

Smart Meters

Unlocking the Future



Department for
Business, Energy
& Industrial Strategy



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Introduction

The development of a world-leading smart energy system delivering secure, cheap and clean energy is an important part of the Government's Industrial Strategy.¹ As our Clean Growth Strategy highlights, smart technologies and services will play a vital role in decarbonisation.²

Smart meters are a vital upgrade to our national energy infrastructure, not only putting consumers in control of their energy use, but also providing the building blocks of a more flexible and resilient energy system fit for the 21st century.³ This could bring consumers, the energy industry and wider economy up to £40 billion of benefits over the next few decades. Smart meters are the key to unlocking these benefits which is why the Government is committed to all homes and small businesses being offered smart meters by the end of 2020.⁴

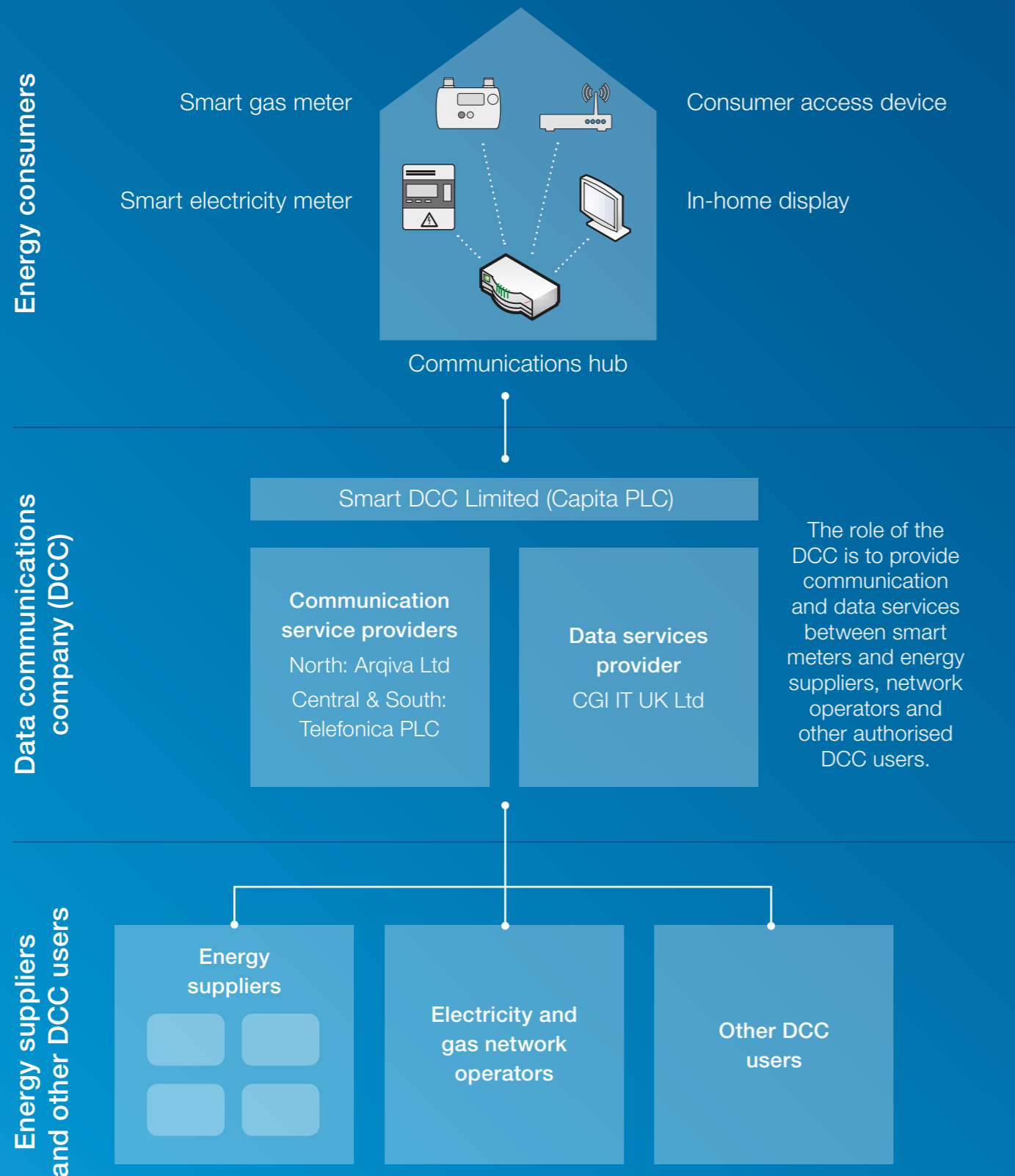
Smart meters will future proof our energy system so we can move to a more digital, data driven system that makes the energy market work better for consumers. This will create opportunities for innovation for organisations inside and outside the energy sector, enabling growing technologies and services such as electric vehicles, smart tariffs and microgeneration to be efficiently integrated with renewable energy generation; lowering emissions and cutting costs

for consumers. Smart meters are also supporting the broader digital economy, unlocking new opportunities in areas such as health and social care.

Millions of people across Great Britain have already made the smart choice to have a smart meter, taking control of their energy use and doing their bit to reduce carbon emissions. Over 80%⁵ of consumers with a smart meter say they have taken at least one step to reduce their energy usage since having them installed. Over the next few years even more households and small businesses are set to benefit from these smart devices as energy suppliers scale up their operations.

This document highlights how smart meters can support innovation and enable new consumer technologies and services to unlock a cleaner, smarter, more flexible energy system.

The smart metering system



Data availability

Consumption Data

Smart metering equipment in the home can store at least 13 months of energy consumption data recorded on a half-hourly basis, and at least 24 months of daily consumption data.

In addition, electricity consumption and tariff data can be made available at least every ten seconds over the Home Area Network (HAN), which can be accessed by an In-Home Display or another device, known as a Consumer Access Device.⁶

Export Data

Smart electricity meters can make data available on the amount of energy generated onsite at home or business and exported to the grid, storing at least three months of half-hourly export data.

Tariff Data

Smart meters support tariffs which can have different prices for different times of the day⁷ as well as different amounts of consumption (e.g. the first 10kWh in a given period is charged at a different price to subsequent consumption). Tariff information (e.g. price for a given time of use period) is stored on the smart meter and can be made available, with consumer consent, to third parties or other connected-home devices.

Data access and privacy

The Smart Meter Data Access and Privacy Framework (DAPF)⁸ governs energy supplier, network, and third-party access to consumer energy data via the smart meter.

The DAPF was designed to complement data protection legislation, which includes the Data Protection Act 2018 and the General Data Protection Regulation⁹ which governs the processing of personal data by any party which obtains consumption data. The central principle of the Framework is that consumers have control over who can access their energy consumption data, how often and for what purposes, except where this data is required for regulated purposes. This principle complements the protections granted in respect of personal data and data subject rights under data protection legislation.

Energy suppliers can only access energy consumption data that is more detailed than daily (e.g. half-hourly) if they have obtained the consumer's explicit consent to do so. Third parties are required to obtain consent to access consumers' smart metering consumption data.

Demand side response

Demand side response enables consumers to engage more actively in the energy system. Offering rewards to those who can support flexibility, ultimately helping to balance supply and demand, whilst cutting costs and carbon emissions.

Smart meters enable demand side response which unlocks new ways for domestic consumers to manage their energy use. Just by having smart meters, consumers can be incentivised to increase, decrease or shift their electricity consumption, with load control functionality and smart tariffs that price energy according to the time of day, helping to reduce peak demand.

The latest Smart Meter Cost-Benefit Analysis¹⁰ identifies around £1 billion of consumer benefits from shifting demand away from peak to off-peak times, when energy is cheaper.¹¹ By providing consumers with a better understanding of the cost of energy, supporting more cost-reflective tariffs and enabling direct load control features smart meters make it easier for customers to take advantage of rewards for shifting their energy consumption. Making it easier for consumers to engage means that there is less need for specialist equipment, with consumers at the most basic levels able to engage in demand side response simply by changing the time they do their washing or charge their electric vehicle.

It will be the consumer's choice whether they decide to use load control services or time-of-use tariffs. Consumers will need to give explicit consent for companies to access any consumption data necessary to enable services.

PREPAYMENT CRITICAL PEAK REBATE

UKPN's energywise project trialed the impact of time-of-use and Demand-Side Response for low income customers. Smart meter prepayment customers were offered 'Bonus Time', a dynamic, nonpunitive, Critical Peak Rebate offer, which reimbursed a customer the cost of 10 units of electricity for every 1 unit of electricity saved during specific 'Bonus Time periods'.

Customers were notified of these periods by text the day before as well as two hours before the event and bonus credits earned during the windows were then applied directly to the meter. Customers were encouraged to manually shift their electricity consumption away from peak periods as automation was not part of the trial. Customers earned rebates ranging from £3 to £111 a year (£37 on average), and a 1.5% reduction in the evening peak demand was achieved across the trial.¹

¹ innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Energywise/Project-Documents/

Time-of-use tariff innovation

Smart meters enable suppliers to offer consumers innovative new tariffs, including new smart tariffs which charge consumers different prices for electricity at different times of the day. These can be based on a pre-agreed schedule, similar to traditional economy-7 tariffs, or real-time price signals in the wholesale market.

By giving consumers more information about their energy use, such tariffs enable consumers to change their behaviour, saving energy and money as a result. Actions as simple as delaying the start time of the washing machine or dishwasher to outside the evening peak can have a significant impact and in the future smart appliances will be able to do this automatically making it even more convenient for consumers to save money (see section on load control).

By allowing electricity use to be recorded and billed¹² in half hour periods, smart meters unlock the possibility for those half-hourly prices to reflect the real price of electricity as it changes throughout the day, further developing the incentive framework for new products and services that encourage load shifting and use of electricity at times of the day when it is cheapest to supply.¹³

Empowering consumers to shift their electricity use away from peak times will be critical to the future of our energy system. Supporting the realisation of up to £40 billion of benefits through avoiding or delaying costly network upgrades, more rapid integration of electric vehicles and renewable generation, and more efficient use of the system.¹⁴ Ultimately lowering emissions, cutting costs, and giving households more control.

DYNAMIC TIME-OF-USE TARIFF

In 2018, Octopus Energy launched Britain's first half-hourly time-of-use tariff, called Agile Octopus. Agile uses data from smart meters to pass on the price of electricity to customers as it varies throughout the day. This means customers can access cheap electricity by using it when demand is low or when there is plenty of generation available.

Data from Agile Octopus customers shows behaviour change, with 28% of people responding to price signals to shift their energy consumption outside of peak times.² If tariffs like these were rolled out at scale, the balance to supply and demand could be optimised to dynamically shift demand to match renewable supply, for example enabling better utilisation of intermittent renewables.

² www.octopus.energy/blog/agile-report/

TIME-OF-DAY TARIFF

In January 2017 Green Energy introduced TIDE, one of the first time-of-day tariffs aimed at domestic consumers. By using price messaging, it encourages consumers to time shift consumption, helping to reduce demand on the national grid at peak times.

Using smart metering, TIDE rewards customers for avoiding consumption at periods of peak system stress via a price differential of over 20p per unit. The times remain constant incentivising consumers to easily programme their white goods, electric heating or electric vehicles to take advantage of the low off-peak rates such as overnight.

Load control

Smart meters can facilitate load control¹⁵ in a variety of ways, both directly and indirectly.

Auxiliary load control switches (ALCS)

Large domestic loads like storage heaters or heat pumps can be connected and controlled independently from a consumer's main supply. An ALCS inside a smart meter can switch the electricity supply to the devices connected to it on or off based on an agreed switching pattern. It works in the same way as today's Economy 7 meters, providing a scheduled period of power to connected devices, but, subject to an agreement made between a supplier and consumer, could also support ad hoc commands allowing switches to respond to wider network conditions such as periods of excess renewable generation.

HAN-connected auxiliary load control switches (HCALCS)

Similar to an ALCS, a HCALCS allows large domestic loads, such as electric vehicles chargers, to be controlled independently of the main power supply. However rather than being integrated with the meter directly, the switch is remotely connected via the Home Area Network. This provides more flexibility, avoiding the need for new wiring back to the meter when a new load is connected.

Smart appliances

Smart appliances, such as washing machines and dishwashers, can connect to the smart metering system to access pricing and consumption data.¹⁶ This includes the price of energy as it changes over time according to the tariff, meaning activity can be programmed to automatically take advantage of cheaper rates.

In the absence of automated control of consumption, smart meter data can be used to incentivise consumers to manually consider when and how best to manage their electricity use. Because smart meters accurately record consumption and facilitate remote (and fast) access to this data, they can then verify that a demand side action has taken place, facilitating billing and payment of financial incentives where a consumer has signed up to such services.

Consumers are increasingly purchasing more smart devices and appliances for the home. According to BT the average UK household will contain 50 connected devices by 2023¹⁷ (e.g. smart TVs, kitchen appliances, smart thermostats). Smart meters are unlocking new ways for these devices to engage in the energy system.

A SMART HOME ASSISTANT

Chameleon Technology's I•VIE links real time energy consumption data and connected home solutions, enabling consumers to control, interact with and understand their energy use more effectively.

By mixing real-time smart meter consumption and pricing data with other high velocity data items – home appliance data, calendar,

weather, budget, electric vehicles, home battery storage, heating and cooling, and security – I•VIE can provide predictive, tailored, actionable insights and automated controls and commands. This not only adds convenience to suit consumer lifestyles but also helps to unlock demand side benefits making it easy for consumers to engage effectively in energy saving and load shifting.



Smart electric vehicles

The UK is seeing a growing number of electric vehicles on the road. Currently electric vehicles only make up 0.1%¹⁸ of the UK's total car fleet but by 2030 National Grid expects 11 million electric vehicles to be on the road.¹⁹

Whilst public charging infrastructure is seeing significant investment²⁰ it is expected that the majority of drivers will choose to charge at home. This could have significant implications for peak demand, increasing electricity demand by up to 15% over the next 30 years. This affects everything, from how much new infrastructure is needed, to the price of power and the climate impact of car charging. Smart metering can help mitigate this by unlocking new products that affect not just when energy is used, but also how much is needed.

New smart meter-enabled tariffs can reward consumers that charge their cars during off-peak times, such as at night, by passing through savings from using energy at lower price periods. When combined with smart chargers consumers can automate this process, not only making it easier to shift charging to cheaper periods but also increasing the responsiveness of their vehicle to real-time signals such as excess renewable generation or local grid constraints.

New two-way smart chargers can even enable vehicles to act as mini power stations, supplying energy back to the grid or even directly to consumers' home.

Given that cars spend over 90% of their time parked this opens up significant new capacity that would otherwise be wasted.²¹ Electric vehicles can also help optimise onsite microgeneration such as roof-top solar. Providing new ways for consumers to use surplus green and free energy that would otherwise be exported to the grid.

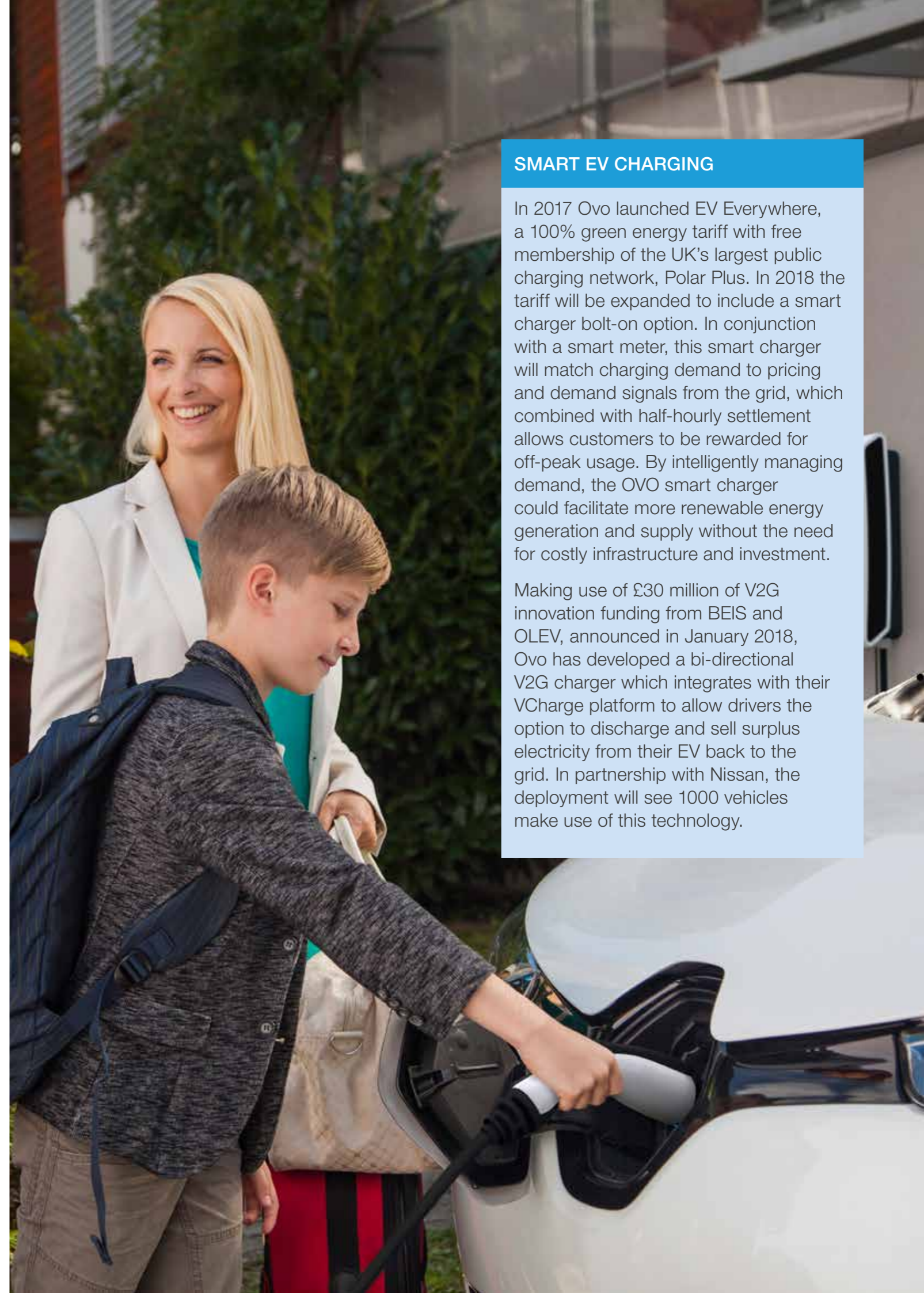
As part of our plans to be world leaders in EVs, we have taken powers in the Automated and Electric Vehicles Act to legislate that in the future all new chargepoints will have to have smart functionality.²² We plan to consult in 2019 on using these powers to prescribe the technical functionality of smart EV chargers. In addition to these powers, from July 2019 all government funded domestic chargepoints must be able to be remotely accessed, capable of receiving, interpreting and reacting to a signal from a third party.

Government is also seeking to demonstrate what a smart meter load control device could look like, and how it would work in practice for loads such as electric vehicles. To support this BEIS has made available £3 million of funding.²⁴

SMART EV CHARGING

In 2017 Ovo launched EV Everywhere, a 100% green energy tariff with free membership of the UK's largest public charging network, Polar Plus. In 2018 the tariff will be expanded to include a smart charger bolt-on option. In conjunction with a smart meter, this smart charger will match charging demand to pricing and demand signals from the grid, which combined with half-hourly settlement allows customers to be rewarded for off-peak usage. By intelligently managing demand, the OVO smart charger could facilitate more renewable energy generation and supply without the need for costly infrastructure and investment.

Making use of £30 million of V2G innovation funding from BEIS and OLEV, announced in January 2018, Ovo has developed a bi-directional V2G charger which integrates with their VCharge platform to allow drivers the option to discharge and sell surplus electricity from their EV back to the grid. In partnership with Nissan, the deployment will see 1000 vehicles make use of this technology.



Switching energy supplier

As well as facilitating new types of tariffs, smart meter data could also unlock new business models for the switching market increasing consumer engagement and competition.

Although there has been a significant increase in switching over the past few years, 60% of consumers still remain disengaged. There is a perception that switching is a time consuming and complicated process. Consumers can also find it difficult to make informed choices based on their specific circumstances and preferences.²⁵

Smart meters will make it easier for consumers to identify better value tariffs and realise bill savings. With consumer consent, price comparison websites and third-party intermediaries can use actual consumption and tariff data to create personalised recommendations. Showing projected costs as they relate to a consumer's actual energy use rather than a modelled average consumer, informing choices on where the greatest savings can be achieved.

Companies are also beginning to offer automated switching services, which can scan thousands of tariffs a day then automatically switch customers to new deals based on analysis of not just their consumption data, but also taking into account additional factors such as exit fees, and any preferences

on low carbon energy. Such services make it more convenient than ever before for consumers to find the best deal for them, removing the need to continually trawl through switching sites to ensure they are on the most competitive tariff for their needs.

Government, and the energy regulator Ofgem, are also committed to the introduction of midata²⁶ into the energy sector to enable consumers to more accurately, and easily, compare energy tariffs using data held by their current supplier and stimulate innovation in data-based services. A cross government project team, supported by leading players in the data space such as the Open Data Institute, the Alan Turing Institute and Energy Systems Catapult, will work closely with stakeholders to define, design and implement the midata framework.

Alongside this Ofgem is taking steps through the Switching Programme to radically transform current switching arrangements, and deliver faster, more reliable switching for energy consumers.

Providing access to markets for micro-generation

In recent years, the uptake of micro-generation has been steadily increasing in the UK.

The Feed-In Tariff scheme (FIT) has enabled over 800,000 installations across Great Britain.²⁷ To date electricity generated by domestic customers is either used at the generation site or sold back to the grid at a fixed rate, with the amount 'exported' to the grid based on an estimate of the total amount of electricity generated.²⁸ Such an approach fails to reflect the value of market signals related to the time of day or season, disincentivising desirable behaviour such as self-consumption, storage or export at times which would benefit the electricity system.

Not only do smart meters measure how much consumers use and when they use it, they can also measure

how much is exported and when. Building on this functionality, half-hourly settlement provides commercial incentives on energy suppliers to offer tariffs that facilitate system optimisation.

With the advent of smart meters and smart tariffs²⁹, small-scale consumers could have greater autonomy over their electricity usage, taking advantage of consuming or exporting at different times to either save or make them money. Stronger price signals and increased data transparency could also support new innovative markets for micro-generation to engage in demand side response and peer-to-peer trading³⁰.



Driving energy efficiency

Empowering consumers to reduce their energy consumption is a key aim of the smart meter roll-out.

To help deliver this objective, suppliers are required to offer tailored energy efficiency advice to consumers during smart meter installations alongside the offer of an In-Home Display. This will help consumers understand what changes they can make to their home and energy habits.

Energy insight tools

Smart meter consumption data, combined with cutting edge data analytics, has the potential to further build on advice at smart meter installations by providing personalised insights to consumers in real time. These could for example show the cost of different activities or appliances (e.g. lighting, cooking, entertainment, laundry). Services can also generate alerts notifying consumers when appliances have been left on unnecessarily, or when spending is over-budget, or use additional data (e.g. weather forecasts) to provide contextual prompts.

Through tailored and contextual feedback alongside actionable prompts and recommendations, consumers can be supported to engage with their energy consumption, change their behaviour, purchase more efficient appliances and make improvements to their homes.

In early 2018 BEIS launched the Non-Domestic Smart Energy Management Innovation Competition.³¹ This £8.8 million investment targets the development of solutions for smaller non-domestic sites in the schools, retail and hospitality

sectors, supporting them to better manage their energy use through tailored energy insights specific to the circumstances of such organisations.

The Clean Growth Strategy³² committed to explore how the smart energy data can, with customers' consent, support personalised recommendations for saving energy. To support this BEIS is launching the Smart Energy Savings Competition, providing £6.25 million of funding to develop and trial products and services that use smart meter data to help households manage and reduce their energy consumption, realising additional energy savings to those already being facilitated by In Home Displays and tailored energy efficiency advice at smart meter installations.

REAL-TIME ENERGY INSIGHTS

Hildebrand's Glow uses smart meter data, via a Consumer Access Device, to provide customers with unique insight into their energy usage, by creating a personalised guide that allows them to track their consumption by day, week, month and year. They can see how their energy use compares to similar homes, and view their likely spend, tracking against set budgets. The app also provides insights on base line energy use, highlighting appliances around the home which may be wasting energy when not in use.

Energy efficiency of buildings

Property-specific consumption data from smart meters can be combined with other data sets (e.g. indoor temperature, building survey data) to provide a better assessment of energy performance, in particular a more accurate measure of the thermal properties of a building. This could deliver more accurate and reliable efficiency ratings, based on monitored data rather than building models, boosting confidence in performance assessments and the impact of installing innovative technologies.

BEIS and the Ministry of Housing, Communities and Local Government are currently considering how smart meter data could be used to improve the accuracy of the Heat Transfer Coefficient used in Energy Performance Certificate calculations. Many other BEIS policies which need to accurately measure a building's performance or the energy savings that have been achieved in a building could also benefit from improved ratings using smart meter data.

In September 2018 BEIS also launched a £5 million funding scheme to develop, test and demonstrate technologies that measure the thermal efficiency of homes using smart meters, and other relevant, data.³³

ENERGY SAVING ADVICE

Energy Saving Trust has been developing a smart meter advice tool, which uses smart meter data to inform personalised energy advice; it is intended for use by the Home Energy Scotland network in advising customers and in the future by householders themselves. Use of smart meter data will allow the network to see the energy consumption levels and patterns for a customer, which will represent a step-change in the ability of the network to influence behaviour change regarding energy use by providing frequent, individually tailored advice. Previously undertaken pilot work has demonstrated significant savings potential.

Health and social care

The number of people over 75 in the UK will rise from one in 12 today, to one in every 7 by 2040. We're also living for longer, with more than 10 million people in the UK today expected to see their 100th birthday.

The number of people with long-term health conditions that have the potential to impair quality of life is also on the rise. Currently there are 850,000 people with dementia in the UK, by 2025 this is expected to reach over 1 million. The resulting strain on national healthcare resources means that providing monitoring to ensure patients are safe, warm and well, is a challenge.

Smart meters have the potential to support the development of new digital care products and services which can meet this challenge.

Energy consumption data can be used to recognise activities or usage patterns that could be associated with a variety of health conditions such as

dementia or depression.³⁴ Creating a view of a person's daily habits that can trigger alerts when there is an irregularity in routine, such as leaving an oven on or use of heating, may indicate a need for additional support. Facilitating a new approach to care which is more personalised, responsive and cost-effective, helping people to live safely in their homes for longer.

Such innovations will need to take account of privacy considerations but have the potential to greatly increase the quality of life of those with long term conditions or vulnerabilities, as well as providing greater peace of mind to vulnerable customers and their care network.

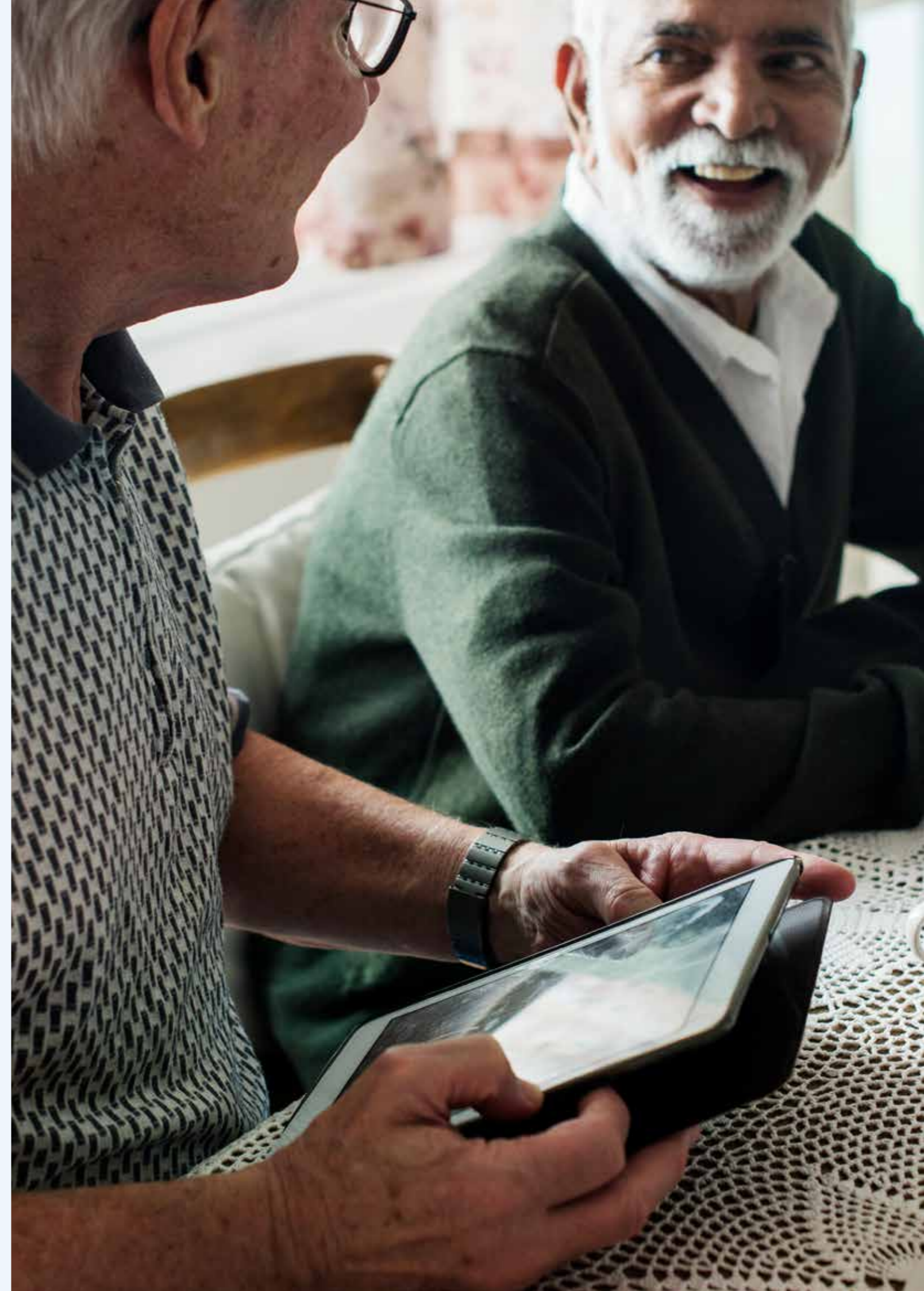
SMART ENERGY, SMART CARE

In 2017 Mersey Care NHS Foundation Trust and Liverpool John Moores launched a project exploring how real time consumption data combined with machine-learning algorithms can support those living with dementia, Parkinson's disease and depression. This has enabled patients to live more safely at home and maintain their independence for as long as possible.

The technology assessed an individual's personal physical and mental-health by monitoring their electricity usage at home. This is achieved by

processing data collected from smart meters, which captures detailed habits of an individual's interactions with electrical devices. By creating a personalised profile of the user's behaviour, the technology can then identify any anomalies in a person's routine, such as changes in wakeup times or ovens being left on.

Based on the successful results from the first trial a larger clinical trial is planned for early 2019.



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- 12 In Great Britain electricity is traded in a wholesale market, with generators and suppliers entering into contracts with each other for every half-hour of every day. Electricity suppliers are required to buy enough energy to meet their consumers' needs in each half-hour period, and 'settlement' is the process for determining, after the event, whether what they bought matched what their customers consumed. Any shortfall or excess is charged or refunded to the supplier accordingly. It is distinct from an electricity supplier billing an individual customer for their energy use, even though both processes use consumption data.
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- 28 Export estimates are currently 50% of the amount generated for all FITs technologies, except hydro which is 75%.
- 29 Smart time-of-use tariffs on the market today are focused on time of import, but in the future they could relate to time of export.
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