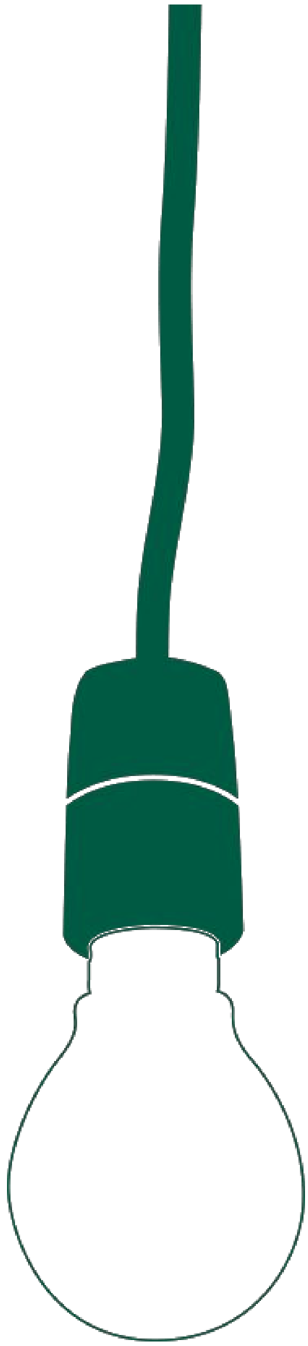
# Generating Value?

A Consumer Friendly Electricity Generation Policy



citizens advice

# Generating Value?

# Executive Summary

The UK has put itself at the forefront of global efforts to tackle climate change. The Climate Change Act, passed in 2008, legislates to cut British greenhouse gas emissions by at least 80% in 2050 from 1990 levels. Intermediate targets include a commitment to increase the proportion of energy use provided by renewables to 15% by 2020. Decarbonising the power sector is one of the biggest, and earliest, steps we must take to green our economy.

In recent years a range of policies have been introduced to deliver this transition. Funding for these policies has largely come from levies on consumers' bills. The cost per household of low carbon generation deployment policies stands at £45 today and is expected to rise to £110 per household in 2020. Bill levies are a more regressive way of paying for essential infrastructure than taxation as they hit the poorest in society harder.

The Department of Energy and Climate Change (DECC) was given a budget for what it could spend on new clean energy generation through bill levies that was expected to increase from £3.5 billion this year to £7.6 billion/year by 2020. But the Office for Budget Responsibility has forecast that it will exceed this budget and spend £9.1 billion/year by 2020. In order to get spending back on track, DECC will be making decisions this autumn that will reshape the form of low carbon subsidies.

This report considers what we can learn from past and present generation policies and their impacts on consumer costs. It assesses the impact of those policies which drive up costs for consumers, and proposes less expensive alternatives that could deliver more for less. In particular, the government is committed to end any new subsidy for onshore wind farms and began implementing this policy in the summer by shutting one subsidy programme (the Renewables Obligation) to onshore wind. We wanted to understand what the cost implications could be if it also closed off a second funding source for onshore wind - by precluding it from bidding in auctions for contracts for difference (CfDs).

We commissioned NERA Economic Consulting to model the results of low carbon generation auctions both with and without onshore wind. A ban on onshore wind resulted in more expensive technologies being purchased instead. The modelling shows that excluding onshore wind imposes significant costs on electricity consumers - around £0.5 billion over the term of the CfD contracts awarded in a 2017 auction, equivalent to around £30 million/year. Because auctions may be repeated over a number of years, the eventual cost to consumers could be much higher.

If the government proceeds with barring future onshore wind projects entirely, it needs to be confident that cheap solar can fill the gap to ensure consumers are not made worse off, and it must refrain from taking steps that would impede the development of solar as well.

There are other policies the government could consider. It is in the process of granting a planning veto to local communities that should mean onshore wind is not forced on those that do not want it. A cap on the price paid to onshore wind could allow it to benefit from the security of long-term contracts without receiving subsidy. This could reduce the need to purchase more expensive low carbon generation.

Currently low carbon generation auctions divide technologies into different pots that do not have to compete with each other for funds.  The modelling also considered what savings could be achieved if that constraint were removed so that the auction process simply focused on buying the cheapest low carbon generation it could.  The savings here could be significant. Applying this approach to the 2017 auction model reduced consumer costs by around £1 billion over the term of the CfD contracts, roughly £50 million a year.

We think that the government should prioritise technologies that reduce emissions at the lowest cost. Other tools - such as local planning vetoes - can be used to give people control over the wider impacts of these decisions. But the economic decisions over subsidies should seek to reduce carbon at minimum cost to consumers.

If the government wants to deliver wider objectives from energy projects, such as job creation, our preference is that these should be funded in other ways. At minimum, the government should be much clearer about the economic benefits of these objectives. Consumers need to know what they are getting for their money.

An efficiently run decarbonisation policy is likely to be expensive; consumers should not have to bear the additional burdens created by an inefficient one.

# Summary of Recommendations

- The government should allocate the majority of CfD funding to the most currently cost-effective technologies.
- Instead of barring onshore wind from CfD allocation completely, government should instead lower the cap on strike prices (for example, by changing the previously set administrative strike price cap on auction clearing prices) to a level equivalent to the cost of new build gas generation.
- Any future decision to allocate funding to the less established technologies pot must be accompanied by a rigorous value for money assessment. DECC needs to start demonstrating the value (if any) of keeping the more expensive technology options open. If it cannot, they should not be funded.
- The criteria used to assess bill-funded low carbon deployment should be consistent across impact assessments. They should be heavily weighted towards reducing emissions at the lowest cost. Government can and must do more to quantify currently uncosted externalities given the size of investment it is committing to at consumers' expense.
- If job creation is the principal, or a major, consideration in the government's decision to stimulate a new project or technology, it should fund the job-creating proportion of any needed deployment support from general taxation.
- Where DECC proposes to award a substantive contract that has been bilaterally negotiated rather than competitively procured, it should publish a full impact assessment for consultation.
- As well as ensuring full impact assessments are carried out in future, the CMA should also demand full publication of terms in existing contracts that affect consumers' liabilities.
- The government should set an upper limit for subsidy per MWh as a stop-loss policy. It should degress over time. A medium term target trajectory should be published to allow investors to have confidence that they understand the terms on which support will, or will not, continue. Competitive procurement processes for new low carbon contracts, such as

auctioning, should continue in order to encourage developers to beat the degression curve and not simply to match it.

- Low carbon generation deployment and energy efficiency programme costs should be transferred from levies on bills into tax-funded programmes.
- Re-establishing energy efficiency policy in the wake of the cancellation of the Green Deal should be undertaken as a matter of urgency. Efficiency policies will be essential to mitigate the bill impacts of decarbonising generation. This should include targeting the successor to the ECO scheme towards fuel poor households, and designating energy efficiency as a national infrastructure priority.

# Chapter 1. Introduction

The UK has put itself at the forefront of global efforts to tackle climate change. The Climate Change Act, passed in 2008, legislates to cut British greenhouse gas emissions by 80% before 2050 compared to 1990 levels. Decarbonisation of electricity generation is one of the biggest, and earliest, steps on this path.

To reach these targets, as well as shorter term targets for renewable energy deployment, over the past 15 years a number of policies have been implemented, on a number of different energy producing and energy demand reducing technologies. As UK energy policy has developed, the value for money of each pound spent on decarbonisation has varied considerably.

The varying value for money of policy can be explained by choices past and present governments have made about energy technologies. Because zero-carbon sources of electricity are currently usually more expensive than carbon-emitting ones (even when a carbon price is charged for emissions), governments worldwide have sought to lower the cost of zero-carbon technologies through energy policies. At the same time, assessments of the requirements of long-term decarbonisation efforts (for example, to reach the timetable to 2050 set out in the Climate Change Act), have emphasised the need to make zero-carbon technologies cheaper in order to meet those targets at acceptable cost.[1]

This has been done in two main ways. Deployment - subsidising building programmes for different technologies to drive down their costs through experience (learning by doing) and building up economies of scale in the supply chain - has taken up the lion's share of the low carbon budget. Research and development - learning about technologies at smaller, non-commercial scale - receives about a tenth as much money.

Strains on deployment policy are starting to show. Given a budget during the last Parliament rising from £3.5 billion this year to £7.6 bn/year by 2020 to build new clean energy generation, the Department of Energy and Climate Change (DECC) is already forecast to spend £9.1 billion by 2020 (all three figures in 2011/12 prices).

The arrival of a new government has also put particular pressure on onshore wind - among the cheapest of the generation types supported by deployment policy. Political desire to slow or halt its deployment has compounded the budgetary

[1] Long-term studies and models of climate change policy assume or demand that the costs of low carbon technologies comes down. Estimates such as the Stern Review and the work of the CCC depend on both technologies becoming cheaper, and on governments deploying the cheapest technologies across the period. Stern, Nicholas (2007). *The Economics of Climate Change*. Cambridge University Press. Cambridge. Chapter 16.

confusion around low carbon energy. Curtailing the role of one of the cheapest options will mean that either the budget will need to rise to get the same amount of low carbon power, further hitting consumers, or that for the same budget low carbon ambition will be reduced. Consumer costs could increase by around £0.5bn over the term of the CfD contracts awarded, equivalent to around £30m/year.[2]

The case of onshore wind highlights a paradox at the heart of UK energy policy. Low carbon policy has emphasised the need to push technologies down the cost curve, to make immature technologies mature, and mature technologies competitive without subsidy. Yet when faced with the prospect of a technology that is becoming mature, and perhaps not far from being competitive without policy support, the prospect of a lot of it being built causes concern to set in - perhaps driven less by issues of cost and more by issues of local consent.

This report sets out why continuing to allow onshore wind development is essential to a consumer-friendly energy policy. It will show the costs to consumers of blocking onshore wind developments, and set out some possible approaches that may be politically acceptable as well as being economically viable.

It will also address the precarious current position of the government's low carbon spending plans. It shows how unwise technology choices have exacerbated the problems with the government's budget control, and puts forward an alternative that would reduce the burden on consumers in the short term and ensure that the most cost-effective options for addressing climate change are prioritised.

Decarbonisation will cost money, and UK consumers will have to pay for it. It is essential, both to protect consumers and to ensure that policy gets as much environmental benefit for the pound as it can, that money is spent prudently. An efficiently run decarbonisation policy is likely to be expensive; consumers should not have to bear the additional burdens created by an inefficient one.

## Call for Evidence

To develop this report, in summer 2015 Citizens Advice issued a Call for Evidence to gather experience of energy R&D and deployment policy in the UK and overseas. The organisations that responded to the Call were as follows:

- Committee on Climate Change (CCC)
- Electricite de France (EDF)
- Energy Technologies Institute (ETI)

[2] Analysis conducted using NERA's CfD auctions model and data published by DECC on technology costs and wholesale prices. See Chapter 3.

- Good Energy
- Imperial College London

The evidence they provided is footnoted throughout the report where it informed our thinking, and their responses or links may be found on the Citizens Advice website accompanying this report. We thank those who responded for taking the time to reply. The conclusions of this report, and any errors which it contains, are those of Citizens Advice and the author.

# Chapter 2. Consumer Impact of Current Policies

To support innovation in low carbon energy, over the past decade and a half the UK has introduced a series of policies to fund construction of low carbon generation technologies. Many of these are being built at scale for the first time in the UK; nuclear, by contrast has a long history of providing carbon free generation in the UK but only one power station has been opened since 1989 and none since Sizewell B was opened in 1995. Policymakers hope that these investments will, combined with equivalent efforts in other countries, drive down the costs of low carbon technologies. Combined with carbon pricing policies to increase the cost of carbon-emitting activities, building and operating low carbon generation should become cheaper than carbon-emitting generation. In time energy firms would choose by-then cheaper low carbon options without needing further policy support.

We are not there yet. Carbon pricing in Europe - arguably the optimal solution - has stalled. Loose caps on emissions mean that carbon prices have stayed low. Confidence in the long-term durability of the policy is too low to justify investments. Efforts to lower costs of clean technologies have made progress (with the possible exception of nuclear), but began from such a high starting point that no large scale technologies are yet able to compete in the UK market without subsidies or guaranteed higher-than-market prices.

## Deployment Policies

Deployment of low carbon energy has been supported by a number of different subsidy programmes. In the 1990s a few early renewable energy projects were brought forward under the **Non-Fossil Fuel Obligation**, though that programme primarily provided cash to nuclear power stations which were already in operation. Large scale deployment support began in earnest with the introduction of the **Renewables Obligation** in 2002. In 2005 the European Union began its **Emissions Trading System**, designed to steadily increase the cost of emitting carbon in key industrial sectors, including electricity generation, by capping emissions and requiring emitters to buy permits to pollute. In 2009 the EU approved a further package of measures including a target to reduce carbon emissions by 20%, and a **Renewable Energy Target** (which requires the UK to get 15% of energy demand - roughly 30-35% of electricity, depending on contributions in other areas - from renewable sources) both in 2020. Adopting the target meant Britain needed to increase deployment rates of renewable energy. The Renewable Obligation was altered to provide tailored bands of support for different renewable technologies, abandoning the previous flat rate. **Feed in tariffs** to support very small ('microgeneration') projects came in in 2010.

Continuing political dissatisfaction with that policy landscape led to the introduction of several further policy measures under the Coalition government between 2010-2015. The **Levy Control Framework** imposed on DECC a limit to the cost of policies it could fund via levies on consumers' bills. A wide ranging **Electricity Market Reform ('EMR')** programme was passed by Parliament in 2013. This overhauled the support provided to low carbon technologies, replacing top-up payments with **Contracts for Difference ('CfDs')**, which would fix the price for power over a long time period. Most CfDs were to be allocated through an auction system, but eight renewable energy projects were granted CfDs without having to compete, through a process known as **Final Investment Decision Enabling for Renewables** (FIDER), as was the Hinkley Point C nuclear power station, through a separate bilateral negotiation process between its developer EDF and the government.[3] EMR also introduced a **Capacity Market**, to provide additional funds to flexible and baseload power stations including gas and coal, and separately a UK **carbon floor price**, intended to bolster the price signal coming from the EU ETS. EMR envisaged the gradual phaseout of the old support systems, eventually leaving the newly introduced CfDs to support low carbon deployment.

Responding to our Call for Evidence, Good Energy also highlight the continuation of other policies, including the nuclear decommissioning programme and the North Sea oil and gas tax regime, which are seen by some to constitute subsidy for non-renewable technologies.[4] More than three quarters of DECC's £4.45bn a year budget is currently spent on nuclear decommissioning, and it is not expected to finish paying down public liabilities for existing nuclear clean up until early in the 22nd century.[5] The government is among those who dispute that the tax treatment of oil and gas constitutes a subsidy, stating plainly, "the UK has no fossil fuel subsidies."[6]

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[3] At time of writing a contract has been agreed between the government and the developer, and approved for state aid clearance by the European Commission, but a final investment decision has not yet been taken.

[4] Good Energy (2015) *Response to Call for Evidence*.

[5] Based on gross expenditure for 2013/14. The proportion reduces to around half when proceeds of fuel reprocessing and power sales are taken into account. National Audit Office (July 2015) *A short guide to the Department of Energy and Climate Change.* http://www.nao.org.uk/wp-content/uploads/2015/08/Department-of-Energy-Climate-Change-short-guide.pdf

[6] DECC Response to a Freedom of Information request, August 2015. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/455512/FOI_2015_15038_PUB.pdf

## The Legacy of the Coalition

The policies introduced under EMR aim to improve the value for money of low carbon deployment policies, while altering the way decisions about the UK energy system are made. Whereas the renewables obligation and feed-in tariff system were essentially bolt-ons to the marketplace, EMR (via the capacity market as well as contract for difference systems) requires government and agencies such as National Grid acting on its behalf to take far more fundamental decisions about the structure of the electricity system.

The Coalition provided a serious financial commitment, but also ended a situation where clean energy spending plans were effectively unlimited. The Levy Control Framework allows spending to rise to £7.6bn per year (in 2011/12 prices) by 2020, committing just under £40bn in total from the introduction of the LCF to 2020. Before the LCF was established, DECC could take on spending commitments, paid for by levies on bills, without the usual strictures imposed by the Treasury on public spending plans. The LCF guarantees that policy support paid for through energy bills will not be allowed to rise indefinitely.[7]

However, the way that money was spent between 2010 and 2015 has been seriously criticised by public spending watchdogs. The FIDER programme was established to prove the market for CfDs and to avoid a hiatus in development of renewables projects as support systems changed. There was no price competition. Developers could bid for FIDER contracts knowing what price they would receive. The variables developers could adjust were the size and timing of their project. In the end, contracts were awarded to eight projects: five offshore wind farms, the conversion of two coal power station units to run on biomass, and one biomass combined heat and power generator.[8]

The National Audit Office, in a 2014 report, identified major failings with the FIDER contracts. It found that:

> "the Department [of Energy and Climate Change] proceeded with the scheme while recognising that it did not bring a clear monetised benefit... Awarding so many early contracts of this scale in this way has limited the Department's opportunity to secure better value for money through competition under the full regime... The value from the early contracts ... will be lost if the Department

[7] If DECC overspends under the LCF it is required to take funding from its other capital spending programmes to offset the balance.

[8] Department of Energy and Climate Change (2014) "FID Enabling for Renewables: Successful Projects". London.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/305781/Successful_Projects.pdf

> does not get competition into place while a substantial part of the funding remains available."[9]

Parliament's Public Accounts Committee was even more forthright, saying:

> "the Department of Energy and Climate Change failed to adequately secure best value for consumers. Yet again the consumer has been left to pick up the bill for poorly conceived and managed contracts. The Department argued that the early contracts were necessary to ensure continued investment. But its own quantified economic case shows no clear net benefit from awarding the contracts early. Indeed, if the Department had used price competition, it should have led to lower energy prices for consumers who are already facing hefty charges… Quite simply, the Department failed to defend consumers' interest under the terms of these contracts."[10]

Joining the chorus, the Competition and Markets Authority in its 2015 investigation into the energy market explained that it considered:

> "that DECC's decision to award such a large proportion of the available CfD budget outside the competitive process under the FIDeR scheme is likely to have resulted in higher costs to customers of approximately £250–£310 million per year for 15 years. These higher costs need to be balanced against the potential benefits that might have arisen from the early allocation of CfDs to FIDeR projects outside a competitive process. However, no robust analysis setting out whether such benefits outweigh these higher costs has been disclosed. As the early allocation of CfDs outside a competitive process appears to us to have led to moderate benefits (eg bringing forward some projects) at considerable costs, this may have caused material detriment to consumers. We believe there is a risk that without further constraints on DECC's ability to award contracts outside the competitive process, further contracts may be awarded that do not deliver value for money – either by awarding CfDs to inefficient projects or by offering strike prices above those that could have been achieved through competition."[11]

It concluded that the methods of allocating CfDs give rise to an 'adverse effect on competition' - its term for the market features that have the potential to harm consumers.

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[9] National Audit Office (2014) *Early Contracts for Renewable Electricity*. http://www.nao.org.uk/wp-content/uploads/2014/06/Early-contracts-for-renewable-electricity1.pdf. p. 9-10

[10] Public Accounts Committee (2014) *Early Contracts for Renewable Electricity*. http://www.parliament.uk/business/committees/committees-a-z/commons-select/public-accounts-committee/news/report-early-contracts-for-renewable-electricity/

[11] Competition and Markets Authority (2015) *Energy Market Investigation - Provisional Findings Report*. https://assets.digital.cabinet-office.gov.uk/media/559fc933ed915d1592000050/EMI_provisional_findings_report.pdf p. 201

Whether this expansion was an efficient use of funding is questionable. Reporting to the Committee on Climate Change, a group of technical experts found that,

> "rapid expansion of offshore wind during the early part of the current decade has created a substantial legacy of projects with support from the RO or FiD enabling. We believe that in comparison to projects developed during the 2020s these early stage projects will probably appear expensive... There is evidence that the UK market was rather overheated in the period until around 2014. ...Important lessons can be learned about ensuring policy bears down on costs and that markets grow fast enough to create the conditions for cost reduction but that policies do not push too far, too fast."[12]

Citizens Advice shares these worries, and agrees with the CMA's view that DECC lacks constraints to stop it depleting its budget on expensive pet projects. The FIDER contracts represent poor value for money. Unfortunately for consumers, the deals are signed and cannot be taken back. Because the LCF budget is fixed, they have soaked up budget that could have been spent on more competitively priced deals. The FIDER programme is a major contributor to the budgetary crunch currently faced by the renewables industry.

Hinkley Point C nuclear power station has also been offered a CfD outside competitive contests, although its process was distinct from the FIDER programme. That deal has also come under considerable scrutiny. The contract still remains to be finalised but (some) key terms have been revealed.[13] With the power station due to cost £24bn to build and with consumers paying an (inflation linked) guaranteed price of £92.50/MWh for 35-years, it is little wonder that commentators have been sharpening their knives.[14]

Consumer Futures (prior to its merger with Citizens Advice), identified some of the grounds for skepticism about the deal:

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[12] Committee on Climate Change (2015) *Response to Call for Evidence*, citing Gross, Robert (2015) *Approaches to cost reduction in carbon capture and storage and offshore wind*. Imperial College. London. https://www.theccc.org.uk/wp-content/uploads/2015/06/Gross-2015-Approaches-to-cost-reduction-in-carbon-capture-and-storage-and-offshore-wind.pdf

[13] Significant terms around variables which affect consumer clawback provisions are still not in the public domain.

[14] Peter Atherton, a managing director at investment bank Jefferies, reckons it may be the most expensive building "on Earth", with only the International Space Station a more costly construction mega-project, in no small part due to not being on Earth. Atherton, Peter, quoted in Ross Clark (2014). "Is the Hinkley C nuclear power station the most expensive object ever built in Britain?" via *The Spectator*. 1 December 2014.
http://blogs.spectator.co.uk/coffeehouse/2014/12/why-is-britain-building-the-most-expensive-object-ever. Nick Butler in the *Financial Times* wrote:
"The obvious losers are the UK's consumers who are trapped into paying a price for electricity that is double the current wholesale price for 35 years after the plant starts up. The deal will go down in history...as an example of the inability of the British government – ministers and civil servants alike – to negotiate complex commercial deals." Butler, Nick (2014) "Hinkley Point: the winners and losers". *Financial Times*. London.
http://blogs.ft.com/nick-butler/2014/10/08/hinkley-point-the-nuclear-winners-and-losers

> "How fair would £93/MWh be? While it tallies with current DECC estimates of the levelised costs of a first-of-a-kind (FOAK) new nuclear project, such estimates have steadily inflated over time. The Treasury was reported to be holding out for a deal of around £80/MWh in the spring. As recently as 2011, DECC estimates suggested the levelised cost for a FOAK nuclear project would be around £74/MWh. Back in 2008, EdF is reported to have told city analysts that it could build new nuclear for £45/MWh… And each pound on the guaranteed price matters, because the volume of energy it would be applied to is so large. At 3.26GW, Hinkley Point C would be able to meet around 6 per cent of national demand.
>
> The government has not been able to test the market because there is no market when it comes to new nuclear. EdF is currently the only game in town."[15]

The Coalition appeared to lose confidence in the Carbon Price Floor as a policy instrument almost as soon as it came into effect. Introduced in 2013 with the intention of it providing a steadily escalating top up carbon price, the 2014 budget saw the escalator cancelled and replaced with a flat rate until 2020.[16] The potential for competitive imbalances between the UK and the rest of the EU scuppered it. The future of carbon pricing is once again tied to reform of the cumbersome but critical EU Emissions Trading System.

However, by the last year of the Coalition, steps in the right direction had been made. Auctioning had been introduced for CfDs, and the first capacity auction had come in cheaper than expected, with further improvements on the way.[17] Yet, with EMR concluded, the Coalition passed on an inheritance to its successors of a much more central role in directing the energy system. As Dieter Helm has pointed out, the attending informational requirements on the government are "very considerable. These include: the ability to predict the path of future prices; and the ability to pick the technologies and projects with which to negotiate."[18] Governments will have to make frequent decisions about capacities, demand, price across the electricity system for multiple technologies - in other words, all major characteristics of the energy system must now be fixed by government officials.

## The New Government

The current government is making some changes out of necessity and others out of choice. Soon after it arrived in office, it has become apparent that forecasts for spending on levy funded policies had underestimated commitments. Within weeks

[15] Hall, Richard (2013) "The Nuclear Option". Consumer Futures. London. http://www.consumerfutures.org.uk/blog/the-nuclear-option

[16] HM Revenue and Customs (2014). *Carbon Price Floor: reform and other technical amendments*. London. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293849/TIIN_6002_7047_carbon_price_floor_and_other_technical_amendments.pdf

[17] Changes to the treatment of interconnection should see even more supply in future capacity auctions.

[18] Helm, Dieter (2012). *EMR and the Energy Bill: A Critique*. Oxford. http://www.dieterhelm.co.uk/sites/default/files/EMR%20and%20the%20energy%20bill.pdf

of the election, documents accompanying the 2015 Budget showed that the Levy Control Framework is forecast to spend all of the £7.6 billion/year by 2020 initially allocated, and may also have fully exhausted the further 20% headroom granted to it to allow for forecasting difficulties (which would take that budget to £9.1bn/year).[19] A combination of lower-than-expected gas (and thus, wholesale electricity) prices, higher production from wind farms than had been predicted, and far swifter adoption of solar panels for feed-in tariff subsidy has depleted the funds for low carbon deployment.

The desire of the government to live within its means and remedy the alarming overspend on the LCF is entirely appropriate. At the time of writing, the government is still working out its full response to this situation. One policy, however, has been publicised from the moment the government was formed. Onshore wind farms will no longer be eligible for subsidy. The Renewables Obligation is being closed to them (pending a grace period to allow projects already under development to be completed) and it is expected that the CfD system will be altered to exclude them from support there. Some small hints have been dropped by new Secretary of State Amber Rudd that onshore wind might survive in some, unsubsidised form,[20] and Scottish and Welsh governments have expressed support for its continuation. Planning rules changes, designed to give a louder voice to local communities when wind farms are proposed, add further barriers to development of onshore wind.

Changes to the feed in tariff and Renewables Obligation are also coming, with the government consulting on ways to reduce returns to solar developers in both schemes.[21] Solar deployment rates have exceeded expectations to this point, and the proposed changes are an attempt to react.[22]

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[19] Office for Budget Responsibility (2015). *Economic and Fiscal Outlook Supplementary Tables - July 2015.* London. Table 2.7. Figures in 2011/12 prices. http://budgetresponsibility.org.uk/pubs/Fiscal_Supplementary_Tables-20151.xls

[20] Energy and Climate Change Committee (2015) "DECC Priorities 2015". London. http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/energy-and-climate-change-committee/decc-priorities-2015/oral/18799.html; Qs 28 and 32

[21] Department of Energy and Climate Change (2015). *Consultation on a Review of the Feed in Tariffs Scheme*. London. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/458660/Consultation_on_a_review_of_the_Feed-in_Tariffs_scheme.pdf. Department of Energy and Climate Change (2015). *Consultation on Changes to Support for Solar PV*. London. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/447321/Solar_PV_within_the_RO_consultation.pdf

[22] Department of Energy and Climate Change (2015). *Consultation on a Review of the Feed in Tariffs Scheme*. London. p. 13 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/458660/Consultation_on_a_review_of_the_Feed-in_Tariffs_scheme.pdf

DECC has also postponed CfD auctions initially timetabled for October 2015, with no replacement date or revised timetable yet emerging.[23] An announcement is expected in Autumn 2015 setting out the government's revised plan.

Tax treatment of renewable energy was also altered in the Summer Budget 2015, eliminating an exemption from the Climate Change Levy for renewable electricity[24]. This change will generate substantial tax receipts but has been criticised in some quarters for exposing non-polluting plant to a pollution tax, and undermining investor confidence.

The final batch of changes made in the first few months of the new government came in energy efficiency policy. The Green Deal, set up to loan money to householders to carry out energy efficiency improvements, was shut down in July 2015. Beset by low levels of public interest and an unattractive cost of finance, the Green Deal had never lived up to the high hopes assigned to it.[25] A policy that all new homes built from 2016 onwards should be carbon neutral was also scrapped.[26]

## An Unsettled Future

The policy turbulence and significant overspend against already substantial previous financial commitments indicates several things:

First, large scale low carbon technologies remain largely unable to survive in the UK market without some form of government financial support.

Second, that up to now efforts at cost-containment have not been as rigorous as intended.

Third, that whatever reputation the UK may have had as being a place where a stable, de-politicised energy sector existed, is eroding.

Investors accustomed to durable markets and durable policies will have to adapt. Increasing cost of capital could result from this, reflecting unavoidable and unhedgeable political risk, with costs flowing through to consumer bills.

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[23] EDIE (2015) "DECC postpones next Contracts for Difference auction". London. http://www.edie.net/news/6/Contracts-for-Difference-CfD-2015-auction-postponed-by-DECC

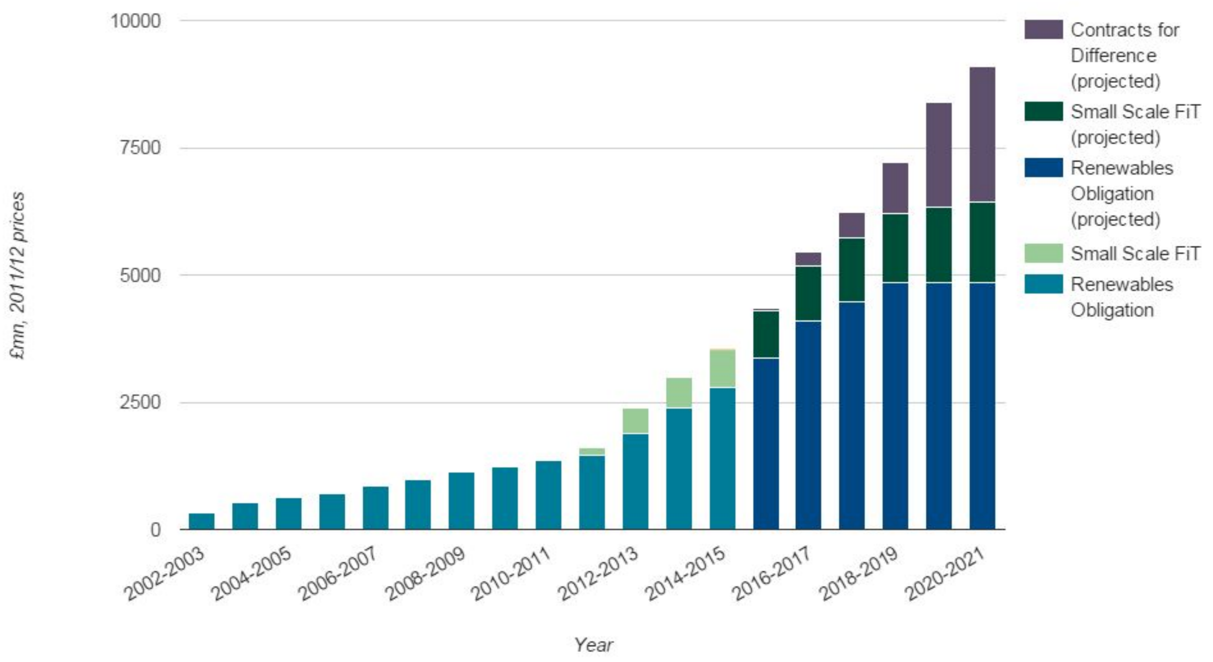
[24] HM Treasury (2015) *Summer Budget 2015*. London. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/443232/50325_Summer_Budget_15_Web_Accessible.pdf p. 58

[25] Department of Energy and Climate Change (2015) "Changes to green home improvement policies announced today". London. https://decc.blog.gov.uk/2015/07/23/changes-to-green-home-improvement-policies-announced-today

[26] HM Treasury (2015) "Fixing the foundations: creating a more prosperous nation." https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/443898/Productivity_Plan_web.pdf

# Deployment Spending

Subsidies for low carbon generation will almost triple in the next 6 years (Figure 2.1). In the last year for which records are available, the combined cost of the Renewables Obligation and microgeneration Feed in Tariff was £3.5 billion. By the end of the decade, with the addition of Contracts for Difference, the three policies are now projected to cost £9.1 billion.




▲ Figure 2.1: Growth in cost of low carbon energy deployment policies[27]

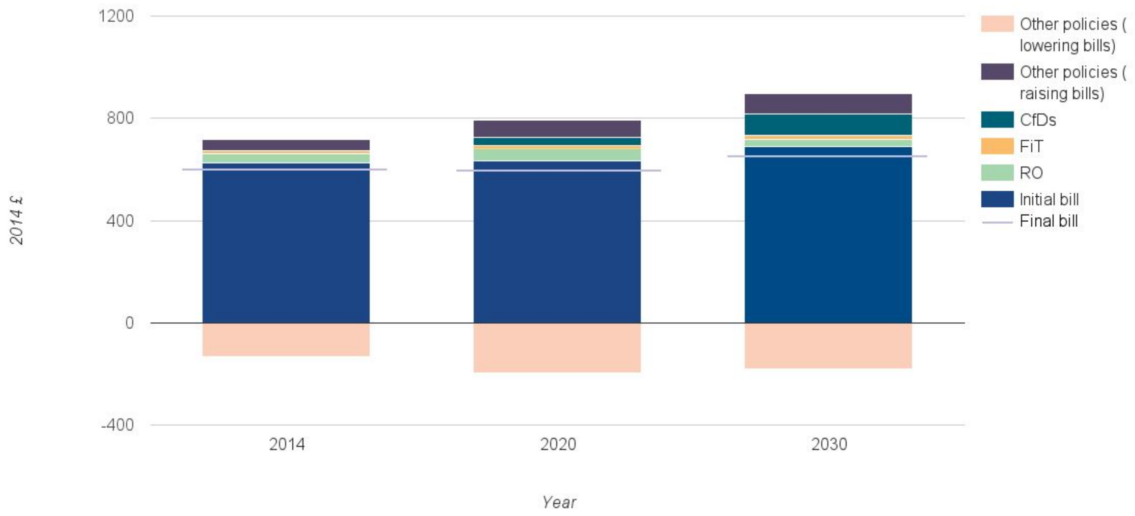
## Impact on Consumers

Increased investment in low carbon deployment will translate into a rise in the costs of deployment policies on electricity bills from £45 per household today to £110 per household in 2020, based on DECC's Central gas price scenario (Figure 2.2).[28] DECC hopes that these rises will be countered by improvements in energy efficiency, that will keep bills unchanged overall (the final bill line in Figure 2.2 shows the expected net effect of all policies). However, the costs of the

[27] Data from DECC (2014). *Annual Energy Statement 2014*, Ofgem (2015) Renewables Obligation Data and Statistics. https://www.ofgem.gov.uk/environmental-programmes/renewables-obligation-ro/renewables-obligation-data-and-statistics and Office for Budget Responsibility (2015). *Economic and Fiscal Outlook Supplementary Tables - July 2015.* London. Table 2.7. http://budgetresponsibility.org.uk/pubs/Fiscal_Supplementary_Tables-20151.xls

[28] DECC; *Estimated impacts of energy and climate change policies on energy prices and bills*; https://www.gov.uk/government/publications/estimated-impacts-of-energy-and-climate-change-policies-on-energy-prices-and-bills-2014. This estimate applies a multiplier of 1.2 to DECC's forecast for the combined cost of the three policies (RO, CfD, FiT) since this document was published to reflect the estimated overspend in the Levy Control Framework which has risen from £7.6 billion to £9.1 billion for the three policies combined. It does not consider the impact of scaling back efficiency policies, which might be expected to raise the number further.
As most policy costs are applied to electricity bills, the policy costs on a dual fuel bill are roughly the same, meaning they make up a smaller proportion of the total bill.

generation-side policies are considerably more certain than the gains from energy efficiency, especially as efficiency policies have been cut back with no replacement confirmed. Efficiency policies were central to the low carbon bargain with consumers. Getting a credible efficiency plan in place will be essential to keeping the burden of the low carbon transition under control.




▲ Figure 2.2: Growth in impact of deployment policy on electricity bills

The Other Policies presented in Figure 2.2 that raise bills incorporate the European ETS and UK carbon prices, the costs passed through to consumers via network charges for connecting low carbon generation to the Grid, and for ensuring secure supplies through capacity payments to dispatchable generators. Policies lowering bills includes projected reductions to wholesale electricity prices and, most significantly, large assumed savings from energy efficiency policies including the now-defunct Green Deal. Around 60% of the expected savings from ‘Other Policies’, though, come from ‘products policy’, the term for a range of performance standards for consumer goods, and building standards.

The public pays for low carbon innovation and deployment policy in two ways. A few programmes are paid for out of general taxation; most are paid through levies added onto electricity bills. Tax revenues will be used to support the first pilot demonstrations of carbon capture and storage (CCS) technology, at power stations in Scotland and Yorkshire. It is expected that the costs of any follow-up CCS projects will be transferred into bill funding. Development costs for other new generation technology (under the Renewables Obligation or Feed in Tariff) has been covered by bill based support. The Renewable Heat Incentive is also paid for out of taxation, but funds for other complementary energy efficiency and home electricity generation policies have been drawn from consumer bills. Some further policy costs will be passed through to households in the prices of goods they buy.

Because lower income households spend a higher proportion of their income on energy bills, and because levy funding makes no allowances for income, bill funding is a more regressive way of financing policy than tax funding. The government has sought to redress this imbalance somewhat, by targeting energy efficiency and rebate schemes toward generally less well-off households. The targeting has not always been as accurate as it could have been, though, with for example well off but elderly people receiving payments while less well-off younger people go without.[29]

Transferring funding to taxation would be a fairer way to share the burden on low carbon policy costs. But at a time of difficult public finances there appears to be limited political appetite for making such a transfer.  With the LCF due to expand materially this Parliament, such appetite may diminish yet further - at the same time as the regressive impacts of funding such a huge infrastructure programme through bills worsens. Nevertheless, it remains the best way to cover the inevitable costs of the low carbon transition

**Recommendation:** Low carbon generation deployment and energy efficiency programme costs should be transferred from levies on bills into tax-funded programmes.

**Recommendation:** Re-establishing energy efficiency policy in the wake of the cancellation of the Green Deal should be undertaken as a matter of urgency. Efficiency policies will be essential to mitigate the bill impacts of decarbonising generation. This should include targeting the successor to the ECO scheme towards fuel poor households, and designating energy efficiency as a national infrastructure priority.

## Carbon benefits of deployment policy

Measures of the relative carbon costs of different policies are surprisingly hard to come by. Impact assessments attempt to predict in advance of a policy being introduced what those impacts might be, but there have been few official efforts to look back at existing policies and account for their cost-effectiveness.

To compare the costs and principal benefits of low carbon deployment policies for different technologies, Citizens Advice has created a series of charts depicting historical and future spending commitments on low carbon deployment.

Figures 2.3 to 2.5 show the value for money, overall spend, and output in terms of clean electricity of existing and future obligations to low carbon support policies and technologies. These Figures all work in the same way - the horizontal axis shows the quantity of electricity output from the particular technology under the

[29] Bridgeman, Toby et al (2015) *Energy Tariff Options for Consumers in Vulnerable Situations*. Centre for Sustainable Energy and Citizens Advice. Bristol. pp. 41-42. https://www.citizensadvice.org.uk/Global/CitizensAdvice/essential%20services%20publications/tariff-options-for-vulnerable-consumers-May2015.pdf

particular support policy (the difficulty of getting data for carbon savings means we have used clean electricity generated, rather than tonnes of carbon saved, as the measure of 'payback' from these investments). The vertical axis shows the top up payment per unit of electricity generated. By derivation, the area of each rectangle represents the total amount paid to each technology class under each technology type.

For Figures 2.4 and 2.5 some assumptions have been made around the expected capacity factors of generators which have been contracted for but are not yet built. CfD top-up payments assume a wholesale reference price of £45 - altering this would change the relative value of CfD recipient technologies in contrast with others. A stable price at this level is exceptionally unlikely, but it provides a constant basis for comparison. If future wholesale prices are higher, the effective subsidy under CfDs will be lower, and vice versa. Figures 2.4 and 2.5 only cover facilities for which a contract has already been agreed - this work does not attempt to forecast future deployment rates of low carbon technologies beyond those already committed to. There is one exception to this - the proposed first UK tidal lagoon facility is included in both charts to compare with the rest of the low carbon budget, as its development is sufficiently advanced for it to have entered into negotiations with DECC and its likely output and an indicative strike price (£168/MWh) are in the public domain.[30]

In cases where subsidy rates have changed, or where different rates are paid to different sizes of installation, the chart shows the lower bound in dark colours, with the lighter colour range indicating the extent of the highest subsidy levels. If every deployment in that class had received the lowest available payment, it would be at the top of the darker rectangle; if every deployment had received the highest payment available, it would be at the top of the lighter rectangle. In reality, the average will fall somewhere within the range between the two. Technology-policy combinations are ranked from lowest to highest in terms of the *minimum* payment for which they are eligible - the best value combinations of policy and technology appear to the left of the chart, the worst to the right.

Figure 2.3 shows data for deployments up to 2015. This covers what has been achieved with two policies, the Renewables Obligation and the Microgeneration Feed-in Tariff. Some renewable facilities (mostly large scale hydro plants, plus a handful of the oldest wind farms) came forward under previous instruments, either as part of the old CEGB system or under the short-lived Non-Fossil Fuel Obligation - these are not included in the chart. Also not shown are technologies whose

[30] At time of writing, negotiations between the government and the developer are ongoing and could result in a lower (or higher) price being agreed upon. Subsequent, bigger, lagoon projects could be materially cheaper than the first, smaller lagoon, although the projected costs for larger follow on projects of £90-95/MWh is no cheaper than that agreed for new nuclear (£92.50/MWh for Hinkley Point C, dropping to £89.50/MWh if a second EPR is built at Sizewell) and is materially more expensive than already achievable prices for onshore wind and solar PV.

contributions over the time period are so small as to not appear on the scale - tidal and wave on all charts, and FIT anaerobic digestion in Figures 2.4 and 2.5.

As can be seen from the green areas, the feed-in tariff has had a much higher maximum cost per unit than the RO, although the highest rates shown on the chart were only in place for a short period. Smaller facilities and those installed much earlier under the FIT scheme receive much higher subsidy per unit of output than even the most expensive RO deployments. For more recent installations of the largest facilities covered by the FIT, the unit cost is close to some RO payments.

Onshore wind under the RO has been the largest single technology class in terms of output to date, although the combined outputs from the various types of biomass, energy from waste and landfill/sewage gas under the RO have had comparable production. Despite its high price tag per unit of output and public profile, to date solar PV has been a small contributor to overall subsidised electricity generation.[31]

Figure 2.4 shows data for the expected per year payments to low carbon technologies by support mechanism, for all generators with existing contracts (plus the proposed first UK tidal lagoon facility). It does not include possible future deployment under these policies which does not already have a contract (for example, it does not include anything under the FiT that has not already been built, nor any offshore wind that does not have an agreed CfD).

The diversity of support policies will increase, as regular and FIDER CfD-backed projects come online. The standard CfD backed onshore and offshore wind projects show better value for money (i.e. lower per unit payments) than their RO supported equivalents. However, assuming a reference price of £45/MWh, the FIDER contracts are considerably worse value than most of their RO-supported competition, and the worst value for money of anything large scale, in some cases only marginally cheaper per unit than the most expensive small scale FIT solar PV and micro-hydro

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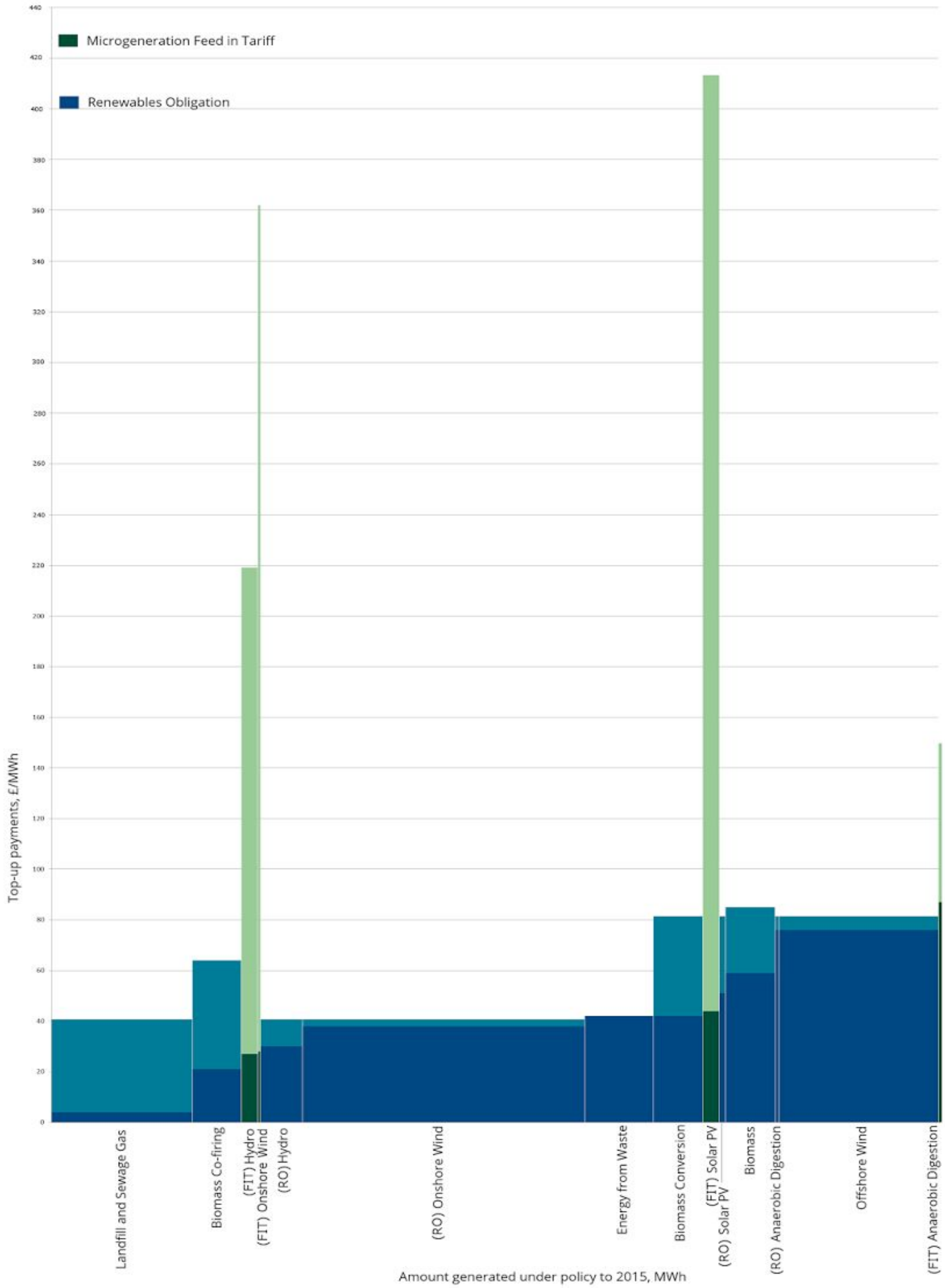
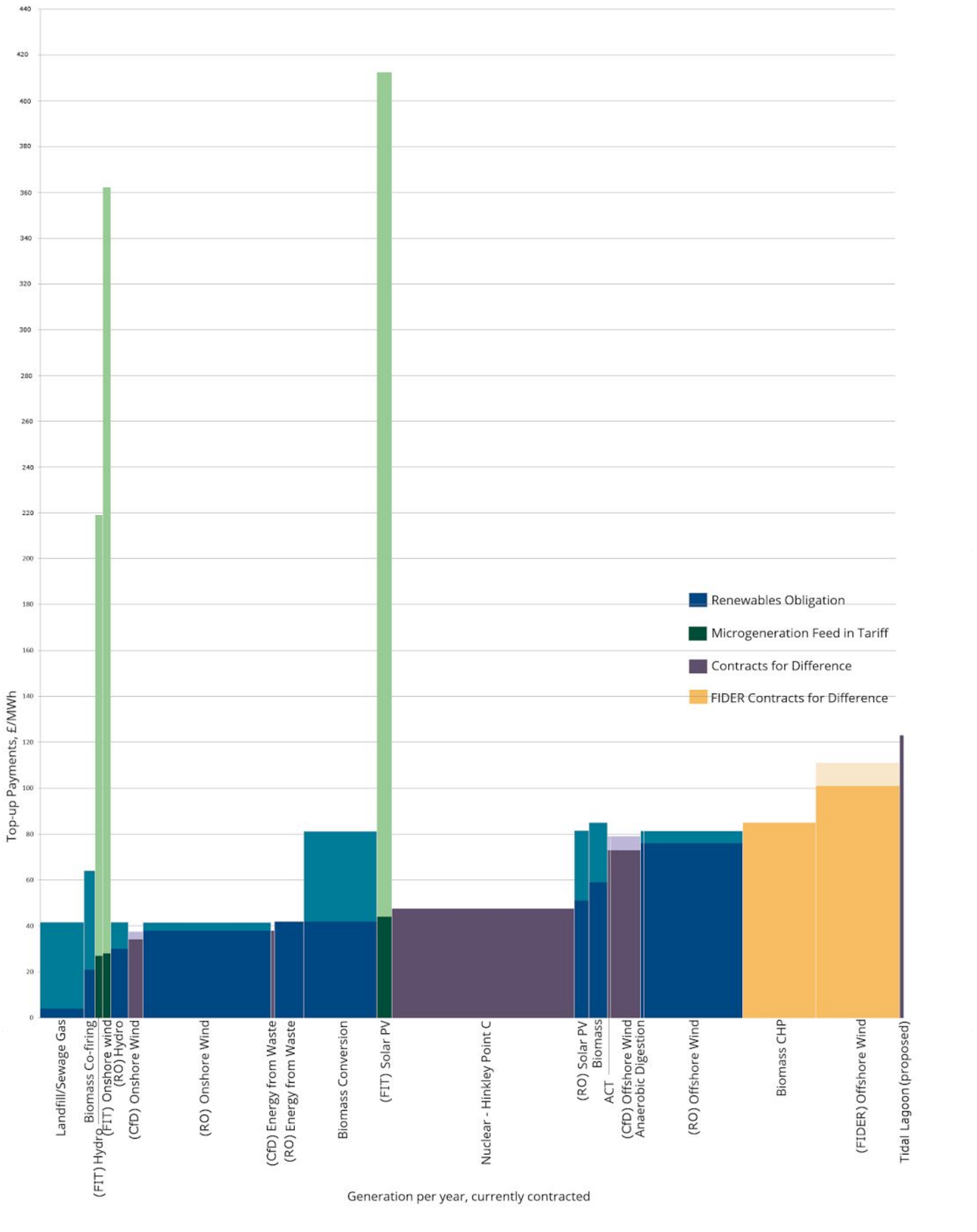
[31] Data from Digest of UK Energy Statistics 2015 electricity data (https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes); Ofgem Renewables Obligation Data and Statistics (https://www.ofgem.gov.uk/environmental-programmes/renewables-obligation-ro/renewables-obligation-data-and-statistics);Ofgem feed-in Tariff reports and statistics (https://www.ofgem.gov.uk/environmental-programmes/feed-tariff-fit-scheme/feed-tariff-fit-reports-and-statistics) ;results of first CfD allocation round and FIDER project winners. Data on Hinkley C and tidal lagoon taken from published information that may be revised as contract negotiations are concluded. Data for RO goes to the end of year 2014-2015; for the feed in tariff to June 2015. Value of RO subsidy taken from buyout price. Future annual production from existing plants assumed to be equal to last year; production from yet-to-be-built plants assumes the following load factors: nuclear 90%, ACT 87%, biomass CHP and energy from waste 85%, offshore wind 42%, onshore wind 28%, tidal lagoon 18%, solar PV 11%. Reference price for CfDs assumed to be £45. Limits to data availability and the difficulty of comparing different accounting schedules means the data are not totally precise, but are indicative of the relative contributions of the different technologies and policies. For example, reporting schedules for different policies mean there may be a disparity of a few months between numbers for the RO and the FiT. Data shortages and the difficulty of comparing on an equivalent basis means we have not included energy efficiency policies and technologies in these rankings.

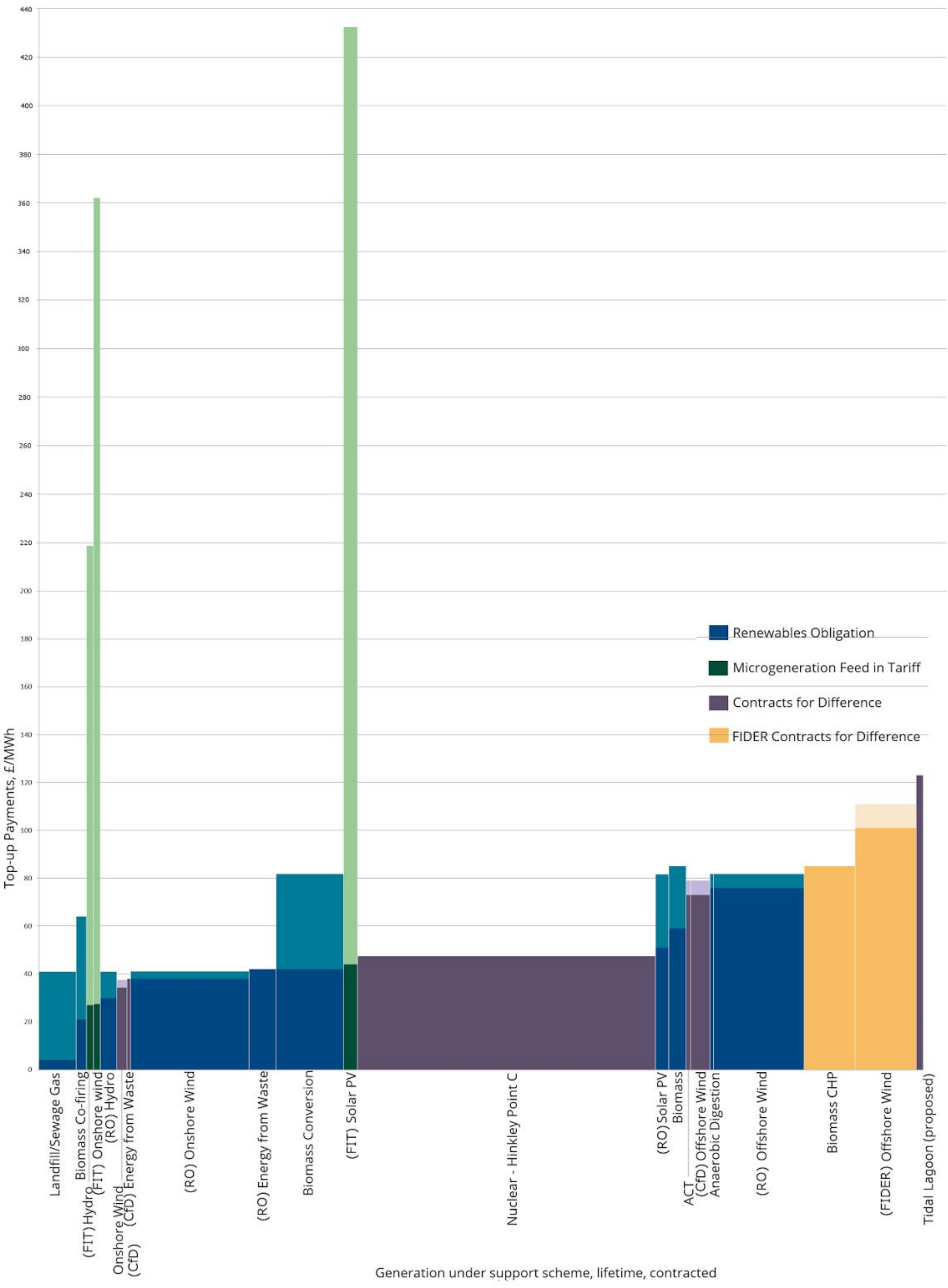
deployments. The proposed first tidal lagoon, if it were to be awarded its desired strike price of £168/MWh, would appear at the far right of the chart as the most expensive item on the list, though with a small annual output.




▲ Figure 2.3: Where has money gone? Top-up payments to low carbon technologies by support scheme, historical




▲ Figure 2.4: Where will money go each year? Top-up payments to low carbon technologies by support scheme, per year, for currently contracted generators




▲ Figure 2.5: Where will money go in total? Top-up payments to low carbon technologies by support scheme, for the full duration of the support mechanism, for currently contracted generators

In contrast with Figure 2.3, Figure 2.4 shows the growth of offshore wind and nuclear (Hinkley Point C) in future financial commitments. Onshore wind's share of the annual budget will become much smaller than these once they are completed.

Figure 2.5 accounts for the varying length of different policy support commitments for all currently operational and contracted generation. The extent of the 35-year commitment to Hinkley Point C with its huge annual production, in particular, becomes more pronounced in contrast with the 15- and 20-year support offered by other policies. Because of the different life expectancies of different technologies, some will produce electricity for longer after their CfDs end than others. Figure 2.5 however only shows the years for which support is provided.

Again, no attempt is made to project future deployment rates, simply to account for money already committed.

Taking the three charts together, a few things stand out. The ordering of technologies, from most to least cost effective, is largely unaffected by support policies. Landfill and sewage gas, hydro and biomass dominate the left hand side, along with onshore wind. Nuclear sits in the middle, with solar PV, offshore wind, and niche generation like anaerobic digestion and tidal at the high end. The range of cost is much greater under the FIT than for other policies, owing to changes to subsidy rates and differing support for different sizes of installation. For each technology, competitive allocation proves to be the most cost-effective support mechanism.

## Non-carbon benefits of deployment policy

As the UK's low carbon deployment policies have evolved, the objective of reducing emissions to help tackle climate change has been increasingly tangled among an array of other policy goals. These other motivations might drastically shift one's view of the value for money of the policy, depending on how highly one values these co-benefits. Decisions to proceed with policies have often involved the overruling of conventional cost-benefit analysis in their impact assessments.

For an example of how this thinking affects policy assessment, take the original DECC impact assessment for the Feed in Tariff.[32] That assessment found that for the expected £8.6 bn cost, only £420 mn worth of carbon savings could be expected. The remaining (unquantified) benefits were believed to be a mix of "contributing to the UK's renewable energy target; greater consumer engagement; diversifying the energy mix; reducing dependence on (imported) fossil fuels; greater energy security at the small scale; business and employment opportunities in developing and deploying renewable technologies; reductions in losses through transmission / distribution networks; innovation benefits and potential reductions in technology costs as a result of roll-out."[33]

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32 This is not an isolated example and there have been other energy impact assessments with a negative net present value running into billions of pounds, including the (2009) Renewable Energy Strategy at -£66bn and the (2012) banding of the Renewable Obligation at -£1.8bn, where policy has subsequently been adopted despite (very) negative cost-benefit assessments.

33 Department of Energy and Climate Change (2010) *Impact Assessment of feed in tariffs for small-scale low carbon, electricity generation*. London.

Quantifying costs and benefits can be difficult, particularly where issues are ostensibly non-monetised, such as consumer engagement. But we think that DECC could, and should, do more when the price tag of policies is so high. Many areas that have often been considered in a qualitative way are actually capable of being modelled. For example, primary fuel production, imports and exports and price formation are all established areas of modelling which should make valuing reduced fuel imports possible. Losses modelling is an established field and something networks are very used to; the take up of low carbon technologies has been extensively modelled in recent price control development processes. The extent to which diversification of production technologies reduces, or increases, total system costs (and security) are becoming more known as both UK and overseas system operators become more used to adapting to new technologies in new locations.

The most prominent uncosted externality in energy policy has been employment. The prospect of investment creating jobs features prominently in energy impact assessments and in lobbying for support for new technologies. Energy intensive users have been equally quick to point to the costs of such support damaging their international competitiveness, in some cases persuading government to exempt them from such costs. Both supporters and detractors lean on export dimensions and the UK's positioning in global markets in their arguments - the positive opportunity for it to become a world leader in developing and exporting new technologies, or the negative risk that UK firms will not be able to compete against international rivals if they face higher energy costs due to national policy support.

The net position - whether innovation stimulus in the energy generation sector is creating or destroying jobs and if so, how many and over what period - is disputed. If it is to be relied on in decision making it needs to be better evidenced.

If jobs are created as a byproduct of energy policy this is very welcome. But the principal focus of energy policy must remain the trilemma: keeping bills affordable; keeping the lights on; and reducing emissions. If specific energy investments are motivated more by job creation than tackling the trilemma then those costs should not be met through energy bill funded levies. No other employment programme would be paid for through such a regressive form of taxation.

**Recommendation:** If job creation is the principal, or a major, consideration in the government's decision to stimulate a new project or technology, it should fund the job-creating proportion of any needed deployment support from general taxation.

Government must be clearer about the intended gains from deployment support, and about the most appropriate way to pay for it. The back catalogue of

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http://webarchive.nationalarchives.gov.uk/20121217150421/http:/decc.gov.uk/assets/decc/consultations/renewable%20electricity%20financial%20incentives/2710-final-ia-feed-in-tariffs-small-scale.pdf cost-benefit analyses of energy policy is filled with clear assessments of costs and hazy speculation about benefits.  This needs to change.

**Recommendation:** The criteria used to assess bill-funded low carbon deployment should be consistent across impact assessments. They should be heavily weighted towards reducing emissions at the lowest cost. Government can and must do more to quantify currently uncosted externalities given the size of investment it is committing to at consumers' expense.

# Chapter 3. Towards a more cost-effective deployment policy

Chapter 2 showed how policy has not aimed to prioritise the most cost effective short term measures but has sought to hedge its bets, putting some of the budget towards technologies that are relatively cheap now, and the rest towards ones that may, or may not, become cost effective in the future.

In its initial guise, the Renewables Obligation offered equal payments for all renewable technologies. Some methods of achieving decarbonisation, such as energy efficiency, nuclear and CCS, were excluded. But of those that did qualify, the cheapest were encouraged to come forward.

It was argued that this encouraged short termism: that some of the technologies that are expensive now might become cost effective in future, but that their potential to do so would be hampered if they did not receive support now to build supply chains and knowhow. 'Banding' in the renewables obligation was instituted, enabling the government to tailor different support rates for the different technologies. In so doing, it removed the incentive on investors to pursue investments in the cheapest technologies because they could get similar or better rates of return with more expensive ones. EMR has continued this banding approach - different technologies receive different strike prices even though the product they produce, low carbon energy, is the same.

Government is trying to strike a balance between providing just enough support that work will continue on every technology, without providing so much that developers can accrue windfall gains. If less mature technologies get cheaper they should move on to compete with other technologies, first for top-up payments and then in an unsubsidised, properly carbon-priced marketplace. The underlying assumption is twofold, and both parts involve gambles rather than certainties: that we can afford to support all technologies; and that if we do so all will make progress to a point where they can simultaneously compete without subsidy. If this does not happen - if the budget runs out, or if one (or several) technologies do not make it - what happens next is unclear. Drop support, and you may never know if a necessary breakthrough was just around the corner; extend support indefinitely, and the desired breakthrough may never appear.

There needs to be a recognition of the risks of failure. Stimulus is not a guarantee of success and governments can back losers as easily as winners. To avoid getting stuck indefinitely supporting an immature industry that shows no signs of ever maturing, the government needs to demonstrate that it has an exit strategy as well an entry strategy for supporting new technologies. This should include explicitly setting out upfront conditions on what progress needs to be made on getting costs down for support to continue - and an expectation that they will walk away if this progress is not made.

Because available financing is finite, decisions to choose higher cost technologies where lower cost ones are available will - in the short term - result in consumers receiving less decarbonisation for their money. This deferral of emissions reduction may or may not be made up in the future if that technology proves to be successful - consumers today are being asked to *definitely* accept less, so that consumers tomorrow *may* receive more. There are also dynamic effects at work as low carbon technologies are not simply in competition with fossil fuel generators but also with each other. Bust the budget on expensive stuff and there may be no money left for the cheaper stuff - and this is not simply a theoretical problem but one we face today, as evidenced by an overspent LCF and the cancelling of the 2015/16 CfD auctions.

The government has started to move back towards competitive procurement with the introduction of auctions for some CfDs. But the current system retains some discrimination between renewable technologies. 'Less mature' technologies are insulated from competition with 'mature' ones. Some technologies are being offered contracts through bilateral negotiations rather than through the auction process. And onshore wind looks set to be constrained by government decree.

This chapter will explore those three instances where the principle of technology neutrality is overridden in current policy.

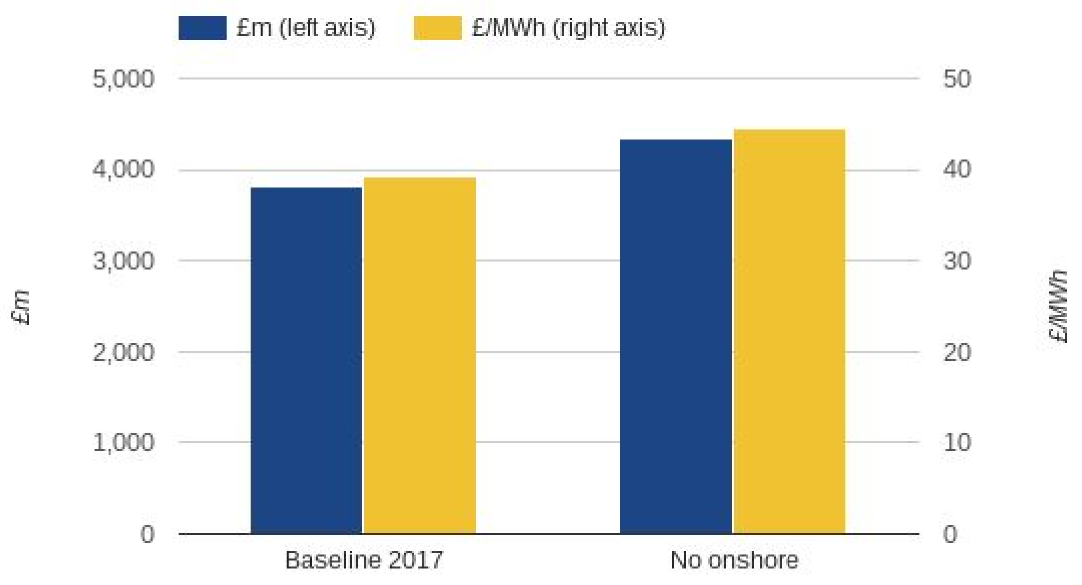
# Onshore Wind

The Conservative Party Manifesto promised that should the party be put in government, it would "end any new subsidy for [onshore wind farms] and change the law so that local people have the final say on wind farm applications".[34] It began implementing this policy in the summer of 2015, by barring wind farms from the Renewables Obligation. Secretary of State Amber Rudd has hinted that similar changes will be made to bar onshore wind farms from the CfD programme, but details have not yet been published.[35]

[34] The Conservative Party (2015). *The Conservative Party Manifesto 2015*. p. 57. https://www.conservatives.com/manifesto.
[35] Energy and Climate Change Committee (2015) "DECC Priorities 2015". London. http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/energy-and-climate-change-committee/decc-priorities-2015/oral/18799.html; Qs 28 and 32

To assess the impact of excluding onshore wind from future subsidy auctions, we commissioned NERA Economic Consulting to model the results of auctions in 2017, and to re-run the 2015 auction with onshore wind excluded. The 2017 modelling additionally included some sensitivity testing to see what effect different assumptions on future wholesale and technology costs would have. The results are summarised below, and fuller detail can be found in an attachment to this report.

The modelling shows that excluding onshore wind from either auction imposed significant costs on electricity consumers. Excluding onshore wind from the CfD auctions would increase costs to consumers because onshore wind is one of the cheapest technologies available at scale in the UK. In both auctions, consumer costs increased by around £0.5bn (undiscounted lifetime value) over the term of the CfD contracts awarded, equivalent to around £30m/year (see Figure 3.1, 'no onshore' scenario).[36]



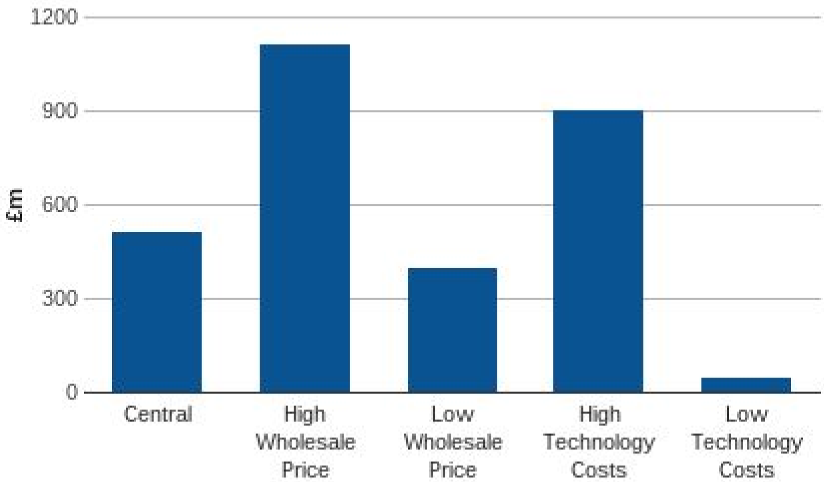

▲ Figure 3.1: Cost of modelled scenarios over lifetime of CfD contracts, 2017 auction. Cumulative CfD support costs, undiscounted but in real terms.

Our approach assumes that even though it has excluded onshore wind, the government would still want to achieve the same amount of renewable generation (in TWh) in order to meet the renewable energy target, and would do so by increasing the budget for Pot 2 (the pot for less mature technologies). The government could also take other approaches, such as deciding not to contract for as much renewable electricity, further reducing the likelihood of meeting the

[36] Analysis conducted using NERA's CfD auctions model and data published by DECC on technology costs and wholesale prices. See https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/NERA%20CfD%20Auction%20Modelling%20for%20Citizens%20Advice.pdf

renewable energy target for 2020 and increasing the amount of low carbon generation that must be procured in the period after 2020, or by increasing the Pot 1 budget, which would lead to significant increases in the amount of solar. The clearing price of other technologies in Pot 1 may be higher than they would otherwise be if more marginal projects needed to be procured to make up for the missing volumes of onshore wind.

NERA conducted sensitivity analysis to analyse the range of costs associated with the exclusion of onshore wind. Depending on future wholesale prices, additional costs of excluding onshore wind could be as high as £1.1bn or as low as £0.4bn.[37] Depending on technology cost assumptions, additional costs could range from as little as £50mn to as much as £900mn[38]. If technology costs were to be significantly lower than in DECC's 2013 generation cost listings, and there were a significant volume of projects that were able to be built (around 2GW in each auction at around the clearing price for onshore wind of £80/MWh - in 2015 0.04GW of solar was available at that price) then all other things being equal, the expected additional cost to consumers would be relatively low (Figure 3.2). It follows, then, that if the government proceeds with barring future onshore wind projects entirely, it must be both extremely confident that cheap solar can fill the gap to ensure consumers are not made worse off, and it must refrain from taking steps that would impede the development of solar as well.




▲ Figure 3.2: Sensitivity analysis - additional cost of excluding onshore wind from 2017 CfD auction. Cumulative CfD support costs, undiscounted but in real terms.

As excluding onshore wind completely from the CfD auction could add significantly to consumer bills, there are other policies the government could consider. It is

[37] Using DECC high and low wholesale prices scenarios.
[38] High technology costs: 50% of DECC learning rate from DECC Generation costs 2013 (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42852/5936-renewables-obligation-consultation-the-government.pdf). Low technology costs assumes costs are 30% lower for less established technologies (and solar), 20% lower for other established technologies than in DECC 2013, and applies 100% of DECC learning rates over time.

already in the process of granting a planning veto to local communities to avoid undesired visual impacts. As projects will need to have planning permission before they can bid into the CfD auctions, this will automatically mean that only projects that have local support will get subsidised.

Alternatively, the Government could ensure that only a maximum volume of MWs of onshore capacity was awarded CfDs in each auction. Wind farms with high wind speeds (largely those in Scotland) would be more likely to be competitive under such constraints. This would have some implied cost to consumers, but less than a full ban.

A further proposal, for 'subsidy-free' CfDs, has been advanced by several organisations.

## 'Subsidy-free' CfDs?

'Subsidy-free CfDs' have been proposed as a solution for onshore wind by several policy analysts.[39] Comments by the Secretary of State indicate that some developers would be willing to proceed under some, unspecified, 'non-subsidised' approach, and that government would be comfortable with this.[40]

There are various suggestions for how a 'subsidy-free' strike price might be benchmarked - compare it with the cost of power from new-build gas generation,[41] the cost of gas generation plus an assumed carbon price,[42, 43] the projected average wholesale prices over the period of the 15 years of the contract,[44] or account for CfD top-ups differently under the Levy Control Framework such that the some of the difference between the reference price and strike price is not deemed a subsidy but rather, in effect, a proxy carbon price.[45]

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[39] Shankleman, Jessica (2015) "Could 'subsidy-free' CfDs solve UK's renewables policy dilemma" *Business Green*. London. http://www.businessgreen.com/bg/analysis/2423368/could-subsidy-free-cfds-solve-uks-renewables-policy-dilemma

[40] Energy and Climate Change Committee (2015) "DECC Priorities 2015". London. http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/energy-and-climate-change-committee/decc-priorities-2015/oral/18799.html; Qs 28 and 32

[41] Caldecott, Ben (2015) *Green and Responsible Conservatism*. Bright Blue. London. http://www.brightblue.org.uk/images/greenandresponsible.pdf. p. 38

[42] Committee on Climate Change (2015) *Meeting Carbon Budgets - Progress in reducing the UK's carbon emissions. 2015 report to Parliament*. London https://www.theccc.org.uk/wp-content/uploads/2015/06/6.737_CCC-BOOK_WEB_030715_RFS.pdf. p. 65

[43] Howard, Richard (2015). *Powering Up*. Policy Exchange. London. p. 37 http://www.policyexchange.org.uk/images/publications/powering%20up.pdf

[44] NERA (2015). *Modelling the GB Renewable Electricity CfD Auctions – the cost of excluding onshore wind and maintaining separate pots*. London. 2015. https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/NERA%20CfD%20Auction%20Modelling%20for%20Citizens%20Advice.pdf

[45] Edge, Gordon, quoted in Shankleman, Jessica (2015) "Could 'subsidy-free' CfDs solve UK's renewables policy dilemma" *Business Green*. London. http://www.businessgreen.com/bg/analysis/2423368/could-subsidy-free-cfds-solve-uks-renewables-policy-dilemma

Onshore wind farms cleared in the first CfD auction at a strike price of between £79.23 and £82.50 (depending on delivery year), suggesting that the thresholds for some of these are well within reach. Of the options listed above, the CCC approach leads to the highest and easiest to reach threshold. Applying the would-be costs of a £23/tCO2 carbon price in 2020 to new build gas generation, the CCC puts the threshold for whether power is subsidised at £70/MWh in 2020.[46] Assuming carbon prices rising to £70/tCO2 in 2030 they raise the threshold to £85/MWh by 2030.

This proposal could be implemented by setting an upper bound on CfD auctions at a defined 'subsidy-free' price, above which projects would not be considered. This would not guarantee that consumers do not have to pay subsidy towards these projects while both gas and carbon prices remain depressed, or if they become so again in future - and the future trajectory of neither can be accurately forecast. However, by capping at a level reflecting the lifecycle cost of new gas generation, including allowance for its life cycle carbon costs, it allows a reasonable argument to be made that, over the life cycle of these projects, no net subsidy is being provided, meeting the Conservative manifesto pledge to provide no new subsidy to onshore wind.

Proposed changes to planning rules will enable local communities a stronger right of refusal over projects which they oppose, reducing the number of developments and ensuring those that proceed are ones that are welcome in their area.

**Recommendation:** Instead of barring onshore wind from CfD allocation completely, government should instead lower the cap on strike prices (for example, by changing the previously set administrative strike price cap on auction clearing prices) to a level equivalent to the cost of new build gas generation.

# Mature vs immature

In the absence of a work-around for onshore wind, what remains of the deployment budget looks set to be tilted even more firmly towards building more expensive, less established technologies. DECC assigned 80% of the first auction's allocated budget to less established technologies.[47] Without onshore wind being able to enter as a mature technology, either a lot of solar PV will need to come forward, or less mature technologies will account for a greater proportion in future.

The initial decision raised questions from the Competition and Markets Authority, who expressed its concern:

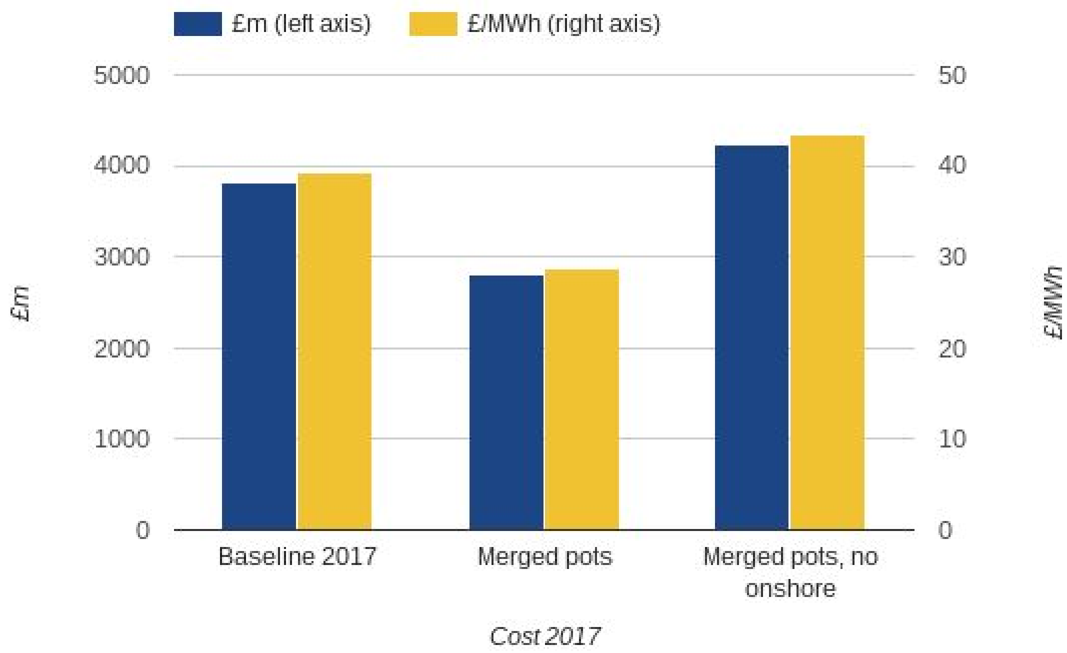
[46] Committee on Climate Change (2015). *Power Sector Scenarios for a Fifth Carbon Budget*. London. https://d2kjx2p8nxa8ft.cloudfront.net/wp-content/uploads/2015/10/Power-sector-scenarios-for-the-fifth-carbon-budget.pdf. p. 88

[47] Department of Energy and Climate Change (2015) *Electricity Market Reform: Contracts for Difference*. London. https://www.gov.uk/government/collections/electricity-market-reform-contracts-for-difference

"Regarding the division of technologies into pots, we consider that DECC did not support its decision with robust evidence demonstrating how its preferred option could be expected to result in the best outcome for consumers. The extent to which DECC should set aside budget for less developed technologies is likely to evolve over time, as these technologies become more developed and less costly, and therefore able to compete with currently more developed technologies.

As with the allocation of technologies into pots, we consider that DECC did not support with robust evidence its decision around the allocation of budget into separate pots in the previous auction. It is important that DECC provides a clear justification for the allocation of budgets between pots for each auction to ensure that an appropriate amount of support is allocated to technologies at different stages of development. "[48]

The short term consumer interest is better served by building the cheapest available technologies. Over longer time horizons this is less clear cut, which is why it is reasonable to devote some portion of funding to deployment support for less mature technologies. But what is not clear, from work the government has done to date, is how it settled on the 80:20 ratio that puts the lion's share of funds towards more expensive projects.




▲ Figure 3.3: Cost of modelled scenarios over lifetime of CfD contracts, 2017 auction. Cumulative CfD support costs, undiscounted but in real terms.

[48] Competition and Markets Authority (2015) *Energy market investigation provisional findings report*. London. https://assets.digital.cabinet-office.gov.uk/media/559fc933ed915d1592000050/EMI_provisional_findings_report.pdf

NERA's modelling work also looked at the likely outcomes of removing the segregation between less and more mature technologies. Merging Pot 1 and Pot 2 in a 2017 auction could deliver significant savings to electricity consumers. Consumers could save around £1bn over the term of the CfD contracts, equivalent to around £50mn a year (see Figure 3.3). This saving is almost the amount the government released for Pot 1 in the 2015 auction (£65mn). Average subsidy cost (the top-up relative to the CfD reference price for the mix of technologies and contracts signed) is significantly reduced by merging the pots, from around £39/MWh to around £29/MWh: 26% lower. This is because with a merged pot the whole budget is taken up by lower cost technologies like onshore wind and solar PV, so the overall budget can be reduced while still achieving the same volume of renewable electricity. When the pots are merged there are no CfD contracts awarded to less established technologies like offshore wind.

Modelling a re-run of the 2015 auction, with more limited availability of solar PV reflecting actual bidders in that auction, yielded £700mn savings, while bringing forward 700 MW of offshore wind. This indicates that even shrinking the Pot 2 allowance, without completely eliminating it, can result in considerable savings for consumers.[49]

The evidence is clear that protecting some technologies through the second pot will cost consumers a significant amount of money, at least in the short term, and that DECC is taking a calculated gamble in diverting funding away from more mature technologies towards less mature ones. Where evidence is more scarce is on whether that gamble is proportionate and well considered. The CMA's report, our own experience and the feedback we have received from a wide range of other stakeholders suggests that, outside DECC, there is very little understanding of how the Government reached past decisions on how to allocate funding between more and less mature technology pots.

The current approach of heavily loading funding towards the least cost effective technologies does not look proportionate or well considered. We would like to see the government reverse its funding priorities to focus the majority of its budget on more proven technologies. Our modelling suggests a strong value-for-money case for abandoning the two pot model and moving to a single auction, but we recognise that this may not be compatible with a desire to keep some technology options that currently sit in the less established pot open. Any future funding decision that allocates funding to the less established technologies pot must be accompanied by

[49] If onshore wind is excluded and the pots merged, most of the savings from merging the pots are lost (see Figure 3.3). The "merged pots, no onshore" scenario shows costs almost as high as in "No onshore". This is because to achieve the baseline level on renewable electricity generation it is necessary to award CfD contracts to some offshore wind projects as well as solar - and the clearing price is therefore significantly higher than in the case where onshore wind is allowed (around £120/MWh rather than around £95/MWh). This means cheaper technologies (solar and energy from waste) are paid their administrative strike prices, which are higher than the clearing price in a two-pot auction.

a detailed value for money assessment that set out the additional consumer costs that decision will impose on consumers and how it can it prove that such additional costs are a price worth paying.  This will require it to be hard-headed about the realistic prospects of driving down the costs of those technologies and a quid pro quo for consumers paying more now must be a genuine prospect that costs will fall rapidly and a guarantee that future funding will be curtailed if they do not.  This could take the form of a defined degression curve for subsidy - we explore this concept more in Chapter 4.

If it cannot provide a convincing case, it should not be funding the less established technologies pot at all.

**Recommendation:** the Government should allocate the majority of CfD funding to the most currently cost-effective technologies.

**Recommendation**: any future decision to allocate funding to the less established technologies pot must be accompanied by a rigorous value for money assessment. DECC needs to start demonstrating the value (if any) of keeping the more expensive technology options open.  If it cannot, they should not be funded.

# Bespoke contracts

DECC has two methods for protecting uneconomic technology types from competition for CfDs. The first, described above, has been to organise intra-technology competition within the CfD auction process with a ring fenced budget. The other has been to negotiate bespoke CfDs outside any auction in a bilateral deal between the government and a developer. So far this has been brought into play for two projects. The negotiation over Hinkley Point C nuclear power station is sufficiently far advanced that State Aid approval has been granted; the negotiation over the first UK tidal lagoon project is further from completion.

Measured in different ways, these are the two most expensive energy proposals currently on the table. The first tidal lagoon proposal appears likely to be the highest in terms of support per unit of output; Hinkley Point C will be the highest total sum of support. The government has not published any impact assessments that would allow for an understanding of how compelling (or not) the business case for public support is in either case. Where preliminary agreement has been reached, as is the case with Hinkley Point C, external scrutiny is made very difficult because key elements of the commercial terms have either not been published at all or have been redacted. The National Audit Office is investigating the value for money offered by that deal[50], and the Public Accounts Committee may also wish to do so. But those investigations will offer consumers little protection if they conclude after the deal is already signed - by that point it will already be legally binding.  Ex

[50] 'Hinkley Point C,' National Audit Office, Work in progress. https://www.nao.org.uk/work-in-progress/hinkley-point-c-2/

post investigation may prevent a repeat, but would not prevent an expensive initial mistake.

The CMA proposes mandating full impact assessments of non-competitively procured CfDs.[51] The proposal would be an improvement on the status quo. It could improve transparency over policy trade-offs and tease out how (and, indeed, if) the costs and benefits of the project have been assessed. To be useful, it is crucial that all key terms that could affect the future liabilities of consumers are published. Relying on the blanket argument that terms cannot be disclosed because they are commercially confidential is unsatisfactory when consumers are the counterparties to the contract. Consumers have a right to know what they are being signed up to. In the case of the Hinkley Point C deal, neither the longstop date, which provides a safeguard to cancel the CfD if construction overruns, nor the parameters of a gainshare mechanism that would share benefits with consumers if it comes in under budget, have been published. This is the case even after a European Commission investigation which forced some new information into the public domain.

The European Commission's statements accompanying its decision to give State Aid approval to the Hinkley Point C deal suggest that it was able to extract more value for UK consumers than DECC was, by setting tougher commercial terms as a precondition for allowing the deal. These resulted in a firm saving to taxpayers of at least £1bn from altering the terms of the State guarantee, and a less certain saving to bill payers that could run into billions of pounds from altering the terms of a gainsharing mechanism.[52] These savings demonstrate the value that can be delivered to consumers and citizens where the terms of a deal are subject to third party scrutiny. Only with full disclosure of all the terms and conditions, before the contract is concluded, can the consumer have any confidence that what they are being asked to support is reasonable and affordable.

**Recommendation:** As well as ensuring full impact assessments are carried out in future, the CMA should also demand full publication of terms in existing contracts that affect consumers' liabilities.

We share the CMA's observation that it is unclear what criteria the government uses to determine whether to invest in a project, or even whether there are any predetermined criteria. It is also unclear whether the same criteria are applied from one negotiation to the next. Because negotiations take place in secret, it is also impossible for third parties to challenge any arguments made by developers that are not already in the public domain. Consistency in criteria applied would be highly

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[51] Competition and Markets Authority (2015). *Energy Market Investigation - notice of possible remedies* London. 2015. p. 8 https://assets.digital.cabinet-office.gov.uk/media/559aac8eed915d1592000023/EMI_Remedies_Notice_-_Final.pdf

[52] 'State aid: Commission concludes modified UK measures for Hinkley Point nuclear power plant are compatible with EU rules,' European Commission, 8 October 2014. http://europa.eu/rapid/press-release_IP-14-1093_en.htm

desirable. This could provide reassurance to both developers and consumers that they understand the rules of the game. It could also reduce legal risk, in the form of judicial review and possible State Aid challenge, by allowing DECC to demonstrate that it has followed an objective process in decisionmaking.

Responding to our call for evidence, EDF stated that "Where projects are awarded CfDs outside an auction process, it remains possible to apply competitive pressures through benchmarking of costs, requirement for competitive tenders for construction work, and rigorous scrutiny of costs by government, supported by expert advisors." EDF highlighted that, "these approaches were applied to the CfD for the Hinkley Point C nuclear project with the added safeguard for customers of a gainshare mechanism (not present in other CfDs) to ensure that benefits will be shared with customers if construction costs are less then anticipated, or equity returns greater than anticipated."[53]

A bilaterally negotiated project must show some additionality over the consumer benefits that could be delivered by a competitively allocated project if it is to go ahead  and the selection criteria should provide a means to explore whether this additionality exists. Where a more costly option is chosen, consumers are by implication being asked to defer carbon abatement to a later period. The criteria should also provide a means to demonstrate how the emissions savings that are being deferred will be made up later, and at what expected cost.

**Recommendation:** Where DECC proposes to award a substantive contract that has been bilaterally negotiated rather than competitively procured, it should publish a full impact assessment for consultation.

Technology classes which are too immature to be economically viable, and too niche at a global scale to make a significant contribution to worldwide decarbonisation, but which may be needed as part of longer-term UK decarbonisation efforts could be sustained and efforts made to cut their costs via R&D support rather than large-scale deployment. The next and final Chapter looks at this side of low-carbon innovation policy.

[53] EDF (2015). *Response to Call for Evidence*

# Chapter 4. Least Mature Technologies

The bulk of spending to drive down costs has come from supporting efforts to deploy generation technologies at scale. Far less has been spent trying to find ways to lower the costs of technologies at earlier stages before they head to mass deployment - laboratory research, smaller scale demonstration projects. That reflects not only the relatively low cost of R&D compared to deployment - one doesn't need to sustain large supply chains and numerous employees at that stage - but also reflects the preference for measuring policy success by deployment rate and the truncated timetable to largely decarbonise the electricity sector before 2030 and to meet the renewable energy target by 2020.

## Current Research and Development Policies

Accounting for deployment policies and spending is relatively straightforward. The programmes are relatively prominent, spending big sums of money and generating commensurately big lobbying efforts from interested stakeholders, keeping the profile high. In contrast, research and development (R&D) spending is much more dispersed, with mostly academic rather than commercial beneficiaries, meaning much less publicity.

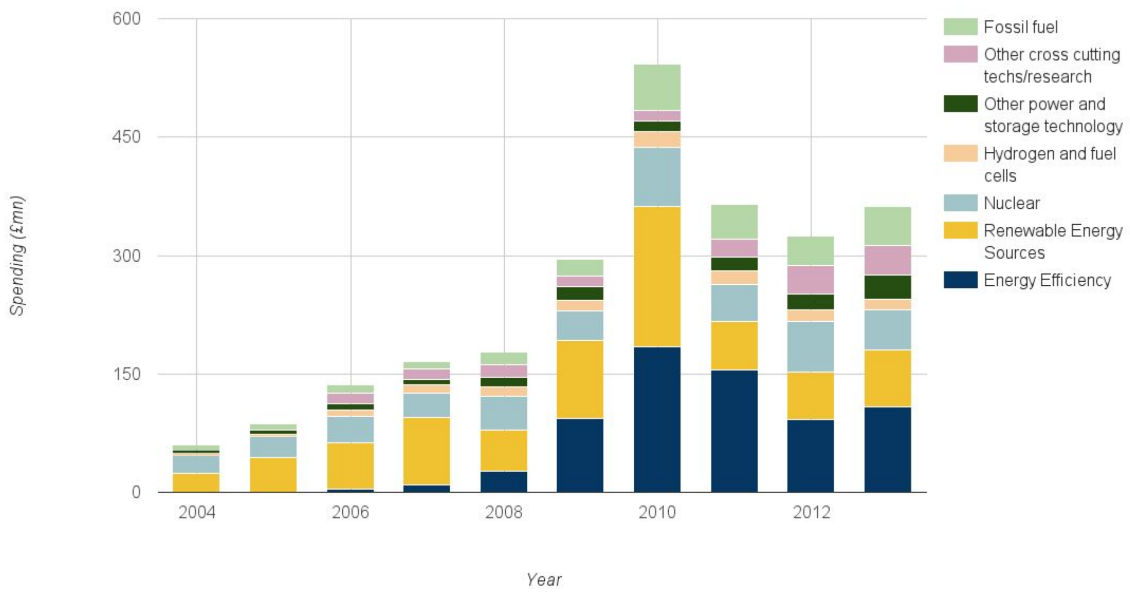
Figure 4.1 shows the spending figures for research and development in different energy technologies reported by the British government to the International Energy Agency, for its survey of member states' energy R&D activity. At just over £350mn in 2013, the most recent year for which data is available, spending on energy RD&D is less than a tenth of that for deployment. This does not deviate far from the worldwide ratio. Global fossil fuel subsidies (mostly consumption rather than production subsidies) were valued in 2012 at US$544 bn, renewable energy (production) subsidies at around $100bn, industrial energy R&D at $16bn and OECD government energy R&D at $19bn. The UK is not alone in having deployment spend that dwarfs R&D spend.[54]

The vast majority of UK energy innovation spending is now related to low carbon innovation - even the figures for fossil fuel research are mostly accounted for by carbon capture and storage technology (£41 out of £48 million). R&D spending has increased considerably across all technology classes over the past decade, as 2004 and 2005 saw qualifying innovation investments of less than £100mn (again, in

[54] Pollitt, Michael (2014) *Why and How to subsidise energy R+D?* EPRG Spring Seminar, 16 May 2014. Cambridge. http://www.eprg.group.cam.ac.uk/wp-content/uploads/2014/05/1A-Pollitt.pdf

2013 prices). The last government's decision to protect the science budget contributed to the relatively steady investment climate when other departmental spending programmes were being cut back.

These numbers are not comprehensive - a detailed and comprehensive listing of UK climate innovation spend seems not to exist.[55] But they are strongly indicative of the scale involved. Currently deployment spending outweighs R&D by a roughly 10:1 ratio. With the planned increases in the levy control framework by the end of the decade this could easily reach 20:1. Of this, deployment spending is paid for almost exclusively through energy bills (as governed by the Levy Control Framework) while the R&D money is drawn from general government revenues.




▲ Figure 4.1: UK spending on energy R&D[56]

## Evaluating R&D spending

Different criteria are needed to assess R&D spending from those used to assess deployment. Outcomes such as units of clean energy generated or cost per tonne of carbon saved are evidently unsuitable for investments which may never connect to the Grid or generate commercial power. Eventually one would expect improvements in these areas to be achieved, but any impacts would only be felt years, even decades after the decision. Likewise, other possible measures such as patent activity may not convey the full value of R&D support, both because they may disguise public sector crowding out of activity that the private sector may have carried out anyway, and because a well-calibrated innovation programme might

[55] A problem also encountered by Chris Goodall in his excellent blog, *Time to Focus on Energy Research*; 2014; http://www.carboncommentary.com/blog/2014/06/04/3603
[56] Data from EIA RD&D Online Data Service. http://www.iea.org/statistics/RDDonlinedataservice.

not be expected to yield constant hits. Indeed, it is frequently suggested that an appropriate "success rate" for government innovation would be well below 100% - a 100% rate would be indicative of too-great a degree of conservatism in picking research to back. The political problems inherent in a riskier strategy are clear. As Chris Goodall describes, "Put $100m into some crazy new idea for making solar panels and you are 95% likely to fail. Faced with media always eager to locate apparent stupidity, or even corruption, no government minister or senior official will want to back the latest idea coming out of the Oxford Science Park or an automotive supplier in Swindon knowing that she is fairly certain to look really foolish within a year. "[57]

Little data is available for the comparative value of spending on R&D compared to deployment at the margin. Work has been done at the aggregate level, assessing the overall learning rates from R&D vs deployment spending.[58] But this does not factor in current spending levels, so does not help to answer the question of where the most effective place to spend the next additional pound lies? It may be that such precision is impossible to achieve given the variations between different technology types and market structures.

Analysis that compares learning by doing (from deployment) with learning by research lends weight to the argument that, particularly for the youngest technologies, too much emphasis has been placed on deployment. Work by Jamasb and Kohler found that for the least mature technologies, most of the improvement in cost was explained by R&D activity, rather than deployment volumes.[59] Learning curves that omit R&D effects, they say, "overestimate the effect of learning by doing in general and that of new and emerging technologies in particular". This study was carried out in 2007, so it is likely that since then some technologies have been widely enough deployed no longer to fit their characterisation of 'new and emerging'. There is little reason, though, to expect the principle to have changed.

How R&D budgets are spent also influences the possible outcomes. Goodall again:

> "At present the UK government doles out its R&D budget in tiny spoonfuls. It gives £1m to this nascent technology, a few hundred thousand to another, and a generous £3m to a particular favourite... Engineers leaving universities or companies with a brilliant idea need money. And government will often provide this, even when venture capital does not. Bodies like the grandiosely named Technology Strategy Board will drip small amounts of cash into many

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[57] Goodall, Chris (2014). *Time to Focus on Energy Research*; http://www.carboncommentary.com/blog/2014/06/04/3603

[58] Frontier Economics (2014). *Returns to Investment in Science and Innovation*. London. http://www.frontier-economics.com/documents/2014/07/rates-of-return-to-investment-in-science-and-innovation.pdf

[59] Jamasb, Tooraj and Kohler, Jonathan (2007). *Learning curves for energy technology*. Cambridge. https://www.repository.cam.ac.uk/bitstream/handle/1810/194736/0752&EPRG0723.pdf;jsessionid=D39A847F2C7B851205D76A754CD1C430?sequence=1

ideas-based companies. It won't actually be enough to pay for real innovation or commercialisation but it will be just about enough to keep the business alive.

> "Why is this bad? It means that the talented engineer will stay beavering in his lab night after night hoping to make marginal improvements that can justify the next request for government rations. He works for the government, not for the marketplace. Actually, it would be far better if he failed, went broke and returned to the labour market where he could exercise his (undoubtedly real) skills on another project."[60]

Relying on experience curves to gain cost reductions becomes more and more difficult as time passes. Doubling deployment to get a 14% reduction in costs is far easier with 1GW already deployed than with 10GW. Returns to experience diminish as installed volumes rise. A small fraction of this value spent on more speculative earlier stage technologies might yield much more significant reductions. Or it might yield nothing. But the scale of the innovation challenge implied by the need for global decarbonisation will only look more out of step with the logic of experience curves as deployment increases.

There is little formal interaction between R&D and deployment policies. Both R&D and deployment is expected, by government and the likes of the CCC, to reduce the costs of decarbonising over time. Commitments to deploy, implicit in carbon budgets, the renewable energy target and the Climate Change Act stand whether or not costs actually come down.

Nor is there any formal requirement to do the lab work first. Hopefully, when assessing whether to support non-commercial and non-competitive deployment options, the government takes into account whether early-stage R&D-type work would be more effective in lowering costs before a deployment programme begins. But it is not required to. Nor is there an upper limit to per-unit costs which might be paid to a very innovative (or just very expensive) deployment proposal. This has meant that both in the past with solar PV, and possibly in the future with tidal lagoons, deployment begins at the most expensive point in the technology lifecycle. This could occur for several reasons: because the biggest savings are to be achieved through process improvements and training, which require an active deployment programme to be realised; because policy has pushed for deployment too early rather than waiting for further R&D gains; or because the technology is a dud which will never get cheaper. In the first of these cases, a deployment programme might be appropriate, if entered into with caution. In the other two, clearly any move to deploy is undesirable.

An upper limit to deployment subsidy could effectively insist that any technology which is too immature remain confined to small scale demonstrations and

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[60] Goodall 2014

laboratory work until it can reach that threshold. In the short term this is unlikely to have much of an effect on policy. Given the degree of overspend in the low carbon budget, it is hard to believe (though cannot be completely ruled out) that support would be given to technologies that could not pass under a sensibly set threshold (for example the £70/MWh above the wholesale price benchmark proposed by Richard Howard).[61] Nevertheless, formalising such a limit would give a clear signal to developers and researchers where they need to be before bids for subsidy will even be contemplated, preventing the priciest attempts to secure subsidy backing.

In addition to setting a maximum support cost threshold for new technologies, existing cost reduction targets could be given more solid footing. For example, working with the offshore wind industry, the Crown Estate established an objective of reaching a £100/MWh cost threshold by 2020. Enshrining that kind of target as a maximum price, either for offshore wind or potentially for all Pot 1 technologies, could again strengthen cost control under the LCF heading into the 2020s. It could improve investor certainty, by giving confidence of the hurdles they will need to meet in future in order for support to continue. The continuation of auctioning should encourage developers to beat the price cap where they can. Crucially, this kind of cap would protect consumers in the event that technology costs fail to reduce.

**Recommendation:** The government should set an upper limit for subsidy per MWh as a stop-loss policy. It should degress over time. A medium term target trajectory should be published to allow investors to have confidence that they understand the terms on which support will, or will not, continue. Competitive procurement processes for new low carbon contracts, such as auctioning, should continue in order to encourage developers to beat the degression curve and not simply to match it.

Technologies that do not make the cut could still be backed in pre-deployment R&D work, but should not be eligible for funding through the deployment budget.

The current 10:1 ratio between deployment and R&D spend appears unlikely to persist. As figure 2.1 showed, LCF spend is expected to considerably more than double in this Parliament. Pressure on wider government spending suggests it is unlikely that energy R&D will follow a similar trajectory. But if it cannot be expanded it should at least be protected.

[61] Howard, Richard (2015) *The Customer Is Always Right*. Policy Exchange. London. 2015. p. 48. http://www.policyexchange.org.uk/images/publications/the%20customer%20is%20always%20right.pdf