Two Paths for Advancing Great Britain's Smart Metering Programme

A DISCUSSION PAPER

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December 2018

THE Brattle GROUP

Notice

The authors would like to thank the various industry stakeholders who generously shared their views on the smart metering programme. Brattle Research Analyst Maria Castaner provided excellent research assistance. We would also like to thank Brattle Principal Serena Hesmondhalgh for peer review. All results and any errors are the responsibility of the authors and do not represent the opinion of The Brattle Group or its clients.

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Executive Summary

Fundamental Challenges

Smart metering rollouts around the world are delivering significant benefits to consumers. Great Britain's smart metering programme could ultimately deliver these same benefits. However, our review of data that has become available during the first seven years of experience with the programme identifies several fundamental challenges. These challenges are often overlooked in reviews of the programme's progress and pose a serious risk to the success of Great Britain's smart metering rollout.

Most critically, voluntary meter adoption rates are lower than anticipated. The experience of a wide variety of consumer programmes, ranging from energy efficiency to recycling to retirement savings plans, suggests that voluntary uptake of smart meters may feasibly only reach 60 percent. Data on consumer preferences for smart meters supports this conclusion.

Additionally, there are early signs that consumer engagement in energy management lags behind expectation. Energy management accounts for 40 percent of the benefits in the national smart metering business case, and is therefore critical to achieving success.

As a result of these challenges, our modelling indicates that the smart metering rollout could feasibly result in a net increase in the average household energy bill, compared to a net reduction of around £200 per household (NPV) estimated in the BEIS business case. Rising smart metering costs would further contribute to consumer bill increases.

Paths Forward

Fortunately, a review of experience since the programme's introduction in 2011 provides a useful foundation for pivoting toward a national deployment strategy that will maximise future programme benefits. To mitigate the emerging challenges and improve the value of the smart metering rollout, we have defined two distinct paths forward.

The "Refocused Rollout" path concentrates the scope of the rollout on the most cost-effective customer segments, rather than on all customers. This approach would maintain the programme's original focus on voluntary, customer-driven adoption of smart meters, but at a lower cost. The Refocused Rollout path includes the following elements:

- Revise supplier deployment targets to exclude costly/difficult installations
- Revise supplier targets to emphasize performance metrics other than number of meters in the field, such as cost-effectiveness of the meter deployments
- Clearly define the requirement that suppliers take "all reasonable steps" to install smart meters, such that the definition includes identified best practices in customer engagement
- Establish an option for an industry-coordinated approach to installations, to address technical inefficiencies

- Expand the in-home display (IHD) deployment requirement to include alternative informational offerings

Alternatively, the "Default Deployment" path transitions to the model utilized in most international jurisdictions, where smart meters are treated as essential energy infrastructure. The meters are rolled out in a manner more closely resembling mandatory deployment. The Default Deployment path includes the following elements:

- Accelerate recertification of conventional meters (pre-2020)
- Tie eligibility for government subsidies (e.g. the electric vehicle grant) to smart meter acceptance (pre-2020)
- Eventually transition to a fee-based opt-out model, where consumers who choose not to install a smart meter are charged a fee set to cover some or all of the costs of maintaining the redundant legacy metering and billing systems (post-2020)
- Provide optional education at point of installation, in order to lessen the perceived time burden of the installation appointment
- Implement a post-2020 engagement campaign focused on energy management
- Explore opportunities for sharing functions/costs across suppliers
- Expand IHD deployment requirement to include alternative informational offerings

2019 will be a critical year for the smart metering programme. Meter deployments are projected to ramp up significantly, the deployment of SMETS1 meters is expected to conclude, and efforts to address significant communications challenges will continue. It would be prudent for government and industry to evaluate possible programme revisions before these ongoing activities progress past a "point of no return." The experience of the first seven years of the rollout can inform the development of a revised approach to full-scale deployment that delivers on the potential benefits of smart metering in Great Britain.

Introduction

Great Britain (GB) is currently upgrading its national electricity and gas metering infrastructure from decades-old technology to digital smart meters. Potential benefits of the smart meters include timely and accurate customer bills, reduced costs of providing gas and electricity, and new consumer product offerings. The Department for Business, Energy, & Industrial Strategy (BEIS) estimates that the total net benefits of the rollout will amount to at least £5.7 billion over 18 years (present value), equating to around £200 per household and small business (present value).[1] Smart metering is also a key element of BEIS's Clean Growth Strategy.[2]

The smart metering programme ("the programme") was initiated by the British government in 2011. In the seven years since the programme's inception, notable challenges have been widely publicized. Smart meter deployment lags well behind initial expectations, costs have risen above planned levels, and outdated metering technology continues to be deployed to consumers. Recently, the National Audit Office released a report documenting these challenges, describing them as "serious issues that need to be addressed if Smart Meter[ing] is to progress successfully and deliver value for money."[3]

Given the significant opportunities that smart metering could unlock for consumers if effectively deployed, it is critical that industry and government identify a path forward for overcoming these challenges. We conducted a review of the programme to identify realistic options for advancing GB's smart metering rollout. Specifically, our review had two objectives:

1. Identify unanticipated challenges that have emerged since the programme's inception and which present a significant risk to achieving the net benefits expected from the smart metering rollout.

2. Develop preliminary recommendations for revising the programme requirements to mitigate the emerging risks and increase the likelihood of a successful smart metering rollout.

We focused specifically on whether achievement of the net benefits quantified in the government's smart metering business case (the 2016 BEIS Impact Assessment) is at risk. Consistent with that assessment, we evaluate the total net benefits of the programme that would accrue to consumers, distribution network operators (DNOs), suppliers, and other

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1 Department for Business, Energy & Industrial Strategy, "Smart Meter Roll-Out Cost-Benefit Analysis Part I," August 2016.

2 Department for Business, Energy & Industrial Strategy, "The Clean Growth Strategy: Leading the way to a low carbon future," October 2017.

3 National Audit Office, "Rolling Out Smart Meters," Report by the Comptroller and Auditor General, 23 November 2018.

market participants.[4] Our study is an assessment of the future risks to the programme based on current market conditions and data.

The analysis is based on a detailed literature review and synthesis of data sources including government and industry reports, academic articles, press coverage of the programme, and public supplier data. Additionally, we interviewed suppliers and representatives from consumer groups, industry trade organizations, and technology firms to gain detailed insight into industry experience with the smart metering rollout. We also spoke with organizations responsible for full-scale smart metering deployments in other international jurisdictions. All of the aforementioned stakeholder conversations provided useful factual background on the state of the smart metering rollout, with a focus on operational experience in delivery. However, the recommendations in this report are entirely those of the authors, based on our review of the programme.

Why Review the Programme Now?

The programme recently reached an important transition point. By BEIS's definition, the launch of the Data Communications Company (DCC) signifies the shift from the "Foundation Stage" of the rollout to "full scale deployment." The Foundation Stage was initially conceived to be a trial phase in which a limited number of smart meters would be deployed prior to the development of the necessary supporting IT infrastructure. These meters, known as SMETS1 meters, are expensive and have less functionality than the eventual national smart metering standard, known as SMETS2.[5] In spite of these limitations, SMETS1 meter deployment was intended to provide the experience and information necessary to establish a basis for the full-scale rollout.[6] While delays in the formation of the DCC prolonged the deployment of SMETS1 meters, the transition to SMETS2 now presents a logical opportunity to review experience with the programme prior to full-scale deployment. Figure 1 summarises this staging of the rollout.

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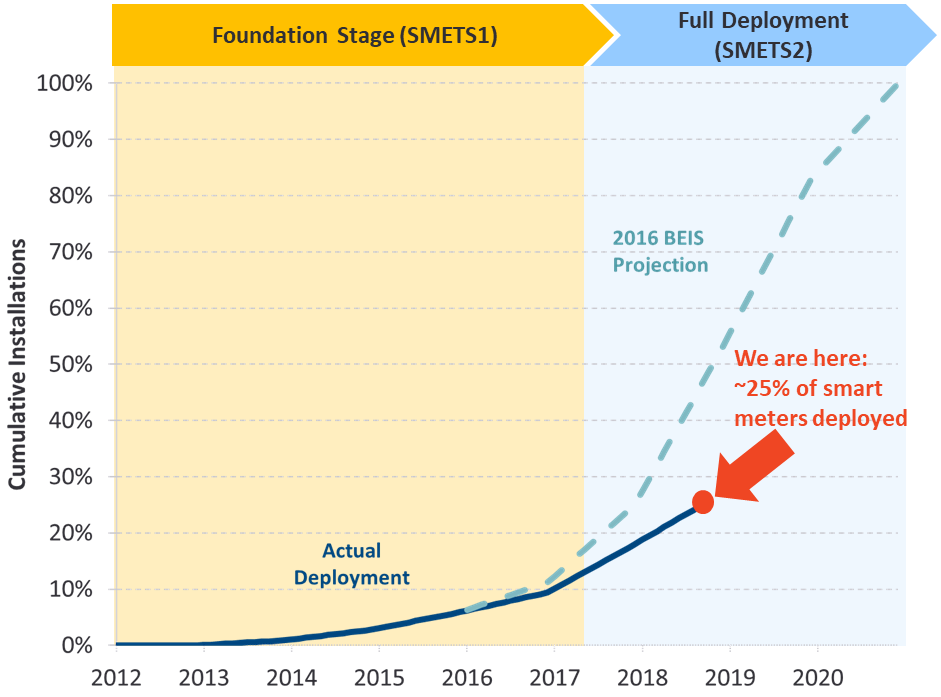
4 This is also known as "societal benefit" or the "welfare economics perspective."

5 SMETS stands for Smart Meter Equipment Technical Specifications.

6 Among the benefits of the Foundation Stage identified by the government is "for the industry to gain valuable learning and experience to inform its preparations for mass roll-out." DECC, "Smart Metering Programme: Foundation Smart Market," May 2013.

Figure 1: GB Annual Smart Metering Deployment



Source: Developed by Brattle with data from 2016 BEIS Smart Meter Impact Assessment and 2018 Q3 BEIS Smart Meter Summary Statistics.

The experience of the past seven years has taught the industry a great deal about the technical operation and costs of an advanced metering network. Additionally, and importantly, this experience has provided new insights into the level of consumer interest in smart metering.

Programme Requirements

Several features of the GB programme distinguish it from smart metering rollouts elsewhere. Our review of programme characteristics in other countries indicates that the following features of the GB rollout are relatively rare:

- *Voluntary adoption:* GB customers are not required to accept a smart meter, and there is no penalty to customers for rejecting a smart meter offer. Expiring meters will be replaced with meters that have "smart" capability (a process referred to as "meter recertification"). However, customers can elect to have those meters installed with the smart capability turned off.
- *Supplier-led deployment:* Retail suppliers are responsible for offering and installing smart meters (as opposed to Distribution Network Operators, or DNOs). The Supplier License Conditions define various supplier responsibilities associated with smart meter deployment. The government requires suppliers to take "all reasonable steps" to offer a smart meter to all customers by 2020. In the interim, suppliers must meet meter deployment targets that are approved by Ofgem. Ultimately, the government has a target to install smart meters in all households by 2020.

– *Mandatory IHDs:* All customers accepting a smart meter must also be offered a free IHD. The IHD is a physical device that must present near-real time energy consumption information to customers.

– *Gas smart meters:* The GB smart metering requirement includes natural gas meters in addition to electricity meters.

– *Above 95 percent deployment target:* The GB target is for smart meter deployment to virtually all homes and small businesses. Some other countries, such as Germany, have targeted deployment only to specific customer segments for which smart meters are deemed cost-effective. The European Commission requires 80 percent deployment to cost-effective customer segments.

Table 1 demonstrates the rarity of these features in the design of other European smart metering rollouts. To ensure that we are making a relevant comparison, we have specifically focused on countries which have submitted positive smart metering business cases for large-scale deployment to the European Commission. The table excludes the 11 countries that conducted cost-benefit analyses in line with the European Commission's guidance, but concluded that smart metering is broadly not cost-effective for them. Other than the 95 percent deployment target, which is observed in roughly half of the European countries that have committed to rolling out smart meters, all of the other features are observed in at most 20 percent of the European rollouts.

Table 1: Smart Metering Programme Requirements in European Countries

Country	No. Metering Points (mil)	Voluntary adoption?	Supplier led?	Mandatory IHD?	Rollout includes gas meters?	>95% deployment target?
Great Britain	**60**	✓	✓	✓	✓	✓
Italy	37				✓	✓
France	35					✓
Spain	28					✓
Poland	17					
Germany	16		✓			
The Netherlands	15				✓	✓
Romania	9					
Greece	7					
Austria	6					✓
Sweden	5					✓
Finland	3					
Denmark	3					✓
Slovakia	3					
Ireland	2			✓	✓	✓
Latvia	1					
% countries with same programme features as GB		**0%**	**7%**	**7%**	**20%**	**53%**

Sources: Great Britain: BEIS 2016 Smart Meter Impact Assessment. All other countries: European Commission, Benchmarking smart metering deployment in the EU-27 with a focus on electricity, June 2014.

Notes: All information shown in table based on original programme design, as described in the above sources. Included countries submitted positive cost-benefit analysis for large-scale smart meter rollout to EC and have greater than 1 million metering points. Germany, Slovakia & Latvia have selective rollout only for customer segments deemed cost-effective. Finland had a deployment target of 80 percent but has achieved 100 percent. The Netherlands has amended its initial programme to include an option for cost-free opt-out from the mandatory meter rollout.

Emerging Risks to Programme Success

The unique design features of the GB programme were a deliberate choice, discussed and debated in various industry working groups leading up to the programme's initiation. As such, these programme features were believed to be advantageous in the GB market context at the time the decision was made in 2011. For instance, it was believed that deploying meters on an opt-in basis would be consistent with the government's focus on promoting customer choice, would incentivize suppliers to advertise the benefits of smart meters to customers in order to encourage adoption, and would result in customer "pull" for smart meters and subsequently higher customer engagement in the market.

Our review of the recent experience with the programme suggests that these features have also jeopardized the success of the smart metering rollout in ways that were not fully anticipated in 2011. In the case of voluntary meter adoption, customer willingness to accept smart meters has been lower than many expected. The purely voluntary nature of the rollout poses a challenge to reaching high meter deployment levels in part because the vast majority of meters in GB are located within the home. Customers must schedule and be available for multi-hour appointment windows in order to receive a smart meter. That hurdle, combined with an inherent degree of consumer apathy toward voluntary participation in programmes of any type, could limit smart meter deployment in GB relative to levels observed in other jurisdictions, where meters are deployed on a mandatory basis and/or meters are located outside the home.

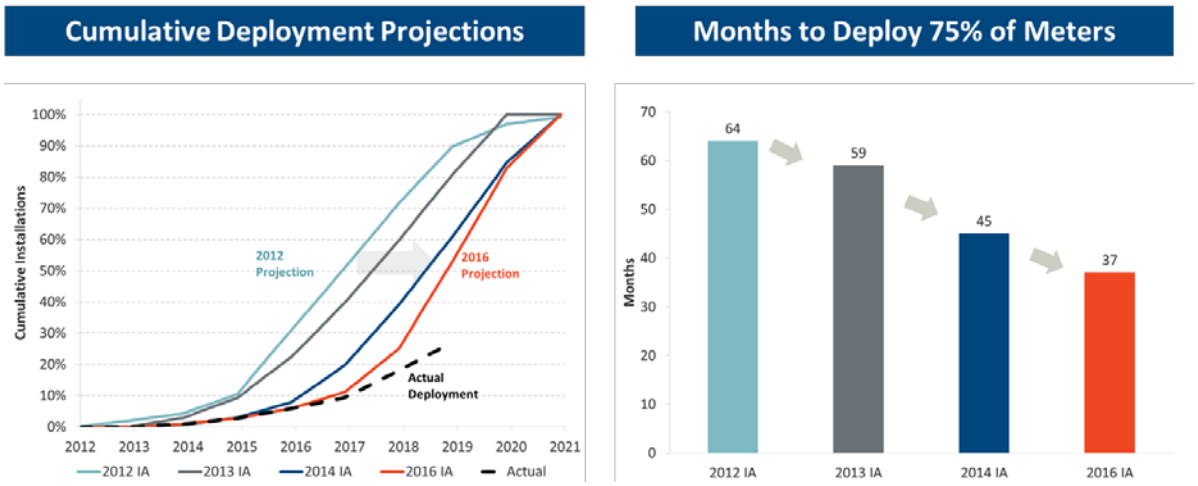
Table 2 summarises the advantages of each uncommon programme feature as they were conceived in 2011, as well as the associated, and perhaps unexpected, challenges that have emerged during the Foundation Stage of the rollout.

Table 2: Advantages and Challenges Presented by Uncommon GB Programme Features

Programme feature	Perceived advantages (2011)	Emerging challenges (2018)
Voluntary adoption	• Gives customers control • Incentivizes suppliers to tout meter benefits • Creates "pull" & higher customer engagement	• Significantly limiting meter deployment levels • Increasing marketing/installation costs
Supplier-led deployment	• Metering already a supplier function • Competition drives innovation and cost savings • Leverages supplier relationship with customer	• Exacerbating geographic installation inefficiencies when combined with compressed timeline
Mandatory IHD	• Enables energy savings • Gives customer immediate tangible benefit	• Forcing installation of dated technology • Early signs that IHD acceptance and interaction may be lower than expected
Includes gas meters	• Leverages electric meter installation efficiencies • Provide some of the same benefits as electric meters	• Many of the same challenges as electricity meters, but with potentially worse cost-benefit case
>95% target deployment	• Ensures all customers have access to benefits of smart metering	• Driving installation in cases where smart metering may not be cost-effective

The time available for smart meter deployment has consistently reduced since the programme's inception, compounding several of the above challenges. Well-documented delays in the formation of the DCC have reduced the time available for SMETS2 deployment by several years relative to the initial plans. Accordingly, BEIS has had to compress the meter deployment profile assumed in its Impact Assessment. Whereas it was assumed in 2012 that 75 percent of meters would be deployed over a period of 64 months, it is now assumed that this will take only 37 months.[7] Figure 2 summarises the meter deployment timeline assumed in BEIS Impact Assessments dating back to 2012.

Figure 2: The Compressed Time Window for Meter Deployment in BEIS Impact Assessment



Sources: Brattle analysis of BEIS Smart Meter Impact Assessments, 2012 – 2016 and 2018 Q3 BEIS Smart Meter Summary Statistics.

At first glance, the time available for deployment in GB is not significantly shorter than that allowed for metering deployments in other jurisdictions. However, it is the combination of the compressed deployment time with the uncommon features of the GB programme that exacerbates the aforementioned challenges. Specifically, the supplier-led approach to meter deployment means that meters are not installed with the same geographic efficiency achieved with a DNO-led rollout, since any individual supplier's customers are dispersed across the country. Additionally, a high proportion of internally-located meters requires a lengthier end-to-end installation process, since customer appointments must be arranged to allow meter installations. And, perhaps most importantly, the activities necessary to generate customer interest in a voluntary adoption model add time and cost relative to a mandatory rollout. The combination of these factors and the compressed timeline has contributed to concerns that meters will be installed in an inefficient and costly manner.

Based on our review, we have identified three significant risks to the success of the programme:

1. Low voluntary meter uptake
2. Low customer engagement with IHDs
3. Rising costs

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[7] We have chosen 75 percent meter deployment as the point of reference, because that is the share of meters remaining to be deployed by the end of 2017 according to the 2016 BEIS Impact Assessment. It is also the share of meters remaining to be deployed at the time of publication of this report.

Risk 1: Low Voluntary Meter Uptake

The primary risk that we have identified is that of low meter uptake. At lower-than-expected levels of uptake, all of the benefits quantified in the 2016 BEIS business case will be reduced, while only the variable portion of the costs will decrease. The "all-or-nothing" nature of some operational benefits will further reduce total benefits relative to total costs. For example, to achieve a benefit such as faster outage detection and restoration, the DNO must have a minimum level of smart metering-enabled visibility across the system. If the threshold level of meter deployment necessary to provide this visibility is not reached, the benefits will materialize at low levels or not at all.[8]

In recent Smart Energy GB polling, 21 percent of respondents to SEGB's survey self-identified as having a smart meter.[9] Of those customers who did not already have a smart meter, roughly half identified themselves as willing to "seek or accept" one in the next six months.[10] SEGB considers a customer's stated willingness to seek or accept a smart meter in the next six months to be an important metric for gauging the customer's general likelihood of adopting a smart meter. According to this metric, **56 percent** of all customers currently are identified as having or wanting a smart meter.

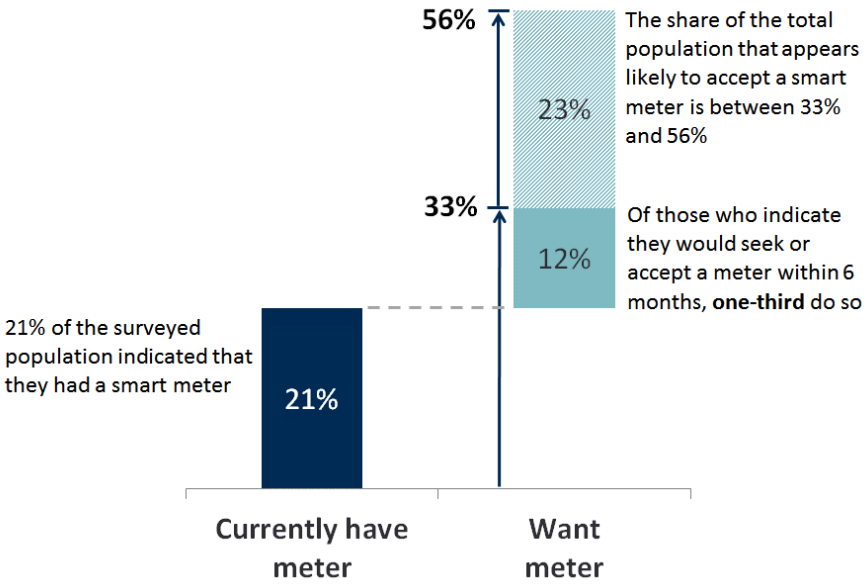
However, as has been widely documented in the academic literature on consumer behaviour, survey respondents' stated responses do not always align with their actions (this is referred to as the difference between "stated" and "revealed" preferences). Follow-up surveys with the same customers after six months found that only around one-third of those customers who indicated they would seek or accept a smart meter in six months had actually sought or accepted an installation appointment. Taking this into account, only **33 percent** of all customers may be identified as having or wanting a smart meter. Figure 3 presents a summary of this analysis of the SEGB data.

8 BEIS recognises this in its modelling of DNO benefits, assuming that a 60 percent deployment level must be reached before the benefits materialize.

9 Smart Energy GB, "Smart Energy Outlook," October 2018, pg. 9.

10 Ibid.

Figure 3: Share of Total GB Population with Stated Interest in Smart Meter

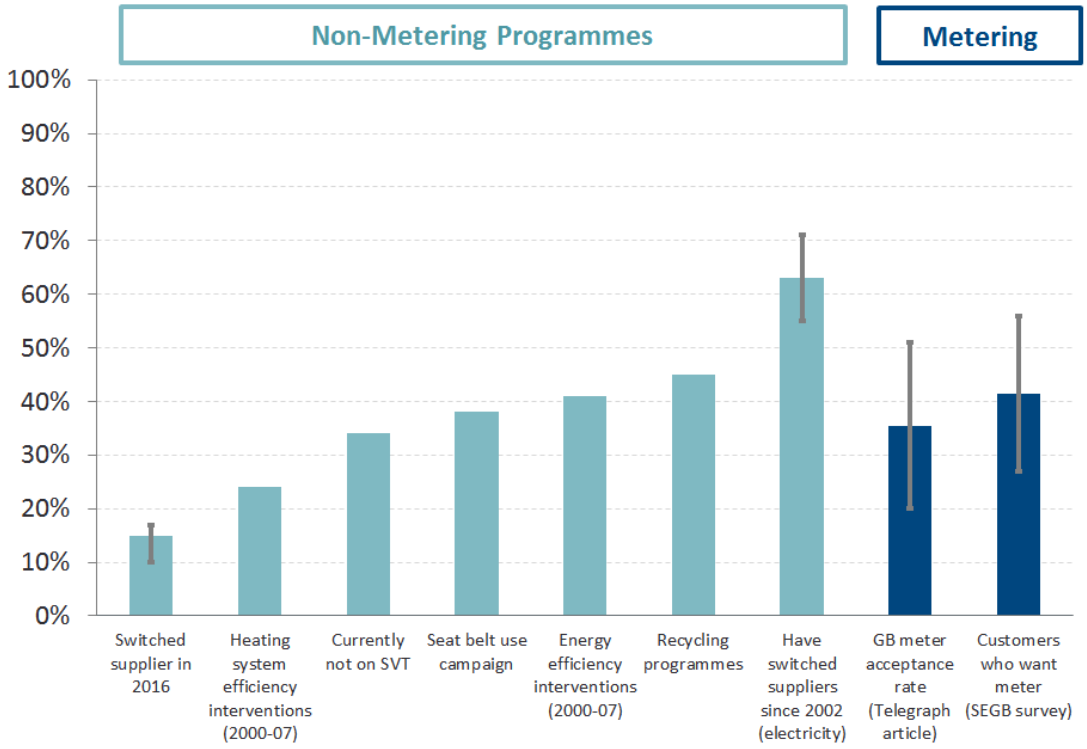


Notes and sources: 21 percent of respondents to SEGB's October 2018 Smart Energy Outlook survey indicated that they have received a smart meter. Of respondents to SEGB's survey who had not received a smart meter, 44 percent indicated that they were likely to seek/accept one in the next six months. Of customers who indicated that they were likely to seek/accept a smart meter in the next six months, a Populus six-month survey found that 34 percent got, tried to get, or were due to get a smart meter.

It is possible that future customer engagement activities will increase the pool of customers who are interested in a smart meter. In fact, one of SEGB's primary targets is to increase the percentage of customers seeking/accepting a smart meter in six months. However, the national smart metering awareness campaign has now been underway for several years. The extent to which there is room for significant growth in interest through these activities is uncertain.

Participation in other (i.e., non-metering) programmes provides useful insight regarding the demonstrated willingness of GB households to proactively opt-in to initiatives that are significantly more mature than the smart metering rollout. Through a review of industry reports and academic publications, we identified participation data on a number of such programmes, including energy efficiency interventions, energy supplier switching activity, recycling programmes, and seat belt use campaigns. Broadly, participation in these programmes has ranged between 15 and 60 percent. A summary of the participation rate survey is provided in Figure 4. The meter adoption survey results discussed previously are included in the figure for comparison.

Figure 4: Voluntary Enrolment in Relevant GB Programmes



Notes and sources: See References section for a complete list of sources. Error bars indicate high and low estimates across a range of observed values. Coloured bar indicates representative average value.

The somewhat limited extent to which domestic customers switch suppliers and tariffs is well-documented, and highlights apparent consumer apathy toward proactively pursuing energy bill savings opportunities. In GB, customers reportedly could save in excess of £200 per year by switching tariffs through a simple phone call or website visit. However, many have not been motivated to do so, with only around 15 percent of customers switching suppliers on an annual basis[11], and between 30 and 45 percent of customers never having switched electricity suppliers since the introduction of retail competition[12].

Seat belt use in GB is another relevant example. In response to concerns about driver safety, the British government conducted a campaign in the 1970s to increase seat belt use. The campaign included public information videos with simple phrases such as "clunk click every trip." However, by the early 1980s seat belt use had only reached 37 percent. In January 1983, front seat belt use was made compulsory to address this low level of usage. Compliance increased significantly, with seat belt use rising to more than 90 percent in the months following the passage of the law, demonstrating the significant incremental impact of mandatory requirements on participation.[13]

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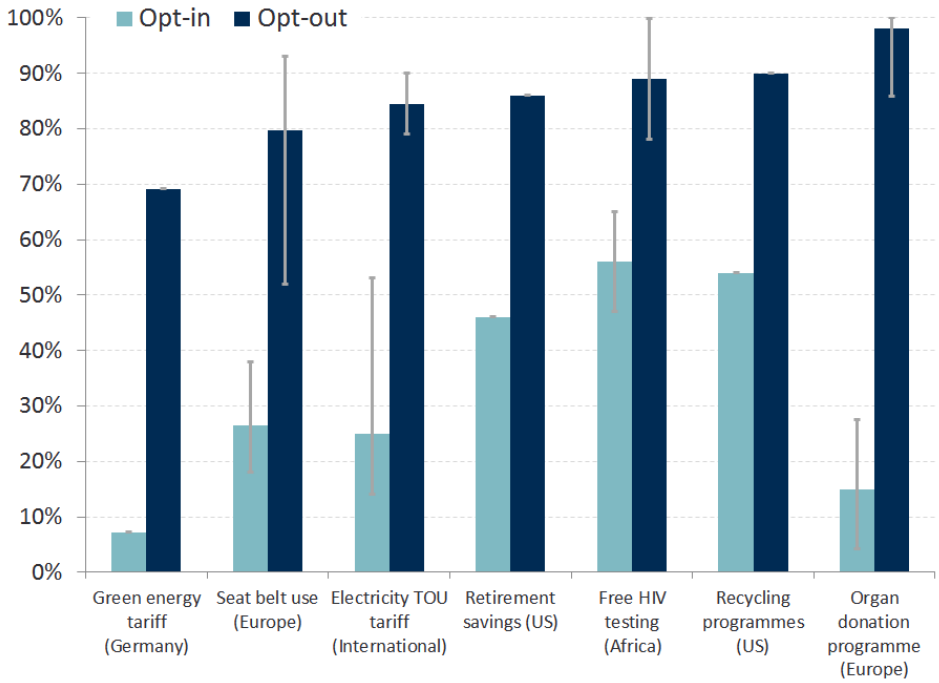
11 Department for Business, Energy & Industrial Strategy, "Transfer statistics in the domestic gas and electricity markets in Great Britain: New Data for Quarter 2 2018," September 2018, Table 2.7.1 - Annual.

12 Ofgem, Retail Energy Markets in 2016," August 2016, p. 19.

13 Karen Jochelson, "Nanny or Steward? The Role of Government in Public Health," working paper prepared for the King's Fund, October 2005.

A number of international cases illustrate that programme participation increases significantly when households are automatically enrolled in a programme (with the option to opt-out). The international cases are largely consistent with experience in GB, with opt-in participation rates ranging from single-digits up to around 60 percent enrolment. When enrolment is on an opt-out basis, participation rates are in the range of 70 to 100 percent. Figure 5 summarises the international cases.

Figure 5: Enrolment in International Programmes, Opt-in vs. Opt-out



Notes and sources: See References section for a complete list of sources. Error bars indicate high and low estimates across a range of observed values. Coloured bar indicates representative average value.

The switchover to digital television in GB is sometimes cited as an example of a successful "voluntary" transition to digital infrastructure. However, the digital switchover was deliberately excluded from our analysis of other programmes due to distinct differences with the smart metering programme requirements. In particular, in the digital switchover, households were informed that they would lose television service on a specific date if they did not switch technologies, effectively adding a mandatory element to the initiative, which does not exist in the smart metering programme. In addition, customer adoption of the digital technology spanned a period of over ten years – a longer deployment window than has been allowed for the smart metering rollout.

Our review of participation rates in non-metering programmes provides insight regarding the extent to which "word-of-mouth" promotion of the programme could be expected to increase participation. It is certainly possible that, as customers gain experience with smart meters, they will encourage their peers to adopt one. However, the limits on opt-in participation in other programmes suggests that even in programmes that reach "critical mass" enrolment, there is a large portion of the population that will not participate for a variety of reasons.

If smart meters were to be deployed on an opt-out basis, we would expect adoption rates to rise significantly. The GB meter recertification process is similar to an opt-out deployment model.

Expiring conventional meters are replaced with a smart meter, but the customer is given the option to opt-out of its smart mode. In that case, the significant hurdle of establishing an installation appointment has already been overcome, reducing the likelihood that the customer will decline the offer. Based on past experience with the useful life of meters in GB, it is likely to be 20 years or more before most conventional meters are replaced with smart meters through the recertification process.

The analysis of smart meter uptake presented above could be enhanced through the systematic collection and publication of smart meter adoption rates achieved by suppliers. While data is available on the number of meters installed, less is known about the number of offers that have been made. Such data collection would have challenges. For instance, the definition of what constitutes an "offer" is complicated by factors such as whether or not the offer was make to a key decision-maker in the home, or whether or not an offer was even received (e.g., deleted emails). Still, the collection and publication of data on smart meter offers of various types would be useful in diagnosing the difficulties associated with voluntary smart meter uptake.

Risk 2: Low Customer Engagement with In-Home Displays (IHDs)

Low customer engagement with IHDs is another emerging risk. Nearly 40 percent of the quantified benefits in the BEIS business case are associated with assumed energy savings attributable to behavioural change enabled by IHDs.[14] If these impacts do not persist at the assumed levels, there will be a material reduction in benefits with little-to-no associated reduction in costs. Data on energy savings attributable to IHDs is more limited than on metering uptake, somewhat constraining the strength of conclusions that can currently be drawn in this area. However, preliminary data suggests that customer engagement with IHDs may be lower than expected. According to industry data, roughly one-third of smart metering customers indicate that they are no longer interacting with an IHD.[15] Additionally, according to SEGB, 47 percent of smart metering customers identify immediate access to energy use information as the primary appeal of smart meters, but only 22 percent of smart metering customers say seeing that information *on the IHD* is a primary source of smart metering appeal.[16] For many customers, receiving alternative information through means other than an IHD could be both more convenient and more effective in facilitating energy savings.

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[14] Includes energy cost reductions, CO_2 reductions, and EU ETS cost reductions from energy savings.

[15] For instance, experience with IHD field trials suggests that at least 10 percent of customers will not accept the free IHD. The SEGB October 2018 Smart Energy Outlook further reports that 28 percent of customers with an IHD indicated that they "hardly/never" use it. Interaction with an IHD does not necessarily translate into energy savings. Similarly, it is possible that energy savings will persist even if interaction with an IHD does not continue over time (e.g., initial interaction with the IHD leading to investment in energy efficient appliances). A systematic national assessment of energy savings from the programme is needed.

[16] Smart Energy GB, "Smart Energy Outlook," October 2018, pg. 17.

Risk 3: Rising Programme Costs

Rising programme costs could also have negative implications for the BEIS business case. While recent DCC cost increases are well documented and accounted for in each update of the BEIS Impact Assessment, there is a risk that further cost increases could persist beyond those already captured in the cost-effectiveness analysis. Examples include additional costs associated with the DCC, continued extended deployment of higher-cost SMETS1 meters, and demanding customer engagement efforts.

While various cost increases have been well documented and accounted for in each update of the BEIS Impact Assessment, our interviews identified a number of areas in which there is a risk of further cost increase. Examples include continuation of the rising trend in DCC costs, costs associated with extended deployment of SMETS1 meters, and higher-than-expected customer engagement costs.

Business Case Implications

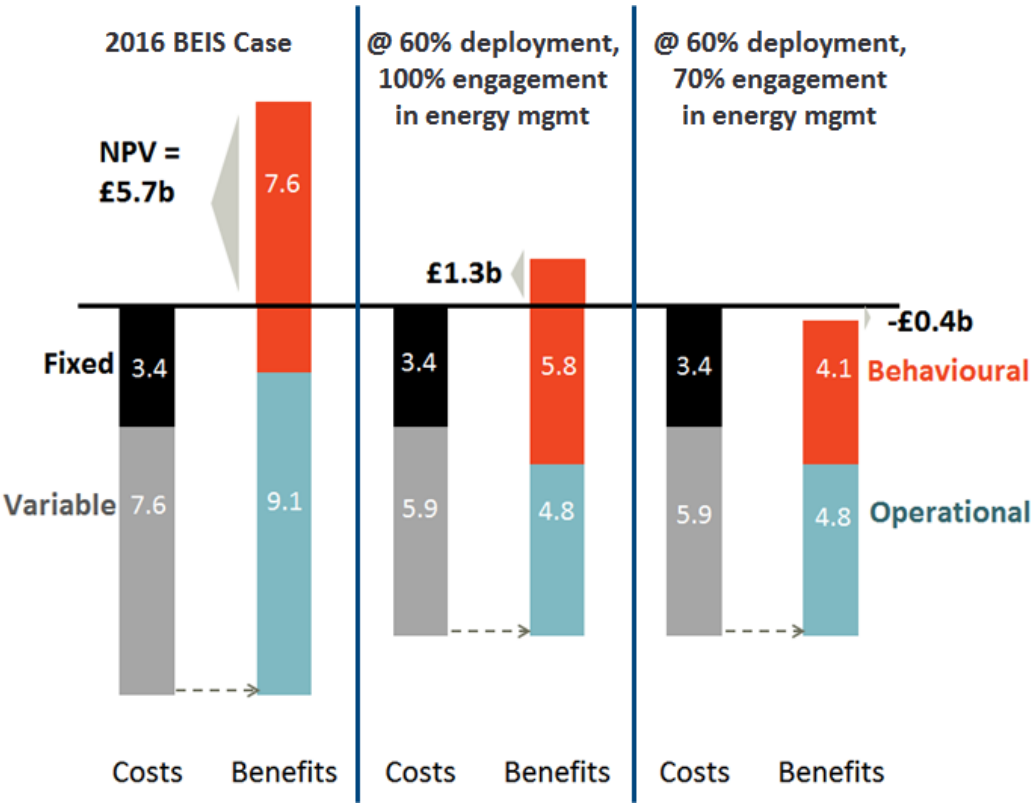
Smart meters must reach high levels of market penetration for the fundamental benefits of the programme to materialise. At low adoption levels, some significant benefits will not materialise at all (e.g., faster outage detection, reduced meter reading costs). Other benefits will materialise at only a fraction of their full potential (e.g., energy savings due to IHDs). Additionally, the cost of maintaining the redundant legacy metering system will be significant.

We have developed a high-level quantification of the impact that lower-than-anticipated smart meter uptake could have on the programme business case. Our modelling is based on scaling benefits and costs in the BEIS Impact Assessment, and should be considered a very rough indication of the magnitude of the potential implications for cost-effectiveness.

BEIS has assumed that smart meters will be deployed to nearly all customers by 2020. Figure 6 illustrates how the BEIS business case would change if (1) smart meter uptake only reached 60 percent voluntary uptake by 2020 and, additionally, if (2) the level of consumer engagement in energy management was 30 percent lower than assumed in the Impact Assessment. In the latter case, the NPV of the programme is slightly negative.

Importantly, our analysis does not account for certain costs that would also materialize at these lower levels of meter uptake, such as the cost of maintaining multiple metering systems (i.e., smart metering and legacy metering systems). We also have not accounted for other potential future cost increases that may be underrepresented the Impact Assessment (e.g., potential additional cost increases associated with setup of the DCC). Accounting for these factors would further impair the economics of the smart metering business case.

Figure 6: GB Smart Metering Costs and Benefits at Reduced Levels of Meter Deployment and Customer Engagement in Energy Management



Notes and sources: Brattle analysis of BEIS 2016 Smart Meter Impact Assessment. Figures may not sum due to rounding.

Mitigating the Risks

If it materialises at sufficiently high levels of adoption, smart metering can play a central role in the transition to a more efficient and consumer-oriented GB energy sector. There are many ways in which smart meters can provide benefits to consumers, some of which are not quantified in the BEIS business case. For instance, smart meters will facilitate a better customer experience through more accurate and timely bills. Smart meters will also enable the provision of innovative new retail energy products beyond those envisioned in the BEIS business case, such as dynamic pricing, demand-side response programmes, or tailored advice toward investments in energy efficiency and distributed generation. Widespread smart metering deployment should also improve fairness in settlement and charging, following the adoption of half-hourly settlement.

It is therefore important to consider paths forward that address growing concerns about low meter uptake. Our research identified a number of possible options for addressing the programme risks discussed in this report through revisions to the smart metering programme requirements.

Based on insights from smart metering rollouts in other jurisdictions and the research conducted in the context of this study, we have distilled available policy options into two distinct paths forward for the smart metering programme. Both paths are designed to address the core challenge that a voluntary smart meter offering in GB is unlikely to result on a national scale in achieving the targeted deployment levels for 2020. **The "Refocused Rollout" path** concentrates the scope of the deployment on the most cost-effective customer segments and reorients the programme to one in which meter adoption is truly driven by customer demand. **The "Default Deployment" path** transitions to a model where smart meters are treated as essential infrastructure and rolled out in a manner more closely resembling mandatory deployment.

Ultimately, the Refocused Rollout path is conceptually consistent with BEIS's original intent for a deliberate, consumer-led rollout, but would result in lower 2020 deployment levels than anticipated when the programme was introduced. The Default Deployment path is designed to achieve high meter adoption rates in an accelerated timeframe, but would depart from the concept of a voluntary meter adoption model. Table 3 summarises they key elements of each path.

Table 3: Two Paths Forward to Mitigate Emerging Programme Risks

	The Refocused Rollout Path	The Default Deployment Path
1	Revise supplier deployment targets to exclude costly/difficult installations	Accelerate recertification of conventional meters
2	Revise supplier targets to emphasize additional metrics such as cost-effectiveness	Tie eligibility for government subsidies to acceptance of smart meter
3	Clearly define "all reasonable steps" to include identified best practices in customer engagement	Transition to opt-out fee for customers who do not accept smart meter (post-2020)
4	Establish option for industry-coordinated approach to installations	Provide optional education at point of installation
5	Expand IHD requirement to include alternative informational offerings	Implement post-2020 engagement campaign focused on energy management
6		Explore opportunities for sharing functions/costs across suppliers
7		Expand IHD requirement to include alternative informational offerings

The Refocused Rollout Path

The Refocused Rollout path manages the costs of the rollout by creating greater organic demand for smart meters among the customer segments that are likely to produce the largest net benefits. This approach emphasises the government's intent that smart metering be a driver of consumer engagement in energy markets. At the same time, it reduces the near-term push for potentially high-cost installations. This scenario is likely to result in lower programme costs

and should have a positive impact on customer experience. The trajectory of meter uptake would be significantly slower than originally targeted by BEIS, with the complete transition to smart meters eventually happening over many years through the recertification process. We expect that the Refocused Rollout meter adoption trajectory would be similar to the current situation, likely falling well short of the target of 50 million meters to be installed by 2020.

Key Elements of Refocused Rollout Path

1. Restrict the base of customers who must receive a meter offer to those segments that do not face significant technical challenges and high costs. For instance, this approach would not require offers to the 30+ percent of the population requiring dual band comms hubs and/or Alt HAN.[17] Further, there may be additional customer segments that are identified as very costly to recruit into voluntary meter acceptance and/or unlikely to provide the types of system benefits upon which the business case is predicated. These are likely to be customer segments to which no supplier has yet been able to deploy smart meters in significant volumes.[18] With this revision, the programme would require that suppliers take all reasonable steps to offer a smart meter to all customers who do not fall into the above categories.
2. Define "all reasonable steps" to include the most effective customer engagement practices observed across suppliers thus far, in order to ensure that all suppliers have clear direction and a well-defined high standard for engagement. The definition could also specify thresholds which certain engagement activities are not expected to exceed (illustrative examples: three trips to a premise, or financial incentives of £50). Refresh these requirements regularly to reflect advancements in customer engagement techniques.
3. Expand the interim metrics against which suppliers are evaluated to include more than just the number of meters installed. Additional metrics would focus on costs and benefits of the rollout, which are under the control of suppliers (e.g., per-meter installation costs but not DCC costs). Reducing the emphasis on meters installed and including other evaluation criteria leads to a more holistic view of the smart metering rollout, rather than focusing exclusively on interim meter deployment targets. This would reduce the incentive to deploy costly SMETS1 meters or pursue geographically inefficient installations, for example.
4. Develop an industry-coordinated approach to installing smart meters for difficult-to-reach customer segments. An industry-shared single installation body could capture cost savings associated with geographic density and best practices in addressing technical barriers. This concept could be extended to other aspects of the rollout where shared functions among suppliers would improve efficiency without sacrificing significant benefits of intra-supplier competition.[19]

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[17] Dual band comms hubs and Alt HAN are solutions that are needed to overcome technical challenges in communicating with the smart meter. The solutions are currently in development.

[18] As a next step, additional work is needed to define and identify these customer segments.

[19] For instance, avoiding the duplication of comms signal relays in tower blocks, or allowing suppliers to share DCC-interfacing IT systems (e.g., as developed by independent meter providers).

5. Modify the IHD requirement to allow for an expanded range of energy information-based offerings that are likely to produce energy savings consistent with BEIS Impact Assessment assumptions.[20] This would allow for a variety of offerings better suited to diverse customer preferences and also enable the deployment of promising new technologies and energy saving techniques that have emerged since the programme's inception.

Strengths of the approach

- *Cost management.* Expanding supplier evaluation metrics, focusing deployment on cost-effective customer segments, and developing an industry-coordinated approach to installations should all help to address concerns about rising costs. These revisions will ease the significant "spike" in demand for labour and equipment that is expected between 2018 and 2020, will allow meters to be deployed at a more predictable and cost-efficient pace, and will focus near-term deployment on customer segments where benefits outweigh costs.
- *Consumer-led smart meter adoption.* Refocusing near-term supplier deployment efforts on cost-effective customer segments and relaxing deployment targets will allow suppliers to tailor and refine their marketing and engagement activities in a more effective manner. This approach is consistent with the original intent of the programme to deploy meters through a model that is truly based on customer "pull" rather than deemed appointments and/or compulsory acceptance. This approach reduces the likelihood of negative customer experience due to a rushed deployment.
- *Near-term behavioural benefits.* We would expect the level of engagement in energy management among customers who adopt a smart meter to be significant, given their demonstrated interest in accepting a smart meter offer. The expansion of the IHD definition to include other emerging options should further enhance behavioural response from customers. For instance, "social norming" techniques, in which customers' energy usage is compared to similarly situated neighbours through enhanced billing information, are a well proven method for producing average energy savings similar to the IHD assumptions in the BEIS Impact Assessment.[21] The use of interval smart meter data to disaggregate loads and provide tailored energy efficiency tips is a recently emerging technique that would appeal to certain customers more than the IHD.

Challenges to overcome

- *Low near-term meter uptake.* The Refocused Rollout approach does not guarantee the significant near-term adoption of smart meters, and is not likely to accelerate longer-term adoption. We do expect high levels of smart metering uptake to be achieved eventually through the meter recertification process, though this could take 20 years or more as meters

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[20] BEIS offered a time-limited allowance for suppliers to conduct trials of alternatives to IHDs. However, the process for proving that the alternatives are sufficient is lengthy and the potential outcomes of the process are unclear.

[21] An additional advantage of these programmes is that they achieve the energy savings benefits without needing to provide realtime information to consumers, and thus avoiding the associated technical challenges. VaasaETT, "Case Study on Innovative Smart Billing for Household Consumers," prepared for the World Energy Council and ADEME, July 2013.

are gradually replaced. As a result, the present value of gross benefits produced by the programme will be lower than quantified in the BEIS Impact Assessment.

- *The perceived exclusion of certain customer segments.* Excluding high-cost or technically challenging customer segments from the deadline could be perceived as discriminating against those customers and/or withholding the opportunity to benefit from smart meters. There may be a disproportionate share of vulnerable customers in this group (e.g., customers living in tower blocks). To address this concern, we would recommend that smart meters still be available to any customer that specifically requests one; the difference is simply that proactive meter offers to these customers are not included in the supplier requirements.

- *Universal industry acceptance*. A limited number of suppliers have made significant progress in deploying smart meters thus far in order to meet interim deployment targets. Those suppliers may perceive the Refocused Rollout approach to be unfairly changing the "rules of the game". Most suppliers probably have not deployed enough meters to fall into this category. For those that do, it will be important to evaluate the extent to which those suppliers may be disadvantaged by the policy change and explore options for addressing this issue accordingly. Alternatively, it is possible that the customers who are exempted from the meter offer deadline due to technical or cost-related constraints are customers, which no supplier has been able to enrol in large numbers. As such, it may be possible to define the exempted customer segments in a way that is palatable to all suppliers.

The Default Deployment Path

The Default Deployment path views the programme as the rollout of necessary energy infrastructure and prioritizes universal deployment through a variety of regulatory- and policy-driven mechanisms. This approach is designed to maximize the number of smart meters that will be deployed, thus locking in operational benefits and laying the foundation for the development of new innovative energy products in the future. The likely end-state in this scenario is a high degree of meter adoption, approaching the levels targeted by BEIS by the early 2020s. Customer engagement in the "smart" environment may take longer than planned to materialize, and the transition to a rollout that is quasi-mandatory in nature is also likely to face pushback from consumers, at least initially.

Key Elements of the Default Deployment Path

1. Prior to 2020, accelerate recertification of conventional meters such that they must be replaced every ten years. Maintain the government policy of replacing expiring conventional meters with smart meters in smart mode, unless the customer proactively chooses to opt out of smart mode.[22]

[22] While there is uncertainty around the share of customers who will opt out of smart mode, data presented in this paper suggests a potential opt-out rate of 10 to 20 percent.

2. Prior to 2020, tie eligibility for government subsidies to acceptance of a smart meter. Examples of possible energy-related government programmes include energy efficiency programmes, the electric vehicle grant, the Warm Home Discount, and applications to install distributed generation. A broader application of this requirement could extend to eligibility for certain non-energy subsidies, such as the council tax benefit. Exemptions could be made for vulnerable customers.

3. After 2020, transition to implementing an opt-out fee for customers who are eligible but have not accepted a smart meter. The fee level would be set to cover some or all of the costs of maintaining the redundant legacy metering and billing systems, thus removing the cross-subsidy that would otherwise exist between those customers who accept smart meters and those who choose to remain on the legacy metering system. As an interim step, the opt-out model could first be implemented with no fee.

4. Continue to provide customer education when a smart meter is installed, but be clear that customers can opt-out of receiving the educational material in order to lessen the perceived time burden of the installation appointment.

5. Implement a post-2020 engagement campaign related to energy management, to mitigate the potential lower levels of customer awareness associated with mandatory/opt-out deployment.[23] The campaign could be led by SEGB and/or through additional requirements on suppliers.

6. Similar to item 4 of the Refocused Rollout discussion, create an Ofgem-sponsored industry group that explores opportunities for coordination and sharing of certain functions and costs in areas where there is the potential for significant efficiency improvements.

7. Consistent with item 5 of the Refocused Rollout discussion, expand the IHD requirement to include alternative information technologies and energy saving techniques.

Strengths of the approach

- *Likely to achieve sufficient levels of meter uptake.* Smart meter deployment on a mandatory or opt-out (with fee) basis is the standard model for most other international rollouts. It is consistently proven to result in excess of 90 percent adoption.
- *Timely realization of operational benefits.* This approach provides a strong incentive for full smart meter deployment to be reached in roughly the next five years, resulting in

[23] There is some evidence that engagement in energy management is lower on a per-customer basis in opt-out models than in opt-in models. A TOU tariff field trial conducted by the Sacramento Municipal Utility District (SMUD) in California tested this concept. It found that the average participant in an opt-out TOU tariff exhibited price responsiveness that was 50 to 60 percent of that of the average opt-in participant. However, aggregate impacts from the opt-out group were higher in total due to a significantly larger number of participants.

timely realization of many of the benefits of the programme. It virtually ensures that the "threshold" level of meter adoption necessary for achieving various operational benefits will be reached.

- *Addresses the "chicken and egg" problem of smart product offerings.* There is a concern that smart products (e.g., smart thermostats and appliances) will not be widely available until smart meters are widespread, but at the same time that smart meters will not be adopted until smart products are available. The Default Deployment approach quickly establishes a broad base of digital infrastructure which will form the foundation upon which the market for new product offerings can be built.[24]
- *Remains consistent with the "headline" requirements of the rollout.* While the Default Deployment approach includes several proposed programme revisions that would be implemented prior to 2020, most of these are fairly nuanced revisions to various codes and rules and do not modify the "headline" requirement that smart meters be offered to all customers by 2020.[25]
- *May receive broad industry support.* The phased approach to mandatory deployment increases the likelihood that the Default Deployment approach will receive support from suppliers that have adopted diverse strategies in the timing of their meter deployments. As discussed above, the approach provides some pre-2020 acceleration of meter adoption and a strong post-2020 incentive to adopt smart meters without dramatically changing course prior to 2020.

Challenges to overcome

- *Customer acceptance of a fee-based opt-out model.* The most significant challenge of the Default Deployment approach is overcoming the psychological hurdle of transitioning from voluntary adoption model to one more closely resembling mandatory deployment. This challenge has not been experienced in other international deployments, since customers in those jurisdictions always understood that meter adoption was not purely voluntary in nature. Relatedly, the concept of a fee for opting out is likely to be met with resistance in the current environment of sensitivity to energy tariff price increases. It will be important to explore methods for a deliberate transition to the opt-out fee. Initially, it may be desirable to transition to an opt-out model with no fee, and then introduce and escalate the fee over time. Other transitional options include developing a communications plan that articulates the purpose of the fee to consumers and provides sufficient advanced notification of the policy change, and protection for vulnerable customers and those that may not be eligible for smart meters due to technical limitations.
- *Significant short-term demand for labour and equipment.* The focus on significant near-term deployment of smart meters in the Default Deployment approach probably will not fully mitigate concerns about labour and equipment shortages. However, as discussed

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24 We note that other policy initiatives that are happening in parallel, such as the implementation of mandatory half-hourly settlement, are also critical elements of this foundation.

25 Depending on the pace of development of technical solutions like Alt HAN and dual band comms hubs, there may be limitations as to who can feasibly receive a smart meter by 2020. However, this potential limitation is not unique to the Default Deployment path as it may also occur under the current design of the programme.

above, delaying the transition to a fee-based opt-out model until after 2020 should help to alleviate some of the stress that would otherwise occur if meters were to be virtually 100 percent deployed by 2020.

- *Implementing a meter opt-out fee in a supplier-led deployment.* A mechanism will be needed to ensure that opt-out fees are universally levied on all eligible customers who opt-out of a smart meter. If the opt-out fee is imposed at the discretion of the supplier, then it is unlikely to be broadly applied due to supplier concerns about customer churn (e.g., customers switching suppliers to avoid the smart meter fee). Possibilities for universally implementing the fee, subject to further investigation and analysis, include government levies on energy bills, fees that are imposed through the distribution charge, or tariff regulations for suppliers.
- *Achieving sufficient meter deployment by 2020.* Even with the more aggressive approach to meter deployment embodied in the Default Deployment approach, transitioning to a fee-based opt-out model as a post-2020 activity will likely result in a meter deployment trajectory that is a couple of years behind that assumed in the BEIS business case. A delay of this nature is unlikely to produce a negative NPV, though it would reduce the cost-effectiveness of the rollout. If an even more accelerated deployment is desired, the transition to a fee-based opt-out could be considered as a pre-2020 initiative.
- *Imposing retroactive eligibility requirements for government programmes.* Retroactively associating government programme eligibility with adoption of a smart meter could be politically difficult to accomplish. It may be desirable to impose this requirement only on new applicants.

Next Steps

We have presented two distinct paths forward for the programme. We have identified the advantages and challenges associated with each path, which are supported with observations from the GB rollout as well as experience in other jurisdictions where available. **As a next step, it would be prudent to quantify the extent to which each path will accomplish BEIS's policy objectives.** The analysis should focus at a minimum on quantifying the likely impact of each path on the BEIS business case. Additionally, it would be useful to assess how various stakeholders (suppliers, vulnerable customers, meter manufacturers, etc.) will be impacted by the changes. Important steps in the analysis include:

1. In a standardized manner, collect data from suppliers to develop a detailed assessment of the extent to which costs have risen relative to the 2016 Impact Assessment. Some costs may differ significantly by supplier, and a comprehensive national perspective is needed.
2. Conduct a systematic assessment of the impact of the smart metering rollout on energy consumption. Recent data on interaction with IHDs provides some indication of a potential trend toward lower-than-anticipated energy savings. However this risk could be quantified more comprehensively through a robust

statistical analysis of the consumption levels of customers who have been equipped with smart meters.

3. Develop a comprehensive assessment of adoption rates among those customers who have been offered a smart meter. This will require clearly defining what constitutes an "offer" and collecting consistent data across suppliers. Similar data could be collected though customer surveys. It would also be valuable to understand which practices have been most successful in promoting smart meter adoption. If feasible, it would be informative to use supplier data to construct an "adoption cost curve" which provides a sense of the increasing incremental costs of successfully marketing smart meters to customers once the "early adopter" market has been saturated.
4. Update the Impact Assessment to account for the risks identified in this report. We have presented a preliminary business case analysis, but a more comprehensive and detailed analysis is needed using the underlying cost-benefit model and the follow-up research activities described above. This will establish a new, realistic baseline for the programme. In particular, achieving the deployment of nearly all 53 million meters across GB, as assumed in the 2016 Impact Assessment, is virtually guaranteed not to happen and should be taken into account.
5. Develop alternative Impact Assessment cases reflecting the impact of the policy revisions described in this paper. Data collected from other jurisdictions can help to develop adoption trajectories associated with alternative meter deployment models (e.g., the fee-based opt-out model). A detailed review of suppliers costs would help to quantify the extent to which costs may be reduced through a more focused and deliberate deployment.

Conclusion

Great Britain's smart metering rollout has the potential to provide over £5 billion in net benefits to energy consumers. Successful rollouts in other countries demonstrate that full-scale smart metering deployments can deliver these benefits. However, recent experience suggests that this opportunity is at risk in GB due to challenges that have emerged since the programme's inception.

The biggest threat is difficulty in overcoming apparent customer apathy toward participating in the programme. This challenge is amplified in GB relative to other countries. A policy of optional meter adoption combined with largely internally-located meters means that customers must be willing to schedule time-consuming appointments in order to receive a smart meter. This significant hurdle to adoption is proving particularly difficult to overcome in an environment where suppliers are unclear as to what is meant by "all reasonable steps" in offering smart meters. Secondarily, early signs point to the potential for lower-than-anticipated engagement with IHDs and continually rising programme costs.

We have defined two distinct paths forward to address these risks. The Refocused Rollout path reduces the scope of the programme to decrease costs, and places a greater emphasis on creating "pull" for smart meters among those customers who are likely to deliver the largest net benefits. The Default Deployment path transitions toward the type of fee-based opt-out approach adopted in most other international jurisdictions, with some enhancements tailored specifically to the GB market. These are two of many possible approaches to revising the programme requirements.

It would be valuable for government and industry to discuss these and other policy revision options. The current transition from the Foundation Stage to full-deployment provides a useful but narrow opportunity to have those discussions. 2019 will be a critical year for the smart metering programme. Meter deployments are projected to ramp up significantly, the deployment of SMETS1 meters is expected to conclude, and efforts to address significant communications challenges will continue. It would be prudent to develop programme revisions before these ongoing activities progress past a "point of no return." The experience of the first seven years of the rollout should inform the development of a revised approach to full-scale deployment that delivers on the potential benefits of smart metering in GB.

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