CATAPULT
Energy Systems

Demand Side Response

DSR in practice - what goes on behind the wheel?

Understanding what consumers want from DSR

As renewable energy generation grows, it can become harder to match available electricity supply to consumers' demands.

Smart technologies can help by increasing demand when supplies are high or reducing demand when supplies are low. This practice is called Demand-Side Response (DSR).

Electric vehicles could offer valuable capacity to balance the grid as more people start to drive them in the future. However, consumers will reject DSR if it prevents them using their cars as they want to - it needs to be designed to fit into their daily lives.

The government is funding innovative domestic DSR demonstration projects. The Flexibly-Responsive Energy Delivery (FRED) project, led by Evergreen Smart Power, is one of a number of projects to win a portion of this funding.

Energy Systems Catapult is working with Evergreen Smart Power, myenergi, Tonik Energy and Swansea University to understand the potential of this technology.

Project FRED (Flexibly Responsive Energy Delivery)

The trial uses Evergreen Smart Power's software platform to increase and reduce electricity demand in real-time. It works with myenergi's zappi, a smart EV charger that can also use power from people's solar panels (if they have them) to charge the car.

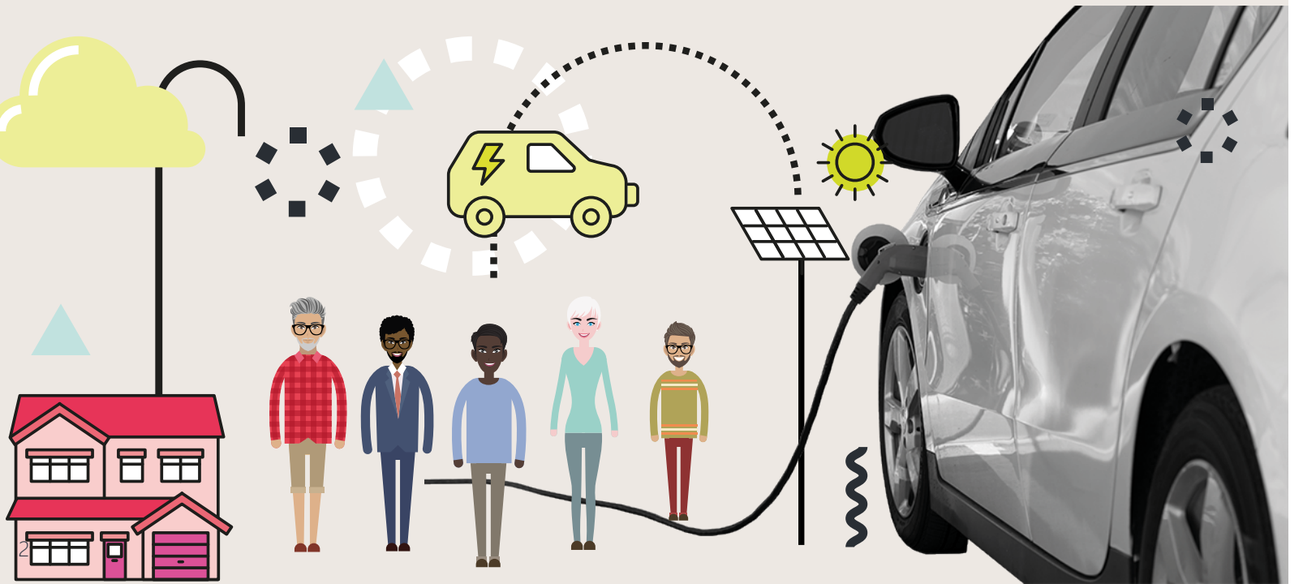
The zappi has 3 different modes:

- **Fast** (charges like a non-smart EV charger, using grid power and any available solar to charge at the maximum rate)
- **Eco** (maintains a minimum charge rate, 1.4kW, using a combination of grid power and any available solar);
- **Eco+** (as Eco but charging pauses if solar power drops below the minimum set level).

Zappi also lets users set up their charge how they like, for instance scheduling a charge to run at a certain time or setting the number of kWh they want delivered to the car. Users can see their charge history by using the myenergi app.

FRED participants are pioneers who have already adopted some of the low carbon technologies envisioned for our future. This paper summarises some of the things they want from EV charging and DSR.

The personas are based closely on 5 participants from Project FRED with names/details changed to protect their identities.

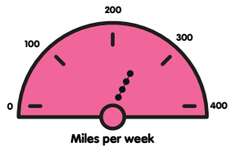


Ben

Aged 40, tech fanatic with little margin for error. Ben lives and breathes technology and both his job and hobbies involve IT. Ben lives with his wife and children in the suburbs of Reading.

Ben has:

- A Nissan Leaf (it's the family's second car; his wife has a petrol car)
- Solar
- zappi



EV journeys

Ben does the school run and local journeys daily. "My biggest day of the week I probably travel 50 miles". For anything longer they use his wife's car because "long trips with frequent charging stops are a pain with the kids!"

Charging

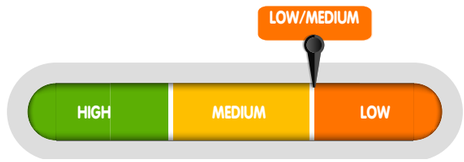
A nightly charge during his tariff's off-peak hours gives him enough power to start every day with a full battery, which he likes. Even with a full charge, he still worries a little bit that he might not be able to travel 50 miles. He works from home so he also leaves his car plugged in on Eco+ mode during the day to make the most of any power his solar panels generate.

His experiences of DSR

Ben has only really noticed one instance of what he thought was DSR. Even then, he wasn't sure – his app showed a slightly different pattern of charge to normal, but within a scheduled charge.

Need for control

Need for convenience



> If each time you go to the car the charge is exactly where you expect it to be, you kind of forget about DSR.

Reactions to DSR

Ben has been given no reason to worry about DSR impacting his EV use yet, but thinks if he started to find the car wasn't fully charged in the morning he might be frustrated and would monitor the app more. Having any less than 100% charge would worry him - he feels it would introduce too much risk about whether he'd have enough range for the journeys he makes.

Attitudes and personality

General

Ben is not a risk-taker. When considering how he uses his car he factors in all sorts of things: whether he'll need to use a public charger (and if they'll be available and working), the weather, whether it's urban or motorway driving and how efficiently he'll drive. He likes to be in control but is more relaxed when he can afford to be, like with money: "I'm lucky enough to be in a situation where I don't penny pinch or worry about the mortgage, but I'm not silly about money either".

Ben's a self-confessed tech-nerd so he's quite happy to spend time figuring out how to make things work.

DSR

Ben thinks that DSR would be delivered around patterns in people's use – for him, as long as he has a full charge each morning, that would be fine.

What might help?

He would like an option to override DSR and get an immediate charge if he needed one. He'd also like to know when DSR has taken place, but that's more out of curiosity!

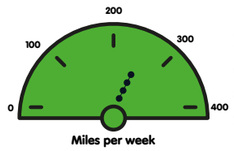
Sarah

Aged 60, Sarah has invested a lot of money in tech to make her home run more efficiently. Reducing her impact on the environment is important to her. Sarah lives with her husband on the outskirts of Leeds.

It's not costing me any more, so I'm not unhappy about it. I'm on a flat rate electricity tariff at the moment...if I'd been on Economy 7 where it would cost me more at peak times then I think I'd be more negative towards it because it would obviously be costing me twice as much to charge the car.

Sarah has:

- A Tesla Model S (her main car). They also have an ICE car but try to avoid using it.
- Solar
- zappi
- Ground-source heat pump
- Household battery



EV journeys

Sarah's journeys are mostly in and around the local area and can range from just one to several a day. They also use their Tesla for long trips around the country every few weeks.

Charging

Each day, Sarah will check the weather forecast for the following day to see how much power her solar panels might generate. If it's going to be sunny she'll turn the overnight timed charge off to leave room for solar power. She'll set an overnight charge if she knows she has a journey the next day that she needs extra charge for. For long journeys, she tries to make sure she reaches a full charge just before setting off.

Her experiences of DSR

Sarah thinks she's probably receiving DSR several times a week, but how confident she is varies. Sometimes it's really clear: "if I hadn't scheduled the car to charge then it was completely obvious that there was DSR because I got a notification saying it was charging". Other times she hasn't known if a DSR command has taken place, because she finds it "impossible" to distinguish charging via DSR during the day from charging with solar.

Reactions to DSR

Neither positive nor negative as DSR commands haven't made any difference to how Sarah uses the car or the cost of charging. But she says if DSR were to stop her charging, she might lose some confidence in being able to use her car as she wants – that could be a problem.

Attitudes and personality

General

Sarah likes to be in control and her trust in technology helps her feel in control. For example, she's comfortable going down to a low range in her car because she trusts the range indicator, and she would trust (and like) a system that could automate DSR around cheap electricity windows if she had a variable rate tariff.

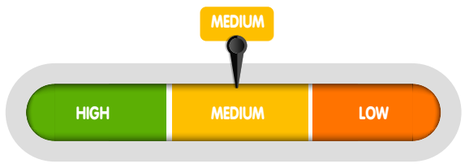
DSR

DSR hasn't interfered with what she wants from her charging so she's confident about being able to use her car as she wants. However, she did set up notifications so her car's app would alert her when it was charging - knowing what's going on helped her feel a little bit more in control.

What might help?

Not a lot at this point!

Need for control



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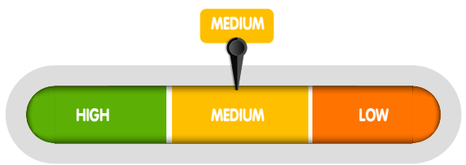
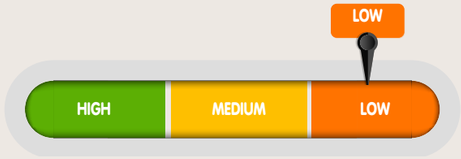


Joe

Aged 25, believes convenient control is king. Works in IT and loves technology, especially green tech. Lives with his parents and brothers near Glasgow.

Need for control



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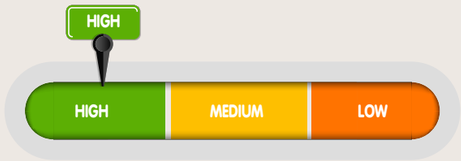


Joe has:

- A Nissan Leaf
- Solar
- zappi and eddi
- Household battery

EV journeys

Joe has a regular commute, which he could probably manage two or three days in a row on one charge (but he charges daily).

Charging

Joe charges at work when he can – it's convenient since he'll be there for 8 hours anyway. Then he tops the car back up to full again overnight. He used to charge in the evening but since switching to a variable tariff he uses a timed boost to charge at the cheap off-peak rates.

His experiences of DSR

Joe thinks he's been quite good at picking up on DSR: he gets notifications when the car stops charging – if that's outside the times that he's expecting the car to charge, he's confident it's due to DSR.

Reactions to DSR

Joe has no big issues with DSR so far, but would like it if DSR didn't cause his car to charge outside his tariff's off-peak hours. He suggests that DSR could be targeted primarily at those on flat-rate tariffs; power used in response to a DSR command "won't cost them any different" than if they were charging at another time. If extra grid balancing is still needed, he suggests those currently within their tariff's off-peak windows could be the next target, before those who are currently outside their off-peak window, where it would cost them more to charge than at off-peak times.

Attitudes and personality

General

Joe likes control but convenience is very important too. He also likes information - even if he doesn't need it, he just likes to know.

DSR

Joe trusts his zappi completely, but slightly less when it's operating with DSR – he knows a command to stop charging could leave him with less charge than he wants.

What might help?

His slight loss of trust could be mitigated by 'making up' for charge he missed out on, i.e. if his charge started late, he'd like the charge to continue beyond the normal end time to compensate. As long as he has the charge he wants each morning, he doesn't mind when and how that's delivered (and can see benefits to it being automated, especially if it optimises use of his cheap off-peak hours).

I don't mind it being stopped and started over the course of the night but it has to be at either a level I set, or 100%, when I'm getting up in the morning.

Chris

Aged 70, Chris has a love of technology and sees it as a toy. Since retiring, Chris has channelled his love of tech and his concern for the environment into making his home as efficient as possible. He lives with his wife in rural Essex.

Chris has:

- A Nissan Leaf (he also has a petrol car for longer journeys… or for fun!)
- Solar
- zappi and a solar diverter (for hot water)
- Air source heat pump

EV journeys

Chris uses his Leaf mostly for short, local journeys.

Charging

The car is generally plugged in whenever he's home and is set to take up any solar the household isn't using. He also uses a local public charger two or three times a week – it's free! If, after all that, he still needs to charge for an upcoming journey, he'll set an overnight charge.

His experiences of DSR

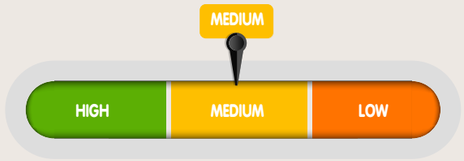
Chris thought he'd be able to tell when DSR was happening but hasn't found that. He's only noticed one instance of DSR – he was looking at the myenergi app and saw activity at a time he'd not set a charge. Without looking at the app, he doubts he'd have noticed.

Reactions to DSR

Chris is neither positive nor negative about it, more neutral. That's partly because he's not sure he understands what people would get out of it – he wants to know more about what's in it for him, for example whether he'll get electricity at a cheaper rate.

> I don't look at the charge on the car every time I've finished with it, so if it's got another 10kWh in it, I wouldn't notice

Need for control



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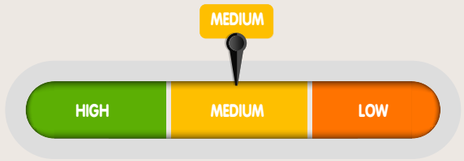


Attitudes and personality

General

Chris likes to be in control – that's one of the reasons he prefers his petrol car over his EV. The EV's range is limited and there aren't many charging points around, so he feels he has less control over being able to use it how he wants.

DSR

Chris recognises that DSR might not cause problems for him as he has low mileage and the back up of an ICE car: "I think if your only mode of transport is electric, you'd have to be a bit more circumspect about it all." Also, he doesn't really monitor how much charge his car has, so he feels he might not notice if a DSR command has taken place.

What might help?

Knowing a bit more about what DSR does and how it could benefit him would help him trust DSR a bit more.

Mark

Aged 55, Mark likes to control carbon and cost. He loves tech, particularly if it helps him to be 'green'. Mark lives with his wife in Devon, with grown-up kids nearby.

Mark has:

- A Hyundai Kona; his wife also drives an EV
- Solar
- zappi and a solar diverter for hot water

EV journeys

Most days Mark drives fairly locally or slightly further afield (with a couple of days a week when the car isn't used). But he drives to Manchester and Newcastle for work fairly regularly, with one or two stops to charge en route.

Charging

The car is usually plugged in on Eco or Eco+ when it's at home to make the most of surplus solar. Mark also charges overnight if his tariff's off-peak prices, which vary day to day, are particularly low. For longer journeys he plans ahead where he's going to charge on the way, with contingencies in case public chargers aren't working.

His experiences of DSR

Mark has noticed very few DSR commands although suspects he has been sent more that he didn't notice. He's picked up on DSR by noticing that the zappi or myenergi app show consumption or charges that he wasn't expecting.

Reactions to DSR

Mark doesn't mind DSR taking place at all and laughs that he's "neutral to mildy pleased" when he spots that a DSR command has taken place! He understands the need to help balance the grid and wants to help show that the technology can work. He's especially pleased at how seamlessly it's worked so far.

> That the technology works is pleasing; that it can be used for helping balance the grid is pleasing. It doesn't bother me that it costs me ten pence worth of electricity at all.

Attitudes and personality

General

Mark likes to be in control and, with things he values (like using power when it's green and cheap), he'd rather invest time and effort into getting things just how he wants them. Being able to charge his EV at home and managing that through apps helps him feel in control.

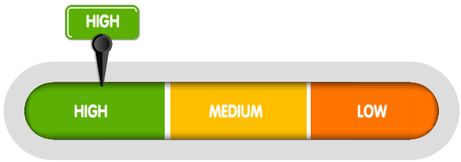
DSR

Mark hasn't experienced any disruption with DSR so far and says that even if it did leave him with less charge than expected, it would rarely be a problem since he mostly only drives locally: "I suppose I could conceive of a circumstance where I want to charge overnight, set it to charge and I might not be as fully charged as I wanted, but it's never happened and it's not something that worries me. If I'm 100% certain about charging with my zappi, I'm maybe 99% certain about charging with my zappi plus DSR".

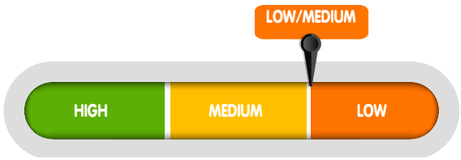
What might help?

Mark would like a bit more information about when or why DSR commands are triggered. That said, it's not something that he's losing sleep over.

Need for control



Need for convenience



Unleashing innovation and opening new markets to capture the clean growth opportunity.

Visit peoplelab.energy to find out more information on this project, the Consumer Insight Capability, and to download our latest report.

You can find out how our personas got on with charging their EVs in the accompanying publication - DSR - Putting consumers in the driving seat.

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The FRED trial - who's involved

Energy Systems Catapult is an independent not-for-profit research organisation with a mission to support innovators and help the transition to a clean, renewable energy system. ESC will be gathering feedback to understand how people interact with flexibility.

myenergi are an award-winning team of passionate people whose zappi, eddi and harvi products are already transforming living and working environments by increasing self-consumption of renewable energy.

Evergreen Smart Power are the creators of the Smart Power platform. The software lets zappis and eddis to respond in real time to grid conditions and energy prices to use electricity in a more intelligent and environmentally-responsive way.

Part of Swansea University, Specific is at the forefront of developing tech for energy efficient living. Their "Active Office" and "Active Classroom" buildings showcase low carbon technologies from solar walls to heat pumps to energy storage solutions

Tonik Energy is a challenger energy supplier whose ambition is to use renewable energy and smart home technologies to cut energy bills in half over the years ahead. They will be using data generated in the trial to demonstrate how flexibility technology can result in cost savings and lower bills.