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Creating an affordable low carbon energy system for the UK

Mike Colechin



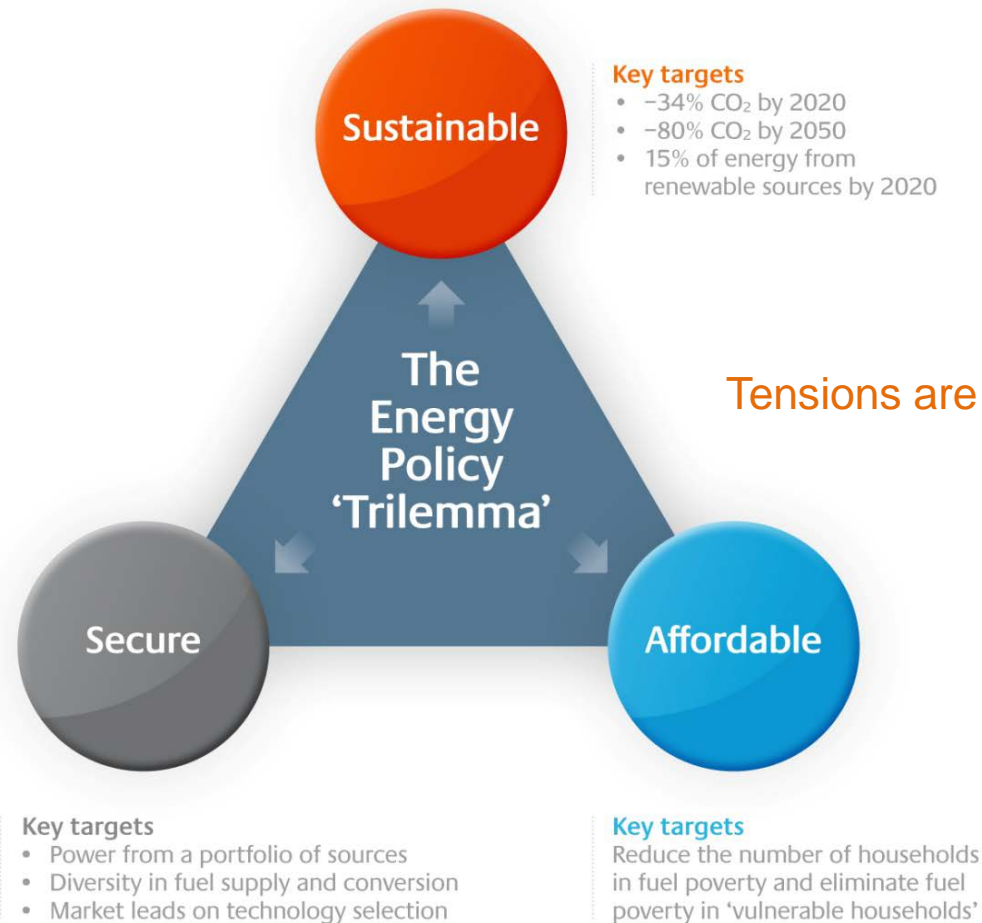
The UK energy challenge...

Demand is growing, assets are aging, prices are rising... irrespective of a CO2 reduction target

- 62m people growing to 77m by 2050
- 24m cars growing to 40m by 2050
- 24m domestic dwellings 80% will still be in use in 2050
total dwellings 38m by 2050
- Final users spent £124bn on energy in 2010 9% of GDP
- 2.4m English households in fuel poverty average 'fuel poverty gap' £438 and increasing
- Over 90GW generation capacity from 1MW to 3.9GW
- Over 200 'significant' power stations average age >20 years
- 50% of power generation capacity in 30 power plants
average age 30 years



The UK energy challenge...





The ETI...

The ETI is a public-private partnership between global energy and engineering companies and the UK Government.

- Providing new technology and business concepts
- Generating UK economic development
- Building better understanding of energy challenges
- A collaborating force
- Informing policy

ETI's industry and government partnership shares risk and creates affordability for development and demonstration of new technologies

ETI Members



CATERPILLAR



e-on



 **Rolls-Royce**



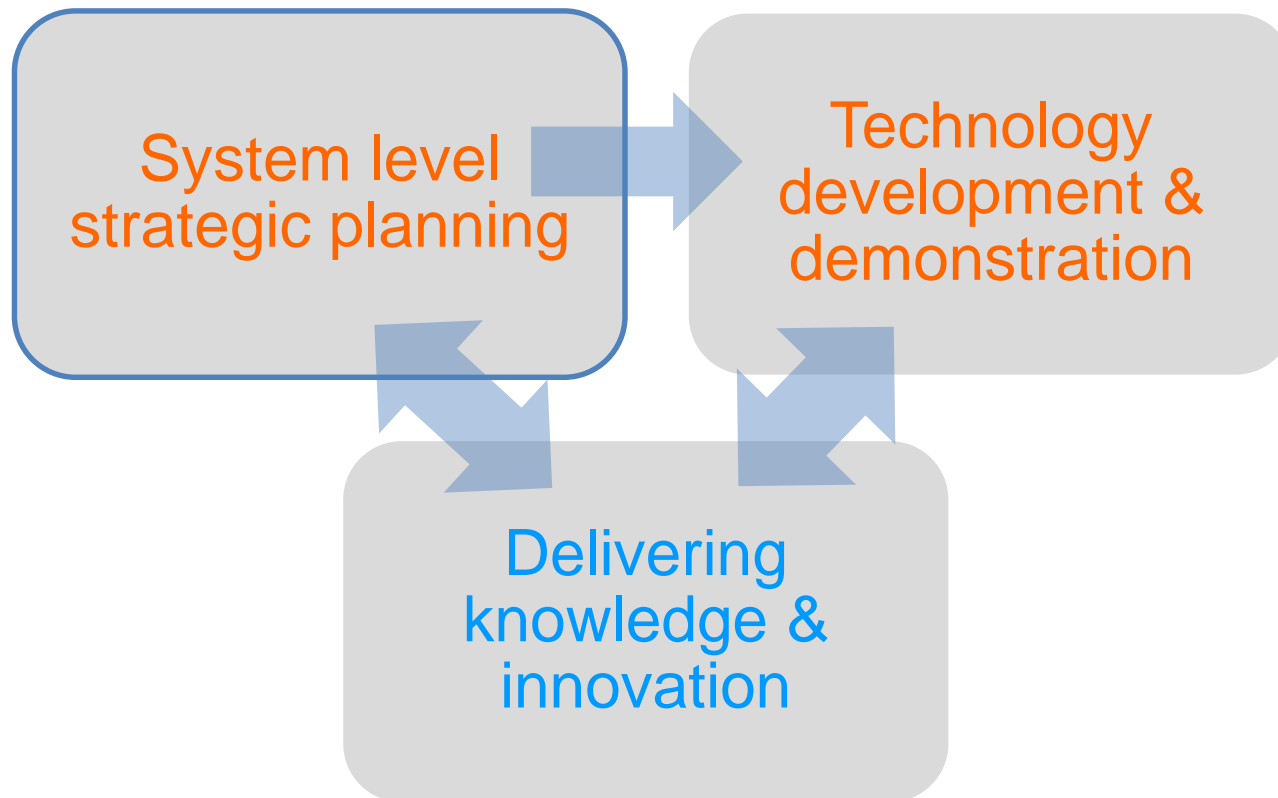
Innovate UK
Technology Strategy Board

ETI programme associate

HITACHI
Inspire the Next

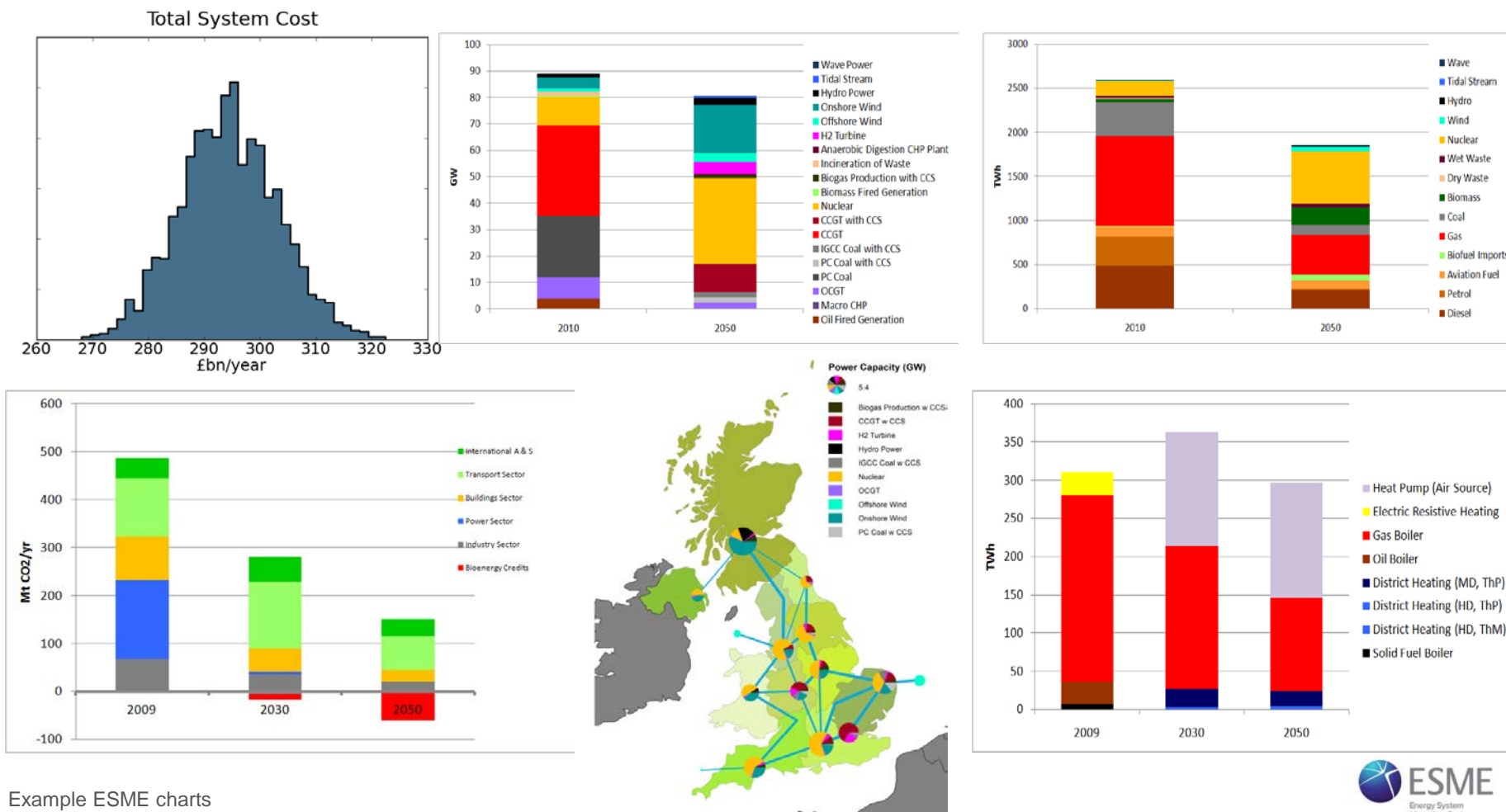


What we do...





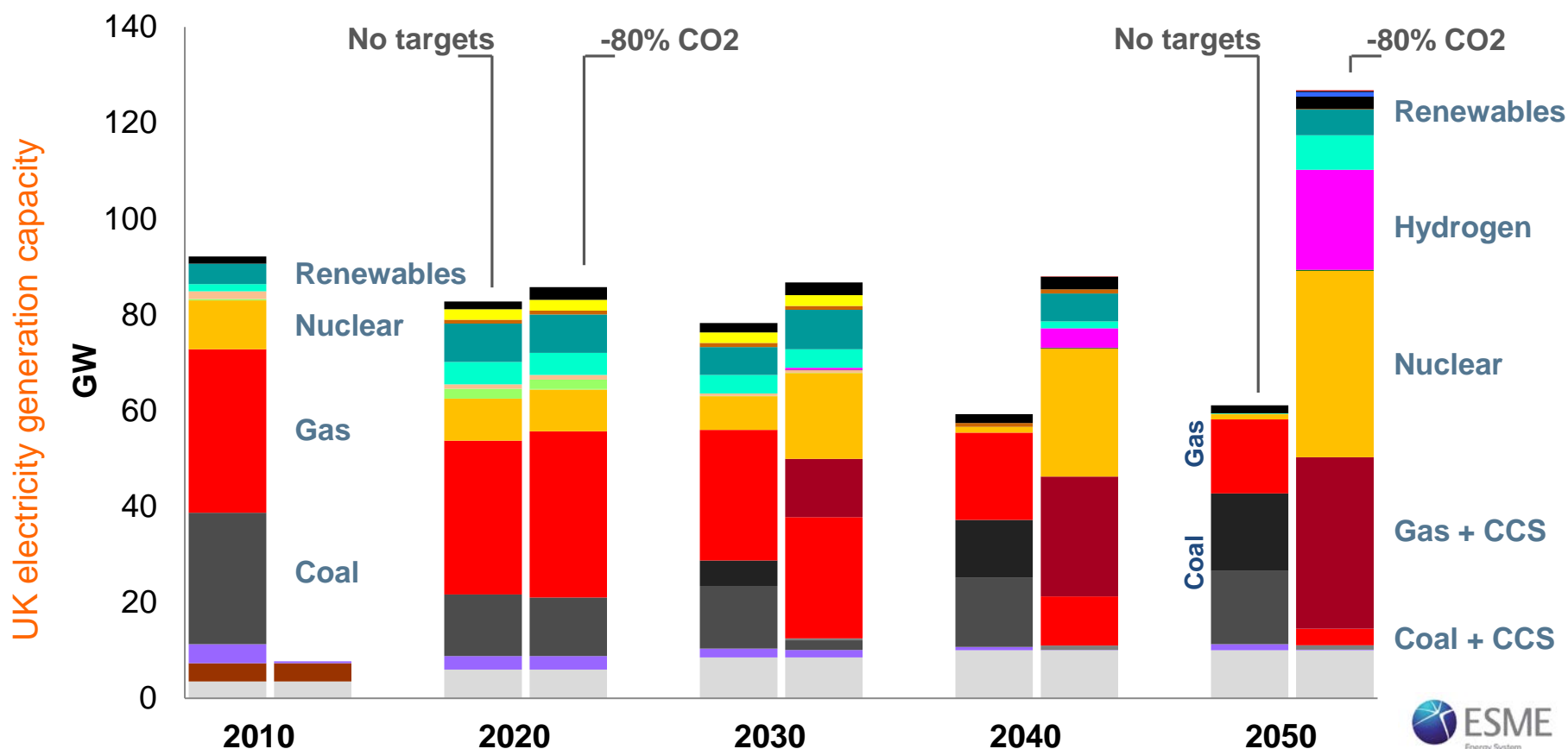
ESME – ETI's system design tool...



Example ESME charts

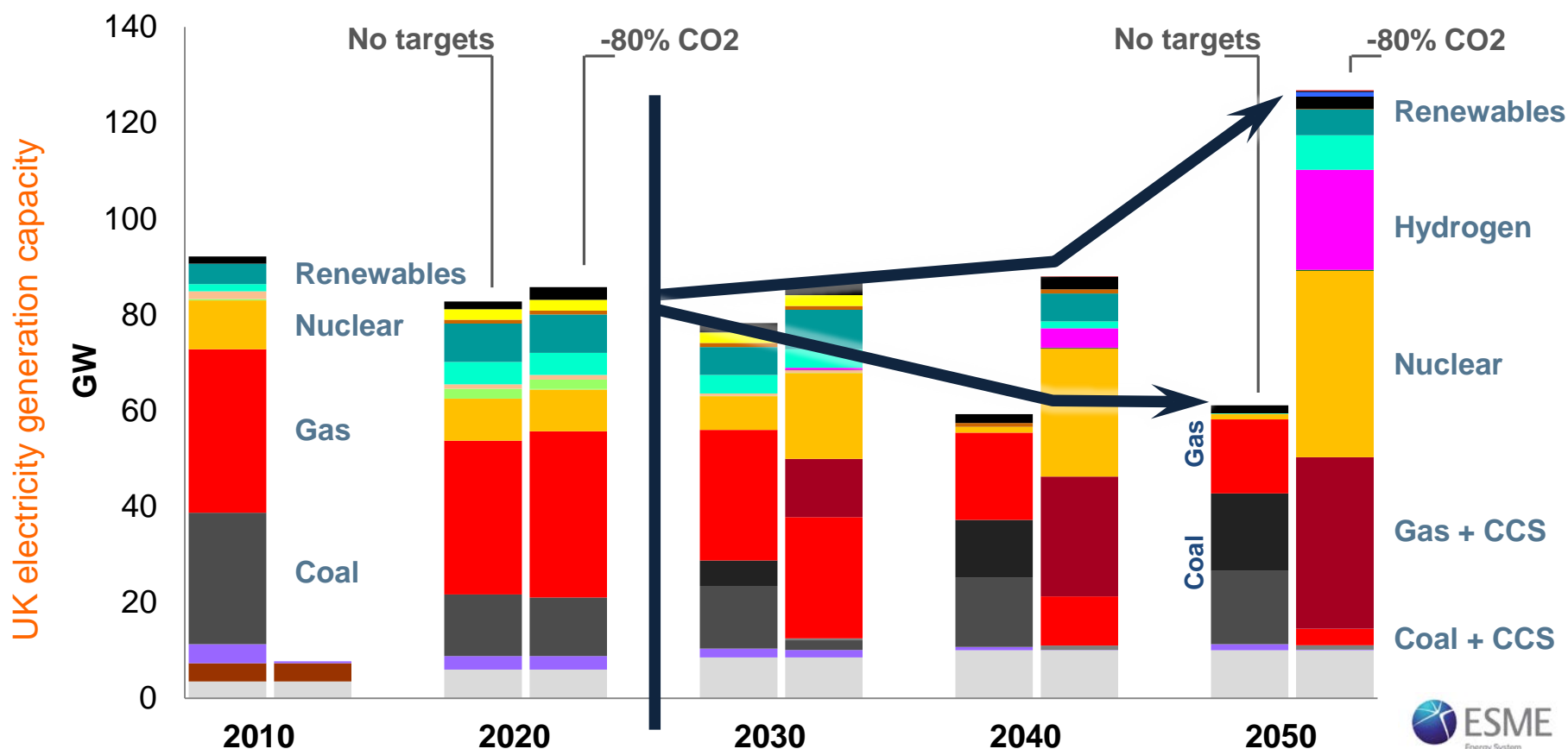


“No emissions targets” and “-80% CO₂ in 2050” are very different worlds...





As long as we prepare NOW, decisions on 2050 can wait... but not for long

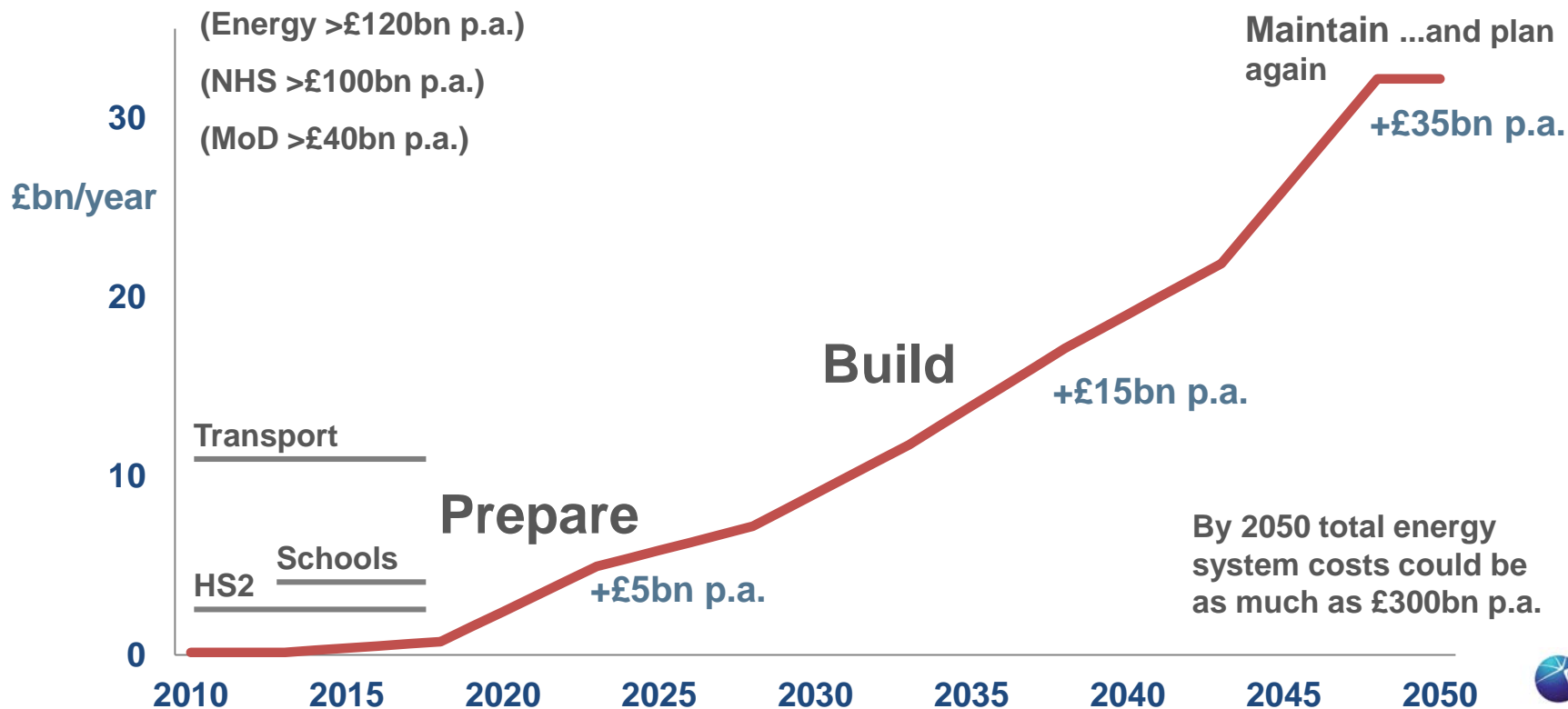




Prepare over next 10 years

creating platform for infrastructure roll-out and growth

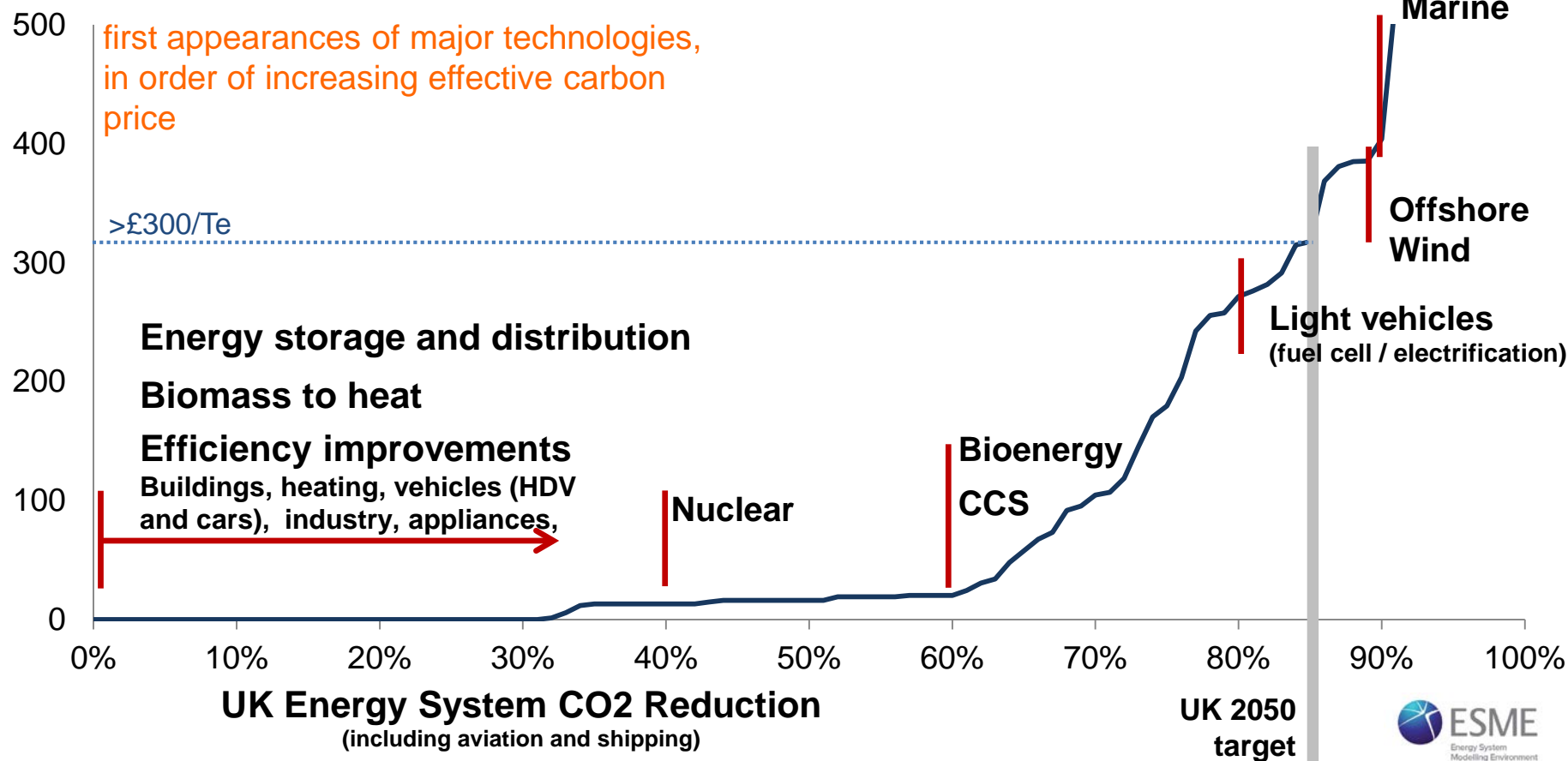
Incremental capital investment in a 'low-carbon'
energy infrastructure





Some options are more expensive...

2010 £/Tc CO₂

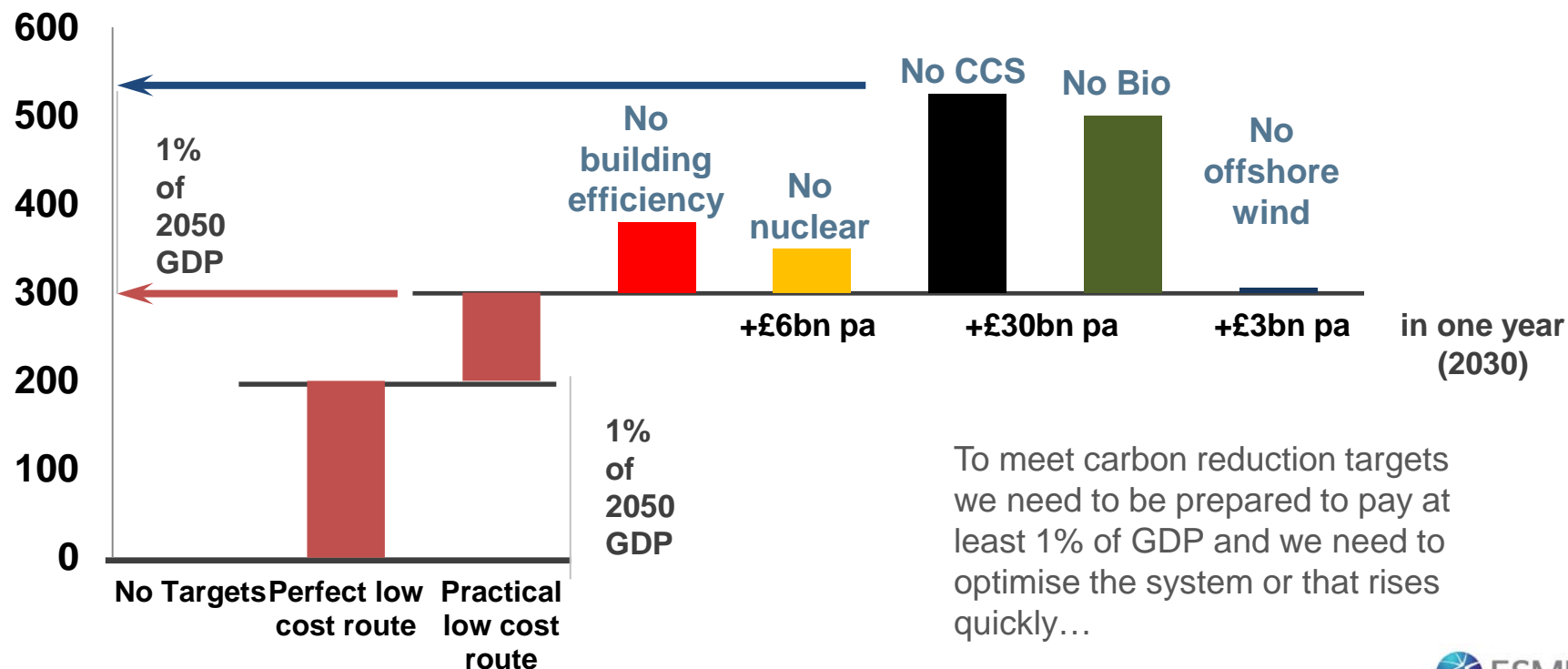




Poor system optimisation doubles the cost of a 2050 UK low carbon energy system

Additional cost of delivering -80% CO2 energy system

NPV £ bn 2010-2050





Key decisions and cost implications

- Direction change between “no targets” and “-80% CO₂” polarises in mid 2020s
- Key electricity decisions are national policy led programmes
 - **Nuclear new build**
 - **CCS**
- plus... local and individual consumer decisions on other critical areas - with major implications for distribution level infrastructure
 - **Heat delivery**
(gas, electricity, biomass, district heating)
 - **Transport**
(liquid fuels, electricity, hydrogen)

Delay in launch of major build programmes beyond mid 2020s **leads to cost increases of ~£5bn p.a.** as more costly alternatives are built

There are logical asset replacements (technically and financially) that ensure security, sustainability and lowest system cost

Efficiency improvement
(transport and buildings)

Gas

Offshore renewables

Bioenergy feedstock's
(for heat and power)

Nuclear

CCS
(fossil and biomass fuels)

all “no regrets” choices for the next 10 years



What we need...

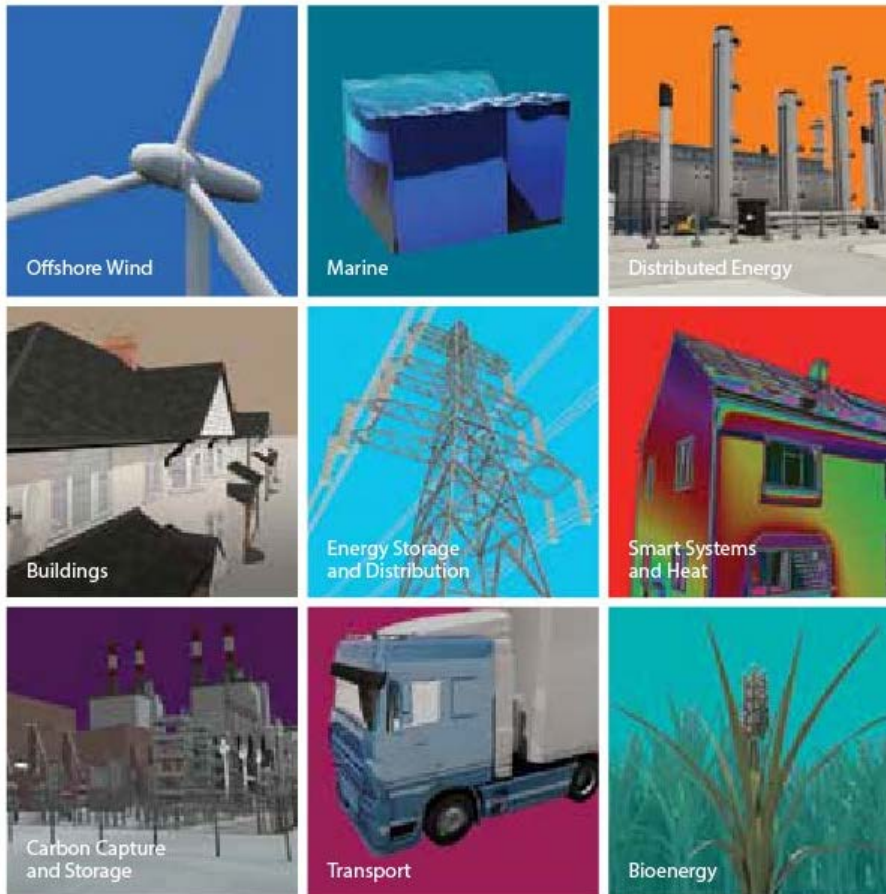
- Understanding of the drivers on future development
 - Costs
 - Supply capability and capacity (in a global market)
 - Infrastructure decisions
 - Investor requirements
 - Consumer needs/desires
- Clear market and value opportunities for investors and consumers
- Supportive and stable policy
- Consumer support

But... the future remains uncertain and we need an energy system design that allows for this

- Ready to make informed choices
- A system that creates and retains optionality
- Prepared for investment in a wide scale infrastructure roll-out
- Innovate to drive down cost (technology and business models)
- We need innovative incentives for industry to invest in the UK



ETI technology programme areas



Addressing UK Energy Development Priorities:

Efficiency

Systems and technologies for reducing cost and improving buildings and transport

Nuclear

Building supply-chain capacity and financier confidence

Gas

A critical fuel for power heat, storage and potentially for transport

CCS

System demonstration for capture, transport and storage

Offshore renewables

Reducing cost

Bioenergy

Creating the science, technology and business knowledge base for decisions on how to use bioenergy crops



Delivering innovation from strategic planning to technology demonstration

Knowledge building



Bioenergy

Multi-site field trial to study impact of bioenergy crops on soil carbonisation and greenhouse gas emissions – Reporting in 2014



Marine

Optimising wave and tidal array yields – Industry use from 2013 – Reporting in 2014



Carbon Capture and Storage

First comprehensive UK CO₂ Storage database – Delivered in 2013

Developing technology



Energy Storage and Distribution

New approach to storing electricity at scale – Testing up to 2017



Marine

3 phase 11KV Wet-mate connector with integrated communications – Delivered in 2012



Transport

Increasing efficiencies of HDV land and marine vehicles by up to 30% – Testing up to 2017

Demonstrating technology and system solutions



Offshore Wind

New designs for Floating turbine platforms – reducing generation costs – Tank testing and design completed in 2013



Bioenergy

Project profiling waste arising's in the UK – this is now progressing through a Waste Gassification project



Marine

1MW tidal generator providing environmental impact and performance – Operational in 2013



Knowledge building to...

- Inform industry decision making through commercially available projects
- Build a better understanding of decarbonisation potential in developing industries
- Inform policy debate

CCS Systems Modelling Toolkit

Project to support the future design, operation and roll-out of cost effective CCS systems in the UK

A modelling tool-kit capable of simulating the operation of all aspects of the CCS chain

Support initial conceptual design and eventual detailed design and operation of CCS systems





Developing technology to...

- Build supply chain capability
- Create economic opportunities
- Exploit UK technologies knowledge and skills

High efficiency SCR

.....
In supply from Caterpillar, Johnson
Matthey, Loughborough University

- £4.5m contract from ETI
- Visualisation rig operational Q3 2013 at Loughborough University
- Test cell and vehicle demo in 2016 (Caterpillar, Peterlee)





Demonstrating technology to...

- De-risk technology
- Accelerate low carbon technology innovation
- Build investor confidence

Energy from Waste

Project profiling waste arising's in the UK
Evaluated different conversion technologies

Identified technology development opportunities in
the area of gasification and gas clean up





ETI Insights

Developed from ETI projects and in-house analysis

Carbon Capture and Storage

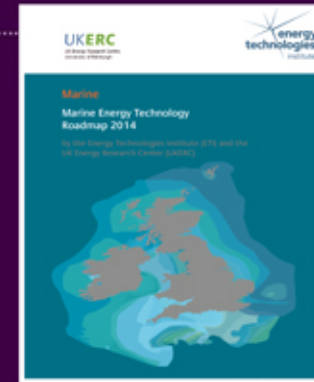
- » **Carbon Capture and Storage – Potential for CCS in the UK**
A demonstration of the system wide importance of CCS through its capability and flexibility to reduce carbon emissions from a large range of activities
- » **Optimising the location of CCS in the UK**
An examination of how informed decisions about CCS infrastructure location is critical to help keep costs and risks low
- » **A picture of CO₂ storage in the UK – Learnings from the ETI's UKSAP and derived projects**
An analysis providing estimates of the size and cost of equipping the UK with a CCS infrastructure which allows it to meet its 2050 climate change targets

Transport

- » **An affordable transition to sustainable and secure energy for light vehicles in the UK**
An analysis of the light vehicle market and its energy supply infrastructure to define a potential carbon transition path that is affordable, secure and sustainable for the UK

Marine

Marine Energy Roadmap
A roadmap developed by the UK Energy Research Centre (UKERC) and the ETI identifying the research and development areas that need to be addressed to make marine energy cost competitive with other energy technologies.



Available to download
at www.eti.co.uk



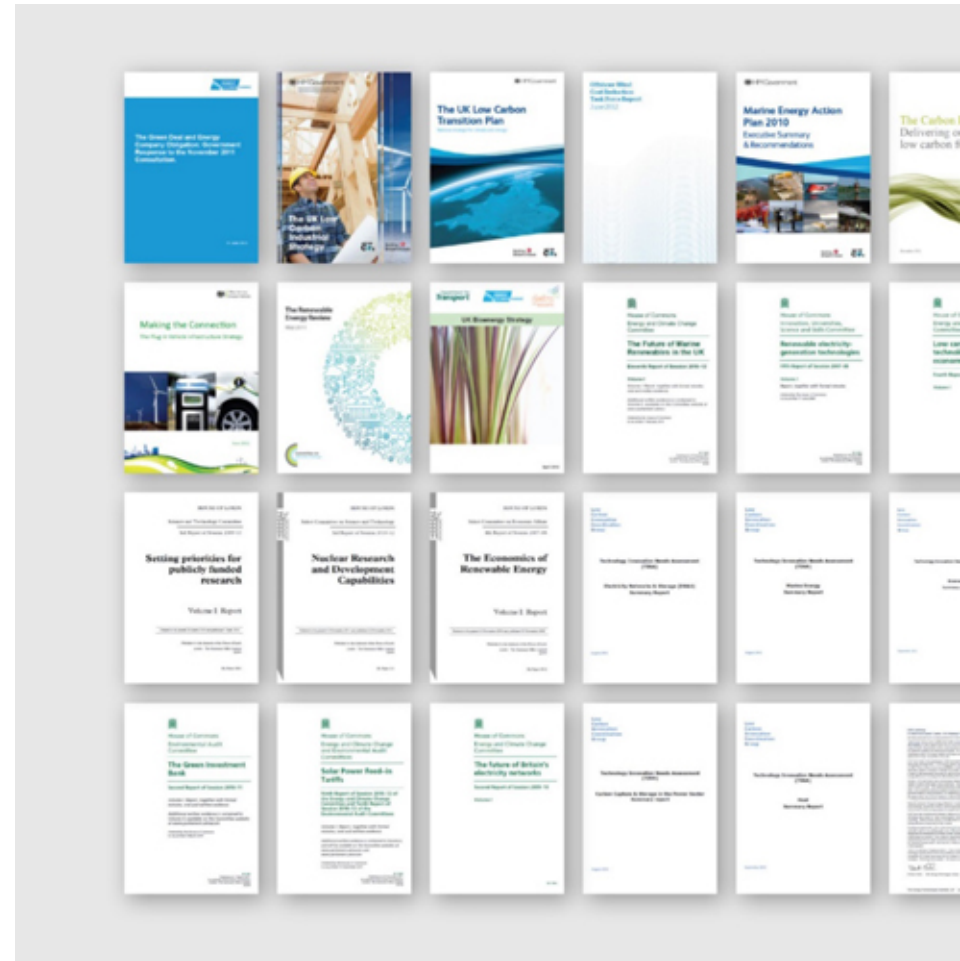
Informing policy to underpin market developments

49 UK Advisory boards with ETI staff members

13 Select committee appearances

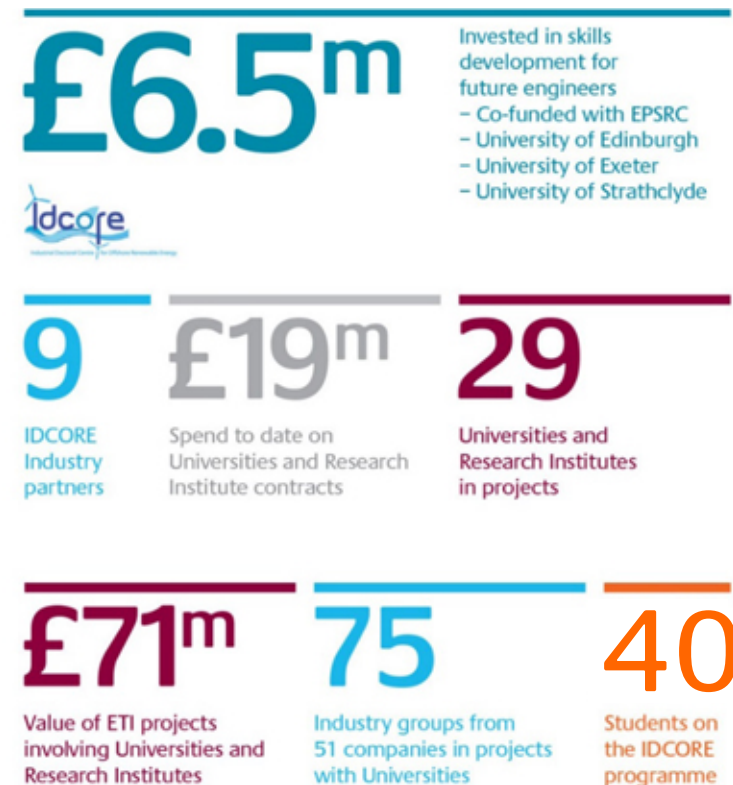
41 Responses to Government consultations

79 Third party policy documents referencing ETI insights





Academic research partnership building knowledge and developing skills





The next five years

Transport

Accelerating the introduction of fuel efficient technologies into the market through research and development work that benefits the industry

Offshore Wind

Very long blade

Next generation high performance wind turbine blade development

- In development by Blade Dynamics for test from 2015



Engaging the Sector

Economic and commercial impact

- Increased support for business development as well as technology development
- Increased engagement with supply chain partners and co-funders on major demonstration projects

Offshore Wind

Floating Wind Turbine Platform

- Design of an offshore floating platform able to deliver lower cost electricity through increased availability in higher wind speed, deep water areas
- Wave tank testing complete and no issues identified with the model
- Site development underway off the South West of England



Carbon Capture and Storage

Next Gen Capture Systems

Focus on lower cost capture technology for gas fired power stations

Transport

Developing and demonstrating innovative, efficient vehicle and vessel concepts using new component technologies

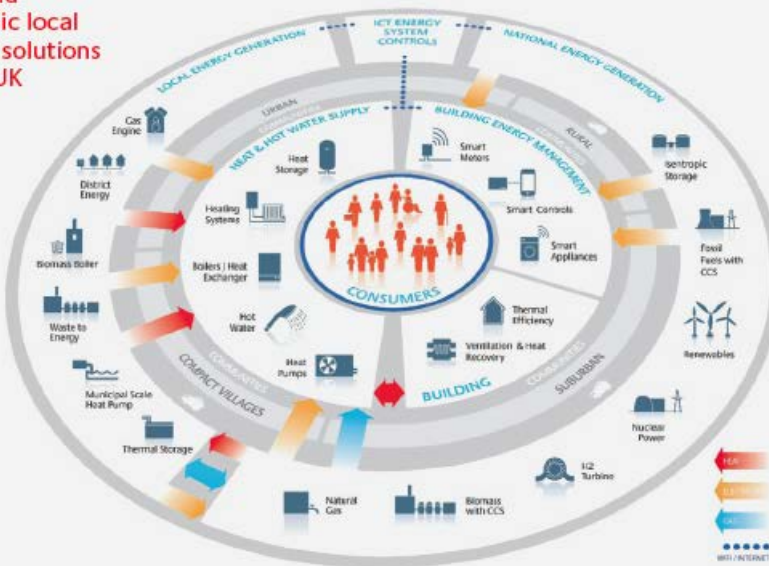




The next five years

Smart Systems and Heat

- Creating future proof and economic local heating solutions for the UK



Bioenergy

Waste Gasification

- Competition to design and build the most efficient, economical and commercially viable waste gasification demonstrator plant

Energy Storage and Distribution

Grid scale energy storage

- Substation scale electricity storage as heat
- In development for UK substation test



Industry Growth

Skills development

- Developing supply chain capabilities
- Investing in future engineers through the IDCORE programme
- Linking academia and industry



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