

UK energy infrastructure: Investment, transition and long-run growth

LSE Growth Commission, 23 May 2012

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Context: Energy use is socially essential but currently unsustainable

“Energy capture is the foundation of social development. At the lowest level, insufficient energy capture (for adult humans, roughly 2,000 kilocalories per adult per day...) means that individuals slow down, lose body functions, and eventually die. To clothe, house, and reproduce themselves, and to extend their power at the expense of other communities, however, humans have to capture more energy (in the case of the US in 2000, for instance, around 230,000 kilocalories per person per day). Energy capture must be the starting point for any discussion of social development.” Ian Morris, *Social Development*, 2010 (<http://ianmorris.org/docs/social-development.pdf>)

“Reliable and affordable energy is essential for meeting basic human needs and fuelling economic growth, but many of the most difficult and dangerous environmental problems at every level of economic development arise from the harvesting, processing and conversion of energy. ... Facing the menace of growing human caused disruptions of climate change, civilization has only three options: mitigation, adaptation and suffering from impacts not averted by either mitigation or adaptation. ... Avoiding increases in suffering that could become catastrophic will require large increases in efforts devoted to both mitigation and adaptation.” John Holdren, Presidential Address, American Association for the Advancement of Science, 18 February 2007

Key evidence points

1. UK energy infrastructure and long-run growth

- Evidence of significant positive impacts of electricity generation capacity on UK productivity growth
- UK energy infrastructure compares well internationally, but there are ...
- ... major investment needs and opportunities that are spread across UK regions

2. Energy transition and UK policies

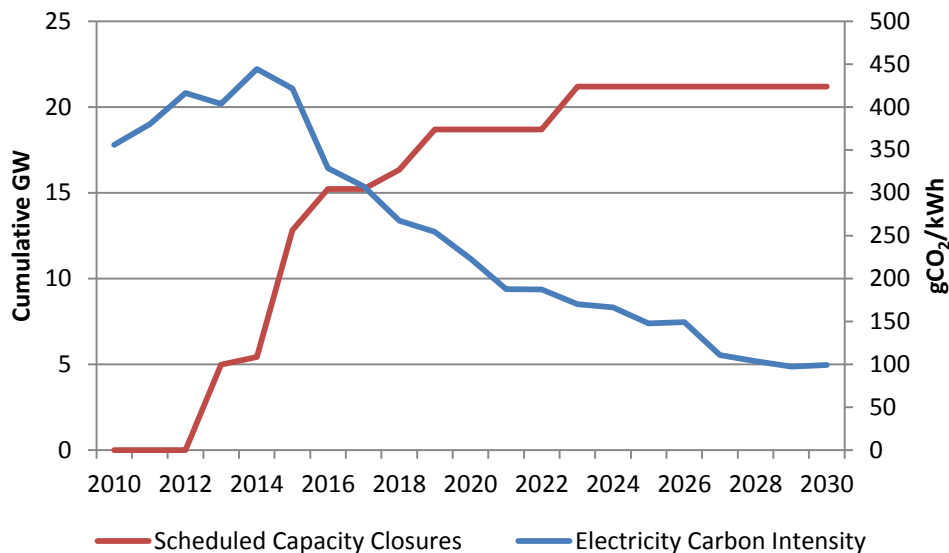
3. UK energy transition and long-run growth

Comparative evidence on UK energy infrastructure and long-run growth

- Egert, Kozluk and Sutherland (OECD, 2009) shows that investment in infrastructure including energy can have a stronger positive effect on GDP per capita than other forms of investment
 - Based on annual and multi-annual growth regressions for OECD countries
 - While there are no common effects of infrastructure on growth across OECD countries, country- and sector-specific effects are significant
 - Significant evidence of positive impact of expansion in UK electricity generation capacity in cross-country growth regressions
- International rankings of UK energy infrastructure are mixed
 - Global Competitiveness Report ranks **quality** of UK electricity supply 4th in EU
 - UK domestic electricity prices are amongst the lowest in the EU, while electricity prices for industrial users are in the middle of the EU range
 - Very high system reliability (99.9999%)
 - But Doing Business ranks **access** to UK electricity supply 54th in the world
 - Relatively long time to connect to the network and high connection costs

UK energy infrastructure investment priorities and opportunities

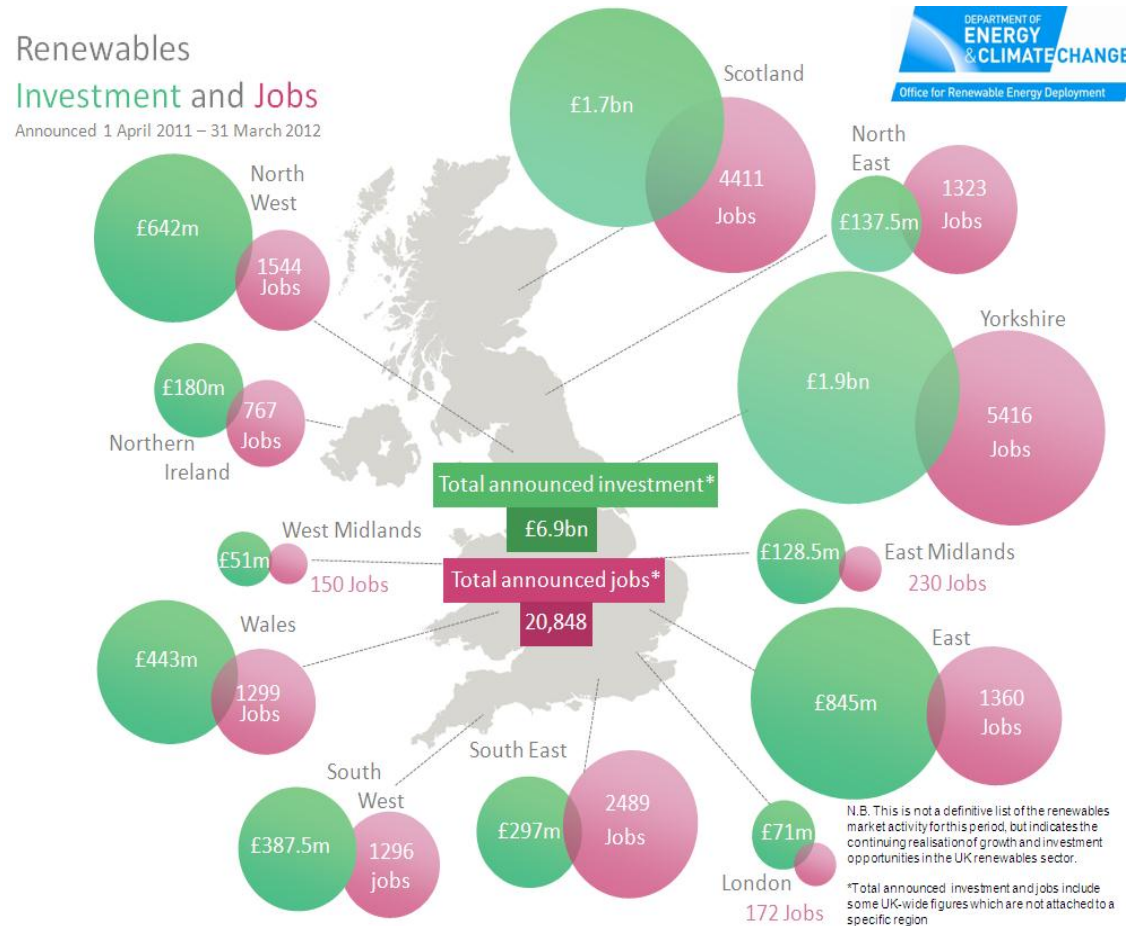
- UK National Infrastructure Plan prioritises key energy infrastructure projects with about £110 billion (real) of investment needed over the next decade



- About 20 GW of current generation capacity will close by the early 2020s due to EU environmental regulations and nuclear retirements, while carbon intensity is set to fall by three quarters
 - A smarter electricity grid must also be put in place with an off-shore grid, inter-connections, storage and smart meters
- UK liberal market framework supports a diverse and low cost mix of natural gas sources, including UKCS, storage and imports (Norway, Continent, LNG)
 - Renewal of the pipeline network and need for natural gas storage is likely to rise
 - Prospects for UK shale gas are highly uncertain and would need to address associated environmental challenges

Energy infrastructure investments and jobs are regionally diverse

- Renewables investment announcements over the past year total £6.9* billion
- Announced jobs associated with these investments total 20,848
- Significant regional spread including North East and Scotland
- It is estimated that the Green Deal and Energy Company Obligation (energy efficiency policy) will create 65,000 jobs by 2015



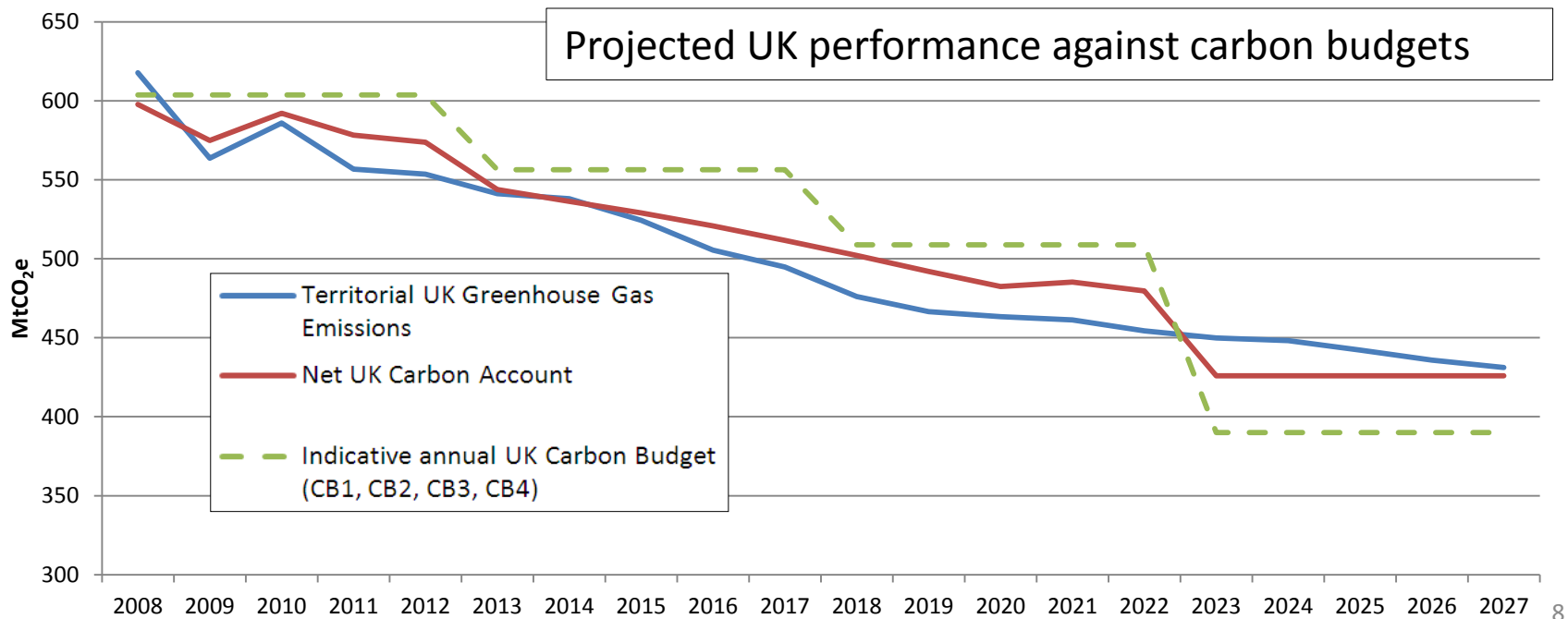
In the current business cycle environment there is also potential for energy infrastructure investment to boost both aggregate demand and net employment

Key evidence points

1. Energy infrastructure and long-run growth
- 2. Energy transition and UK policies**
 - Objectives and instruments
 - Energy efficiency and low carbon energy
3. Energy transition and long-run growth

Energy and climate change policy framework – objectives

- Maintain secure energy supplies and drive the low carbon transition
- EU Renewables Directive requires the UK to source 15% of final energy consumption from renewable energy sources by 2020
- Climate Change Act 2008 legally commits the UK to reducing greenhouse gas emissions by 80% in 2050 compared with 1990 levels
 - It also established carbon budgets which place legally binding ceilings on GHG emissions over 5-year periods that must be set three budget periods in advance

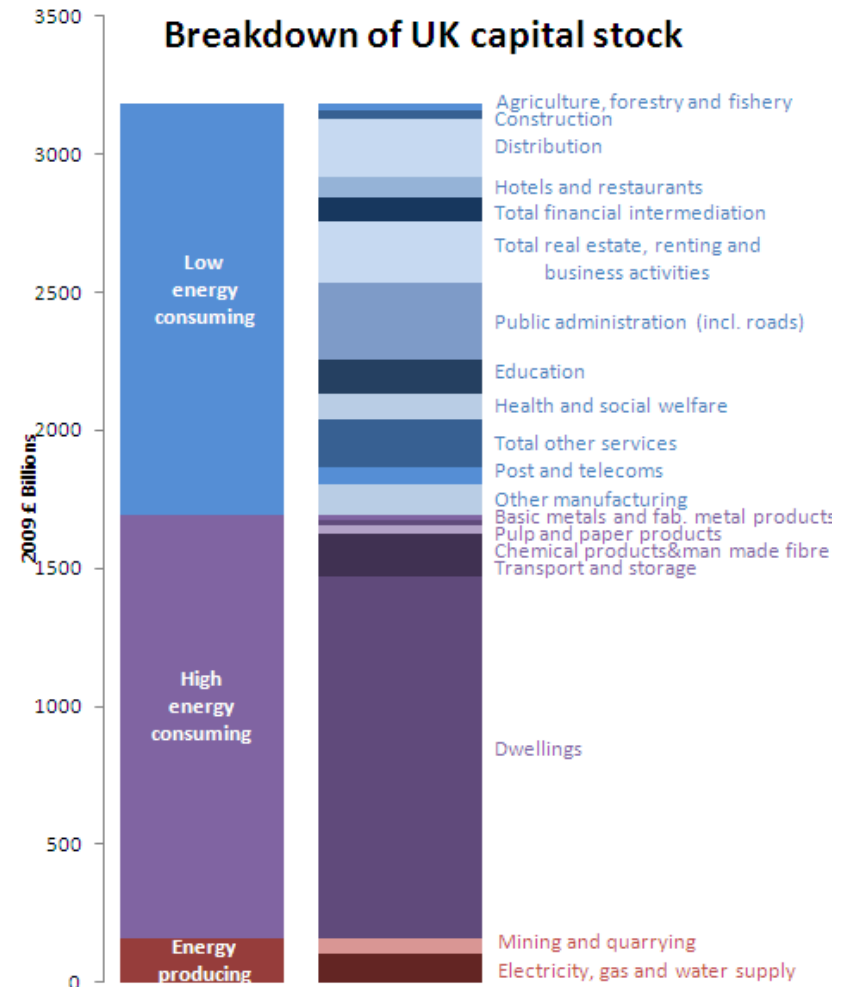


Energy and climate change policy framework – instruments

- Market-based instruments that price carbon emissions and tax energy
 - EU-ETS and Carbon Price Floor, Climate Change Levy and Climate Change Agreements, Carbon Reduction Commitment and Energy Efficiency Scheme
- Energy efficiency regulations that impose minimum standards
 - Transport, buildings and products
- Obligations on Energy Supply companies that aim to improve efficiency
 - Smart meters, Carbon Emissions Reduction Target, Energy Company Obligation
- Market based and financed energy efficiency
 - Green Deal (together with the Energy Company Obligation)
- Supports to accelerate deployment of low carbon energy technologies
 - Renewables obligation, feed-in-tariffs and CCS commercialisation
- Electricity market reforms
 - Feed-in-tariffs with contracts for differences for low carbon generation
 - Capacity market to complement the electricity market
 - Carbon price floor and emission performance standard

Energy and climate change policies and the UK capital stock

- Energy and climate change policies focus on decarbonising **energy production** and promoting energy efficiency particularly in the **high energy consuming sectors**
- Total policy spend over policy lifetimes is approximately £170 billion (in 2010 £) (due to data limitations this does not include costs from the Carbon Reduction Commitment or Climate Change Levy)
- This policy spend is about 10% of the capital stock related to energy production and high energy consuming sectors, that combined account for £1,691 billion of the total UK capital stock (£3,181 billion)



Key evidence points

1. Energy infrastructure and long-run growth

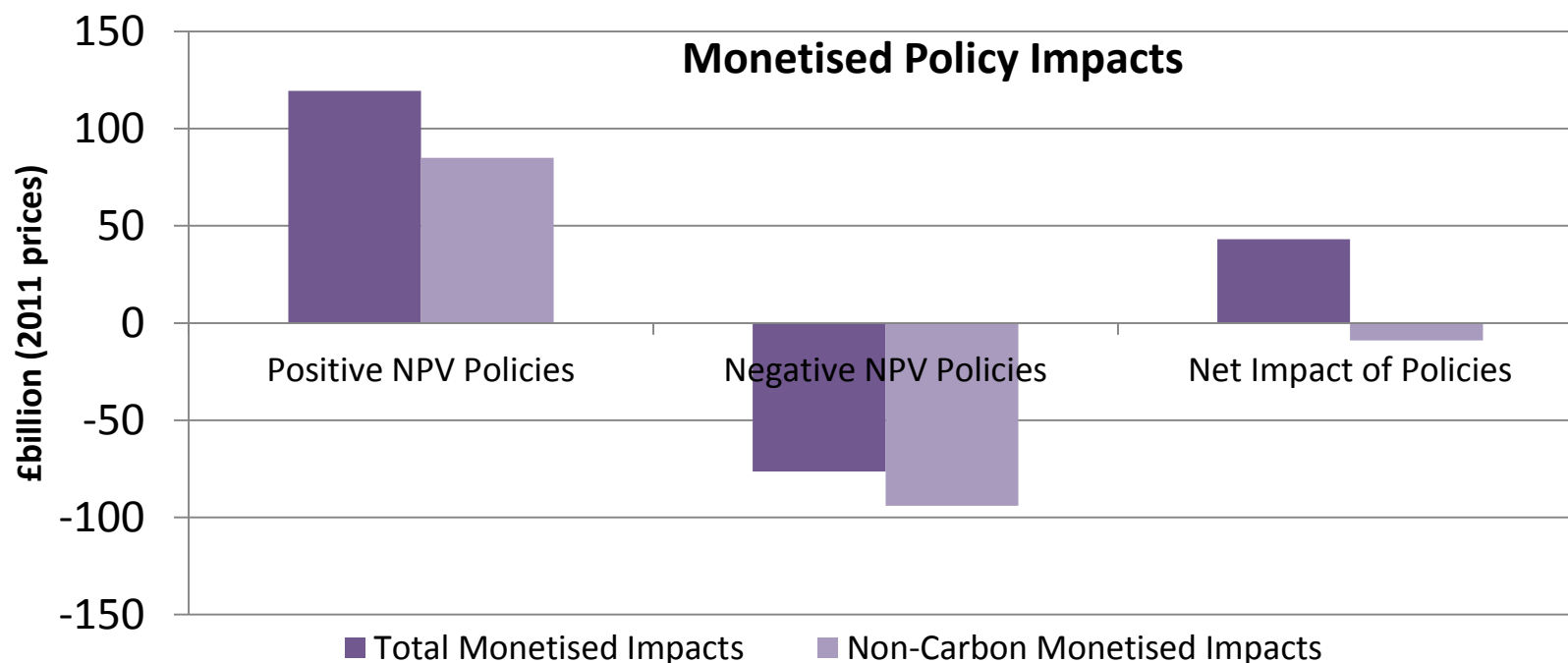
2. Energy transition and UK long-run policies

3. Energy transition and growth

- Policies to drive energy efficiency tend to have positive monetised private and social returns
- Policies to accelerate low carbon technologies tend to have negative monetised private and social returns
- But both types of policies have material non-monetised benefits
 - Reduced exposure to energy price shocks and macroeconomic volatility (energy efficiency and renewables)
 - Increased diversification of primary energy supplies (renewables)
 - Gains from economies of scale in new low carbon technologies through deployment and learning and creating new potential sources of growth

Monetised policy impacts

- Total monetised NPV of policies is +£44 billion over first 3 carbon budgets
 - Positive monetised NPV policies aim primarily to drive greater energy efficiency
 - Negative monetised NPV policies aim primarily to accelerate new technologies
- Excluding carbon values, overall NPV is -£9bn over first 3 carbon budgets
- Implies slight drag on **narrowly measured** real GDP growth (few basis points)
- But must also consider sustainability and key non-monetised benefits

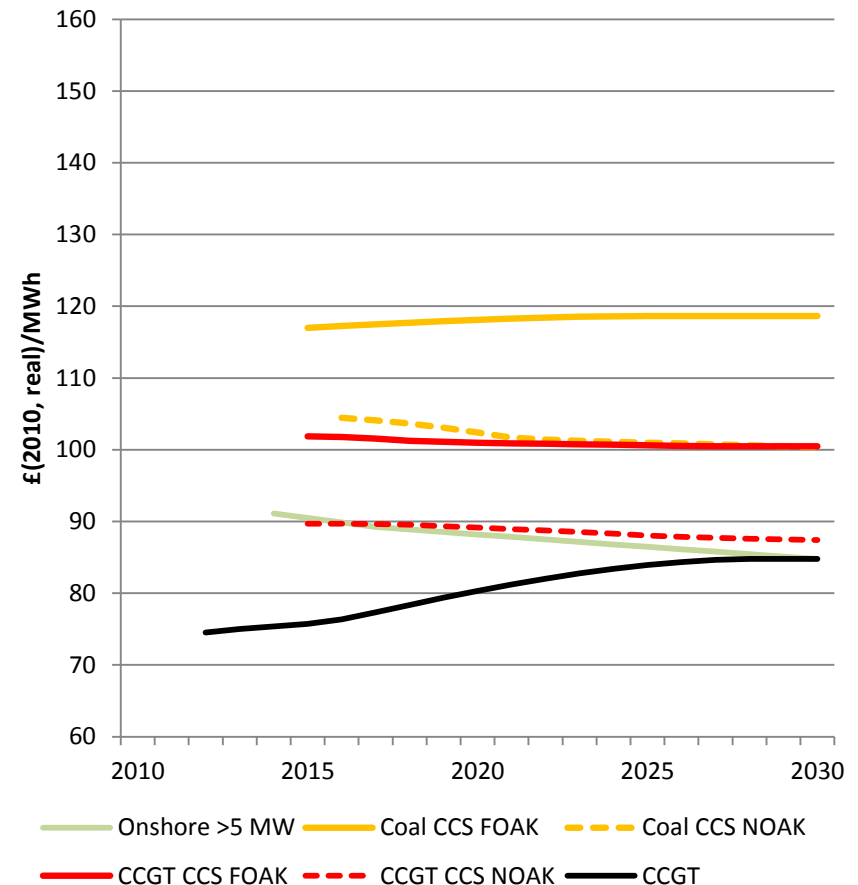
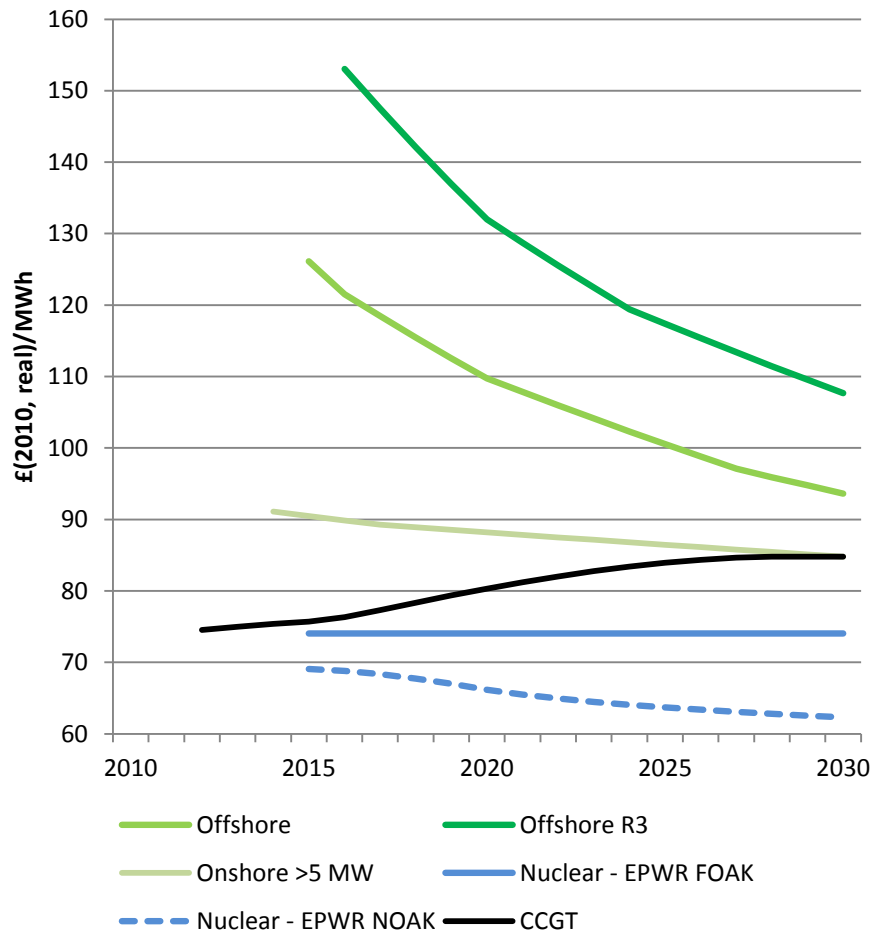


Non-monetised policy benefits: Less macroeconomic volatility

- Energy efficiency and low carbon technology policies reduce macroeconomic volatility by reducing the oil and gas intensity of the economy
- Policies act through two distinct channels
 - Energy efficiency measures reduces the energy intensity of the economy
 - Renewables policies increase the diversity of primary energy supplies and substitute renewable energy for oil and gas further reducing the sensitivity of the economy to fuel price shocks
- Oxford Economics (2011) estimates that a 50% increase in the price of oil and gas would reduce UK real GDP in 2010 by 0.9%
 - In a scenario in which oil and gas demand relative to GDP are respectively 10% and 20% lower in 2020 than today, a 50% oil price increase would reduce GDP by 0.7%

Non-monetised benefits: economies of scale in low carbon technologies through deployment and learning

Levelised electricity generation costs, 2010 – 2030



Notes:

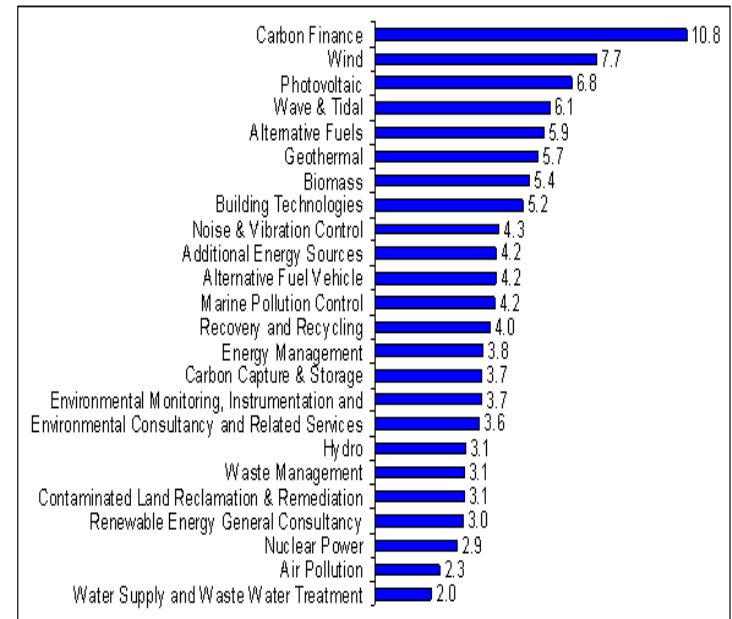
- 1 Levelised costs are based on Arup (2011) and PB (2011) data and all levelised costs use a discount rate of 10%.
- 2 All technology costs are medium costs.
- 3 The chart uses Arup (2011) offshore wind cost adjustment over time and is not endogenously driven by UK deployment.

Non-monetised policy benefits: New potential sources of growth

Low carbon transition has the potential to create new winners in the UK

- The UK has the sixth biggest Low Carbon and Environment Goods & Services (LCEGS) sector
- The sector was worth over £116 billion in the UK and employed around 914,000 people in 2009/10
- Growth forecasts for segments of the UK market indicate they are expected to grow substantially in the coming decade with the transition to the green economy
- The global market was worth more than £3.2 trillion in 2009/10 and is projected to reach £4 trillion by 2015

Average growth rates for UK LCEGS sectors weighted by turnover until 2016/17



But some existing sectors will face significant adjustment challenges

- Direct energy costs are a relatively small proportion of most total business costs - energy and water represents around 2.7% of the total costs for the UK manufacturing sector as a whole
- But for some sectors, such as iron and steel, aluminium, chemicals, refining and cement where energy represents a more substantial share of total costs and value added

Summing up

- Evidence shows that energy infrastructure investment makes a strong contribution to UK productivity and the UK Infrastructure Plan prioritises this
 - Electricity infrastructure investment needs total £110 billion over next decade
- At the same time, UK policies aim to drive significant improvements in energy efficiency and to accelerate new low carbon energy technologies
- Excluding value of avoided carbon and non-monetised benefits, current policies are essentially growth neutral
- Must also consider sustainability and key non-monetised benefits
- But policy ambition must increase to deliver the 4th Carbon Budget
- Looking ahead, keys to delivering both energy transition and growth are:
 - Well targeted technology supports to drive down the costs of low carbon technologies and to maximise potential for new sources of growth
 - Effective international cooperation to deliver the climate change mitigation benefits of the low carbon transition