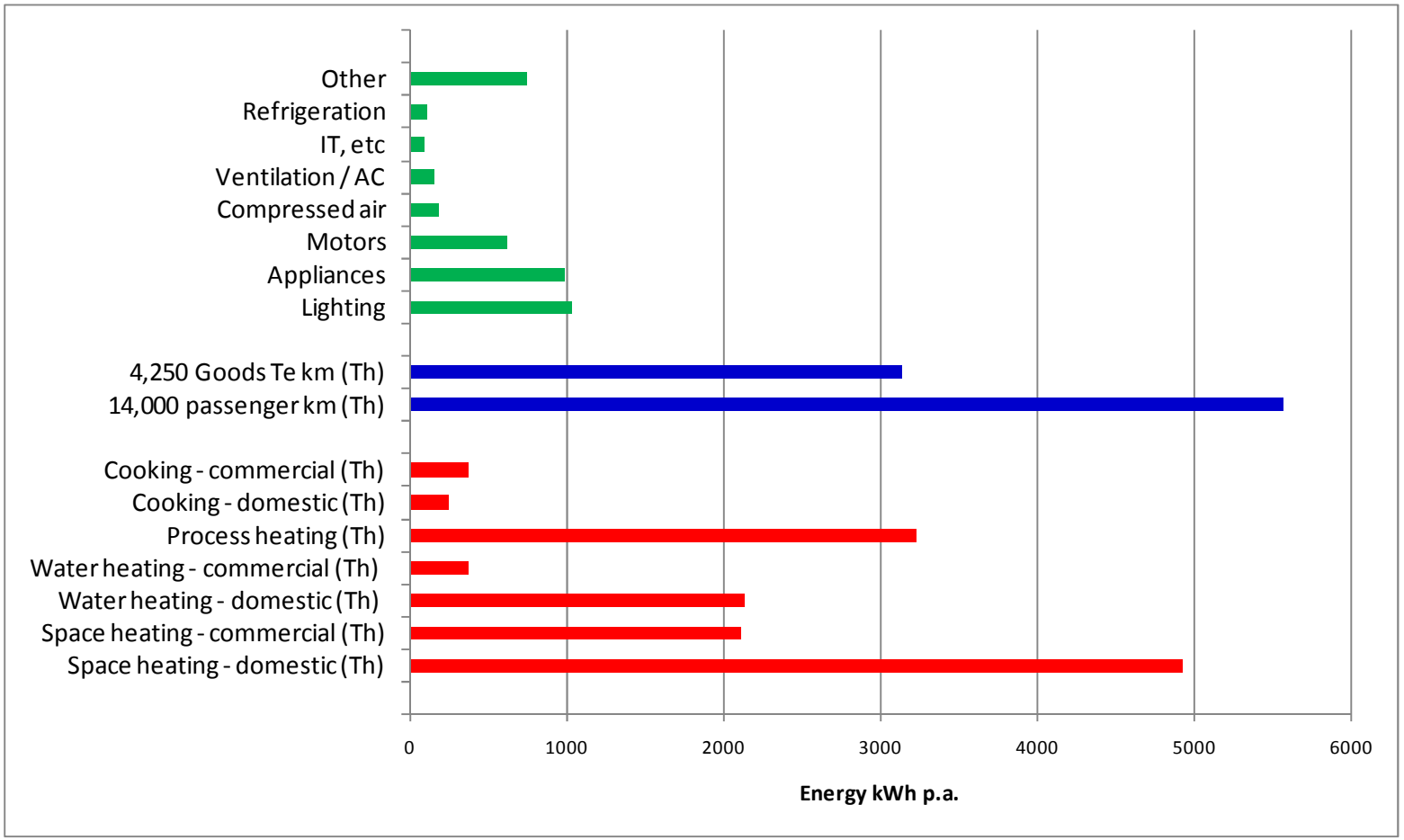
£15-30m+, 3-5 years

Whole system analysis based on sector specific detail

ESME - On track to 2050

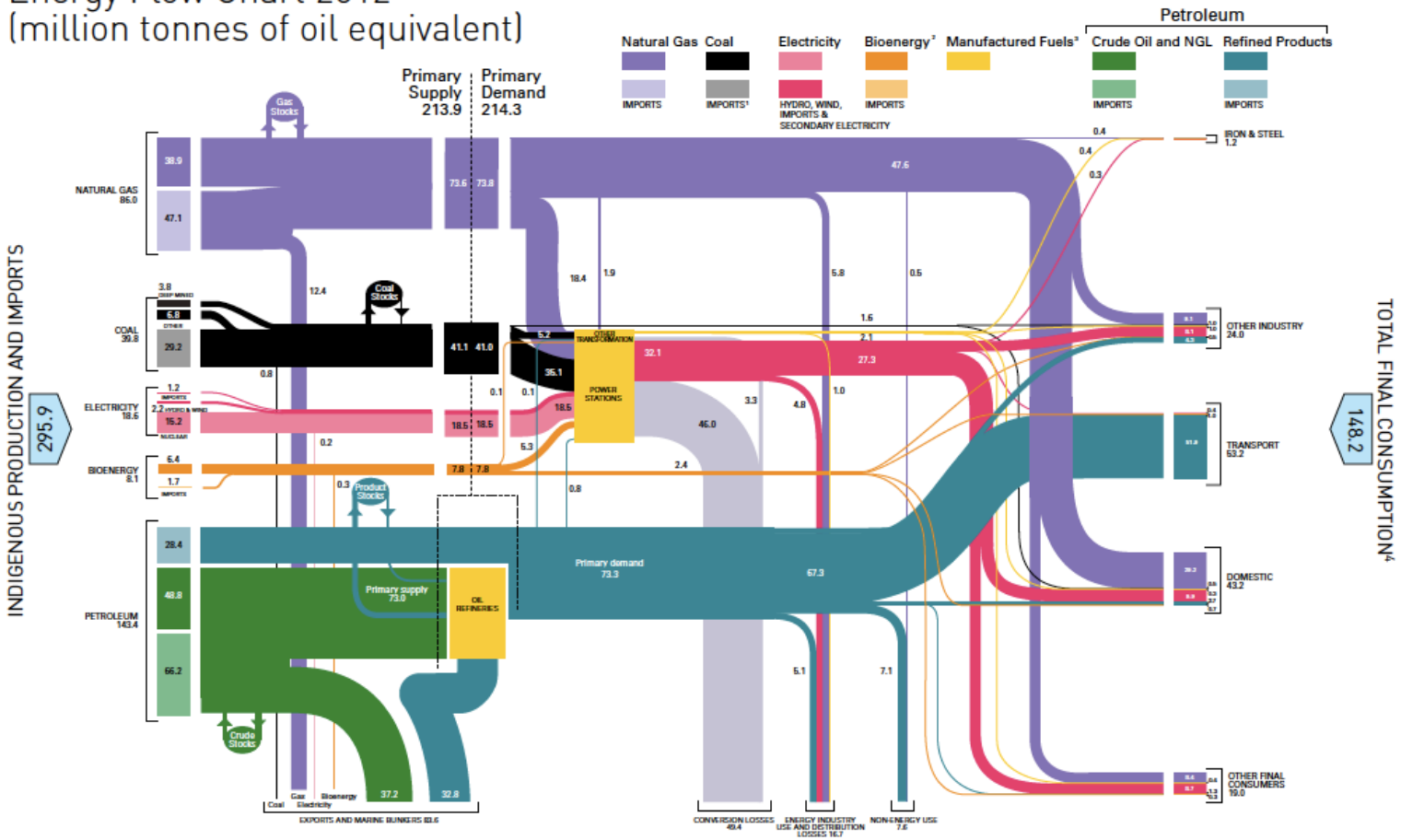


Annual energy use per person in UK (2010)



Digest of UK Energy Statistics 2013

Energy Flow Chart 2012
(million tonnes of oil equivalent)

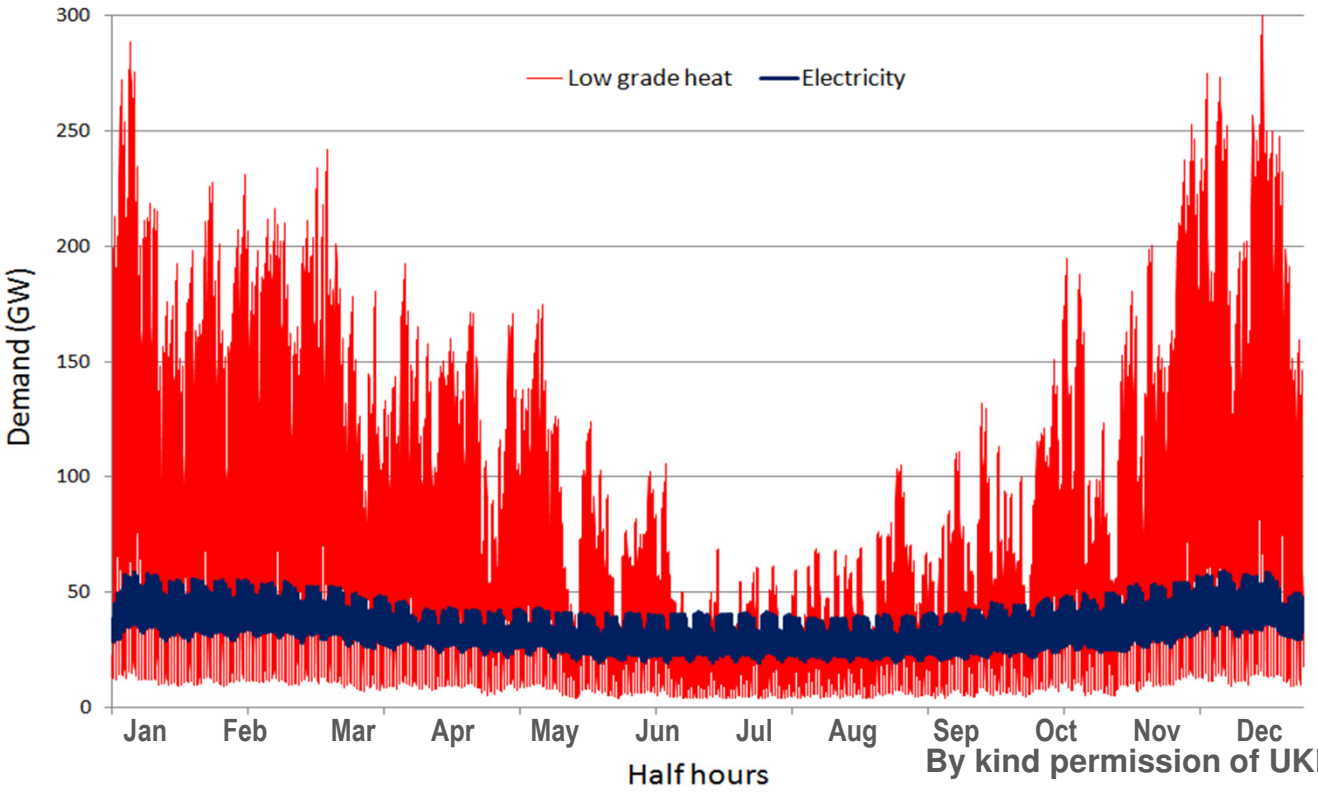


FOOTNOTES:
1. Coal imports include imports of manufactured fuels, which accounted for 0.1 million tonnes of oil equivalent in 2012.
2. Bioenergy is renewable energy made from material of recent biological origin derived from plant or animal matter, known as biomass.
3. Includes heat sold.
4. Includes 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.

Department of Energy & Climate Change

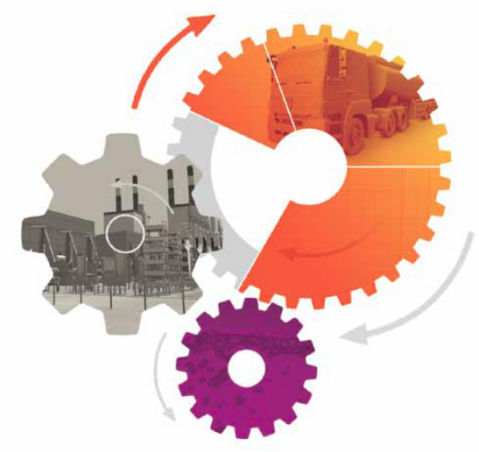
Variability (Duty Cycle) is very important



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

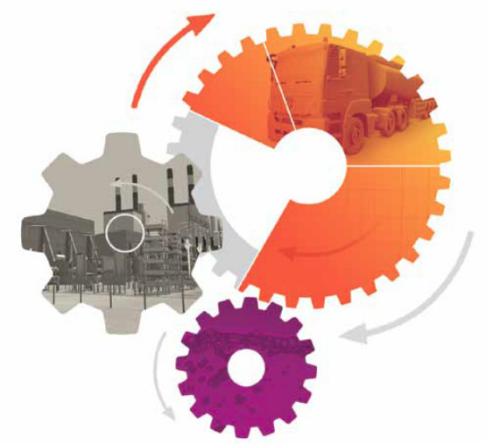
A focus is placed on national co-ordination of supply-side generation and shared national, regional and local infrastructures.

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.

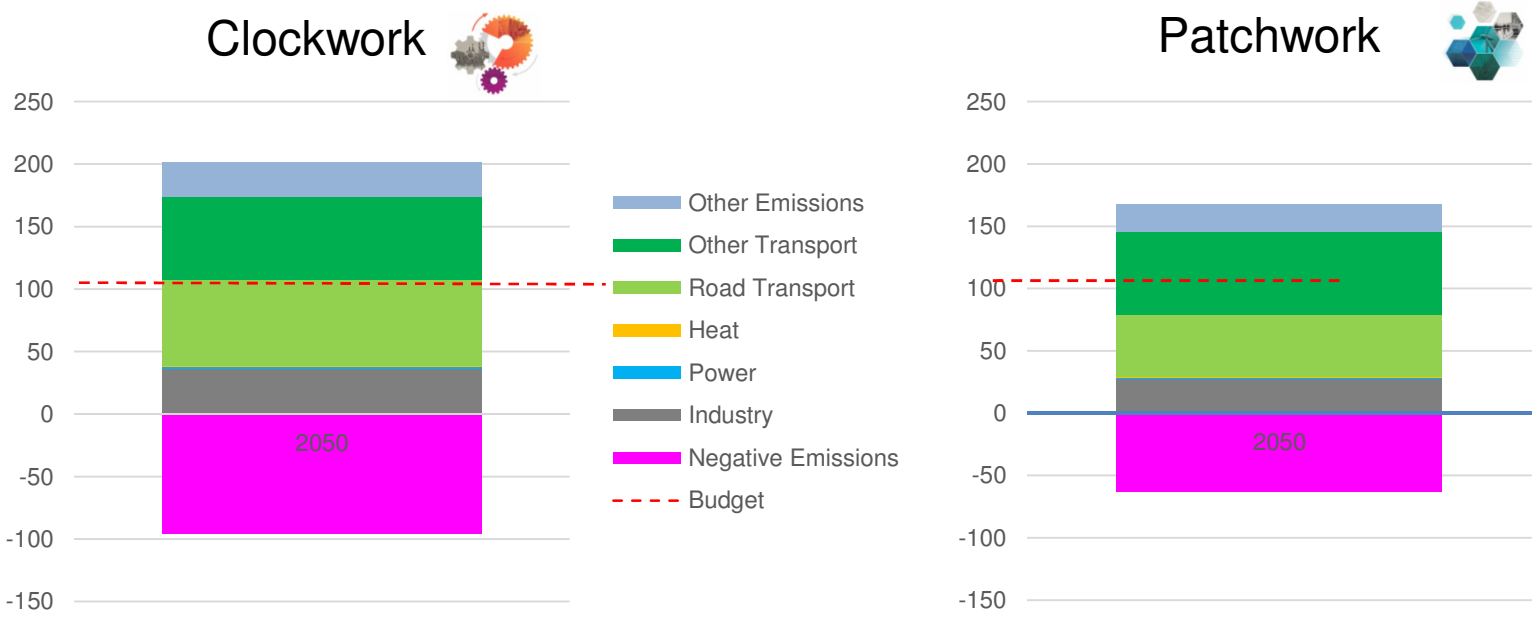
Renewables Optimism

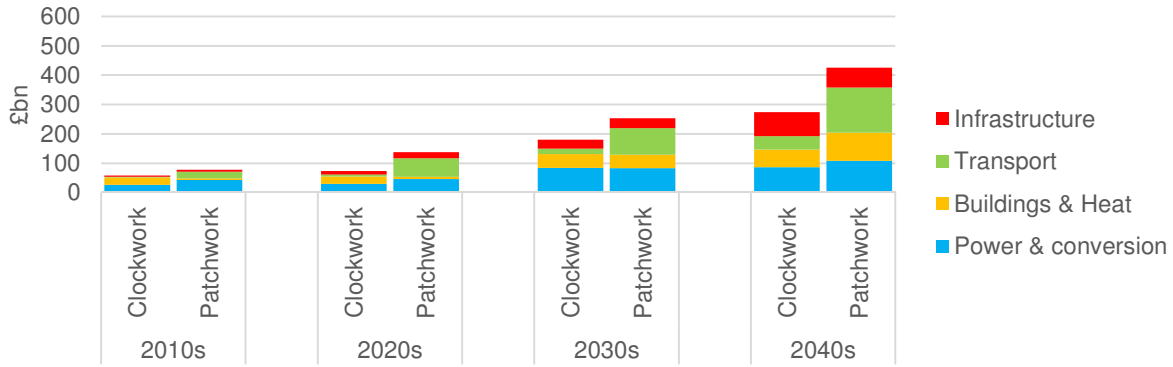
A focus on renewables drives offshore wind at large scale, supported by significant capacity of smaller-scale technologies.

Parallel Decarbonisation

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

Carbon pricing across the economy?





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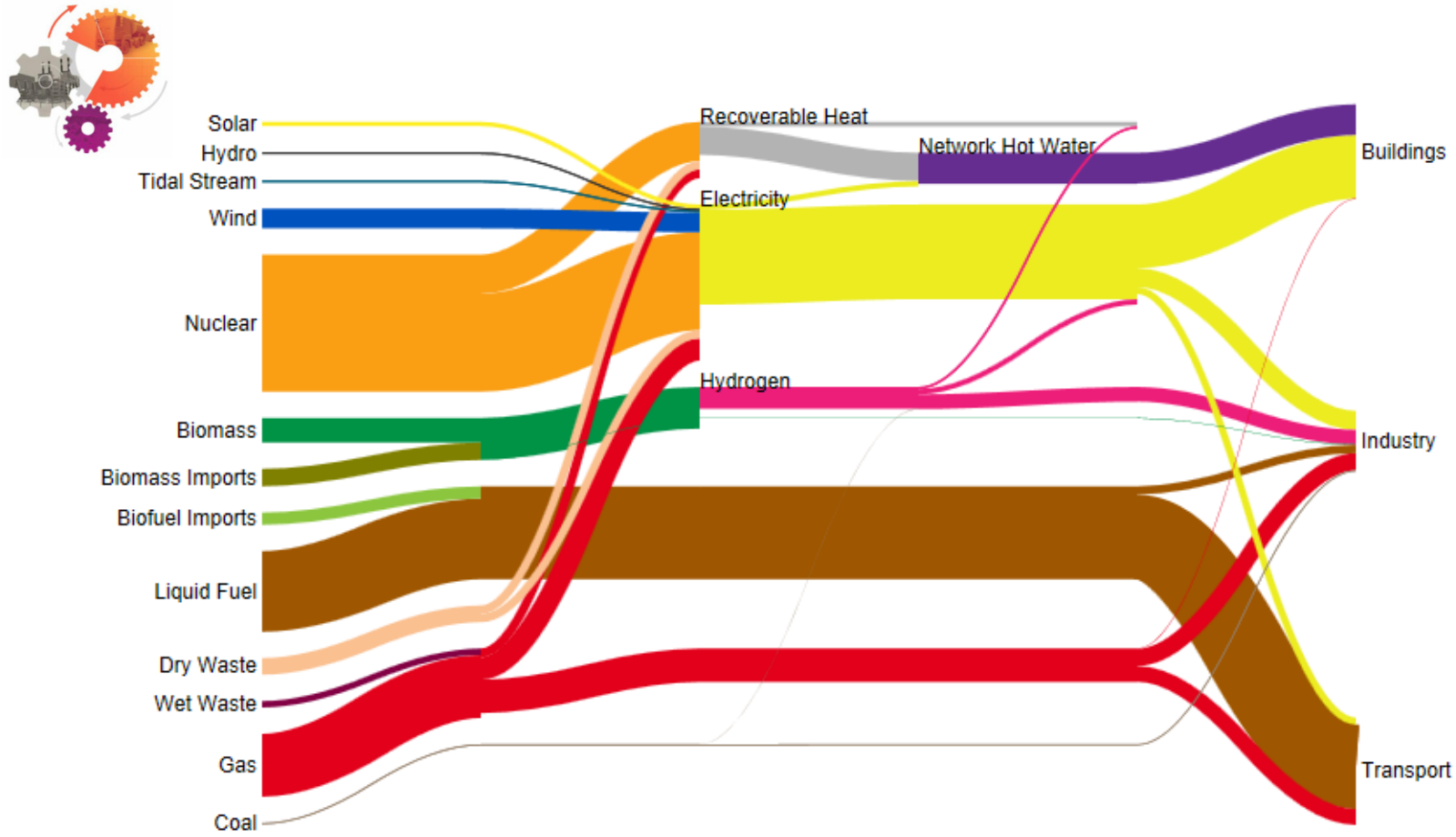

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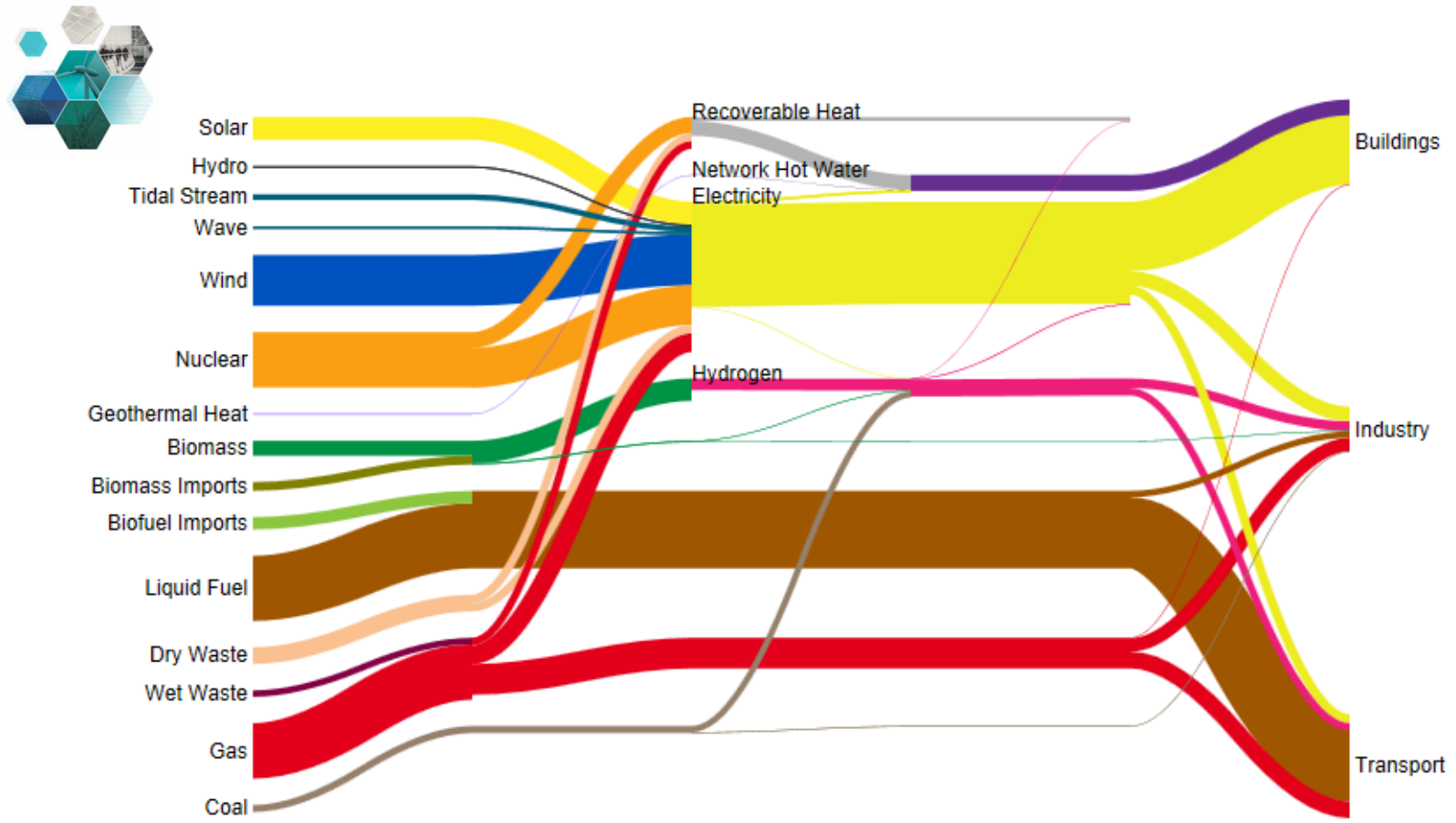

Impact on daily life

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

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