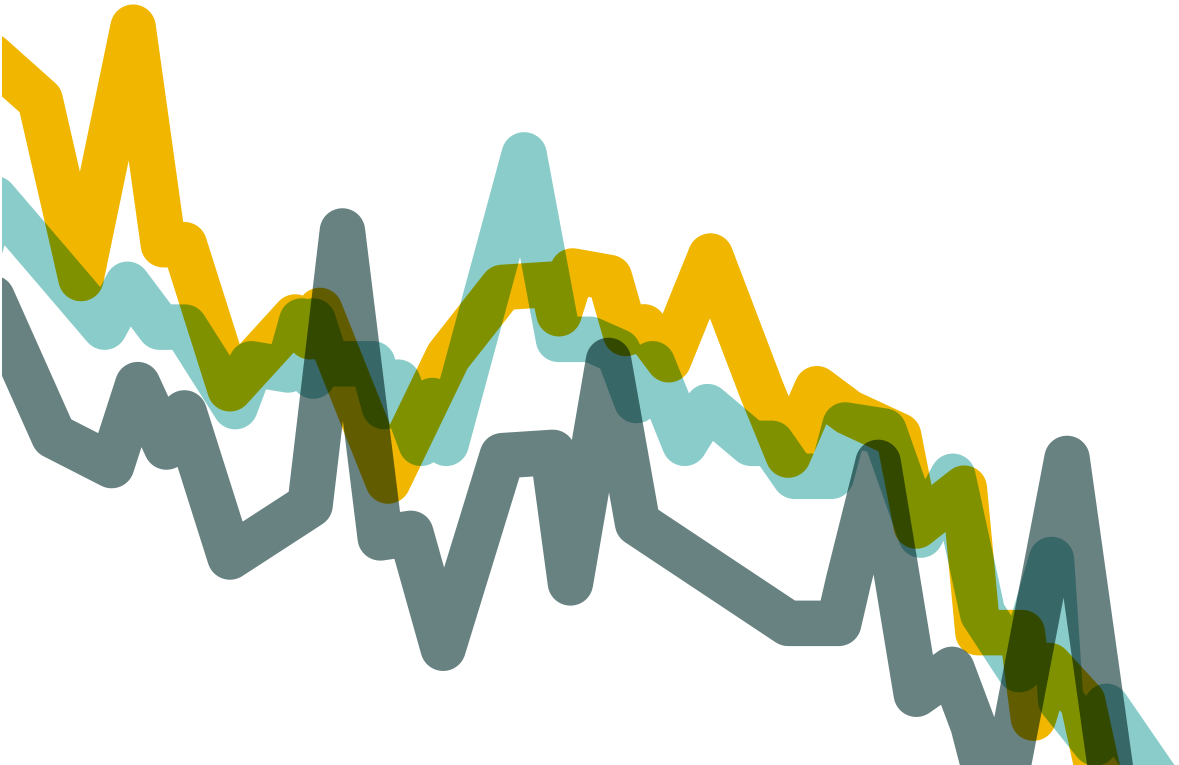
Beyond subsidy

How the next levy control framework can cut carbon at least cost



green alliance...

Executive summary

Investment in Britain's electricity infrastructure is stalling. New investment is needed to reduce the risk of a capacity shortfall and to meet the UK's carbon budgets. The government's solutions have been to create capacity payments to incentivise new gas capacity, and new contracts for low carbon power. But, despite these efforts, no new gas plants are being built; and investors in low carbon power are delaying decisions due to uncertainty over the finance and conditions attached to the Levy Control Framework (LCF), via which the government supports low carbon power.

This analysis focuses on low carbon power which, with gas, will make up all of the UK's electricity generation in 2025, after the phase out of coal. We show that there is a high risk of a significant low carbon gap. Current policy is unlikely to deliver enough low carbon power, due to constraints on the build rate for the very limited range of technologies the government has chosen to support: offshore wind, nuclear and possibly tidal lagoons.

To fill this gap at the least cost, the LCF needs to allow the cheapest and most deliverable projects to deploy faster, via subsidy free contracts and a feed-in tariff for electricity efficiency, also known as negawatts. At the same time, the LCF should create forward funding visibility, so developers can invest in supply chains to lower the cost of immature technologies. Achieving these two goals will mean adopting a strategy which minimises the cost of subsidy, rather than the size of the levy.

This strategy would serve consumers better than current plans. To understand why, two beliefs implicit in the current LCF need to be unpicked.

The first is that the wholesale market will provide an adequate signal for investment, which leads to the false assumption that any spending above wholesale prices is a subsidy. In truth, all new generation, including gas, requires support above the wholesale price. The additional cost of low carbon generation above that of new gas power stations facing a carbon price is subsidy, and can be justified as an innovation premium to enable new technologies to come down in cost.

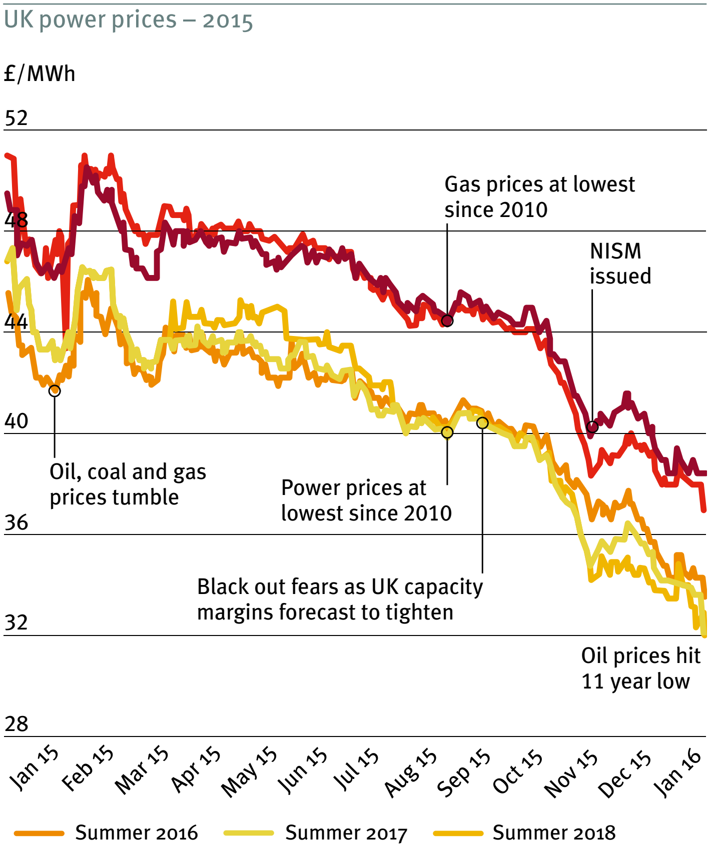
The second belief is that the best way to protect consumers from high bills is to constrain deployment via the LCF. It is likely that onshore wind and solar will provide cheaper power than gas plants by 2020, so constraining their deployment would push bills up. A feed-in tariff for negawatts, which requires LCF funding, would further lower prices by reducing the need for all forms of generation. The route to subsidy free offshore wind, and perhaps tidal power, is through economies of scale, supply chain competition and learning by doing, which all require consistent funding.

Our modelling shows that constraining the deployment of technologies will slow the pace at which they can come down in cost. Such a strategy would risk doubling subsidy payments per MWh by 2025, making the low carbon transition more expensive.

This analysis demonstrates a different strategy, designed to keep the UK on the least cost decarbonisation trajectory. It would result in an innovation premium of £0.23 billion by 2025, below the level required by current policy in 2025. Even its total accounting cost – a substantial share of which has to be paid anyway if the UK builds high carbon generation – would cost consumers no more than £25 per household by 2025.

New electricity market dynamics

Wholesale prices no longer create an investment signal



[Graph courtesy of Cornwall Energy]

Capacity margins (the difference between electricity demand and supply) are declining. In a normal market, prices would rise in response to scarcity, encouraging new investment, but the exact opposite is happening. As the graph below shows, wholesale electricity prices fell in response to lower long term capacity margin forecasts and a short term notification of insufficient margin (NISM), which is National Grid's formal warning of insufficient supply.

Policy is part of the reason why the market is no longer securing investment. The capacity market and National Grid's balancing reserve are designed to secure supply, but this suppresses wholesale prices. The lack of credible carbon price signals also depresses the wholesale price because it excludes the cost of pollution from the market. At the same time, zero marginal cost renewable electricity depresses short term price signals. It is clear that market actors do not see the wholesale price as an investment signal for any new form of generation. The fact that no new gas plants (CCGTs) are being built is clear evidence of this.

The LCF exaggerates the cost of low carbon power

The wholesale price is not driving investment in new infrastructure, so any new plants require a top up payment if they are to be built. Right now, CCGTs provide the cheapest source of new generation, so their cost, including the carbon price, is the minimum needed to secure additional electricity supplies.

Current real world gas projects require a price of around £72 per MWh, and the wholesale electricity price is below £45 per MWh. In the graph below, the difference between these two levels, described as the 'new generation premium', is shown in grey.

Technologies such as offshore wind and tidal lagoons are more expensive than CCGTs so they require an 'innovation premium', shown in orange. This top up payment is justified if it drives cost reductions so these technologies can compete with other forms of generation.

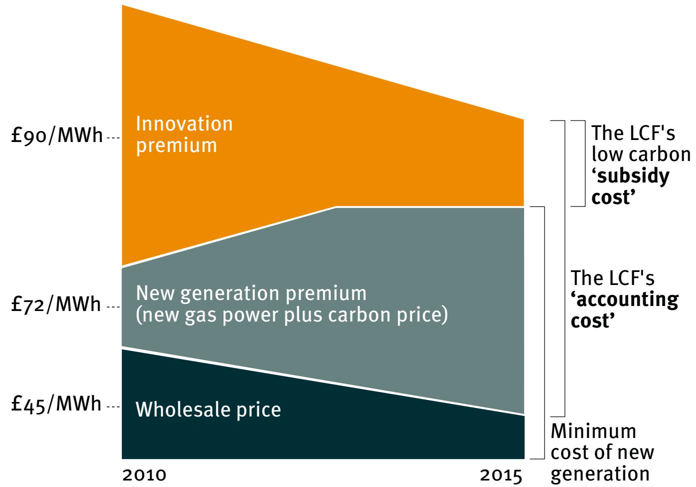
Because consumers will have to pay the new generation premium anyway, the real cost of low carbon subsidy is just the additional top up: the innovation premium.

The current LCF covers both premiums, but only for low carbon generators. The cost of new fossil plant is not covered by the LCF; instead, new gas plants are provided with financial incentives through the capacity market.

The LCF's 'accounting cost' significantly exaggerates low carbon spending, because the new generation premium will still have to be paid by consumers if high carbon power is built instead. The only difference is that the high carbon levy, paid via the capacity market, is not covered by the LCF.

This accounting approach has led to a perception that low carbon power should be constrained on cost grounds, even though projections for onshore wind show it is likely to be cheaper than new CCGTs by 2020.

Only part of the LCF is subsidy



The LCF's accounting cost is highly variable

Using the wholesale price as the reference price for the LCF makes it subject to significant variability and risk.

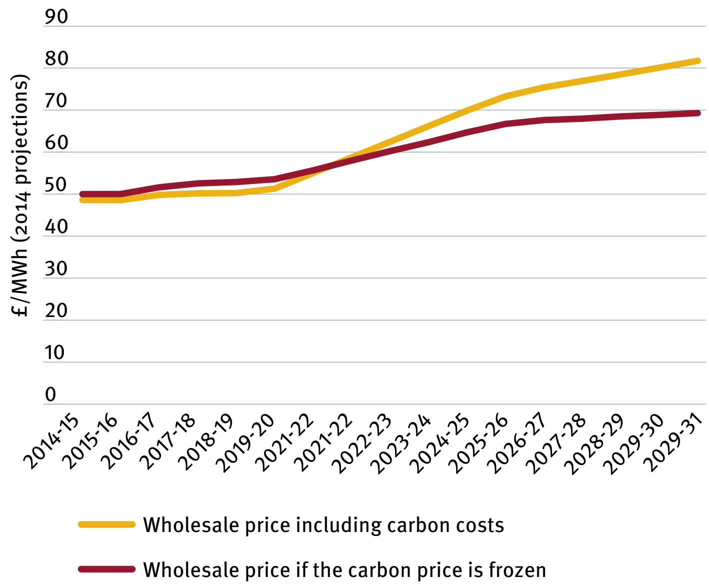
The first cause of variability relates to uncertainty over the future of the Treasury's carbon price support (CPS) mechanism. The CPS affects the wholesale price directly by raising the cost of high carbon power to account for the cost that carbon pollution imposes on the economy. When it was introduced in 2011, it was set to rise to £78 per tCO_2 by 2030. However, the chancellor has since capped the price at £18 per tCO_2 until 2020, to ease pressure on household bills.

If the price freeze is extended to 2025, it would increase the LCF's accounting cost by around 20 per cent. But this would have no net effect on bills; it simply moves the cost of carbon from the wholesale market into the LCF.

The second cause of variability relates to the volatility of global commodity prices, particularly for gas. In 2015, DECC revised electricity price projections downwards. This increases the cost of the next LCF by around eight per cent, compared with 2014 projections.

Cheaper gas reduces the wholesale price and the new generation premium, which increases the difference in cost between new gas plants and low carbon power. But the major part of consumer bills pays for electricity from existing plants which has become cheaper, so the net effect is to reduce bills, even though the LCF rises.

Wholesale price projections with and without a continued freeze of the carbon floor price



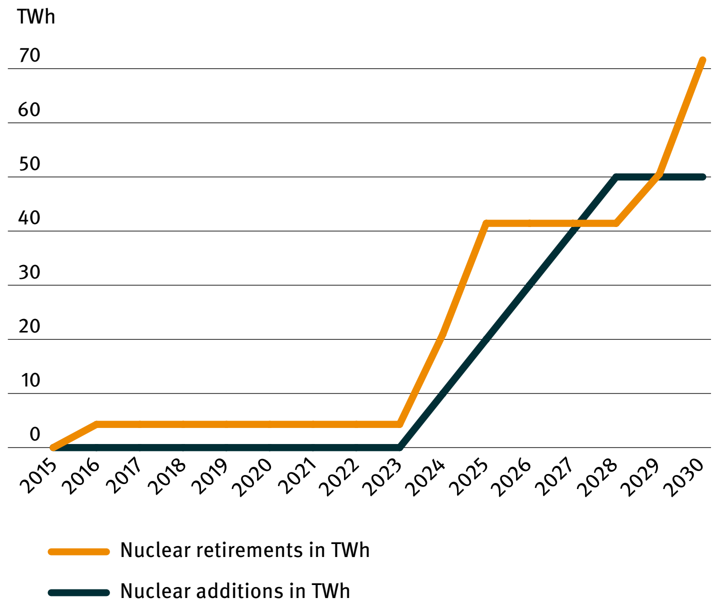
Nuclear delivery is uncertain

A third significant source of uncertainty for the LCF in the 2020s is the timing of new nuclear plants. Most of the UK's nuclear fleet is due to be shut down during the 2020s, removing 35TWh of generation before 2025. This gap is due to be filled by a set of proposed new plants, providing around 30TWh of new generation by 2025. New nuclear is a straightforward replacement of old nuclear: the new nuclear plants will not add to net new low carbon generation, so they won't decrease power sector emissions in the 2020s; they will just hold emissions steady.

The uncertainty arises from the risk of delays. New nuclear has already experienced significant delays, and old nuclear plants may be life extended, deferring their retirement. EDF's announcement, in February 2016, that it would extend the operational life of four nuclear plants reduces some of this uncertainty and is reflected in the chart below. However, EDF has made the extensions contingent on a continuing capacity market and carbon floor price, presumably on an unfrozen basis.

Because these plants are such large generators, their presence or absence dramatically affects the amount of new low carbon generation needed in the next LCF. The difference between the best and worse case is equal to 60 per cent of low carbon deployment by 2025.

New nuclear capacity vs old nuclear retirements



Three scenarios for 2025

Scenario 1
Business as usual
New generation delivers 70TWh, costing £2.2 billion by 2025

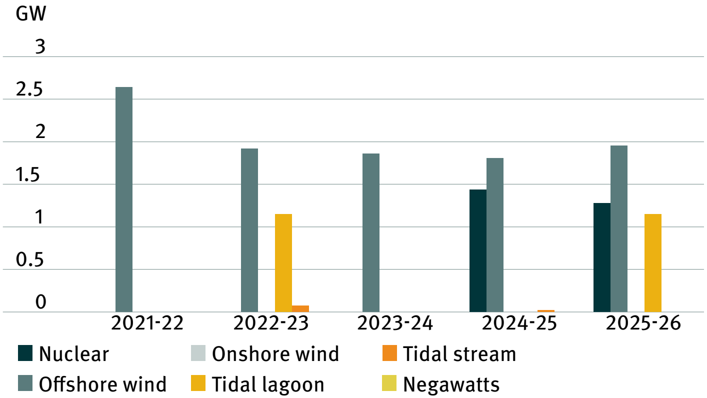
Current policy bans onshore wind, effectively halts carbon capture and storage and is ambivalent about large scale solar. The technologies left in the mix have significant cost and delivery risks: offshore wind is more expensive than onshore wind, nuclear is slow to deliver and tidal lagoons are still at demonstration stage.

This scenario uses the available technologies to attempt to generate the amount needed to meet carbon budgets at least cost. It allows offshore wind to deploy at a rate of 2GW per year, consistent with its proven delivery rate, which allows its costs to fall rapidly. Both nuclear and tidal lagoons are deployed as quickly as possible. Even so, this combination of technologies can only provide 70TWh of low carbon power by 2025, no matter how much is spent, due to build rate constraints.

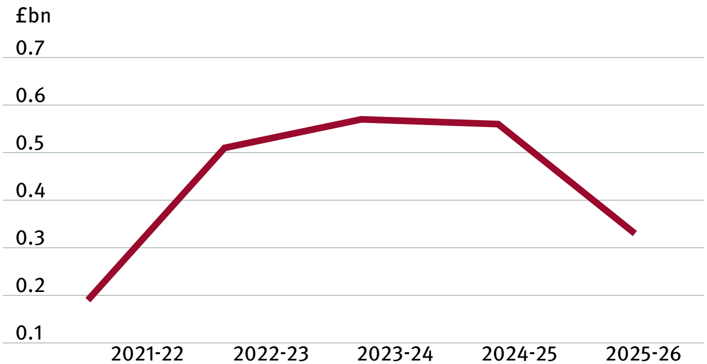
Under this scenario these constraints create a low carbon gap of 20TWh by 2025, compared to the 90TWh of low carbon power needed to meet carbon budgets at least cost. By 2030, this trajectory would lead to power sector emissions of around 125gCO_2 per kWh.

This scenario would cost £2.2 billion, in accounting cost terms. However, the innovation premium would be significantly smaller than this: it would rise to £0.57 billion by 2023 and then fall.

Amount of low carbon capacity and negawatts deployed each year



Amount of innovation premium paid



Scenario 2
Business as usual: slow delivery
New generation delivers 48TWh by 2025, costing £1.6 billion by 2025

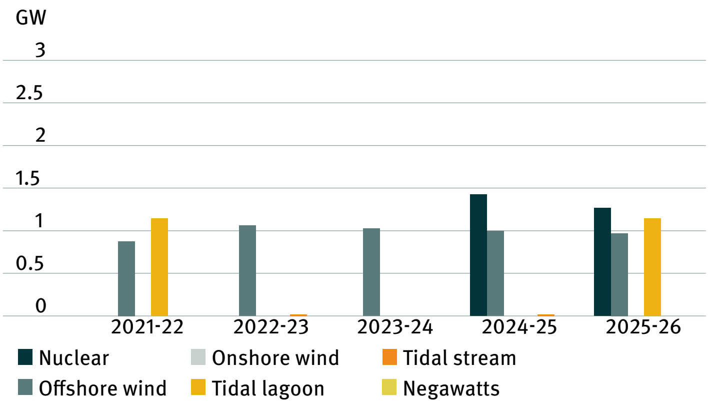
This scenario uses the same technology assumptions as scenario one, but assumes that the government's commitment to 10GW of offshore wind in the 2020s creates a self imposed ceiling of 1GW per year to 2025. Like the previous scenario, nuclear and tidal are deployed as quickly as possible. This represents a minimalist interpretation of the government's commitments to low carbon power.

Limiting offshore wind constrains deployment to 48TWh of low carbon power by 2025. Of this, 40 per cent (20TWh) is generated by two new nuclear reactors, assumed to be Wylfa Newydd and Hinkley C, which are scheduled to first operate in 2024 and 2025 respectively.

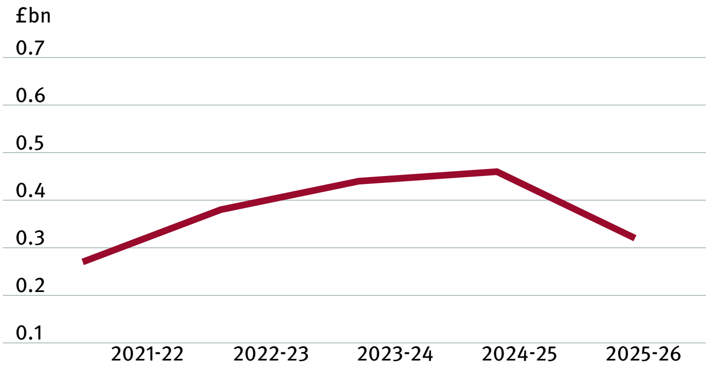
Slower delivery leads to a 40TWh low carbon gap by 2025, which means emissions cannot fall below 140gCO_2 per kWh by 2030. This carbon intensity is approximately 60 per cent above the Committee on Climate Change's expectations, even if the UK deploys all planned nuclear power stations and increases offshore wind deployment to 2GW per year after 2025.

The accounting cost of this scenario would be £1.6 billion. However, unlike scenario one's central deployment scenario, the innovation premium would peak later and fall less sharply. This is because slower deployment of offshore wind means it will take much longer to come down in cost: the technology would be £8 to £13 per MWh more expensive than it could be in 2030.

Amount of low carbon capacity and negawatts deployed each year



Amount of innovation premium paid



Scenario 3
Meeting carbon budgets at least cost
New generation delivers 90TWh by 2025, costing £2.7 billion by 2025

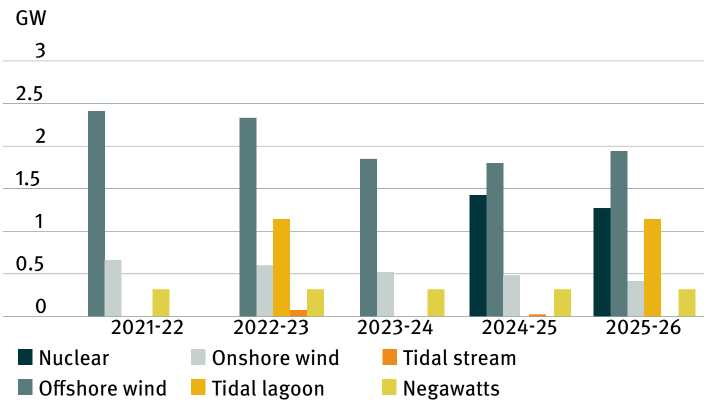
This scenario expands the technology mix to lower cost onshore wind or solar and negawatts (electricity demand reduction). It will fill the low carbon generation gap and result in a lower annual innovation premium by 2025 than both of the other scenarios.

Specifically, it expands current policy by creating a subsidy free contract for difference for onshore wind or solar, generating approximately an additional 9TWh of low carbon power, and a negawatts feed-in tariff, which reduces demand by 13TWh.

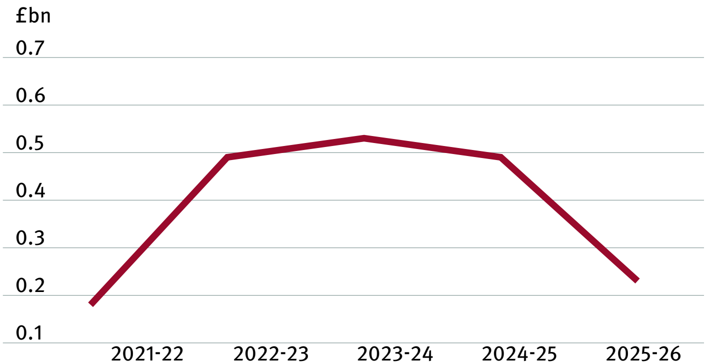
Adding these technologies to the mix allows 90TWh of low carbon power to be generated by 2025. It would enable the UK to reach a carbon intensity of 100gCO_2 per kWh by 2030, consistent with meeting carbon budgets. The broader mix of technologies also creates resilience: delays in a single technology can be compensated for by increases in other technologies.

The innovation premium in this scenario would be £0.53 billion in 2023, falling to £0.23 billion by 2025. This would be cheaper than the current policy approach due to cost reductions in offshore wind and the use of lower cost mature renewables and negawatts. At £2.7 billion, the accounting cost of this option is about a third greater than for scenario one, adding £7 per household to bills in 2025.

Amount of low carbon capacity and negawatts deployed each year



Amount of innovation premium paid

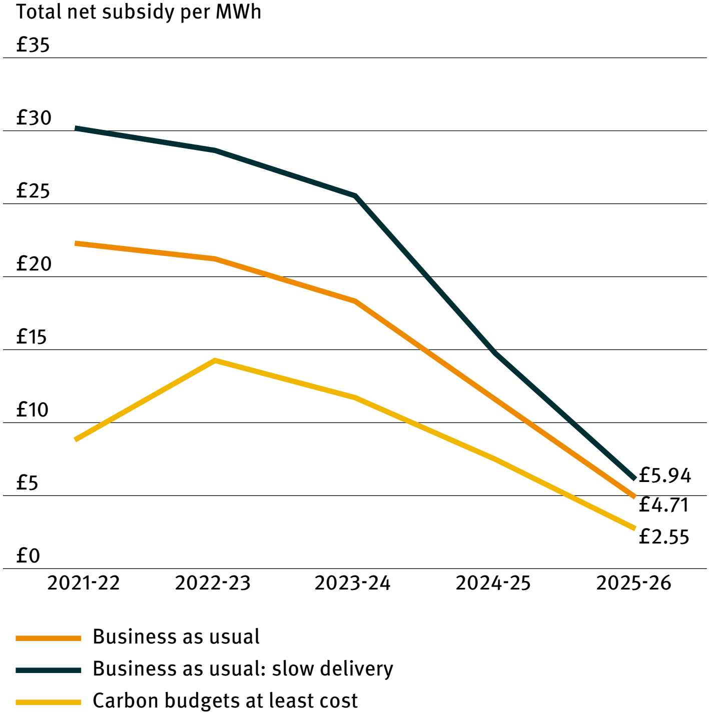


‘Meeting carbon budgets at least cost’ reduces net subsidy the most

The graph below shows that the strategy in scenario three reduces net subsidy the most. It does so by deploying subsidy free renewables and negawatts, while maintaining sufficient deployment of expensive renewables to help bring their costs down. The result is subsidy payments declining to around £2.50 per MWh by 2025, and peaking at nearly half the level required by current policy.

In contrast, attempting to constrain costs by limiting deployment, as in our slow delivery scenario, makes subsidy costs higher for longer. It more than doubles the subsidy cost of technologies deployed per unit of generation by 2025, making it more likely that technologies will not be able to compete without subsidy after 2025.

Change in net subsidy in the early 2020s for each scenario



Summary

	Scenario 1 Business as usual	Scenario 2 Business as usual: slow delivery	Scenario 3 Meeting carbon budgets at least cost
Innovation premium in 2025	£0.33bn	£0.29bn	£0.23bn
Accounting cost in 2025	£2.2bn	£1.6bn	£2.7bn
2030 carbon intensity	~125gCO_2/kWh with an acceleration of effort after 2025	~140gCO_2/kWh with an acceleration of effort after 2025	~100gCO_2/kWh with steady deployment after 2025
Delivery risk	+ proven offshore wind deployment rate – relies on punctual new nuclear build and tidal lagoons	– offshore wind 'stop start' supply chain risk – relies on punctual new nuclear build and tidal lagoons	+ broader range of renewables at proven deployment rates – relies on punctual new nuclear build

As the table makes clear, the innovation premium peaks earlier and falls faster in the 'meeting carbon budgets at least cost' scenario. The accounting cost varies more, but in all scenarios, it is equivalent to around a third of the first LCF.

There is considerable delivery risk across all scenarios, because they all require one or two new nuclear reactors to be built each year after 2024. This would be a historically unprecedented rate for the UK, although the recent life extensions announced by EDF create some breathing space in the case of delays to new builds. Both of the business as usual scenarios also require tidal lagoons, a technology whose future is in question, pending a feasibility review announced by the government in February 2016.

In contrast, the 'meeting carbon budgets at least cost' scenario allows some flexibility for delays or for technologies to fail, because more low carbon options are available.

Visit www.green-alliance.org.uk/LCF_methodology for details of how we assessed the three scenarios.

Conclusions and recommendations

Conclusions about deployment and costs

Our scenarios analysis leads to four conclusions about the deployment implications of different policy decisions, and the costs of decarbonisation.

1
Current policy will result in a deployment gap

The current technology mix supported by the government will not deliver the UK's 90TWh low carbon generation needs by 2025, due to the build rate constraints of the few selected technologies. Attempting to constrain costs by restricting offshore wind to 1GW per year would see a shortfall of at least 40TWh. Faster deployment after 2025 could not compensate for this, meaning the UK would have to spend more on decarbonisation than necessary.

2
Renewables cost overruns are no longer a big risk

The original purpose of the LCF was to limit the risk of cost overruns. But new policies have largely removed this risk: competitive auctions for low carbon contracts, cost reduction conditions for offshore wind and subsidy free contracts for difference for mature renewables all cap renewables costs without an LCF. Even in inflated, accounting cost terms, new LCF costs after 2020 are around a third of the costs of the first LCF period, ie £2.7 billion vs £7.6 billion.

3
Lower wholesale prices reduce consumer bills, even if LCF costs rise

By 2020, DECC's own projections show that falling wholesale prices will cancel out the whole cost of the current LCF. This gives the government room to allow the accounting cost of the LCF to rise, while simultaneously protecting consumers, as long as the innovation premium for low carbon generation continues to fall.

4
A broader technology mix and steady deployment can bring costs down

Allowing onshore wind (eg in Scotland), solar and negawatts to be supported without subsidy under an expanded LCF would lower the innovation premium for low carbon power, reducing costs to consumers and closing the deployment gap. Steadily deploying these technologies, alongside offshore wind, will help to spur further cost reductions.

Recommendations for the design of the LCF 2021-25

The UK can avoid a low carbon deployment gap and reduce the costs of meeting its carbon reduction commitments if it adopts a least cost deployment strategy. This should be built on a wider mix of technologies and stated cost reduction expectations. But four changes to how the LCF operates are necessary for this strategy to succeed:

1
Separate nuclear funding from LCF spending on renewables

The delivery uncertainty over nuclear power, combined with the lumpy cost and non-competitive contract allocations for new nuclear plants mean that the volume requirement of the next LCF could change by 60 per cent. Spending on new nuclear plants should be separated from the LCF, to prevent delivery uncertainties from undermining cost reduction in renewables.

2
Exclude carbon price changes from LCF accounting limits

The cost of a continued freeze on the carbon price support (CPS) mechanism is as large as the current LCF's entire headroom (around 20 per cent). The CPS can be changed at each annual budget, increasing uncertainty and injecting a large degree of unnecessary additional risk into low carbon investment, which increases costs. To reduce risk and costs, the size of the LCF should be automatically adjusted if the carbon floor price does not rise to its planned trajectory.

3
Set narrow deployment expectations to encourage supply chains

The least cost, target consistent scenario requires around 2GW of offshore wind per year, 0.5GW of onshore wind (or equivalent in large scale solar) per year and 0.3GW of negawatts per year. Advance information about the timing of auction rounds, and the amount of funding available at each auction, would enable developers to build up supply chains optimised to deliver cost reductions.

4
Hold few, large auctions for offshore technology and many, smaller auctions for onshore technology

Different low carbon technologies have different characteristics: the latest round of offshore wind projects are being deployed in 1.2GW blocks, because smaller installations are more expensive per MWh. This is largely due to the high fixed costs of grid infrastructure and offshore installation. Tidal power has similar characteristics. In contrast, solar and onshore wind can deploy inexpensively at lower volumes. Holding a smaller number of large volume auctions would enable offshore wind and tidal power to reduce in cost more quickly; while holding smaller, more frequent auctions for solar and onshore wind would improve price discovery and ensure healthy competition.

A full methodological note and comprehensive list of data sources is available at www.green-alliance.org.uk /LCF_methodology

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By Dustin Benton, Angela Francis and Amy Mount

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Green Alliance
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Green Alliance
36 Buckingham Palace Road
London SW1W 0RE
020 7233 7433

ga@green-alliance.org.uk
www.green-alliance.org.uk
blog: greenallianceblog.org.uk
twitter: @GreenAllianceUK

The Green Alliance Trust
Registered charity no. 1045395
Company limited by guarantee (England and Wales) no. 3037633
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