energy technologies institute

www.eti.co.uk

Transitioning the UK energy system to low carbon

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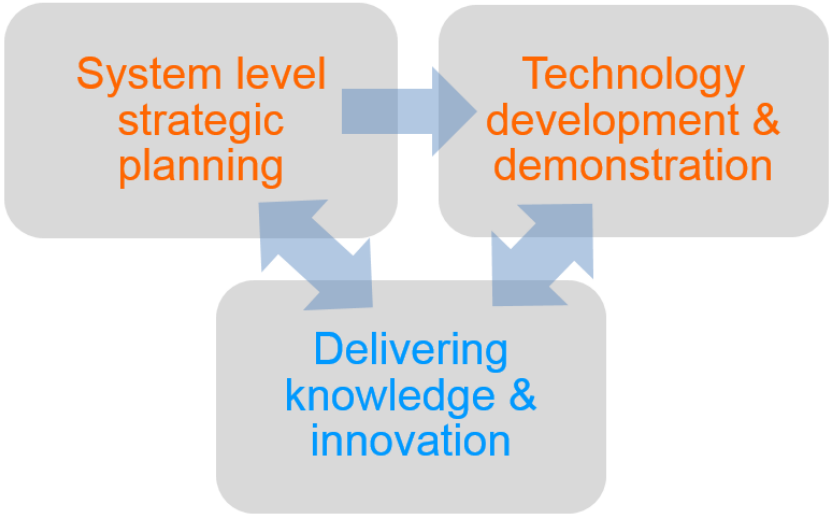
23rd November 2016

Topics

- Introduction to the ETI
- What the current UK energy sector looks like and trends over the last 30-40 years
- Why things will need to be (very) different in the future
- What the UK energy transition to 2050 might need to look like
- Implications and key messages

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

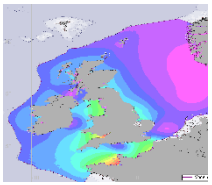
bp
CATERPILLAR®
EDF ENERGY
Rolls-Royce
Department for Business, Energy & Industrial Strategy
EPSRC Pioneering research and skills

ETI programme associate

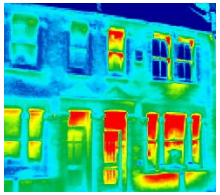
HITACHI Inspire the Next

ETI invests in projects at 3 levels…

Knowledge building



Marine
Simulated Marine Array Resource Testing – Now available from HR Wallingford



Smart Systems & Heat
Retrofit methods for improving building efficiency in existing housing stock

CO_2 Stored

Carbon Capture and Storage
First comprehensive UK CO_2 Storage database

Typically up to £5M, 2 years

Developing technology

Offshore Wind
Development and test of a modular 80m wind turbine blade

Transport
System optimised Continuously Variable Transmission - $7.5m

Energy Storage and Distribution
Development and grid connected demonstration of a pre-saturated core fault current limiter

Typically £3-15M, 2-4 years

TRL 3-5

Demonstrating technology and system solutions

Transport
Increasing efficiencies of HDV vehicles by up 30%

Carbon Capture and Storage
Development and Demonstration of system to monitor CO_2 stores for leaks

Bioenergy
Commercial development of Waste Gasification plants at 5-10MWe suburb level using commercial waste streams

Typically £5-25M+, 3-5 years

TRL 5-6+

ETI technology project examples

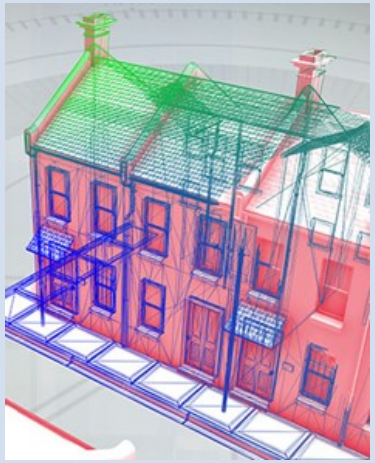
Current UK energy sector

Electricity

- Dominated by large-scale gas, nuclear and coal power stations; many coming to end-of-life or (in the case of coal) being phased out
- Increasing participation of renewables, especially wind and solar PV

Heat

- Gas-fired heating dominates across all building sectors
- Some electric, oil and other heating exists
- Incumbent technologies popular with consumers

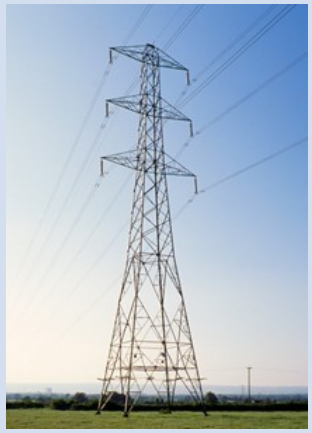


Transport

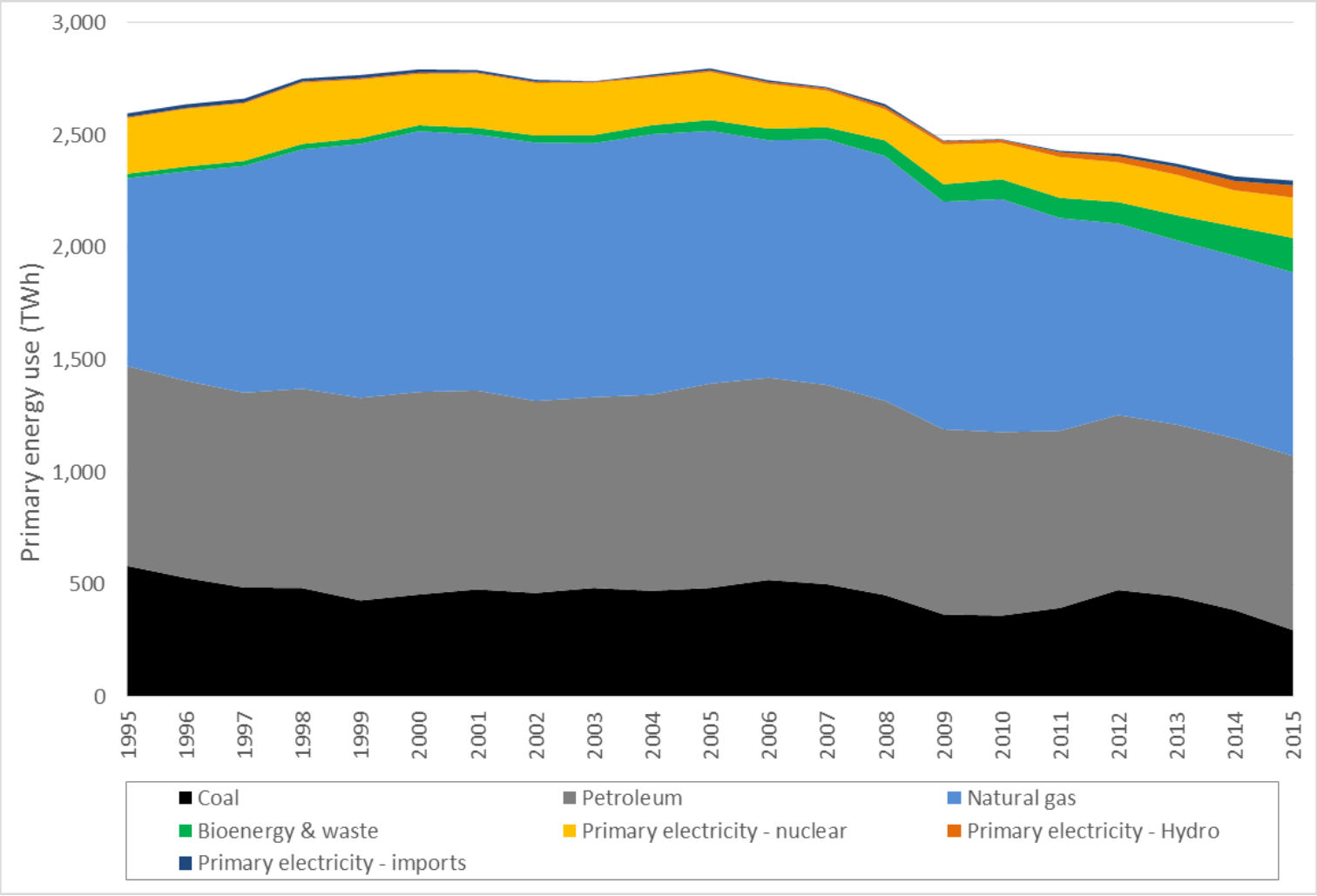
- Light vehicle fleet dominated by petrol & diesel fuels; some hybrids, fewer pure electric cars
- In HGVs diesel fuel predominates; gas is main lower carbon option – electrification very difficult

Infrastructure

- Well-developed electricity and gas networks, much of it developed in the 1960s and 1970s, managed by regulated monopolies
- Extensive and expanding road network; rail network not changing much
- Ongoing asset replacement programmes all over

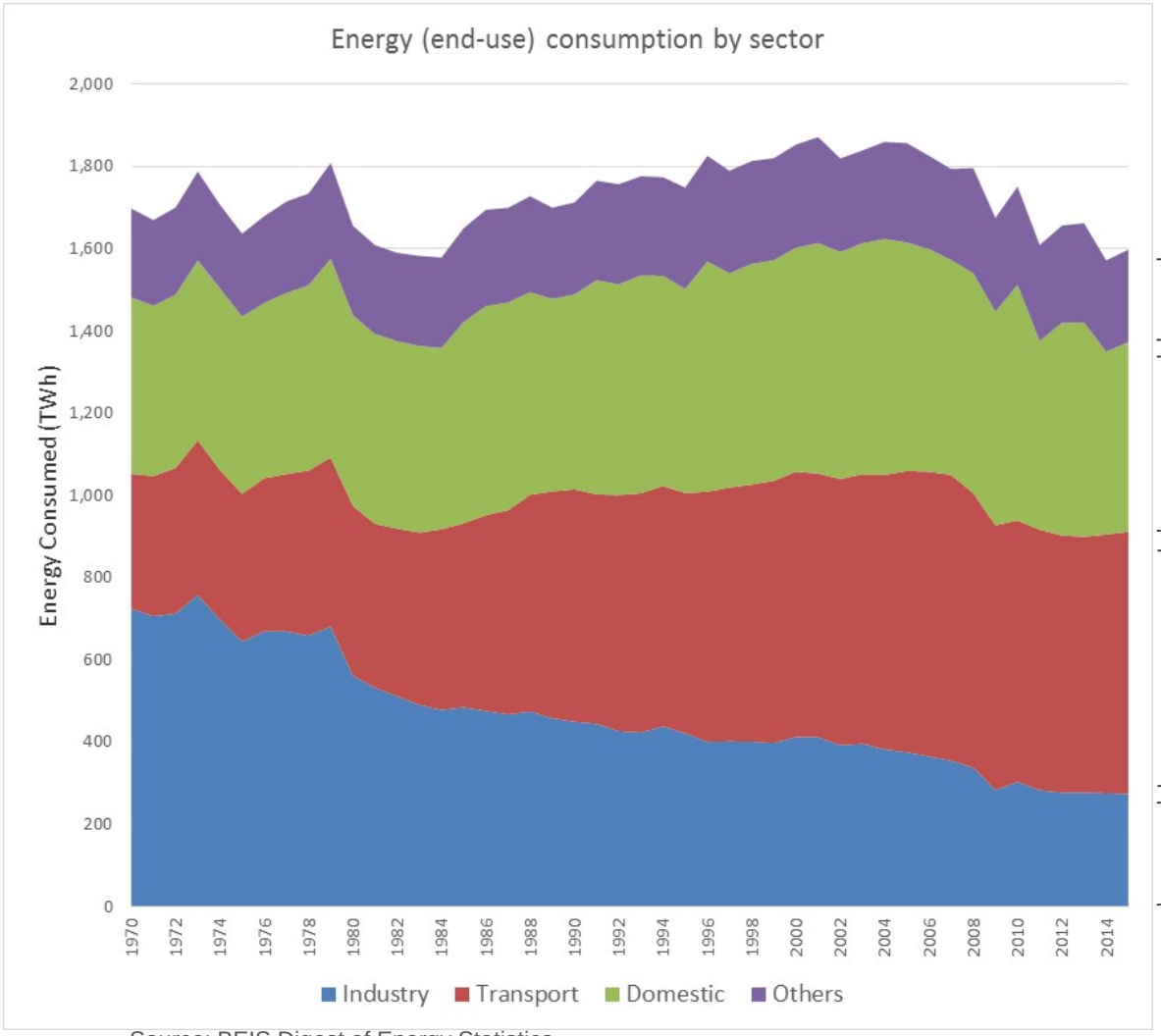


UK primary energy use trends



Source: BEIS Digest of Energy Statistics

UK end-use energy trends



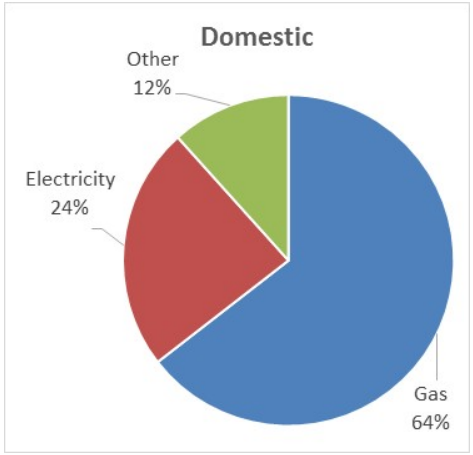
2015

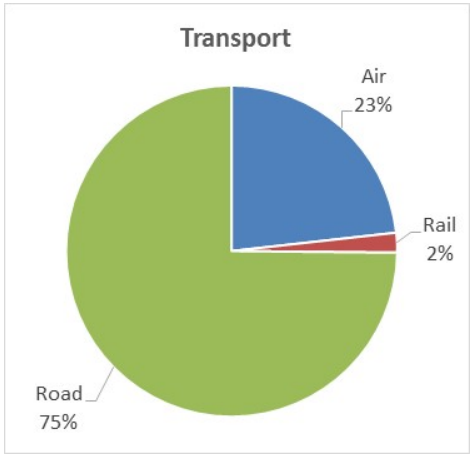
Others 14.1%

Domestic 28.8%

Transport 39.9%

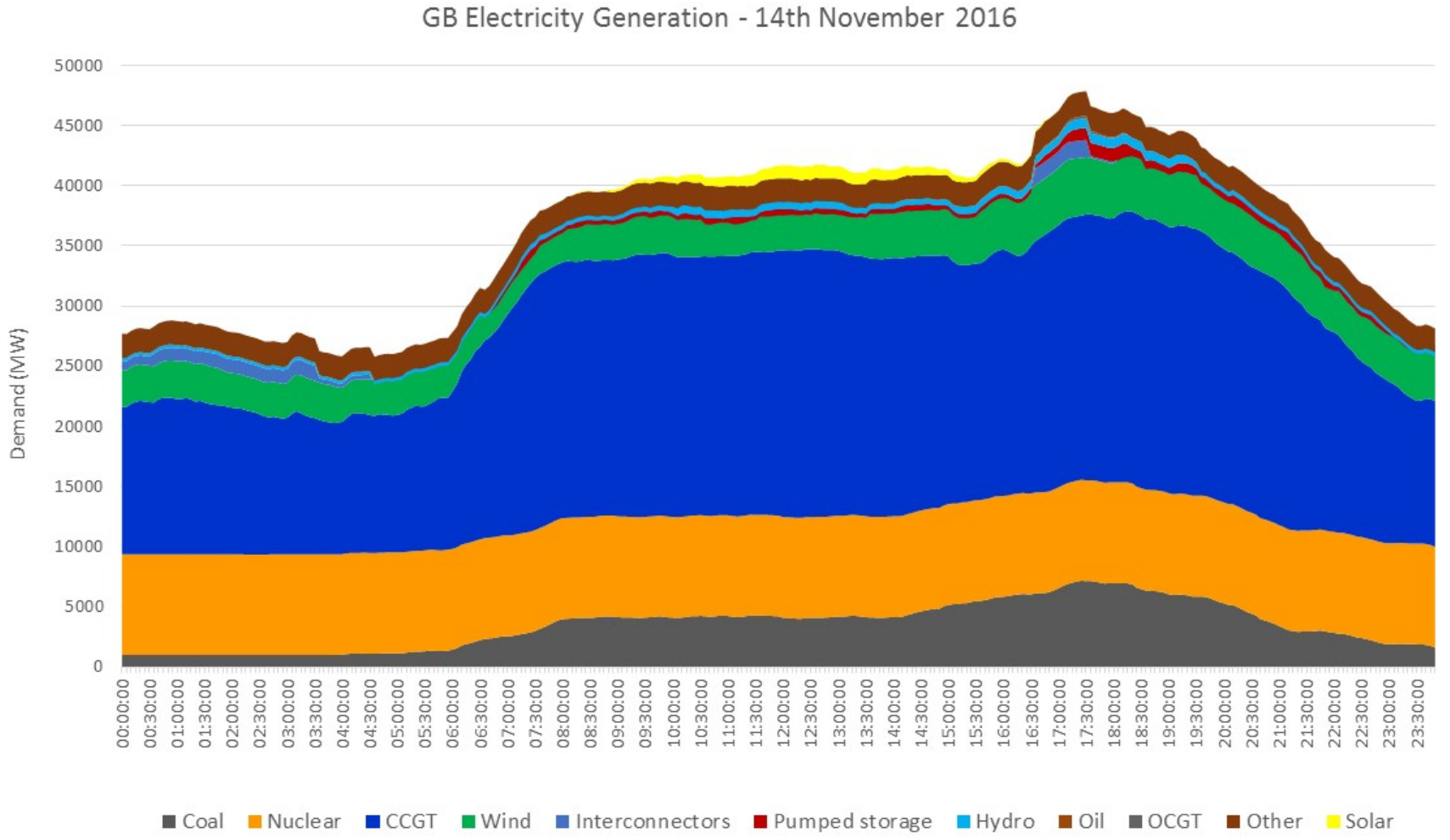
Industry 17.2%





Source: BEIS Digest of Energy Statistics

Daily electricity generation in GB



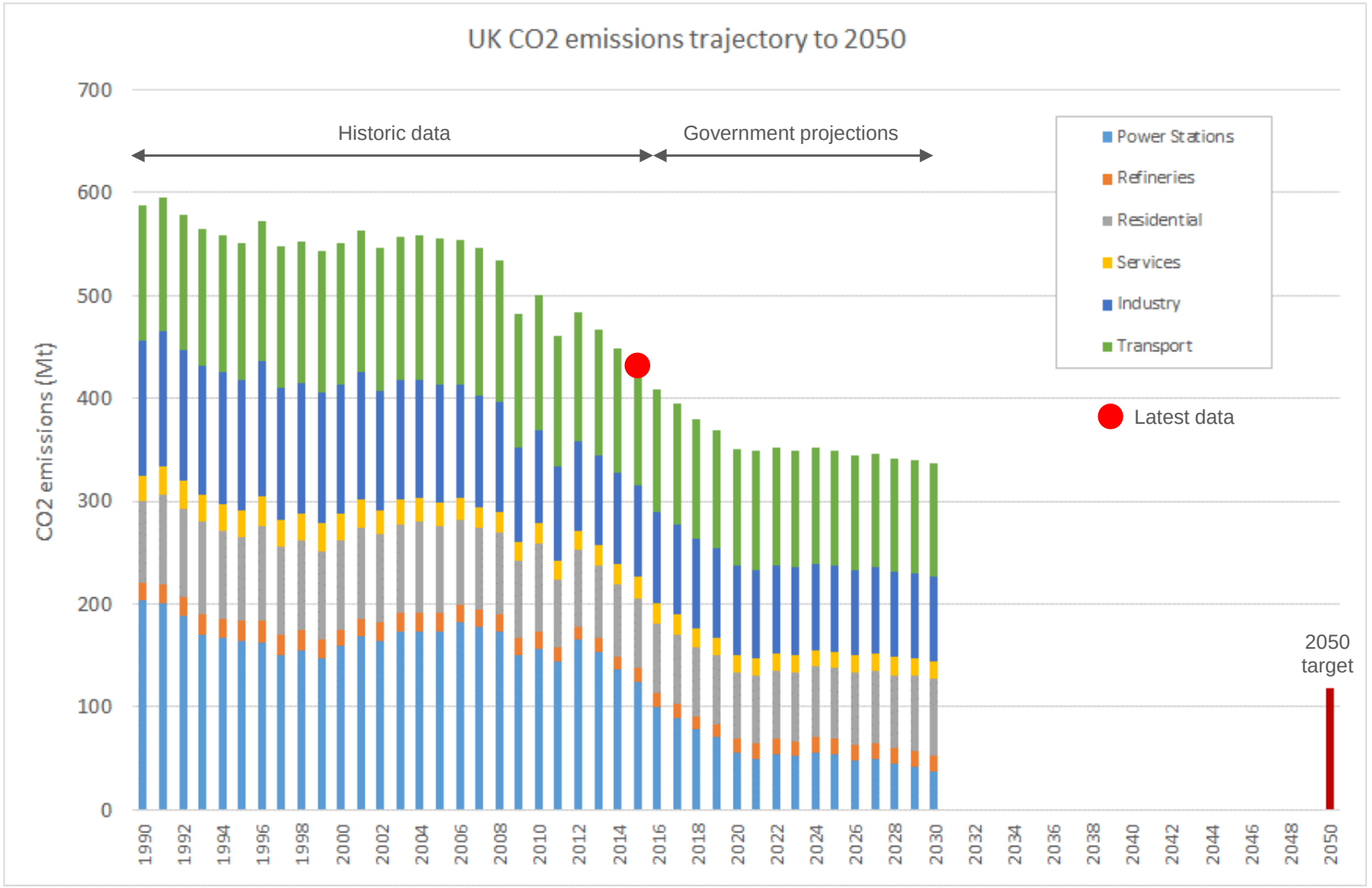
Source: Gridwatch (http://gridwatch.templar.co.uk/)

The UK energy challenge

UK target >> 80% GHG emissions reduction by 2050 (based on 1990 levels)

2010		2050
62 million people	→	77-79 million people
24 million cars	→	35-43 million cars
24 million domestic dwellings	→	80% still in use in 2050, growing to 38 million houses

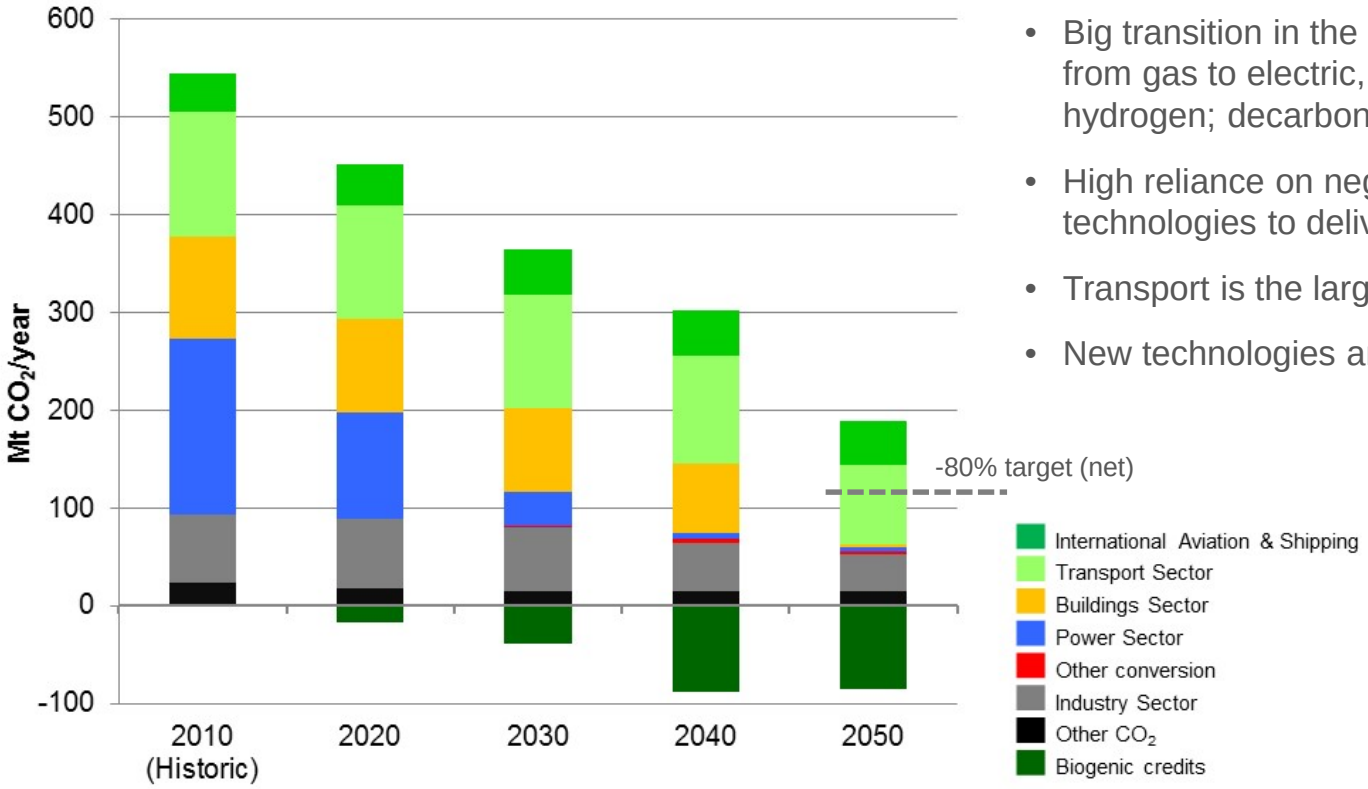
How are we doing so far?



Source: BEIS

One route to meeting -80% CO_2 for the UK

Cost optimal decarbonisation pathway - power now, heat next, transport gradual



Implications

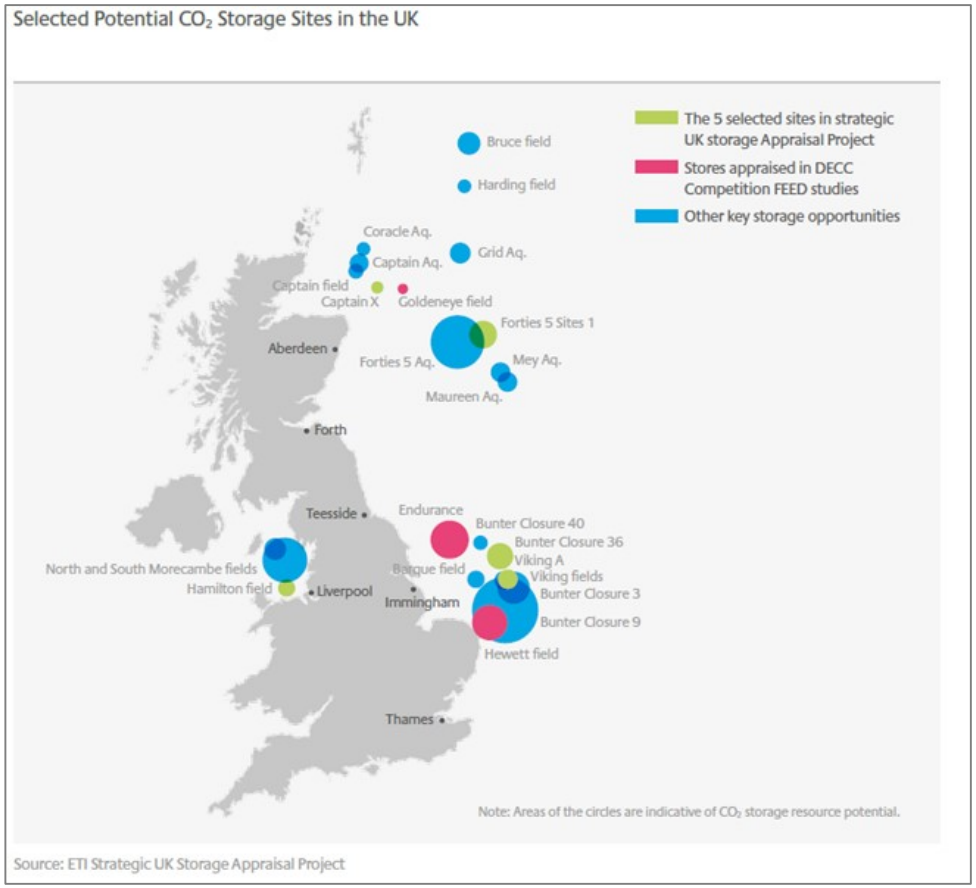
- Major interventions in the power sector needed immediately (renewables, nuclear...); decarbonised by 2040
- Big transition in the heat sector after 2020 from gas to electric, district heating or hydrogen; decarbonised by 2050
- High reliance on negative emissions technologies to deliver lowest-cost pathways
- Transport is the largest CO_2 emitter in 2050
- New technologies and innovation needed

ESME Energy System Modelling Environment

Key opportunities?

Carbon Capture & Storage

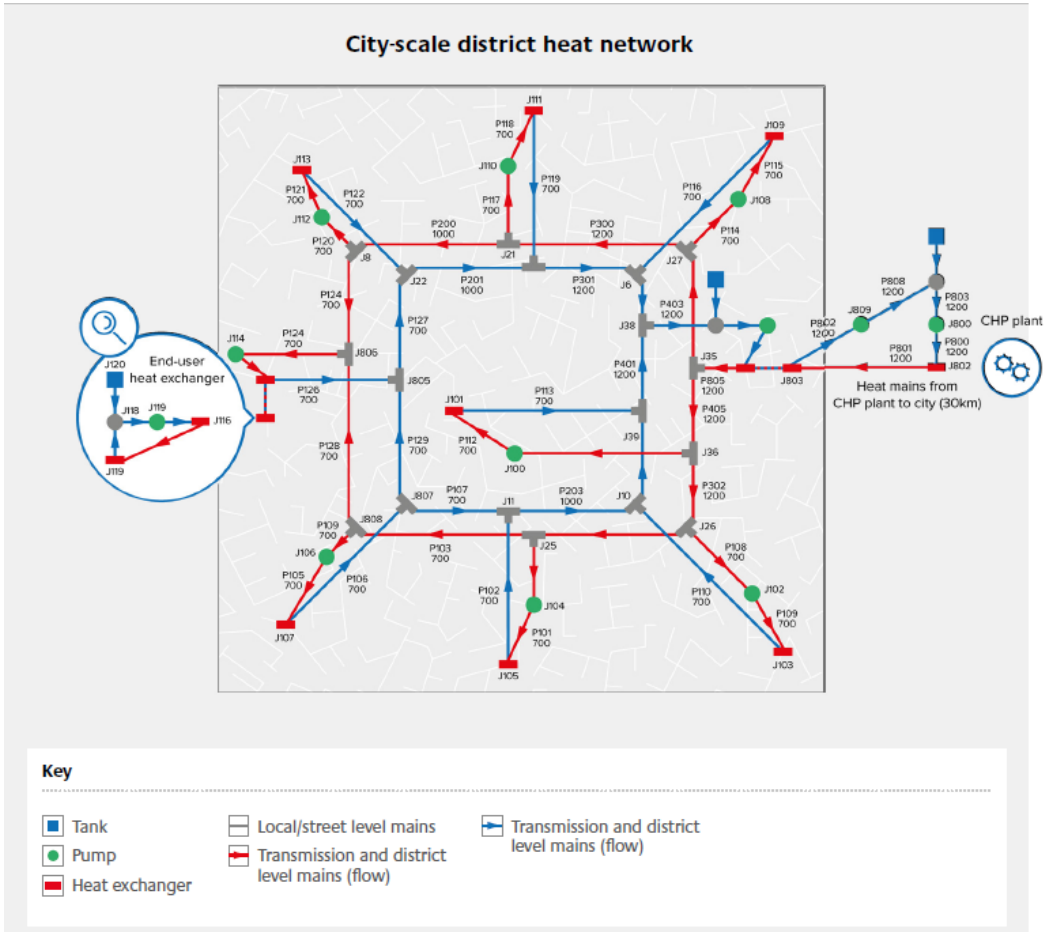
Boundary Dam CCS demonstrator, Saskatchewan



Source: ETI Strategic UK Storage Appraisal Project

Key opportunities?

District Heating

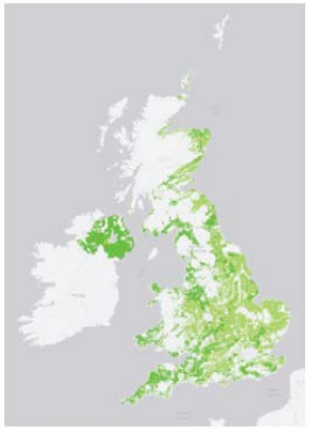


Key opportunities?

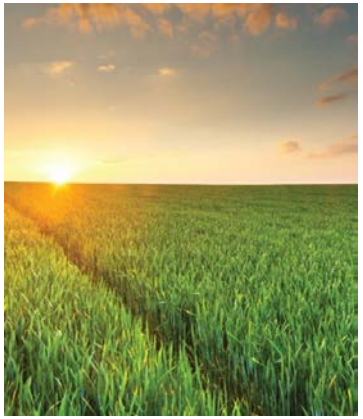
Bioenergy

A. Arable to Miscanthus

B. Arable to SRC-Willow



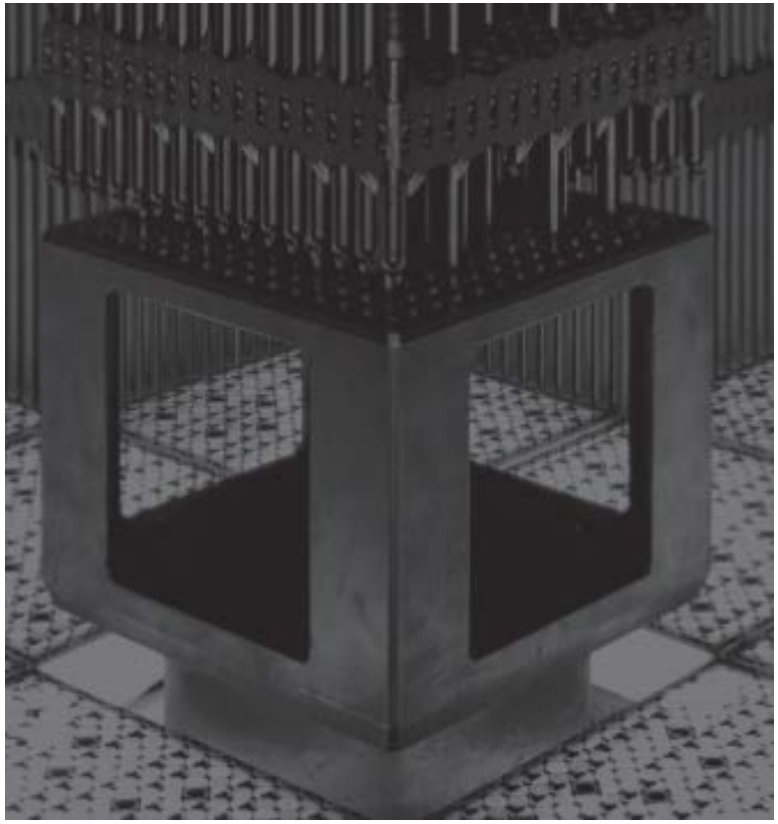
C. Arable to SRF (Poplar)



Offshore Wind

Key opportunities?

Small Modular Reactors



Hydrogen

ETI Scenarios

- UK energy system – power, heating, transport, industry & infrastructure
- Bound by Climate Change Act – 80% emissions reduction by 2050
- Building on several years of modelling, analysis and scenario development using ESME
- Devised in consultation with ETI members and stakeholders
- Launched on 4th March 2015

http://www.eti.co.uk/options-choices-actions-uk-scenarios-for-a-low-carbon-energy-system/

Key messages

1

The UK can achieve an affordable transition to a low carbon energy system over the next 35 years. Our modelling shows abatement costs ranging from 1-2% of GDP by 2050, with potential to achieve the lower end of this range through effective planning

2

The UK must focus on developing and proving a basket of the most promising supply and demand technology options. Developing a basket of options (rather than a single system blueprint) will help to limit inevitable implementation risks

3

Key technology priorities for the UK energy system include: bioenergy, carbon capture and storage, new nuclear, offshore wind, gaseous systems, efficiency of vehicles and efficiency/heat provision for buildings

Key messages

4

It is critical to focus resources in the next decade on preparing these options for wide-scale deployment. By the mid-2020s 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

High levels of intermittent renewables in the power sector and large swings in energy demand can be accommodated at a cost, but this requires a systems level approach to storage technologies, including heat, hydrogen and natural gas in addition to electricity

“ BY 2025, CHOICES MUST BE MADE REGARDING INFRASTRUCTURE DESIGN FOR THE LONG-TERM. CLOSING DOWN OUR OPTIONS TOO SOON COULD PROVE UNNECESSARILY COSTLY FOR THE UK, BUT THE BIGGER THREAT IS FAILING TO BUILD UP THOSE OPTIONS AT ALL ”

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