



A RECC consumer guide to Demand-Side Response

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1.0	23/10/2018	SMB	Document issued to coincide with ADE Code for non-domestic consumers.

Introduction

*'DSR is the way in which consumers can engage with the energy system, turning up or down their consumption, in response to signals, such as price.'*¹

*'Consumers (the 'demand-side') can sign up to special tariffs and schemes which reward them for changing how and when they use electricity (known as 'demand-side response'). Smart meters and other technologies will make this easier than ever for domestic consumers.'*²

Demand-side response or DSR incentivises energy users to be flexible about when and how they use electricity. Traditionally energy suppliers supply and energy consumers consume most electricity at certain peak times of the day and year. At those peak times, when lots of people are using electricity, suppliers need to buy electricity from more expensive, less efficient, often older more polluting power stations in order to make sure consumers have enough. That means it costs more to generate electricity at times of high demand. DSR arrangements are designed to incentivise consumers (and businesses and industry) to reduce or shift some of their demand for electricity at times of peak demand on the system to times when it is cheaper to supply.

DSR is already fairly widespread in the industrial and commercial settings. With developments such as rooftop solar PV, home storage batteries, Electric Vehicles and smart meters, consumers at home can also be more flexible in their use of energy and potentially save money.

The Renewable Energy Consumer Code (RECC) has put together this guide for domestic consumers to explain DSR and to help you decide if signing up to a DSR deal is right for you

1. What is demand-side response?

'DSR is the way in which consumers can engage with the energy system, turning up or down their consumption, in response to signals, such as price. This benefits the overall system by helping to balance supply and demand, and helps consumers to manage their bills in combination with smart offers, such as time of use tariffs, which allow consumers to benefit from the variance in electricity price throughout the day.' BEIS, March 2018

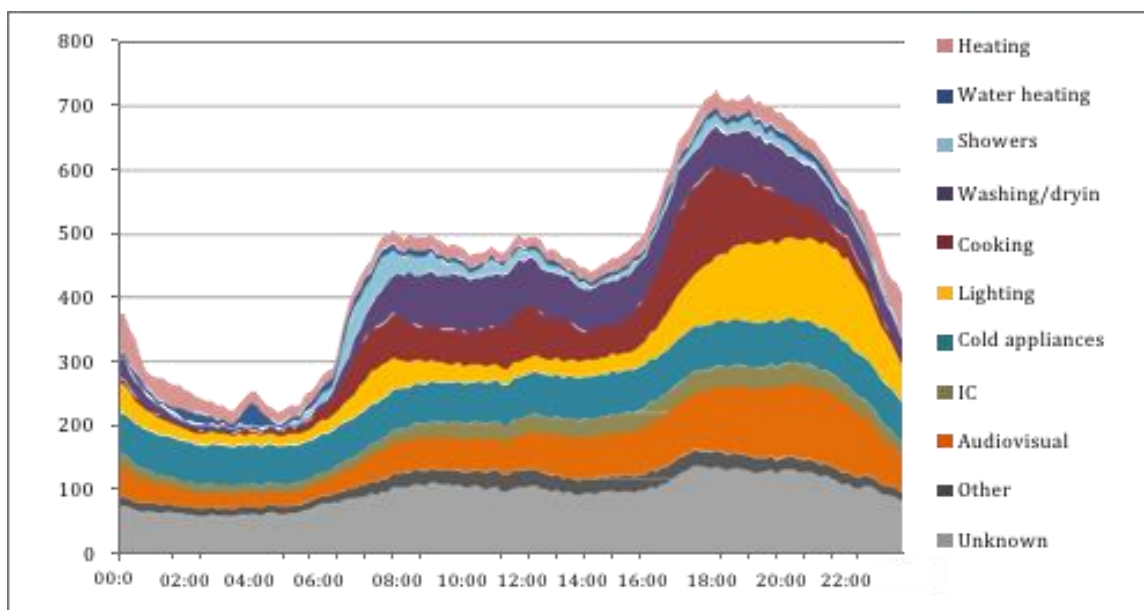
1.1 Electricity supply and demand

To make sure the supply of electricity always matches demand, electricity power stations change how much they generate in response to the levels of demand. So when England's footballers are playing Germany and it's half-time at Wembley, millions of households put the kettle on. Electricity power stations have to supply more electricity to meet the huge spike in demand.

In the UK the demand for energy varies throughout the day and across the year, as well as in response to particular events. Homes, for instance, typically have two 'peaks', one in the morning and another in the evening, as can be seen in Chart 1.³

CHART 1: Household demand for electricity

Average 24-hour profile for 250 homes



Some power stations generate electricity more cheaply than others. At peak times, when lots of people are using electricity, suppliers need to buy electricity from more expensive, less efficient, often older more polluting power stations in order to make sure consumers have enough. That means it costs more to generate electricity at times of high demand. Yet most of us pay the

same price for electricity whatever time we use it.

1.2 Demand-side response

To put it simply, demand-side response (DSR) is just changing how and when you use (or create a demand for) electricity in response to a 'signal' of some kind, such as changing prices or an incentive payment. The signals aim to bring about a reduction in peak demand in electricity systems by moving customers' demand to other times of the day – or week.

So the British Gas 'free weekend energy' tariff a few years ago was a price signal to consumers to shift as much as possible of their demand for electricity away from weekdays. Economy 7- type tariffs with a very low night-time tariff and a much higher day-time rate are also designed to evoke a 'demand-side response' by incentivising consumers to maximise electricity use at night and minimise it during the day, for example by setting electric storage heaters to come on at night and using the heat stored overnight the next day.

1.3 The benefits of DSR

*'If some of us could move some of our usage to cheaper times of day, we could avoid using these expensive power stations. If consumers were regularly willing to shift their usage away from these busy times, fewer power stations would need to be built overall. Doing these things could save us money...So rather than building a power station that will only be used for a few hours a year, it makes more sense to occasionally reduce overall demand...'*⁴ Ofgem, the UK's energy regulator.

As the quote from Ofgem explains, DSR on a wide scale can help keep costs down for all consumers. And it can further benefit you at a personal level, depending on the sort of deal agreed. For example, you could get:

- **Lower bills.** If you sign up to a special tariff that offers you a lower price for electricity you use in the day and a higher price for evening use, then you could save on your electricity bills by 'shifting demand' to the cheaper period. You could put your washing on at off-peak times rather than in, say, the morning peak. (It's not a good idea to put washing machines or dishwashers on when you are out though).
- **Financial reward** Another option might be to agree not to go above a certain level of electricity usage during peak time (known as 'load limiting' – see p. 10), in return for a financial reward such as price reductions.
- **Lower-cost appliances** Signing up for a special tariff at the same time that you buy an appliance could allow you to buy the appliance at a lower price.

You'll potentially be able to have, and to benefit **most** from, a DSR scheme if you:

- have a smart meter (and smart appliances) or you are willing to have them
- use a lot of electricity (have a 'large load') eg you have electric heating, air conditioning, or charge an Electric Vehicle
- can easily or comfortably shift some or all of your electric load to off-peak periods eg using a storage heater to store up heat in advance, using off-peak power to heat hot water (if you have a water tank)
- use time controls to automate the switching of use away from peak times
- have a battery or other means to store power, particularly renewably-generated power, that's been generated at off-peak times and that you can use or make available at peak times.

NB You should NOT consider DSR if you have critical equipment that must be able to run at all times, such as medical equipment, unless you are able to exclude this equipment from the DSR control.

2. DSR for homes: the kit

DSR is already fairly widespread in the industrial and commercial settings, but a number of recent developments, from smart meters to Electric Vehicles, have seen new deals being offered to households, with more new offerings expected to come soon.

2.1 Smart meters

The Government-backed roll-out of smart meters should see every household and small business offered a smart meter by the end of 2020.



A Secure Meters Liberty 100 smart electricity meter

Smart meters automatically deliver meter readings to your energy company through mobile networks, so you don't have to send them in when requested. The meters can record usage in half-hour chunks, making it possible to see roughly at what time of day a unit of electricity was used and in theory to charge accordingly. The price of electricity could vary according to the time it is used - known as 'Time of Use' (ToU) tariffs – as it does with the Agile Octopus deal from Octopus Energy (see 'DSR offers for households' on p12).

In addition, a switch built into a smart meter (an Auxiliary Load Control Switch) can be connected to an ordinary appliance or a heating system to switch it on and off remotely.

2.2 Smart appliances

Some smart appliances can respond to the grid. For example, washing machines that turn on at off-peak times when electricity is cheaper and fridge freezers that turn off for a short period when there's a nationwide spike in electricity use. These appliances have a mechanism built in that also allows the amount of energy they use (their 'load') to be varied up or down. They can be connected to a smart meter or via a wifi-enabled 'gateway device'.

The response can be automated – that is, it can be controlled (either by a timer, or remotely on your behalf by a supplier or network, for example) without the consumer needing to do anything. Or consumers can be prompted to take action by requests from the supplier.

2.3 Storing energy

Batteries and other forms of energy storage can shift demand by charging up with imported grid electricity when it's cheap or from solar panels, then discharging that stored energy for use in the home at peak times when grid electricity is expensive. Charging and discharging at the 'best' times can be automated, via a smart charger.

As battery prices fall, more households are installing them, usually to store 'surplus' energy generated by solar PV panels in the day to use in the evening. Every stored kilowatt hour (kWh) is one less you need to import from the grid and, at current tariffs, saving kWhs is worth more than any incentive payments from the Government for selling the 'surplus' back to the grid. And with Time-of-Use tariffs in the offing, it could begin to make economic sense even for people without solar PV panels to install batteries.

2.4 Electric Vehicles (EVs)

The batteries that power electric vehicles or EVs can be charged at home or at one of the ever-growing network of EV chargers around the UK. Those batteries can also be used to store energy for the household⁵ charging up off-peak – from solar panels in the middle of a sunny day when no-one's home, for instance – and providing energy in the evening. They could also be connected to the grid (known as 'vehicle-to-grid') via a smart plug that could be discharged and charged remotely in line with the needs of the grid, in return for a payment.



The Nissan Leaf

2.5 Renewable energy

Renewable energy is growing in importance in our overall energy mix. But sources such as wind and solar are harder to control and don't necessarily produce most at times when demand is highest. Large-scale storage can be used to 'mop up' energy produced but not used at the time it's generated. And, on a windy day, prices could be varied to encourage us to take full advantage of cheaper electricity available.

2.6 Interoperability

There are potentially various pieces of kit involved in DSR – the automation system for smart appliances, the smart meter, the battery storage controller etc – and they may not all be readily operable with each other or with the kit of competitors. Octopus Energy's Agile deal (see 'DSR offers for households') is only available with a specific make of smart meter, for example.

The Government is currently considering setting standards for smart appliances, including how best to maximise their interoperability.⁶

3. DSR for homes: the likely deals

Currently there are few DSR deals for domestic consumers (see 'DSR offers for households' for examples). There may be more innovative offerings emerging as the market develops, but for now it looks as if DSR will be along the following lines:

DSR contracts: For DSR you may contract with your energy supplier or with another party, most likely the local Distribution Network Operator (DNO) or an 'aggregator'.

Aggregators⁷: An aggregator contracts with the individual demand site – your home – and with other consumers for their DSR, consolidates (or aggregates) their response and sells the net effect on to another party in the energy market. The aggregator gets a percentage of the value created by reducing peak demand (or other services).

Types of flexibility: DSR in the domestic market seems likely to take the form of responses to **price signals** and/or agreed **load limiting** of some kind.

3.1 Price signals

With smart metering, a range of Time of Use (ToU) tariffs could be on offer such as:

- *static* tariffs where the times you'll pay less (or more) for your electricity stay the same. Economy 7-type tariffs are static.
- *dynamic* ToU tariffs that vary according to conditions in the market (Agile Octopus in 'Household DSR' on p7 is an example).

See box 'Some tariff types' on p8 for more on these.

In theory, consumers can be left to manually modify demand in response to price incentives but automation can make this easier: timers can be set to take advantage of cheaper periods; smart appliances, batteries and thermostats can be set up to respond automatically to price signals carried by the smart meter or over the internet. In practice the more complex dynamic tariffs are unlikely to be possible without household automation.

Some tariff types

Static ToU tariffs: an electricity price schedule which charges different unit rates according to the time of day/week/year. This schedule has fixed time bands set in advance, like the Economy 7 tariff, in which electricity is cheaper during the same hours every night and more expensive during the remaining hours.

Dynamic ToU tariffs: electricity prices fluctuate according to conditions so can change from one day to the next. Octopus Energy's Agile Octopus deal has dynamic pricing that varies as wholesale electricity prices move up and down, for instance. Price changes can be signalled to the consumer (eg by SMS or via an app); smart devices can be programmed to respond appropriately.

Critical peak pricing/rebates: Critical peaks are periods of exceptionally high demand vs supply. Critical peak prices are particularly high for a short period to encourage a steep reduction in demand for that period. Under critical peak *rebates*, consumers receive a rebate for reducing their energy use below a baseline during a critical peak event.

3.2 Load limiting

Rather than paying more for electricity at peak times, consumers could receive a financial reward if they agreed not to go above a certain usage during these times – in practice, to limit their load. Again this could be automated to respond to a signal that loads need to be limited.

Load-limiting then is a restriction placed on the flow or amount of electricity allowed to a consumer. Smart meter technology can enforce this by temporarily disconnecting the supply if the limit is exceeded.

3.3 Direct control

If you are willing to allow 'direct control' of your energy use, DSR arrangements can be automated and managed by an external party such as your energy supplier or an aggregator.

An example could be the offer of a 'free' or subsidised new fridge, washing machine and dishwasher in return for it being controlled remotely by a supplier or an aggregator who can then turn it off and on, up and down.

In a project in Barnet, North London, several homes with batteries charged by solar panels will allow the aggregator to remotely control those batteries, discharging them to the grid when necessary (see 'DSR offers for households' for more on this).

3.4 Things to be aware of

With certain deals, you could pay more or lose out on the benefits if your demand is not as flexible as you think⁸

Time of Use tariffs, for example, usually offer cheaper tariffs at certain times but significantly higher tariffs at peak times, so if you don't manage to shift your demand away from peak times⁸ you could end up paying more than you currently do for electricity.⁹

With deals that involve automation/direct control, you can usually over-ride that control if you need to but you may incur a penalty/reduction in benefit if you do.

Cyber security

Connected devices like smart meters and smart appliances generate new data about you that can be accessed remotely. So data security becomes even more important. (The Government is currently setting standards for smart appliances to ensure data- and cyber-security.¹⁰)

Equipment costs

You may have to invest in certain kit in order to access DSR deals.

Smart metering impact on 'deemed' export

If you already have solar PV installed, and you go from having 'deemed' export of 50 per cent to having actual export measured by a smart meter, your export tariff payments would be affected.¹¹

Other ways to save

You could weigh up the costs and benefits of signing up to DSR vs investing in energy efficiency measures to reduce your demand overall – by installing some or all of insulation, heating systems and energy efficient lighting and appliances.

DSR offers for households

Agile Octopus

Octopus Energy has introduced 'Agile Octopus' which it describes as 'the 100% green electricity tariff with Plunge Pricing' that is 'perfect for electric vehicles, storage heaters or anyone who can shift their electricity use outside of the 4pm-7pm peak.'

With this deal, the price its consumers pay for electricity varies as wholesale electricity prices go up and down with changes in the market. A smart meter provides half-hourly data which shows when electricity is used allowing Octopus to charge accordingly.

If in a particular period more electricity is being generated across the UK than is being consumed, wholesale prices fall and so does the price the consumer pays. Sometimes electricity prices can even fall below zero ('negative prices') and suppliers are paid to take energy off the grid. (According to the company's website, unit prices fell below 2p per kWh more than 30 times, and to less than zero four times, in the last 12 months). With Agile Octopus's 'Plunge Pricing', which Octopus says is a world first, consumers can be notified via SMS or have their smart devices programmed so when these negative prices happen they can use, and get paid for using, electricity.

Prices can obviously go up too. Agile Octopus includes 'Price Cap Protect', so that when prices go up, the consumer is guaranteed never to pay more than 35p per kWh. There's a calculator on the website that works out potential savings for certain household 'profiles' (for example a family home, a home with people working 9 to 5, a home with night chargers) and levels of demand so you can estimate how your costs change based on when you use electricity.

Gridshare

Battery manufacturer Moixa's 'Gridshare' scheme provides owners of smart batteries (including those in an electric vehicle) with a yearly payment or a profit share in return for allowing Moixa access to excess power in those batteries. With thousands of batteries under its management, Moixa in effect has a 'virtual power plant' whose output it can trade with the National Grid at a profit.

Barnet's 'virtual power plant'

In June 2018, UK Power Networks (UKPN), an electricity distributor or DNO, and battery manufacturer Powervault announced the launch of what they described as London's first 'virtual power station' powered solely by solar panels on the roofs of people's homes. Powervault will install batteries in around 40 properties in the London Borough of Barnet which will charge from the solar panels. On days when there is a particularly high demand for electricity, UKPN will effectively be able to call on the combined capacity of the batteries to relieve pressure on the grid via Powervault acting as an 'aggregator' and remotely controlling the batteries to discharge in unison. In return for making their battery capacity available at such peak times, residents will receive a payment.

4. Twenty questions for you to ask

If you do decide that signing up to some form of DSR deal might be for you, there's no substitute for doing your homework to be as sure as you can be of picking the most suitable one. We've listed the kind of questions you need to ask here.

1. Who are you contracting with?

Are you contacting with your energy supplier, an aggregator or another organisation? DSR can involve you in effect in contracts with multiple parties. For example, a smart appliance manufacturer provides a fridge through partnership with an energy supplier, and it is automated by an aggregator¹ according to calls for DSR from an electricity network operator. You need to know who to contact in the event of a malfunction or a billing query, for example.

2. If they're an aggregator, are they signed up to a Code of Conduct?¹²

3. Can they show you any independent reviews or testimonials about them in relation to this type of deal?

4. What are their arrangements for protecting your data/cyber security?

5. Do you need to get any permission/notify anyone before signing up? 6 Are you tied in to the contract for a minimum period?

6. Are you tied in to the contract for a minimum period?

If you are tied in to the contract, how long for? Are there penalties for quitting early? Is there a 'cooling-off' or a trial period during which you can cancel without penalty?

7. Are there any costs to signing up or ongoing charges?

8. What are the rewards?

For example, do you get cheaper electricity at certain times? Do you get direct payments or rebates for allowing access to your stored energy?

9. What is the estimated value of those rewards to you over a year?

Can they you how they've calculated that estimate?

10. What equipment is necessary?

Who provides it? What does it cost to you?

11. Who is responsible for its repair and maintenance?

12. Can all the equipment work with other equipment?

For example, are smart appliances interoperable with different suppliers' smart meters?

13. Will any equipment interfere with anything in your home?

14. How do you get a signal to reduce or shift usage?

15. What are the time bands and prices for any Time of Use tariffs?

Are they dynamic or static?

16. Will you be allowing direct control of your appliances?

Can you override this?

How do you override? Is any override function easy to identify and use?

What happens if you do override (eg are there any penalties?)

17. Could your electricity be limited at certain times?

Are there time bands that tell you when you'll be liable to have supply reduced?

Can you override any load limiting if necessary eg an emergency in the home?

Is any override function easy to identify and use?

What happens if you do override (eg are there any penalties?)

Will clocks, Personal Video Recorders and the like be affected?

18. Who is liable if things go wrong?

This is particularly important to identify if more than one party is involved in the contract.

19. Who is liable if an error somewhere along the line causes you to lose out financially?

20. What if you want to switch electricity supplier and/or aggregator?

Your electricity supplier cannot oblige you to accept them as your aggregator but you should check if there are any issues if you subsequently want to switch eg are there any issues around compatibility of controls for DSR?

5. Further information

On DSR, from Ofgem:

https://www.ofgem.gov.uk/sites/default/files/docs/2013/04/20130430_how-managing-your-energy-use-could-help-you.pdf

On smart meters, from Smart Energy GB

<https://www.smartenergygb.org/en/about-smart-meters/what-is-a-smart-meter>

On smart appliances, from Which?

<https://www.which.co.uk/reviews/smart-home-automation/article/smart-home-products-and-systems/smart-home-appliances>

On storage, from RECC/BRE National Solar Centre:

http://www.bre.co.uk/filelibrary/nsc/Documents%20Library/NSC%20Publications/88166-BRE_Solar-Consumer-Guide-A4-12pp-JAN16.pdf

On Electric Vehicles, from Ofgem

https://www.ofgem.gov.uk/system/files/docs/2018/07/ofg1086_future_insights_series_5_document_master_v5.pdf

You can watch a short Ofgem video that explains how these developments help make the energy system more 'flexible' here:

<https://www.ofgem.gov.uk/electricity/retail-market/market-review-and-reform/smarter-markets-programme/electricity-system-flexibility>

Notes and References

¹ Department for Business, Energy and Industrial Strategy (BEIS), March 2018

² From the website of Ofgem, the UK's energy regulator.

³ Source: Further Analysis of the Household Electricity Use Survey, Electrical appliances at home: tuning in to energy saving, Cambridge Architectural Research Limited, Element Energy and Loughborough University, November 2013

⁴ Ofgem: How managing your energy use could help you: a guide for households on Demand-Side Response, Factsheet 119

⁵ EV manufacturers are increasingly exploring a 'second-life' for used EV batteries as 'stationary storage' in the home. Cars require high battery performance and once the battery's capacity declines past a certain point, it has to be 'retired'. It can still handle a lot of charge and discharge, however, so can be useful for storage in less intensive stationary domestic settings.

⁶ Consultation on Proposals regarding Smart Appliances, Department of Business, Energy and Industrial Strategy, March 2018 [at the time of writing, the consultation is closed and the Government is considering the responses].

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/690805/Consultation_on_Proposals_regarding_Smart_Appliances-.pdf

⁷ The Association for Decentralised Energy (ADE) is developing a voluntary 'Demand Side Response Code of Conduct' for aggregators working with commercial, industrial and public sector energy users. If the household domestic DSR market takes off, RECC will be working with ADE to extend the Code's coverage to consumers.

⁸ Research suggests people are actually pretty inflexible in terms of when they do certain activities such as cooking meals, putting the lights on and watching TV, but more flexible about when they put the washing-machine and dishwasher on.

⁹ A project to study ToU tariffs conducted by British Gas and Northern Powergrid found that while 60 per cent of participants benefited, the other 40 per cent paid more than they would have done otherwise. More automation might have reduced this effect but brings its own concerns. See: Customer-Led Network Revolution (2014), Progress Report 7.

¹⁰ Consultation on Proposals regarding Smart Appliances, Department of Business, Energy and Industrial Strategy, March 2018 [at the time of writing, the consultation is closed and the Government is considering the responses].

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/690805/Consultation_on_Proposals_regarding_Smart_Appliances-.pdf

¹¹ At the time of writing, exports for most households were 'deemed' ie in the absence of a meter that can measure the amount you export to the grid, you're deemed to be exporting half of all you generate. With a smart meter that can measure the actual amount you export, the export payments will be based on actual export and your export tariff payments altered accordingly.

¹² At the time of writing, the Association for Decentralised Energy was about to launch a Code which applies to business to business aggregators only.