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# Decarbonisation on the cheap

## How an electricity efficiency feed-in tariff can cut energy costs

"Electricity consumers have persistently not reduced their demand, even when it is economically rational to do so."

Reducing demand for electricity is a cost-effective part of decarbonising our economy, but it won't happen on its own. Even though saving energy saves money, electricity consumers have persistently not reduced their demand, even when it is economically rational to do so. The expectation that increasing energy prices will change this ignores the behavioural, financial, and policy barriers which have prevented energy saving in the past.

Indeed, rising electricity prices are likely to have a negative impact on decarbonisation by reducing public support for funding the transition to low carbon power, which is widely accepted as the first step in decarbonising the wider economy. The government's tacit bargain with the electorate is that decarbonisation policies which raise the unit cost of energy will be offset by demand reduction policies such as the Green Deal, yielding a net equal cost to consumers.

Our analysis suggests that current policies will not go far enough to encourage people to reduce their electricity use, meaning bills will rise more than they need to. A drive to encourage greater demand reduction could avoid future expenditure of up to £125 billion on new low carbon generation and save consumers at least £35 billion.



# Decarbonisation on the cheap

"Current policies will not go far enough to encourage people to reduce their electricity use, meaning bills will rise more than they need to."

To reduce energy use and costs most effectively, we propose a counterintuitive policy approach: pay for demand reduction, even if rational electricity consumers are already incentivised to reduce demand by the cost savings that such reduction would bring, because this is cheaper than the alternative of paying for new power stations. The government could most easily pursue this approach by creating a demand reduction feed-in tariff to mirror supply-based feed-in tariffs (FiT CfDs) outlined in the electricity market reform white paper. This would be a simple change which would not delay the implementation of the electricity market reform package, and would deliver a readily understandable mechanism to drive new entrants and competition into the electricity market.

The government is already banking on demand reduction. Its projections of the cost of meeting the 2020 renewables targets and 2030 decarbonisation of the power sector include an assumption of a 16 per cent reduction in electricity demand in 2025 compared to business as usual. If this did not occur, the UK would need to build the equivalent of 8GW of new zero-carbon baseload power plants by 2025. This could mean up to six new additional nuclear power stations or CCS coal plants, or around 5,000 large offshore wind turbines. Generating low carbon power from these new plants could cost £70 billion over the 15 years from 2010 to 2025.

More effective demand reduction policies delivering savings in line with forthcoming EU targets could avoid the need to spend £125 billion on low carbon power compared to baseline demand over this period. Even if paying to incentivise demand reduction were to cost half as much as new, low carbon generation – and evidence from overseas suggests it could be significantly less – consumers would save at least £35 billion through a well designed electricity efficiency feed-in tariff.

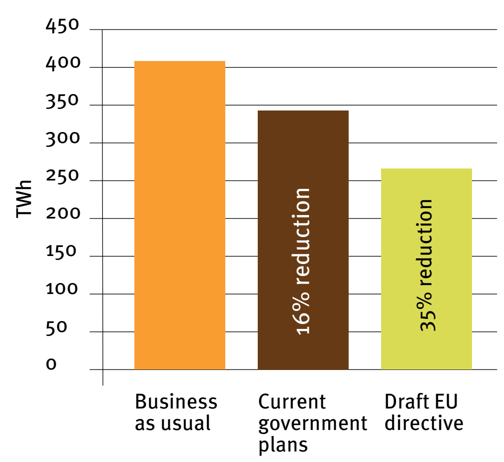
## Why reducing demand is cheaper

The government, with support from all the major political parties, has embarked on a major reform of UK electricity policy to help deliver three complementary goals: to source 15 per cent of overall energy from renewables by 2020; to very substantially decarbonise the power sector by 2030; and to cut greenhouse gas emissions by at least 80 per cent by 2050. In the near term, it has put forward two new mechanisms it claims will set the UK on a path to meeting these targets: electricity market reform (EMR), initially conceived as a means to address electricity supply; and the Green Deal, its flagship energy demand reduction policy.

We suggest that, rather than viewing EMR as fundamentally supply side focused, with the Green Deal as the primary demand side mechanism, EMR should be thought of as a holistic, electricity focused policy, incorporating both supply and demand. The Green Deal could then primarily focus on demand reduction for heat. Viewed this way, policy mechanisms announced in the EMR white paper could be repurposed to deliver electricity demand reduction, reducing the cost of the transition to a low carbon power sector.

The government's own analysis of the feasibility of its EMR assumes significant demand reduction: around 16 per cent compared to business as usual[1]. The forthcoming EU energy efficiency directive draft suggests a target of year-on-year 1.5 per cent reduction in energy consumption which, if applied at the same rate to

Electricity demand in 2025



"Evidence from the United States suggests that it is around three and a half times cheaper per MWh than conventional generation and transmission."

electricity, would mean a 35 per cent decrease in consumption in 2025 compared to business as usual.

Achieving these significant energy reductions would have major economic benefits. Generating power from new, low carbon sources to meet business as usual demand between 2010 and 2025 could cost £70 billion. If new policies managed to reduce demand further, in line with the EU energy efficiency directive, they could avoid the need to spend £125 billion compared to business as usual, from 2010 to 2025.[2] In theory, consumers should spend up to £70 billion (or £125 billion) to avoid paying for higher cost generation but, in reality, this won't be necessary. Although energy reduction is not free, evidence from the United States suggests that it is around three and a half times cheaper per MWh than conventional generation and transmission which, in turn, has historically been much cheaper than low carbon power sources[3]. Even if delivering energy efficiency at scale in the UK is only half the cost of new low carbon generation, just meeting current government goals could save consumers £35 billion.

But it is not clear that existing government policy will be able to achieve this. If demand isn't reduced, more low carbon generation will have to be built, meaning that bills will rise more than is necessary. The following sections explain how existing policies fall short; identify the barriers to the greater demand reduction needed to meet government and EU aspirations; and show how mechanisms introduced through the EMR can be used to address these barriers and achieve a step change in demand reduction.

## Why current policies won't reduce electricity demand

### The Green Deal won't deliver

The Green Deal may be effective at cutting energy demand for heating. However, its design is unlikely to deliver significant demand reduction in electricity. This is for several reasons.

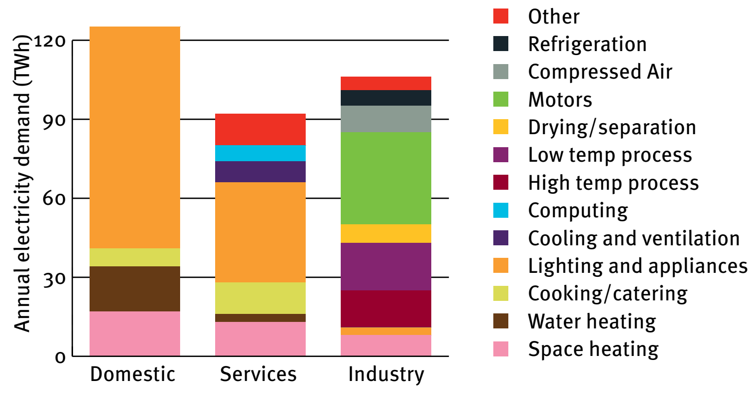
First, the Green Deal is focused on space and water heating, which are mostly provided by gas. The proposed list of eligible measures demonstrates this focus:

| Heat-focused Green Deal measures[4] | Electricity-focused Green Deal measures |
|---|---|
| **Heating, ventilation and air conditioning:** Condensing boilers; heating controls; under-floor heating; heat recovery systems; mechanical ventilation (non-domestic); flue gas recovery devices<br>**Building fabric:** Cavity wall, loft, floor, flat roof, pipe, internal and external wall insulation; draught-proofing; energy efficient glazing and doors<br>**Water heating:** Innovative hot water systems; water efficient taps and showers | **Lighting:** Fittings and controls |

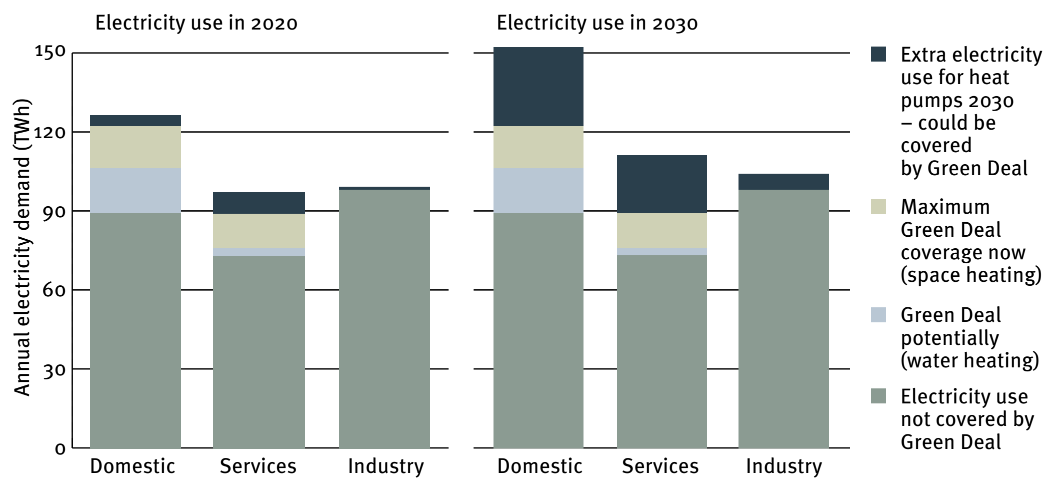
Second, even if there is significant electrification of heat by 2020 and 2030, increasing the proportion of electricity used for heating, the Green Deal will not cover the majority of electricity use. This is because most electricity demand is not for heating, as outlined in graph 1. Graph 2 shows how uptake of heat pumps will affect electricity use in 2020[5] and in 2030.[6]

Despite a significant increase in electricity demand due to the shift from gas to electric heating, even in 2030 the majority of electricity use[7] will not be eligible for demand reduction measures available through the Green Deal. As a result, the Green Deal cannot deliver significant demand reduction for electricity.

Graph 1: Current electricity usage




Graph 2: Heat pumps – future Green Deal coverage




### Other demand reduction drivers and policies are inadequate

A number of other policies which might be expected to encourage reduced electricity demand across the economy are also unlikely to deliver savings on the scale required.

**Price rises:** Mechanisms like the Carbon Floor Price/EU emissions trading scheme (ETS), Climate Change Levy, Renewables Obligation, and the Supplier Obligation all increase the price of electricity and, as such, should provide an incentive for greater energy efficiency. However, these have not been significant drivers of retail electricity prices, making up around seven or eight per cent of household bills[8], with most of the near doubling of retail prices since 2004 being due to the rising price of gas. The lack of uptake of demand reduction measures in the UK over this period suggests very inelastic demand for electricity and, therefore, that rising prices will not be effective in stimulating significantly increased demand reduction. Analysis of US demand elasticity in response to price rises suggests that a ten per cent increase in electricity prices only decreases demand by around one per cent.[9] If there were similar price inelasticity in the UK, and we relied simply on price rises to reduce demand to the level government projections require, per unit electricity prices would need to rise to two and a half times their current level by 2025.

**Product standards:** Standards help to remove the most inefficient appliances from the market, thereby increasing efficiency for households and business. However, product standards alone are not sufficient to deliver demand reduction. This is for several reasons. First, most standards are based on relative, rather than absolute energy use and appliances are getting bigger. Second, people are using a greater number of appliances. Third, standards only have the opportunity to reduce energy when consumers purchase new appliances, which they may not choose to do because of their capital cost. Finally, it's not clear that old appliances are always replaced when new appliances are purchased, potentially negating any energy saving.

**Climate Change Agreements (CCAs):** These are a valuable tool in helping to deliver energy savings for large energy consumers, in so far as these encourage supply side energy efficiency[10]. However, the information asymmetry between the regulator and industry may mean lower than optimal energy saving targets. Evidence of over delivery in CCAs[11] supports this hypothesis. In any case, the incentive to enter into a CCA is relatively low, as the alternative is to pay the Climate Change Levy, which increases bills by around six per cent, and is far less than recent price rises.

**Carbon Reduction Commitment (CRC):** Like CCAs, the CRC can play a useful role in incentivising demand reduction in large, non-energy intensive companies, but it suffers from a number of flaws which limit its effectiveness. Perhaps most importantly, it has low coverage as it doesn't include small and medium-sized enterprises. Its league table may provide a reputational incentive to improve energy efficiency but, in the absence of much greater cultural focus on efficiency, it is unlikely to be significant. Changes in the latest Comprehensive Spending Review have significantly reduced its effectiveness by removing the revenue recycling element, which turns the scheme into a tax set at £12/tCO2, roughly equal to current Climate Change Levy prices, making the likely impact of the policy similarly small.

## Electricity Market Reform: a new driver for demand reduction?

The EMR white paper aims to set "demand reduction and energy efficiency at the heart"[12] of government policy. It proposes that the capacity mechanism, a payment designed to reward power station availability, will provide the policy tool to deliver this central goal of demand reduction.

In describing the purpose of EMR, and how the capacity mechanism fits within this, the government sets out three types of security of supply goals which need to be addressed:

- 'diversification of supply' to avoid overreliance on a single source of energy;
- the need for 'resource adequacy' to cover situations in which demand is high and renewable output is low, such as during a week-long winter anticyclone; and
- 'operational security', or the need to balance the electricity grid in real time.[13]

The white paper aims to address the diversification of supply problem through feed-in tariffs, and resource adequacy through a capacity mechanism. It suggests that operational security should continue to be provided by the system operator via the Short Term Operating Reserve (STOR) mechanism. This is summarised opposite.

Unfortunately, it is not clear that demand side measures are well suited to delivering resource adequacy, the aim of the capacity mechanism. This is because demand side measures tend to fall clearly into two groups, operating over different periods of time: demand response, which tends to operate over short periods of time; and demand reduction, which operates all the time and is, therefore, inflexible. The table below gives examples of typical activities which are used in both demand reduction and demand response.



Examples of demand reduction and demand response

| Demand reduction | Demand response |
|---|---|
| Replace appliances such as dishwashers, refrigerators, boilers, and washer/dryers with more efficient products and make energy efficient modes the default option | Turn off unnecessary lighting, office equipment, computers, and machinery |
| Behaviour change including turning off lights, temperature control, shutting off equipment when not in use, using less equipment to achieve the same ends | Delay the start of non-urgent loads, like dishwashers, washing machines, and heat pumps to non-peak times |
| Replace lighting and fixtures with lower wattage and higher efficiency equipment | Shut down extra lifts, escalators, and other automated systems |
| Replace HVAC systems with efficient systems and controls; use heat pumps and thermal mass | Adjust temperature controls for space heat, refrigeration, or industrial process heat |
| Replace motors with high efficiency motors | Use energy management systems to reduce demand at peak times |
| | Start on-site generators |
| | Shut down production at times of system stress or during pre-arranged times |

The demand gap: security of supply challenges and DECC's proposed policy options

| | Seconds to a few hours | Several hours to a week | Months to years |
|---|---|---|---|
| Goal | Operational security | Resource adequacy | Diversification of supply |
| Policy options | Fast reserve, STOR and others | Capacity mechanism | Feed-in tariffs |
| Generation options | Pumped hydro, existing fossil plant | OCGTs and newer CCGTs | Nuclear, Renewables and CCS |
| Demand options | Demand response | | Demand reduction |

As the above examples show, most of the measures used to deliver demand response are limited to relatively short periods of time, from seconds to perhaps as much as a day[14]. This is because they involve either moving electricity demand from periods of peak demand to periods of lower demand, without actually reducing demand; or voluntarily reducing demand for a short period by not pursuing activities which an electricity consumer expects to carry on doing in the future. In contrast, absolute demand reduction involves either not using electricity because the activity is not considered necessary or substituting lower consuming technologies to achieve the same or similar aims.

The EMR white paper misses two demand side opportunities. First, it focuses on demand response only, rather than demand reduction. It claims that demand response "will drive the uptake of cost-effective measures to ensure security of supply."[15] It is true that greater use of demand response could avoid the need to build peaking plant. But this ignores the lasting value that demand reduction measures have.

Second, even in seeking to promote demand response, the difference between the problem that the capacity mechanism is designed to address – a mismatch between demand and supply lasting up to a week – and the short duration over which a demand response can operate presents a major problem. If the capacity mechanism is designed to address this problem, it is not clear that it could be readily adapted to deliver either demand response or demand reduction. Most demand response can't operate for as long as a week and would therefore not be targeted directly by the policy, and demand reduction is unlikely to achieve the flexible response which government envisions as the aim for the capacity mechanism, although it could reduce the overall need for this flexibility. As a result, because of the way the problem of resource adequacy is framed, demand reduction and response would only be useful at the margins. This is summarised in the demand gap diagram on page 7.

Turning to proposals for the design of the capacity mechanism, the first of the two lead options, the 'strategic reserve', could not be adapted to deliver either demand response or demand reduction. It would not use demand response effectively because it has been designed to operate only in response to generation losses, forecast errors and emergency situations. As a result, demand response contracted through the strategic reserve would not be allowed to operate as often as would be economic because the reserve would prevent cheaper demand response from competing in the market with generation. Because demand response is likely to be more cost-effective than building additional capacity, this would be contrary to government aspirations to "ensure a fair and equivalent treatment of demand side resources such as storage and demand side response, alongside generation, with the aim of securing best value investment across the power system."[16] In the case of demand reduction, because the strategic reserve is designed only to operate in exceptional circumstances, demand reduction measures, which operate all the time, would be effectively excluded.

The second option, a 'market-wide capacity market', is more promising, but is not currently designed in a way that would facilitate best use of demand response and reduction measures. This policy is designed to secure short to medium term resource adequacy, which covers a period of time well suited to fast-flexing plant such as newer generation combined and open cycle gas turbines, but it is poorly suited to either demand reduction or response. This is fundamentally a policy problem. Although fast-flexing power stations may only operate for several hours to a week at a time, a capacity market needs to ensure that it is economically viable to build these in the first place, after which they are available at any time. The same is true for demand reduction measures. To use a capacity market to deliver demand reduction, the market would need to be designed to address resource adequacy over the period which demand reduction measures operate. To maximise use of demand reduction, a capacity market would have to be as easily understandable to new market entrants as a feed-in tariff. This would require a fundamentally new approach to the capacity mechanism, which we do not cover here.

## Why is demand reduction so difficult?

Incentives to reduce demand do exist, but price signals and other government policies inadequately address barriers to demand reduction or, in the case of mechanisms in the EMR white paper, are not being used appropriately to incentivise demand reduction. There is an extensive literature on barriers.[17] Below we summarise those barriers which might be addressed through adaptation of measures in the EMR white paper.



### Financial barriers

It is widely accepted that demand reduction is cheaper than generation, but several financial barriers prevent the deployment of economically-efficient levels of demand reduction. These barriers are: the uncosted benefits of demand reduction; capital cost; and electricity price volatility.

**Uncosted benefits:** Demand reduction is rewarded through avoided expenditure on electricity. Unfortunately, the electricity price does not capture the value of the environmental benefits of not building new generation plants. Furthermore, while the electricity price does include the cost of new generation and transmission and distribution upgrades, the benefits of avoiding these costs are socialised and, therefore, do not accrue exclusively to the consumer who is reducing demand.

**Capital cost:** Many demand reduction measures have short payback periods, but individual and business investors have proved to be loss averse, a phenomenon widely recognised in psychological research[18]. Because high capital cost demand reduction measures require companies and investors to bet on the future electricity price, with the knowledge that they may lose out if electricity prices are lower, investment in demand reduction seems less attractive than investment in generation.

**Volatile prices:** Electricity prices have historically been low in the UK, reducing the value of demand reduction. Prices are now higher, but their volatility and significant uncertainty about the potential magnitude of future price rises has reduced investor confidence.

### Policy barriers

Three policy barriers prevent the adoption of greater electricity demand reduction: misaligned incentives, arising from the design of the market; concern about additionality; and concern about verification of energy saved. These keep policy-makers from directly addressing demand reduction.

**Misaligned incentives:** Unlike those markets which have proved to be successful in delivering demand reduction, such as the Californian electricity market[19], the UK power market incentivises increasing electricity generation, both at the wholesale level, where power companies earn more as they generate more, and at the retail level, where consumers pay less per unit as their electricity use rises. There is currently no benefit to energy companies in reducing consumer demand as this reduces their sales and profits.

**Additionality:** Policy-makers assume that economically rational electricity consumers are already incentivised to reduce demand by potential reductions on bills, and that additional funding is unnecessary as it would simply reward action which is already adequately incentivised.

**Verification of energy saved:** Because demand reduction is relative to future energy consumption, which may be rising, measuring electricity demand reduction is less immediately tangible and measurable than electricity generation. As a result, policy-makers understandably want to ensure that policy mechanisms and funding for demand reduction actually result in reduced demand.

### Behavioural barriers

Reducing demand for electricity is intuitively more attractive than power generation in principle but, in practice, behavioural barriers prevent consumers from taking up demand reduction opportunities.

"If rising prices are insufficient to incentivise mature, low carbon power sources such as nuclear, there is no clear reason why they should be sufficient to incentivise demand reduction."

**Low visibility:** Demand reduction tends to be low on the list of priorities for companies focused on their core business. This is especially the case for businesses that are not major energy users, and for which energy is a small part of their overall costs. The same is true for individuals, who are understandably more focused on living their lives than energy saving. Most demand reduction measures are not as visible as generation – compare the use of a highly efficient refrigerator or industrial motor to solar panels – which means there is low social payback for investment in energy saving.

**Hassle:** Because most energy consumers are not energy experts, there is a significant degree of hassle involved in understanding how energy can be saved. Once energy saving measures are identified, further hassle may occur if demand reduction requires extensive retrofitting, especially where changes were not already planned or have recently taken place.

**Small individual savings:** Many demand reduction measures produce small individual savings when viewed from the perspective of the grid as a whole. This complicates the measurement of savings, reducing the perceived benefit of energy savings compared to large, gigawatt scale generators, which seem more significant when viewed from a national perspective.

## Policy solutions available through EMR

Effectively targeted policy measures in the EMR white paper can address some barriers outlined above, and help the government to meet its demand reduction goals. But they need to address the right barriers and operate within a wider framework designed to reduce demand for electricity.

The logic of the government's analysis of security of supply and measures to address it is to incentivise demand reduction through feed-in tariffs. Demand response could be incentivised through either a redesigned capacity mechanism addressing both resource adequacy and operational security, or by ensuring that STOR adequately values the full range of benefits that demand response delivers.

An effective demand reduction policy needs three things: aggregators which assist in reducing behavioural barriers, a steady stream of funding to overcome financial barriers, and policies designed to mitigate misaligned incentives and ensure actual electricity savings. The framework created by the EMR white paper provides an opportunity to address financial and policy barriers. For this opportunity to be taken up, policy-makers need to be confident that concerns about additionality and verification can be addressed by those who will actually deliver demand reduction.

### Tackling behavioural barriers

Existing government mechanisms and institutions are not well placed to tackle the behavioural barriers which prevent greater action to reduce demand. To be successful at tackling these barriers, aggregators are needed to proactively seek out opportunities to reduce demand. A successful aggregator would focus on:

- overcoming hassle barriers by understanding how demand reduction measures work and motivating or assisting energy consumers to act to reduce demand;
- identifying and acting at trigger points, particularly where they are an opportunity to secure large-scale savings;
- aggregating small savings to create reductions which are significant and visible enough to avoid the need for new generation capacity; and
- increasing the visibility of demand reduction to the consumer.



"Adopting the FiT CfD to reward non-generation would be straightforward to design and deliver."

Examples in the United States include private sector aggregators such as Opower and Greenbox, which focus on behaviour change. These companies act primarily by increasing the visibility of demand reduction to the consumer, largely by providing energy saving advice tailored to individual consumers and by incorporating non-economic motivators based on social norms, and then aggregating the savings that consumers make. An alternative model has been pursued by PG&E, the monopoly electricity supplier in California, which has focused on installing energy saving equipment.

These aggregators are paid to deliver mandated energy savings, the cost of which is recovered from consumer bills in a transparent, bankable income stream. This is justified because the cost of energy reduction is below the cost of procuring new capacity. In the UK, a similar income stream will be required to incentivise demand reduction.

### A simple change to EMR

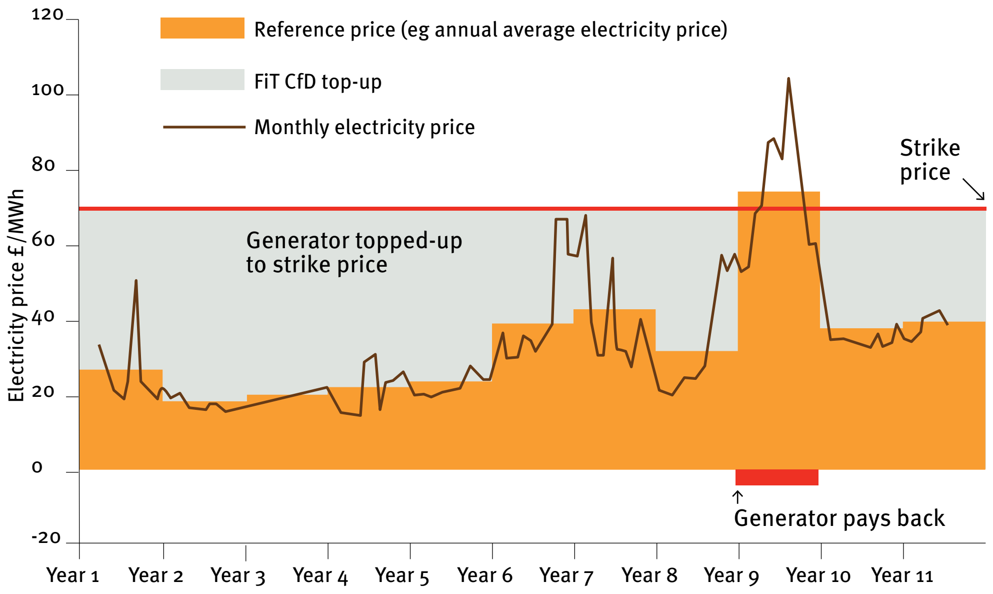
In the UK, demand reduction faces a significant financial barrier because of electricity price volatility. The government can address this by creating a steady, bankable stream of income for consumers who can demonstrably reduce demand. This will allow electricity consumers and aggregators to focus on demand reduction measures by managing predictable financial flows to invest in capital-intensive projects, which would help to address the capital cost barrier identified above.

The government has accepted the argument that an unreformed market will not provide adequate incentives for mature low carbon technologies, and that feed-in tariffs designed to reduce exposure to electricity price volatility are required to address this. The same reasons underlie the financial barriers which prevent wider uptake of demand reduction. Put another way, if rising prices are insufficient to incentivise mature, low carbon power sources such as nuclear, there is no clear reason why they should be sufficient to incentivise demand reduction.

However, in addition to providing income stability, the government should consider incorporating the value of currently socialised benefits which demand reduction brings, including avoided investment in power stations and transmission and distribution, as well as the non-costed environmental value of not building new power stations, into payments for efficiency measures. Doing so would enable demand reduction to be valued according to its contribution to reducing emissions, environmental impact, and electricity costs. So long as the cost of this support is below that of new generation, this would reduce the overall cost of decarbonisation. In practice, this means that demand reduction could be incentivised through a strike price for FiT CfDs set at a level just below that required to incentivise the cheapest forms of low carbon generation, which currently have a levelised cost of between £70 to £90/MWh. These costs will grow as the availability of cheaper technologies like landfill gas declines. If a robust administrative process or an auctioning mechanism were used to determine prices, the cost of FiTs for demand reduction measures could be considerably lower.

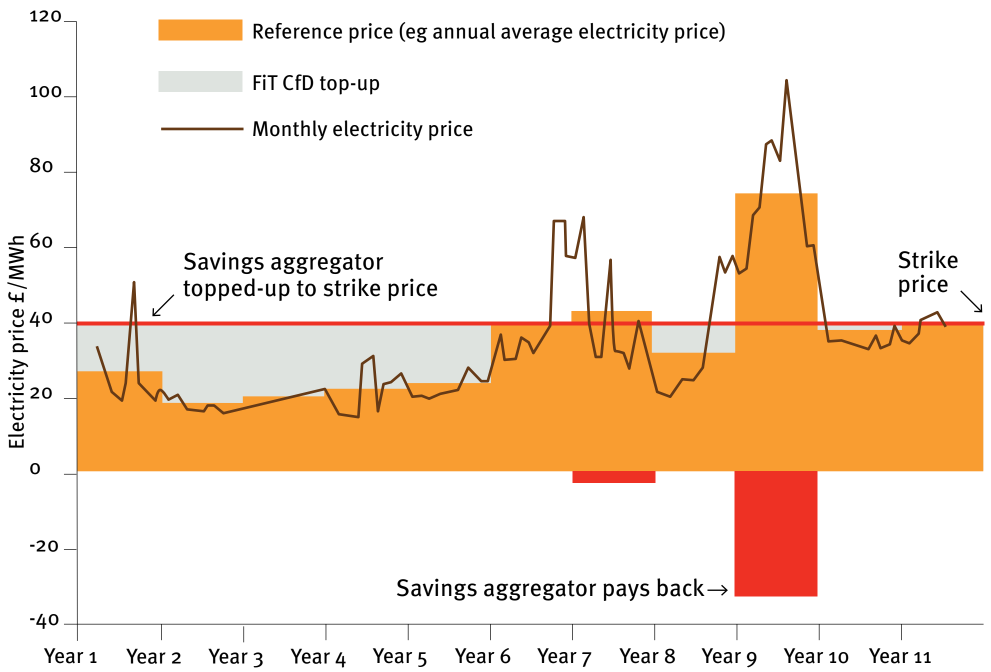
Adopting the FiT CfD to reward non-generation would be straightforward to design and deliver. Demand reduction measures could be eligible for the baseload variation of the FiT CfD outlined in the white paper, with a market reference price initially determined by administrative price discovery, moving toward auctions as with other baseload resources. Because demand reduction can be delivered rapidly and at a small scale, the initial roll-out of administratively determined FiT CfDs could be for a limited volume, with a rapid introduction of auctioning to allow the market to determine prices. This makes it much less risky than FiT CfDs for nuclear, which may otherwise be amongst the first recipients of a FiT CfD.

Graph 3: Proposed baseload FiT CfD for generation[20]




Instead of determining the contract volume by metered output of electricity generated, the volume would be determined by metered output saved, measured as outlined above. The institution charged with administering FiTs would need to be directed to allow non-generation approaches to bid for this electricity efficiency FiT (EE FiT) on an equal basis with generators bidding for generation FiT CfDs, and would need to monitor and verify electricity reductions. An EE FiT would therefore allow demand reduction to compete directly with new generation.

Graph 4: Proposed baseload FiT CfD for electricity demand reduction






## How would an electricity efficiency FiT work in practice?

Energy saving in the UK has thus far been delivered through a supplier obligation, which has been limited to existing energy suppliers, has relied on set measures with deemed energy saving, and has not been incentivised by market forces. A brief characterisation of this approach is outlined below:

### A supplier obligation

Government mandates energy savings

↓

Suppliers fund efficiency out of profits from energy sales, with costs passed on to consumers

↓

Suppliers cannot profit from energy savings, so are not incentivised to deliver more than minimum, mandated savings

↓

Consumers ignore or incorrectly implement efficiency measures, partly because low competition reduces incentives to engage consumers

↓

Some energy is saved

In contrast, a feed-in tariff provides a stable, predictable incentive to foster competition to deliver measurable energy savings:

### Energy Efficiency FiTs

Government offers stable income for energy savings

↓

Predictable income incentivises new entrants and innovation as payment is based on measured savings

↓

Because savings are measured and profitable, the market strongly incentivises aggregators to ensure efficiency actually happens

↓

Consumers respond to successful aggregators, who demonstrate the consumer value of energy savings

↓

More energy is saved

The benefit of this approach is that it doesn't prejudge the means by which energy aggregators find ways of saving energy: it doesn't rely on a central bureaucracy to decide how energy will be saved. Instead, by providing income certainty to businesses which actually reduce energy demand, this mechanism means that potential energy aggregators don't need to be existing utilities, have a deep understanding of electricity trading, or have large capital reserves. An aggregator can very simply forecast income and expenditure on energy saving measures, and use this certainty to focus their business model on delivering better consumer engagement to encourage energy saving, securing financing for longer term energy saving, and increase the market for energy saving measures. This approach harnesses the power of the market to drive innovation in energy saving.

"An electricity efficiency feed-in tariff would reduce the cost, and environmental impact, of decarbonising the power sector."

### Ensuring additionality and verifying savings

Additionality and verification are essentially the flip side of the same coin: both can be addressed by a clearly defined mechanism based on actual, metered savings. This is in contrast to the measurement mechanism used in the carbon emissions reduction target (CERT), which relies on deemed savings based on expected performance of efficiency measures. The benefit of this approach is that it is not open to problems such as occurred under the CERT with energy saving light bulb distribution, where energy companies sent out thousands that ended up in people's drawers, unused.

To use measured savings, meter readings are needed from both before and during the period of the efficiency programme. To demonstrate savings, meter readings would need to be benchmarked against two baselines. The first is historic data from an energy consumer or group of consumers, taken over the course of a defined period, which could provide a baseline for comparison. Although this data is already collected by energy companies, a requirement to collect meter readings on a monthly or quarterly basis could improve the measurement of both the baseline and electricity savings. This could demonstrate savings on its own, but would need to be adjusted according to seasonal and annual weather.

A second baseline is used by Opower to demonstrate savings in the United States. This involves randomly selecting statistically equivalent groups of electricity consumers and benchmarking consumers who receive efficiency advice against those who do not over the period of the efficiency programme. The difference between consumption in these groups is then analysed using several independent statistical methods to identify reductions.[21] This rolling baseline is used to benchmark actual, measured savings.

Using such a measurement and verification framework would make managing interactions with other demand reduction policies like the Green Deal relatively straightforward. Because the Green Deal will use a list of acceptable technologies and will include an assessment of the likely amount of energy saved due to the installation of these measures, savings attributed to their installation could be excluded from reductions rewarded by an efficiency programme. This would not involve significant additional effort as these figures are needed for the purposes of the Green Deal in any case. In practice, because the Green Deal is focused on heating and insulation, interactions with an electricity efficiency policy would be limited. Interactions with the Climate Change Agreements could be managed using a similar mechanism.

### Conclusion

The government has laudable aspirations to reduce demand for electricity. It has also built its case for electricity market reform, and for the wider policy of decarbonising the economy starting with the electricity sector, on assumptions of significant reductions in demand. But it does not yet have policies which will actually achieve demand reduction equal to its assumptions. However, the feed-in tariff with a contract for difference developed to incentivise secure, low carbon power generation can be adapted to incentivise demand reduction, which would enable the government to achieve its aspirations for demand reduction. An electricity efficiency feed-in tariff would open up an income stream for a low cost, low carbon transition, enabling competition between new generation and non-generation, which would reduce the cost, and environmental impact, of decarbonising the power sector.



# Endnotes

1 Based on the difference between business-as-usual demand growth and government demand projections including policies announced in the 2010 Low Carbon Transition Plan, available from http://www.decc.gov.uk/media/viewfile.ashx?filetype=4&filepath=Statistics/Projections/50-annex-c-final-energy-demand-.xlsx&minwidth=true

2 Both figures assume a levelised cost of new low carbon generation of £100/MWh, based on approximate future figures for onshore wind, nuclear, and gas carbon capture and storage, all of which are scalable, low carbon technologies. See in particular pages xv and xvi Mott Macdonald, 'Costs of low-carbon generation technologies', (May 2011) available from http://hmccc.s3.amazonaws.com/Renewables%20Review/MML%20final%20report%20for%20CCC%209%20may%202011.pdf. Note that this estimate does not include any savings from avoided transmission and distribution upgrades.

3 Calculation based on figures from Efficiency Vermont analysis, 'Success stories and performance' (2010) available at: http://www.efficiencyvermont.com/docs/about_efficiency_vermont/annual_summaries/2010_results_summary.pdf

4 Department of Energy and Climate Change (DECC), 'What measures does the Green Deal cover?' (July 2011) Adapted from Box 4, p 6 available at: http://www.decc.gov.uk/assets/decc/what%20we%20do/supporting%20consumers/green_deal/1734-what-measures-does-the-green-deal-cover.pdf

5 In line with the 2020 target in the Committee on Climate Change's (CCC's) Renewable Energy Review, this includes electricity used by heat pumps in 2020 to deliver 12 per cent of renewable heat. Assumes electricity demand for all uses except space heating is the same as today.

6 Assumptions as above, but based on heat output of heat pumps in 2030 to meet 35 per cent renewable heat in line with the CCC's assumptions, and excluding any electricity use from electric cars.

7 Although lighting may be partially covered by the Green Deal, it currently consumes only around 20 per cent of domestic demand from 'lighting and appliances', based on DECC/National Statistics, 'Energy consumption in the United Kingdom factsheets' (2011) available from http://www.decc.gov.uk/assets/decc/11/stats/publications/energy-consumption/2323-domestic-energy-consumption-factsheet.pdf

8 A summary of costs is available from: http://blog.decc.gov.uk/2011/07/28/the-true-cost-of-energy-and-climate-change-policies-on-bills/

9 T Nakajima and S Hamori, 'Change in consumer sensitivity to electricity prices in response to retail deregulation: a panel empirical analysis of the residential demand for eectricity in the United States,' *Energy policy* Volume 38, Issue 5 (May 2010) available from http://www.sciencedirect.com/science/article/B6V2W-4Y4XCVK-6/2/28de2d40133e2c077c862e6553fe33f0

10 Examples of actions that CCAs encourage include increasing the efficiency of power supply through greater use of CHP, lower loss transmission and distribution, and higher efficiency generation equipment.

11 See, for example, P Ekins and B Etheridge, 'The environmental and economic impacts of the UK climate change agreements', *Energy policy*, Volume 34, Issue 15 (October 2006) available from http://www.sciencedirect.com/science/article/pii/S0301421505000285. CCAs have been tightened since this paper was produced, but it is unclear that changes proposed earlier this year will foster greater emissions reductions.

12 Ministerial foreword by Chris Huhne, p4 'Energy market reform white paper – planning our electric future: a white paper for secure, affordable and low-carbon electricity' (July 2011) available from http://www.decc.gov.uk/assets/decc/11/policy-legislation/EMR/2176-emr-white-paper.pdf

13 p62, ibid

14 We assume that much more transformational demand response from industrial users is unlikely. An example of this might include week or longer shutdowns in production from manufacturers, while fulfilling orders from surplus inventory. Opportunities to directly address 'resource adequacy' as defined by the EMR white paper through demand reduction do exist, but would require significant shifts in business culture.

15 p62, 'Energy market reform white paper – planning our electric future: a white paper for secure, affordable and low-carbon electricity' (July 2011) - http://www.decc.gov.uk/assets/decc/11/policy-legislation/EMR/2176-emr-white-paper.pdf

16 p10, ibid

17 See, for example, http://www.sussex.ac.uk/Units/spru/publications/reports/barriers/final.html; http://www.sciencedirect.com/science/article/pii/S0140988306000983; http://www.rff.org/documents/rff-dp-09-13.pdf; http://www.greenbuildinglawblog.com/uploads/file/mckinseyUS_energy_efficiency_full_report.pdf

18 Loss aversion was first demonstrated in A Tversky and D Kahneman 'Loss aversion in riskless choice: a reference dependent model'. *Quarterly journal of economics* Volume 106, pp 1039-1061. (1991). Subsequent research has confirmed the phenomenon, in which people prefer to take risks when these are framed as ones which may create potential gains, rather than ones which may avoid potential losses.

19 In California, profits for regulated energy companies are 'decoupled' from sales volumes. Briefly, this works in the following way: the regulator sets the revenue requirement for a given utility using traditional regulatory methods; but allows the utility to collect that revenue regardless of actual sales volume. Revenue is instead set in relation to the number of customers: revenue per customer is fixed and overall revenue is adjusted to match any new or departing customers. As a result, utilities are no longer incentivised to maximize sales volume and those that reduce costs through efficiency measures will see an increase in short term profits because the revenue stream is largely fixed. This system depends on regulated wholesale industry and regulated retail prices.

20 Op. cit. p38 'Energy market reform white paper –planning our electric future: a white paper for secure, affordable and low-carbon electricity'

21 Connexus Energy Ramsey, 'Measurement and verification report of OPower energy efficiency pilot program' (July 2010) Available from http://opower.com/uploads/library/file/14/power_systems_engineering.pdf

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