Department for
Business, Energy
& Industrial Strategy

Non-Domestic Smart Energy Management Innovation Competition

Overall impact evaluation report from NDSEMIC's Research and Evaluation Programme

BEIS Research Paper Number 2020/050

November 2020

Acknowledgements

This report was prepared by Ipsos MORI, in partnership with the Carbon Trust and Technopolis. The research would not have been possible without the cooperation of all of those who participated in interviews, surveys and workshops. BEIS would also like to thank Professor Elliot Stern for his advisory input.

Any enquiries regarding this publication should be sent to us at: smartenergymanagement@beis.gov.uk

List of abbreviations

AEMS	Alert Energy Management System
AMR	Automated Meter Reading
AND TR	AND Technology Research
BEIS	Department for Business, Energy and Industrial Strategy
CP	Competition Partner
DCC	Data Communications Company
DCDA	Data Collector Data Aggregator
E-CAT	Energy Comparison & Advice Tool
EaaS	Energy-as-a-Service
kWh	Kilowatt-hour
NDSEMIC	Non-Domestic Smart Energy Management Innovation Competition
Ofgem	Office of Gas and Electricity Markets
REP	Research and Evaluation Programme
SME	Small and Medium-sized Enterprise
SMETS	Smart Metering Equipment Technical Specifications
SMIP	Smart Metering Implementation Programme
ST	Socio-technical (configurations)
TPI	Third Party Intermediary

Contents

Chapter 1 Introduction to this report

The Non-Domestic Smart Energy Management Innovation Competition (from here on referred to as 'the Competition') was an £8.8 million competition led by the Smart Metering Implementation Programme (SMIP) within the UK Department for Business, Energy and Industrial Strategy (BEIS), which ran from 2018 to 2020. It aimed to maximise the potential for energy saving in three priority sectors (retail, hospitality and schools). To do this, it developed energy management products and services that use smart meter data to help smaller organisations to manage their energy consumption better.

Nine projects were selected as part of the Competition to receive initial development funding. Seven of these passed through to the next 'feasibility and initial testing' stage. All seven project developers ('Competition Partners') also went through to the final stage of the Competition (from February 2019 to January 2020) during which the innovations were piloted with small businesses and schools in a real-world setting.

The Research and Evaluation Programme (REP) was a two-year programme running alongside the Competition to extract meaningful learnings and support broader market transformation. The REP was led by Ipsos MORI along with the Carbon Trust and representatives from Technopolis and Loughborough University.

This report describes:

- The outcomes of the seven innovation pilots.
- The factors that were effective in driving outcomes (overall and per sector).
- Considerations for future market development.

It is part of a package of reports published as products of the Competition, which also includes seven pilot evaluations, insights for innovators, user impact case studies, an executive summary report and an evaluation technical report. These are available on www.gov.uk.

For further information and resources related to the Competition please visit: www.gov.uk/government/publications/non-domestic-smart-energy-management-innovationcompetition

The following two chapters of the report provide an overview of the Competition (Chapter two) and the methodology that guided the research (Chapter three). The next four chapters then explore the immediate (short-term) outcomes of the Competition: first, at an overall level across the three sectors (Chapter four), and then in greater depth for the school sector (Chapter five) and the small retail and small hospitality sectors (Chapter six).

Chapters seven and eight then explore findings with regards to the Competition's intended longer-term outcomes, considering factors that may affect the development of a market for non-domestic smart energy management services (Chapter seven) and how broader market transformation may be supported by wider net zero policy making (Chapter eight). Chapter nine presents key conclusions from the evaluation.

Chapter 2 Overview of the Competition

This chapter provides a brief introduction to the Competition, including its aims, the outcomes that were anticipated within the three sectors targeted, the tools developed and piloted, and how the Competition expected to achieve its target impacts (its theory of change).

The rationale for the Competition

Smart meters are replacing traditional gas and electricity meters in homes, small businesses and schools across Great Britain as part of an important upgrade to the national energy infrastructure and underpinning the cost-effective delivery of Government's net zero commitment. They are a critical tool in the transition to a low-carbon energy system, for example by enabling incentives for consumers to use energy when renewable generation is available and automatic charging of electric vehicles when prices are low. A key expected benefit of the transition to smart meters is that the energy data that they record will be used by consumers to engage with, and better manage, their energy consumption.

Research commissioned by BEIS prior to the launch of the Competition[1] showed that energy management by SMEs and microbusinesses was limited; but suggested that smart and advanced meter data had the potential to prompt organisations into taking action provided they know how to interpret it within the context of their own operations and that a cost-effective solution is available. The research pointed to the value of innovation in this area – developing easy and accessible appropriate products and services that help smaller organisations understand their energy use and identify practical ways to save energy.

Market analysis also concluded that there was the technical and market potential for innovative products and services, which could be offered to smaller organisations without placing great demands on their time. However, the existing market primarily served larger non-domestic organisations (likely those with an energy management strategy and higher capacity for savings). The analysis concluded that there was a market failure, in terms of both third party and energy utility market offerings, for products and services based on data analytics to provide such actionable information to smaller non-domestic sites.

The Competition aimed to address this market failure and also to understand wider requirements for improving and widening the management of energy use by such organisations, focusing on three priority sectors – retail, hospitality and schools. These sectors were chosen as they represent a significant proportion of the organisations targeted in the rollout of smart meters to the non-domestic sector, both in terms of the total number of organisations and amount of energy consumed. The retail, hospitality and school sectors were also considered to be easier to engage in the Competition, and on the issue of energy management more generally, than other sectors.

[1] BEIS (2017) Smart metering in non-domestic premises: early research findings https://www.gov.uk/government/publications/smart-metering-in-non-domestic-premises-early-research-findings

The aims of the Competition and how the Competition expected to achieve these (theory of change)[2]

The Competition had both a short-term purpose (i.e. funding the development and piloting of a range of innovative smart energy management tools) and a long-term purpose (i.e. contributing to the longer-term development of markets for non-domestic smart energy management services). Specifically, its objectives were to:[3]

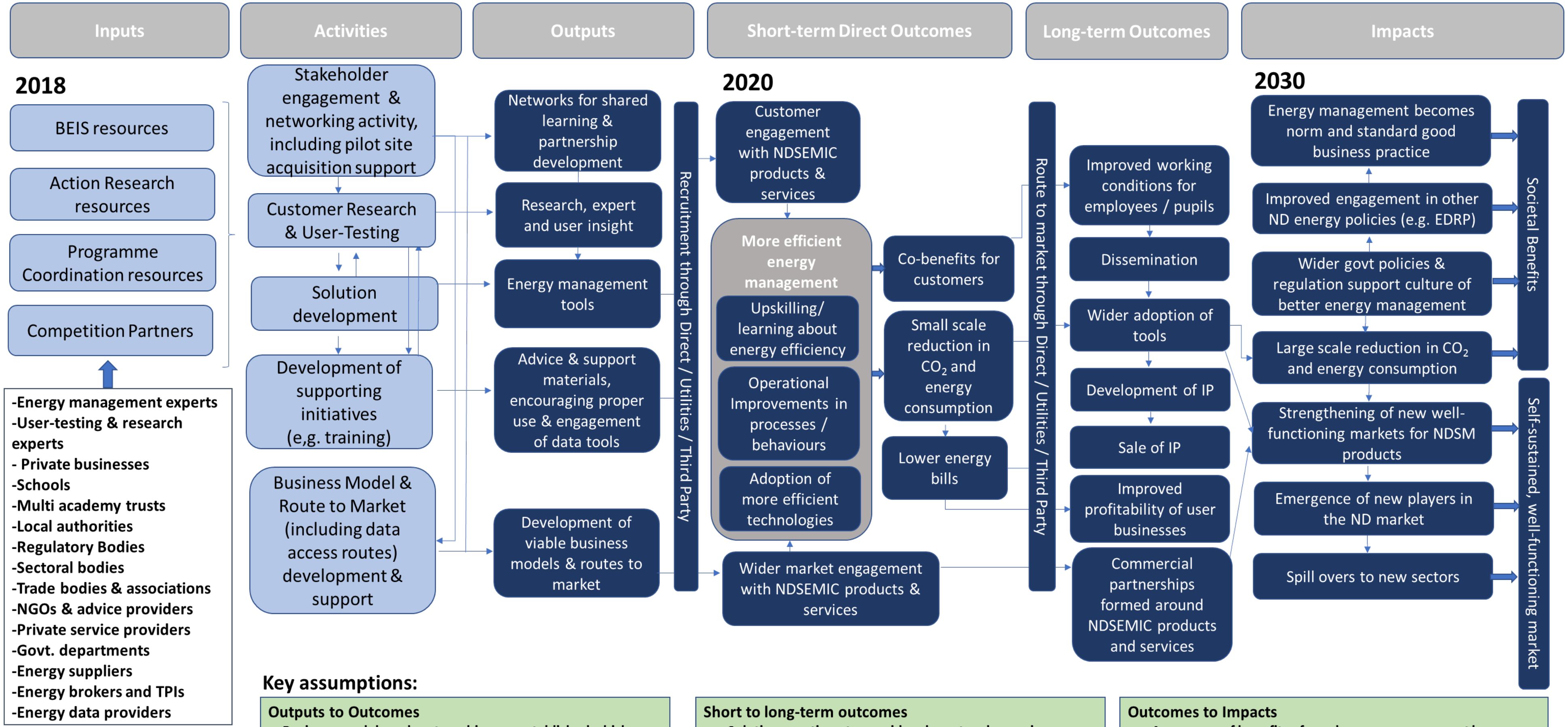
- Develop examples of innovative and easy-to-use data tools and services (such as online platforms, apps and behaviour change interventions) which were tailored to the requirements of the target sectors, added value to smart meter data and facilitated user engagement.
- Develop packages of complementary interventions and support mechanisms (such as advisory and training materials and case studies) tailored to the requirements of the target sectors which would drive the uptake and effective use of data products and services.
- Secure earlier and greater levels of energy management activity within the key sectors, leading to reduced energy costs and carbon emissions.
- Develop and strengthen the market for energy management products and services for smaller non-domestic consumers by reducing the barriers to / stimulating the market for organisations developing solutions.
- Support the implementation of energy management within the target sectors by enabling increased and more effective activity by partner organisations (e.g. Smart Energy GB, energy suppliers, devolved administrations and others).[4]

In targeting these objectives, the Competition aimed to support the realisation of benefits from Great Britain's non-domestic smart meter roll out, through delivery of energy savings[5] to those piloting the tools, and to enhance the smart offering for smaller non-domestic sites. Such benefits would contribute to wider environmental objectives as set out in the Clean Growth Strategy.[6]

At the outset of the Competition, a theory of change was developed to hypothesise how the Competition would contribute to both these short-term and long-term objectives (this 'theory' is visually demonstrated in the logic model in Figure 2.1 overleaf).

[2] A theory of change describes how change is assumed to come about through an intervention. It describes the connections between interventions and outcomes – often called 'causal pathways' or results chains.
[3] NDSEMIC – Competition Invitation to Tender.
[4] This was an implicit objective of work surrounding the Competition and its research programme, and therefore is not the focus of this report.
[5] Programme non-domestic energy consumption reduction benefits are projected to reach £1.5bn (discounted 2011 prices) over the period 2013 to 2034.
[6] Available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/700496/clean-growth-strategy-correction-april-2018.pdf

Figure 2.1 Theory of change for the Competition



Key assumptions:

Outputs to Outcomes

- Business models and partnerships are established which enable necessary access to data needed to drive solutions.
- Awareness-raising effective in encouraging take-up of tools
- Solutions provide new information to users, or known information but in a more engaging or applied way.
- Users able to correctly interpret and act upon info & advice.
- Solutions encourage behaviour change and the implementation of energy efficient actions or measures, including at decision-making level.
- Processes and policies put in place by decision makers encourage employees/others to change their behaviour in positive ways.

Short to long-term outcomes

- Solutions continue to provide relevant and engaging information.
- Users are able to observe impact of changes made to their energy use behaviours through their energy bills.
- Users satisfied with solutions & able/willing to pay for more advanced versions (encouraging ongoing engagement & driving business models)
- Initial user spreads use of solution to others in & beyond own organisation, and shares positive experiences with others.
- Organisations and users are influenced by the sharing of positive case-studies by others in their sector and their peers.

Outcomes to Impacts

- Awareness of benefits of good energy management become pervasive and encourage ongoing uptake and use of energy management tools.
- Value propositions exist through the supply chain, encouraging wider market actors to become involved in partnerships which further expand development and rollout of solutions.
- Learning generated by NDSEMIC is effectively shared with those interested in developing energy management solutions and engaging small non-domestic sites in energy management.
- Momentum initiated by NDSEMIC is sustained after the end of the Competition through active engagement of market actors in collaborations, working groups and other initiatives.

The theory of change is structured around two primary causal pathways:

1. **Tool development**: The theory of change envisaged that resource investment (in stakeholder engagement, networking, pilot site acquisition, customer research, user testing and solutions development) would result in the creation of innovative energy management tools and ‘support packages’ that would lead to improved energy management practices amongst users. In addition, it was expected that such Competition activities would result in the realisation of productive partnerships and networks that would add value to the tools created (e.g. between innovators and energy market actors, as well as sectoral stakeholders). It was also anticipated that, at user sites, energy management tools (depending on their design) might generate additional benefits, such as educational outcomes in schools and/or improvements to business management, customer comfort, and/or company branding of ‘green credentials’ in smaller businesses.
2. **Market development**: It was anticipated that activities facilitated by the Competition (for example, networking events to raise the Competition’s profile, the development and dissemination of ‘case studies’ around the effectiveness and outcomes of the tools, and research (including this evaluation) into what’s effective for customer benefit realisation) would support the longer-term objectives of the Competition (i.e. market development). In this way, the Competition itself would act as a vehicle for market change.

Longer-term it was expected that – providing shorter-term benefits were realised – the Competition would contribute to the development and sale of intellectual property, as well as the formation of commercial arrangements. By 2030, it was hoped that the Competition would have contributed towards the emergence of a well-functioning market for non-domestic smart meter products and services.

As illustrated in Figure 2.1, the theory of change also sets out a number of assumptions that would need to hold true in order for outcomes to be realised.

For short-term outcomes (the timeframe covered within the scope of this evaluation), the theory of change theorised that Competition Partners would need to obtain access to energy data to pilot their tools and develop their propositions, gain customer interest in their tools, sufficiently target their tools at decision makers and provide new and actionable information to users (who in turn would need to be able to interpret and act on such information).

For longer-term outcomes to be realised, these would be dependent on sustained customer interest in and satisfaction with the tools, customer willingness to pay for the tools,[7] and word-of-mouth promotion of the tools to normalise the use of such tools within the non-domestic market.

In line with the theory-based approach to this evaluation, this evaluation report describes, in Chapters four to six, the extent to which the short-term outcomes of the Competition, behaviour change and energy savings, were realised and the extent to which the assumptions underpinning these causal pathways held true. Chapters seven and eight revisit the original theory of change and update it to reflect learnings from the Competition’s research programme regarding the development of a sustainable market in non-domestic smart energy management products and services.

[7] Or the realisation of other routes to market, including the bundling of the product within the offer of related energy products and services, including energy provision.

Overview of solutions piloted through the Competition

Table 1 provides an overview of the seven innovations piloted.

Table 1: Overview of the seven innovations ('tools') piloted

Name	Tool description
Alert Energy Management System (AEMS) Developed by: AND TR	**Key Features**: AEMS is a dashboard and mobile app that tracks and visualises energy usage for users and provides 'push' alerts via mobile phone when there is unusual or changing energy activity. AEMS also provides users with energy saving insights.[8] It includes functionality to set energy budgets and performance targets. **Target Audience**:[9] Business owners and managers responsible for energy management ('energy managers') in the small retail and hospitality sectors (both chain and independent businesses). **Objectives**: AEMS intends to help small retail and hospitality businesses monitor and understand their energy usage, so that they can become more energy efficient in their operations.
Fluttr Developed by: Considerate Group	**Key Features**: Fluttr is a mobile application that correlates users' energy use data with key business metrics (such as room bookings for hotels or food covers for restaurants). Fluttr also provides energy saving tips tailored to business type on how to achieve energy, emissions and cost savings. **Target Audience**: Energy managers in small hospitality businesses (independent and chain hotels and restaurants) as well as staff. **Objectives**: Fluttr aims to increase awareness of energy usage and encourage reductions in energy consumption by showing how individual actions can lead to increased energy efficiency and cost savings.
Energy Comparison & Advice Tool (E-CAT) Developed by: Element Energy	**Key Features**: E-CAT is a web application that monitors energy data and provides it to users at half hourly intervals. It shows a comparison of users' energy use with organisations of a similar type and size, and provides energy saving tips and recommendations tailored to the user's business. **Target Audience**: Energy managers in the small retail and hospitality sectors (both chain and independent businesses) and primary and secondary schools. **Objectives**: E-CAT aims to increase users' understanding of their energy consumption and the ways they can reduce it.

[8] Energy saving insights refers to information provided to tool users to help them understand their own energy consumption or energy use more broadly. This differs from energy saving tips which refers to actionable advice provided to tool users to help them reduce their energy consumption.
[9] Target audiences referenced in this report refer to the audiences targeted by each Competition team as part of the Competition. Some Competition teams will target a broader audience of businesses when commercialised.

GlowPro Developed by: Hildebrand	**Key Features**: The GlowPro system is a range of inter-connected web applications, each targeted at one user type. It provides users with live energy consumption data and alerts them to consumption increases and inefficiencies. GlowPro also includes functions for billing management, business planning, checklists and customer comfort management. **Target Audience**: Property managers, tenants, business owners and staff in the small hospitality and retail sectors (both independent and chain businesses). **Objectives**: GlowPro aims to help businesses identify operational and energy efficiency opportunities and, hence, reduce costs, improve operations and engage their staff.
Energy in Schools Developed by: Samsung	**Key Features**: The Energy in Schools initiative comprises an online portal through which energy data is displayed graphically to allow schools to access and monitor their data; and a complementary educational package. As part of the educational package, children are given the role of 'Energy Champion' and access to the tool and energy monitoring equipment (including temperature sensors). The package also comprises lesson plans and other educational resources. As part of the pilot, participating schools were given a TV, to be displayed in a communal area, which would display school energy performance against other schools in a league table. **Target Audience**: Management, teachers and pupils in primary and secondary schools. **Objectives**: Energy in Schools aims to help schools become more engaged with their energy supply and tariff arrangements, reduce their energy usage / bills and educate pupils about energy efficiency.
Energy Sparks Developed by: Energy Sparks	**Key Features**: Energy Sparks is an online tool that provides energy data visualisation dashboards for school pupils and staff, including recent and historical energy use. It includes a notification system to flag unusual consumption levels and potential inefficiencies; provides energy saving recommendations; and displays performance in energy saving activities in a league table with other participating schools. The Energy Sparks system includes educational resources to be used within extra-curricular 'eco-clubs'. Participating schools are encouraged to assign adults as 'Energy Champions' to promote use of the tool. **Target Audience**: Management, teachers and pupils in primary and secondary schools. **Objectives**: Energy Sparks aims to support school management to monitor, manage and reduce energy consumption at the school and to engage pupils and teachers in this process.

Untapped Developed by: Hoare Lea	**Key Features**: Untapped is a web application which provides energy saving advice and activities tailored to school management, teachers and pupils. It uses data analysis and visualisation software to create current-usage and historic electricity and gas profiles. It also compares schools' profiles to a 'best practice' model of energy usage (in order to benchmark the school's usage). Educational resources linked to school curriculums are also provided. **Target Audience**: Management, teachers and pupils in primary and secondary schools. **Objectives**: Untapped intends to help 'automate' energy monitoring and planning for energy managers (helping them to make more energy efficient operational decisions) and make teachers and pupils more 'energy conscious' (leading to them to be more efficient in how they use energy).

Table 2 further summarises the characteristics of the tools and how they differed.

Table 2: Overview of the main characteristics of the tools

Whom the tool targeted	Tools differed in whether they targeted multiple users or a single user. For businesses, GlowPro offered tailored apps to different users of the same system whereas fluttr was expected to be accessed by both management and front-of-house staff. Energy in Schools and Energy Sparks offered different access points and dashboards to management, teachers and pupils.		AEMS, E-CAT
			fluttr, GlowPro, Energy in Schools, Energy Sparks, Untapped
How the tool was accessed	Most of the tools were made accessible via online platforms, except for fluttr, which was only available via an app. AEMS and GlowPro were available via both online platforms and mobile app. In the case of AEMS, the mobile app offered slightly different functionality to the online platform (alerts were only available via the app).		E-CAT, Energy in Schools, Energy Sparks, Untapped
			fluttr
		/	AEMS, GlowPro
Access to live data[10]	Five tools provided access to live data.		AEMS, E-CAT, GlowPro, Energy in Schools, Energy Sparks

[10] Live data, in the context of this Competition, describes energy consumption data at half hourly (or more detailed) granularity, fed to the tool or platform on an on-going basis. Non-live data may provide the same level of granularity but is not updated on an ongoing basis, for example being uploaded to the tool or platform once a day (and in arrears).

Level of data detail (granularity and scope of detail)	All of the tools showed users their energy data in half hourly (or more detailed) intervals, meaning that the usage per time of day / activity could be closely tracked. Some tools were able to provide information on energy consumption by equipment, e.g. where sensors were attached to these, and/or to provide information on temperature and energy use.	Half hourly or sub half hourly data	All
		Equipment	AEMS (for some users only), GlowPro
		Temperature	GlowPro, Energy in Schools
Features keeping energy ‘front of mind’	To keep energy use front of mind, and to catalyse action, several tools offered alerts (e.g. to overspend or unusual usage), energy saving tips and/or communal displays.		AEMS, GlowPro, Energy Sparks
			AEMS, E-CAT, fluttr, Energy Sparks, Untapped
			Energy in Schools
Other features	Several of the tools offered users a view of their energy data benchmarked against that of other similar businesses or schools. Others contextualised the energy data they provided by presenting energy consumption in terms of number of hotel rooms occupied, restaurant tables covered etc. (fluttr) or in terms of relatable energy use – e.g. number of kettles boiled (Energy Sparks). Others offered energy data reports in pdf format.		E-CAT, Energy in Schools, Energy Sparks, fluttr, Untapped
			fluttr, Energy Sparks
			AEMS, GlowPro, Energy Sparks, Untapped

How the tools were developed and piloted

The Competition comprised the following Phases:

- **Phase 1 (March 2018 to September 2018)**: Nine projects distributed across the three sectors were selected to receive initial Phase 1 funding to develop innovative energy management solutions using smart meter data. Two projects did not progress past Phase 1.[11] The remaining seven projects passed through to the Phase 2 ‘feasibility and initial testing’ stage.
- **Phase 2 (October 2018 to January 2019)**: During this phase (October 2018 to January 2019), these seven projects undertook ‘real-world’ initial feasibility testing of the solutions they developed in Phase 1.

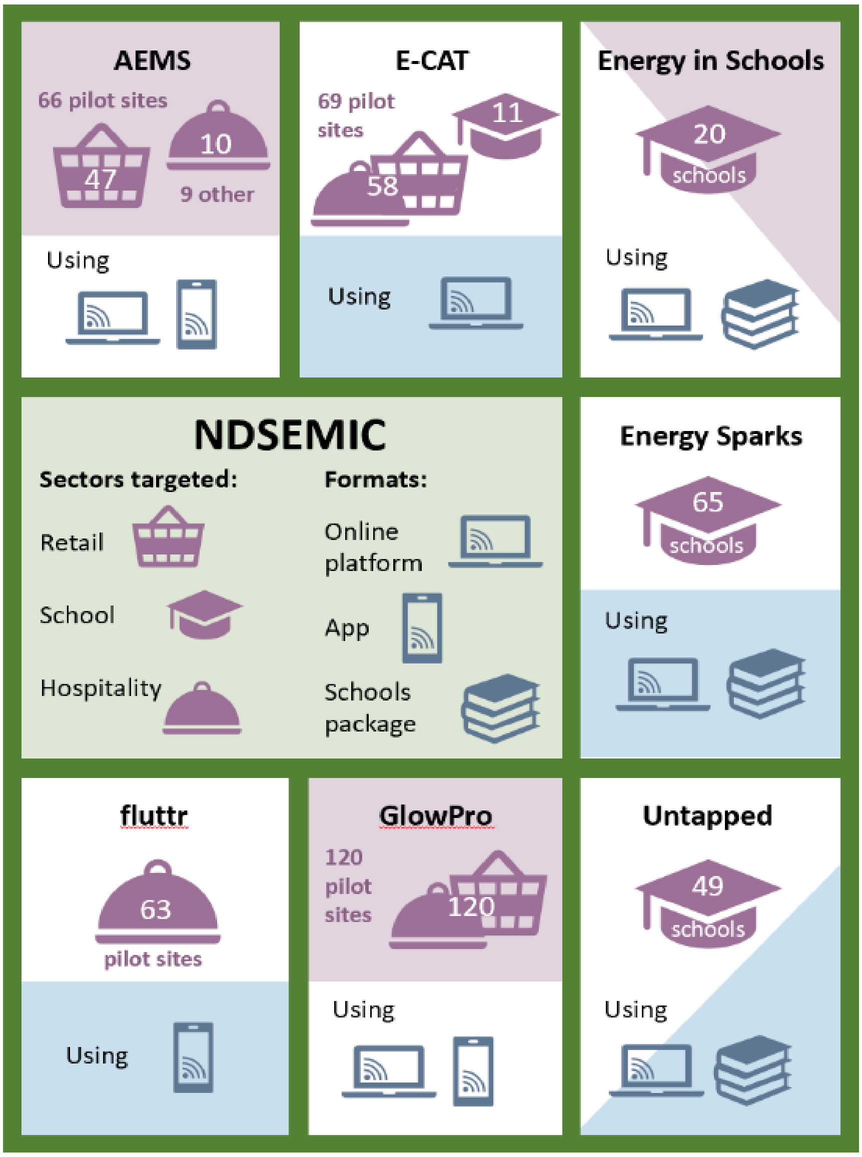
[11] These were projects developed by Pilio and Toshiba. Pilio developed an energy management platform and marketplace, aimed at helping small businesses to manage their emissions and save money and Toshiba tested an energy insight solution targeting small retail, small hospitality and schools.

- **Phase 3 (February 2019 to January 2020)**: All seven Phase 2 projects successfully progressed to Phase 3 where they were piloted in real life settings.

Across all seven projects, 452 sites were engaged in piloting the tools, including 307 chain and independent businesses within the retail and hospitality sectors, and 145 primary and secondary schools. The number of sites recruited into each pilot varied from 20 (Energy in Schools) to 120 (GlowPro), but all pilots achieved the minimum target set by the Competition of 20 participants.

Figure 2.2 visualises the seven projects by number and sector of pilot sites (retail, hospitality and school) and tool format.

Figure 2.2: Visual of tool pilot sites and sectors



Chapter 3 Evaluation approach and methodology

This chapter provides an overview of the approach and methodology for the evaluation. Further detail is provided in the technical report published alongside this evaluation.

This evaluation was conducted by Ipsos MORI in conjunction with its consortium partners. Ipsos MORI designed the overall research and evaluation approach and managed its delivery, leading on the qualitative data collection activities and overall analysis and reporting. The Carbon Trust provided coordination support to Competition Partners, leading research into specific market dependencies and conducting the energy consumption analysis. Technopolis led research into how energy is used and managed within the small retail and small hospitality sectors and provided advisory, quality assurance and ad-hoc research inputs. Finally, Loughborough University provided inputs into the initial set-up of the evaluation.

The REP had two primary strands of activity: evaluation and action research.[12] The former consisted of an impact evaluation of the seven supported pilot projects (that progressed to Phase 2) and a process evaluation of programme delivery; the latter involved activity-based learning with Competition Partners and industry actors to support market development. As the REP evolved, the action research element increasingly focused on understanding the barriers and enablers to the development of a market for non-domestic smart energy management services for smaller sites. The results of all activities have informed the analysis in this report.

Evaluation objectives

The purpose of the evaluation was to improve the evidence base around the effectiveness of smart energy management products and services within smaller non-domestic organisations. It sought to generate learning on what works in terms of encouraging energy efficient behaviours and key dependencies underpinning market development of such products.

The objectives of the evaluation were to:

1. Understand whether the tools piloted were effective in achieving their expected outcomes. This is summarised in Chapter four.

2. Explore and conclude upon the factors supporting and hindering the realisation of outcomes. This is explored in Chapters five (outcomes in the small retail and small hospitality sectors) and six (outcomes in schools).

3. Extrapolate from this, a set of implications and lessons for diverse key stakeholders - innovators, industry associations, schools, small businesses and Government - around the role energy consumption data can play in driving better energy management. This is embedded throughout and explored in conclusions.

[12] Within the context of this Competition, action research comprised: best practice sharing, shared problem solving, creating communities of learning and activity-based learning towards cross-programme themes.

4. Draw conclusions about what still needs to happen for the Competition to achieve its longer-term goal of market transformation by 2030. This is explored in chapters seven, eight and nine.

Key elements of the evaluation approach

The evaluation approach comprised three key elements:

- **Theory-based**: Both the overall evaluation and the seven pilot-level evaluations took a theory-based approach. Under this approach, data collection and analysis are designed in such a way as to provide evidence (qualitative and quantitative) that support, refute or refine the ‘theory’ of how a programme’s inputs are intended to lead to its desired outcomes.[13]

- **Case-based**: The evaluation assessed and compared different ‘cases’ within the Competition in order to explore why certain changes happened and the role of different features of the Competition and its pilots in contributing to these observed changes. Case-based evaluations are often used in circumstances where there are too few cases overall to conduct quantitative analysis and when the emphasis is on causal analysis.[14] Here, cases refer to the seven distinctive pilots which each tested distinct user contexts and tool functionalities and complementary packages.

- **Data triangulation**: A key question for the evaluation was: do smart energy management products and services contribute towards energy consumption reductions? Evidence from several qualitative and quantitative sources (see below) was brought together and rated for robustness and validity to provide an overall analysis. In most cases, through such triangulation, the team was able to draw conclusions, with a high level of confidence, as to the tool’s contribution to energy savings.

Sources of evidence

The pilot evaluations were developed upon the following primary sources of evidence:

- **Site visits to schools and businesses piloting the tools**: These involved interviews with tool users and on-site observation of tool use and on-site energy use.

- **Telephone interviews with tool users**: Conducted mainly with people who had signed up to receive access to the tool, but then did not actually make use of / engage with it.

- **Surveys amongst tool users**: Online surveys were conducted at the start and end of the pilot to gather information on site profile and user perceptions of the tools. These were aimed at covering most users but faced limitations in response rate.

[13] More information on theory-based and case-based approaches to evaluation can be found here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/67427/design-method-impact-eval.pdf

[14] https://www.intrac.org/wpcms/wp-content/uploads/2017/01/Case-based-evaluation.pdf

- **School pupil survey**: For the Energy Sparks evaluation, a short (ten question) paper survey was conducted with 41 pupils across three schools to assess how they had used the tool.

- **Energy consumption data analysis**: Data on energy use during the pilot was collected by Competition Partners from businesses and schools registered to use the tools. Where available, historical energy consumption data was collected to enable a before-and-after analysis at the aggregate level (i.e. for all user sites) and at specific user sites where triangulation with other data sources was feasible. The energy consumption analyses were undertaken in two stages:

    - Controlling for weather and sector-specific seasonal changes in energy use (e.g. more energy being used in schools during term-time and in the hospitality sector during the holiday seasons), analysis of energy use for all participating sites, before and after using the tools, was undertaken to determine whether any reductions in energy use could be identified that might be attributable to the tool (Stage 1 analysis).

    - 'Deep dives' into energy use over the pilot period at specific sites were undertaken to assess whether any dips in use matched the timings of self-reported changes in energy use (identified via surveys and interviews) (Stage 2 analysis).

- **Interviews with Competition Partners**: These were conducted at the start and end of the evaluation to understand key aspects of tool design and delivery, their views on the support provided to them through the Competition, progress towards commercialisation, and their views on market enablers and barriers.

Further information on the samples and quality of these sources of evidence is discussed in the next section and in the technical report published alongside this evaluation. Additionally, each evaluation made use of the following secondary sources of evidence:

- **Regular observation of the tool's development and delivery**: Two REP team members met weekly with Competition Partners to discuss project progress, ongoing evaluation data collection needs and access to tool users (for stakeholder consultation).

- **Competition Partner research**: Several Competition Partners conducted their own research including user testing and user feedback, and one (Samsung, for Energy in Schools) conducted its own evaluation activities alongside the REP.

- **Project and programme documentation review**, including project proposals, monitoring and reporting to BEIS and Competition strategy documents.

- **Literature reviews** focused on the market context (delivered as part of the REP's 'action research' strand).

- **Stakeholder workshops** with policy makers, industry representatives, suppliers, sectoral and innovation experts (delivered as part of the REP's 'action research' strand).

Energy savings analysis: approach and strength of evidence

Assessing the energy saving potential of smart energy management tools was central to the evaluation, however in the context of the Competition it was not possible to collect a single definitive estimate of impacts and there were a range of challenges in using and interpreting energy consumption data for pilot sites. In recognition of the circumstances involved (limited access to historical data, small sample sizes, no control groups), a mixed-methods approach to evaluating energy savings was taken.

This approach drew on a range of evidence (outlined above) to create a summary indicator of the evaluation's confidence that the tools had contributed to energy savings for pilot sites (by comparing the findings of energy consumption analysis, self-reported savings, and evidence of behaviour change from qualitative interviews). An analytical framework that considered both the strength of evidence, and its robustness, was used to produce the indicator (Table 3 below) and is set out in the technical report published alongside this evaluation.

Table 3: Strength of evidence ratings (indicating tool contribution to energy savings)

0- 1	Low level of confidence that the tool has contributed to energy savings at any site*
1 – 1.99	Medium level of confidence that the tool has contributed to energy savings in at least some sites
2 – 2.99	High level of confidence that the tool has contributed to energy savings in at least some sites
3 to 4.5	Very high level of confidence that the tool has contributed to energy savings in at least some sites

** A low confidence level does not preclude the tool from working in the future, if some adjustments / lessons learned are taken on board.*

Chapter 4 Key evaluation findings

This chapter summarises the main evaluation findings. It begins with a recap of the theory of change and its validity, then provides an overview of the outcomes of the tools. The chapter provides more detail and discussion on the energy savings realised by each tool; but in-depth information on other direct pilot outcomes, including customer engagement, upskilling and learning on energy efficiency, operational improvements in processes / behaviours and the adoption of energy efficient technologies, is provided in Chapters five (for small retail and small hospitality businesses) and six (for schools).

The validity of the theory of change

The theory of change described in Chapter two considered that energy savings could be achieved within organisations through the use and uptake of smart energy management tools where these tools increased understanding of energy use and facilitated energy management. This was based upon the assumption that users would be able to correctly interpret and act upon the new information and change their (and other energy users') behaviour to reduce overall use within the organisation.

This evaluation has found evidence to support this theory within each of the pilots. The discussion below (and in Chapters five and six) demonstrates that within each of the pilots, to a varying degree, the tools were successful in engaging users, increasing their understanding of energy use and influencing changes in the ways that users used energy. In six out of seven of the pilots, there was clear evidence (to varying degrees of strength) that the tools were already contributing to energy savings.

The findings also suggest that most of the **key assumptions underpinning the theory's pathway from outputs to short-term outcomes and short-term to longer-term outcomes are valid (i.e. evidence suggests that they were indeed important)** though there are other key dependencies which were not recognised from the outset. These are explored in Table 4 below and throughout the remainder of this report.

Table 4: Validity of the assumptions underpinning the output to short-term outcome pathways

Assumption	Validity
Business models and partnerships are established which enable necessary access to data needed to drive solutions	All Competition Partners managed to gain access to the consumption data needed to pilot their solutions, though often not as seamlessly as Competition Partners had anticipated. In particular, complex metering arrangements (i.e. establishing data flows), industry processes and consent requirements had implications for the timeliness and ease of data access. At times, delays impacted the consumer experience. The implications of this for longer-term outcomes are discussed in the insights for innovators note ('*Developing smart energy management services*

	for SMEs - NDSEMIC insights for innovators') published alongside this evaluation.
Awareness raising effective in encouraging take-up of tools	Tool take-up was dependent on a range of factors. The drivers behind initial and sustained customer interest are discussed in-depth in Chapters five and six and include the offering of the tool and the customers' needs and interests (including their desire to save energy). Some users indicated they had participated in the pilot because they received a cash incentive or because they would 'lose nothing' in doing so, which suggests that some of these may not have otherwise taken up the tool, e.g. if they had to pay for it. Findings on willingness to pay (an assumption underpinning one of the pathways to market)[15] are discussed in Chapter seven.
Solutions provide new information to users, or known information but in a more engaging or applied way	The evaluation found that the utility and novelty of the energy efficiency insights that tools provided was crucial to take-up. Users who felt that insights were not actionable were deterred from using the tools and therefore did not benefit from them. These findings are discussed in Chapters five and six.
Users are able to correctly interpret and act upon information and advice	Support and advice appear to have been a key factor driving success across businesses and schools. This may have implications for the way that tools are packaged and sold to customers in the future. Some of the hands-on support that Competition Partners offered would be potentially expensive to provide at scale, though by working with partners to train users or provide bespoke advice, innovators could address this dependency. This is discussed in Chapter seven.
Solutions encourage behaviour change and the implementation of energy efficient actions or measures, including at decision-making level	Across the pilots, users reported that the tools had increased their knowledge and understanding of energy use within their organisation and that they were using this information to make decisions about energy management, energy use and (in some cases) operations and investments (in equipment). To some extent, behaviour change was dependent on processes and policies being put in place, and widespread buy-in, which was not always guaranteed. For example, some energy managers had not disseminated information from the tools to staff, because they did not have the time or see the added value in sharing the tool (e.g. wanting staff to prioritise other activities). However, in other cases energy savings could still be made through changes introduced just by the energy manager / decision maker – i.e. it was not dependent on whole-organisation action.

[15] One of the assumptions underpinning the pathway from short-term to longer-term outcomes is that users will be satisfied with solutions and able or willing to pay for more advanced versions. However, this also recognises that users might also access the tools through bundled services – i.e. as part of their energy supply.

	Other key barriers to behaviour change not covered here but discussed in Chapters five and six included: organisational culture (e.g. low prioritisation of energy efficiency), restrictions on changes to processes and a lack of capital (or unwillingness) to invest in more efficient technologies.

The theory of change presents key assumptions upon which the pathway from short-term to longer-term outcomes is based. Competition findings have supported these assumptions – for example, as outlined in Chapters five, six and seven, some users have expressed interest in maintaining the use of the tools, particularly where they have identified energy savings from them. Some users have also recommended the tools to peers within their sector. As explained in Chapter seven, some of the Competition Partners have formed partnerships with wider market actors which were necessary to meet short-term Competition outcomes, and which may also lead to longer-term commercialisation outcomes.

The Competition has also explored broader factors which can be expected to shape the pathway from short-term to long-term outcomes, and beyond this, the potential development of a sustainable market. Chapter seven highlights some of these factors which could impact outcomes. This includes the extent to which innovators' products and services reflect key drivers of consumer demand (in particular, energy cost saving and environmental concerns), governance and regulatory regimes (and the influence these could have on other dependencies such as smart meter data access), and wider energy market activity (including innovators' development and consumers' take-up of 'bundled' packages which include smart energy management tools).

The short-term outcomes of the pilots

The short-term outcomes of the pilots (explored in Chapter two, Figure 2.1, page 4) were those anticipated to occur during the Competition as a direct result of the pilots i.e. better energy management and energy savings amongst pilot sites. Table 5 below summarises the findings across the seven tools in terms of initial engagement, ongoing engagement and behaviour change. The tools had varying degrees of success in reaching outcomes, but most were successful in engaging customers and driving behaviour change among at least some of their users. The tools' contributions to energy savings are covered in in the next section.

Table 5: Overview of the short-term outcomes of the seven piloted tools

Tool	Key outcomes
AEMS	Initial customer interest / pilot recruitment: AND TR recruited customers to pilot AEMS through four different channels (11 directly through AND TR's own network, 41 through a single chain of retail stores, six through a third party energy efficiency consultant, and eight through an energy supplier). A range of businesses, including several small independent businesses and one chain, were recruited. Most users were motivated to participate in the pilot either because they were familiar with AND TR or had a direct relationship with them, or because of the induction support they received from AND TR.

	Ongoing customer interest: The majority of user sites did not engage with the tool. Only one third of the businesses given access to pilot the tool (25/66) made use of it, because 41 sites were part of a chain whose head office did not disseminate the tool (as they felt their existing energy management system was adequate / preferable). Six other sites, recruited via an energy efficiency consultant, had not understood how to properly use the tool. The tool was marketed to both chains and independent businesses but had greater success with the latter. Indeed, the sites which benefited from use of the tool were all microbusinesses and the support and advice they received from AEMS, e.g. in interpreting energy data, played a critical role in sustaining interest. These active users also found the appliance-level monitoring and energy use charts highly useful and appreciated the regular reports (in pdf form) they received via email. Behaviour change: Two out of eight businesses consulted through the evaluation reported behaviour change - switching off equipment and using equipment less - after identifying energy wastage through AEMS. Two other businesses consulted had started using AEMS and considered it might benefit them, but they had not had sufficient time to put any changes into action (though they had started planning / thinking about such changes). The four remaining businesses were not using the tool. In three cases this was because they had not received support from AND TR and didn't fully understand how to use AEMS; the remaining business preferred their existing energy management system. Where businesses experienced changes in energy use, this was largely because of the support and advice received directly from AND TR.
Energy in Schools	Initial customer interest / pilot recruitment: The Samsung consortium successfully recruited its target of 20 primary and secondary schools by advertising through its consortium's networks and at an educational event they attended. Sixty schools requested to participate, and these were primarily attracted by the possibility to improve energy efficiency (in some cases building on existing initiatives) and the offer of a range of IT equipment (specific to this project) at zero cost. Ongoing customer interest: The pilot was successful at engaging pupils, teachers and decision makers (headteachers, business managers) within schools. Each of these groups reported high levels of engagement with the tool across the 13 out of 20 schools consulted. The support provided by Samsung in inducting schools onto the programme was pivotal to initial engagement. Afterwards, ongoing technical support helped sustain interest. The most important drivers of engagement were the focus on empowering pupils (particularly the 'Energy Champions'

	scheme)[16] and the tailored features aimed at different users, keeping energy front of mind across the school community.[17] Behaviour change: Almost all schools consulted through the survey and site visits reported behaviour change which they attributed to use of Energy in Schools (mainly switching off lights and equipment when not in use). The tool had an effect on the behaviour of all users in schools (pupils through to managers). The Energy Champions (pupils given responsibility for improving energy efficiency in the school), in particular, played a major role in changing the energy use habits of school staff and other pupils. Energy managers at several schools reported that they had already made or were planning to make energy efficient upgrades (e.g. to lighting), as a result of using Energy in Schools.
Energy Sparks	Initial customer interest / pilot recruitment: Energy Sparks recruited 65 primary and secondary schools. Schools were recruited through local authorities, school trusts and through initiatives promoting sustainability in schools. Most schools heard about Energy Sparks via word of mouth through governors or at headteacher meetings or through Energy Sparks' partners' programmes. The main driver for take-up was the Energy Sparks educational package. Many of the participating schools were seeking to raise awareness and inspire pupils to have a sense of agency over energy use and environmental issues. Ongoing customer interest: According to Energy Sparks analytics, across the 65 participating schools, at least 27 schools engaged with the tool on one occasion or more.[18] Six out of the seven schools consulted for the evaluation were highly engaged with the tool; the remaining school had not fully engaged, because they had not received induction training and were not fully aware of what the tool offered. Such training was critical to engagement. It was most effective when delivered by Energy Sparks, though some local authorities that signed up to disseminate the tool across multiple schools also managed to successfully induct schools. Energy Champions (in this case, adults - teachers, governors, administrators - trained to support their school in using the tool) were also pivotal to initiating and sustaining engagement. Where the Champion left the school, this impacted on engagement. Behaviour change: Five out of seven schools interviewed for the evaluation reported behaviour change as a result of using Energy Sparks. The tool catalysed change in schools across all user types: energy managers introduced new policies and practices after using the tool and teachers and pupils changed the way they used energy too. Even where schools were already taking action to reduce energy consumption / act more sustainably, Energy Sparks helped them to

16 'Energy Champions' were pupils who volunteered for the role and received access to Energy in Schools and its complementary energy monitoring and coding technology to monitor energy within the school. They would then be given training in how to programme the technology and use to trouble-shoot energy wastage, raise awareness through the school and encourage energy efficient behaviour.
17 Energy in Schools enabled schools to display energy data in common school areas (through a complementary TV), to embed energy management and energy data into their school curriculum, and to involve all members of the school in trying to reduce energy consumption.
18 Based on the number of schools logging eco-club activities.

	realise energy efficiency ambitions by advising the school on where and how to make changes. The Energy Sparks learning resources motivated pupils to change their own energy use and campaign for others to do so. Indeed, the fact that Energy Sparks empowered pupils was a key factor in inducing change. The competitive element of the tool (which awarded points to schools when they carried out energy efficient activities suggested by the tool) also encouraged schools to act more sustainably.
E-CAT	Initial customer interest / pilot recruitment: A total of 11 schools and 58 businesses were recruited for the pilot through Element Energy's partner, Octopus Energy and via networking events and webinars organised as part of the Competition. A cash incentive was offered which, for several users, was a key reason for signing up. Most organisations piloting the tool were independent businesses or single outlets of a chain – no chain joined up to pilot E-CAT across all sites. Ongoing customer interest: Fourteen businesses responding to the survey of users had engaged with E-CAT at least once, and nine of these had used it monthly or more frequently. E-CAT had less success in sustaining schools' interest. The three schools consulted for this evaluation reported that this was because E-CAT could not be used by schoolchildren (it was designed only for managers in schools) and because they needed more support to help them use the tool. E-CAT provided email support to users for the first month of its operation, but – after that – support was generally limited. Active users of the tool most appreciated the E-CAT live energy data and the ability this gave them to test different aspects of their organisation's energy use. They also appreciated the easy-to-understand presentation of data. Behaviour change: Around half of those surveyed and a third of those interviewed reported behaviour change which they attributed to using E-CAT. This consisted of changes to how equipment was used, with businesses switching off equipment overnight and/or at other times of the day and adjusting equipment (refrigeration and lighting) to make them more efficient. In each case the change was triggered either by a suggestion ('tip') made by the tool or by the user being able to pinpoint wastage using E-CAT's live data. A perception that any changes to energy use would either cost too much or compromise business operations prevented some businesses from changing behaviour. Users were more likely to change their behaviour in response to a tip they felt was more tailored to their business.
fluttr	Initial customer interest / pilot recruitment: 63 sites participated in the pilot of fluttr. These were either existing clients of Considerate Hoteliers or new customers who had signed up to the pilot after seeing it advertised online. All were hotels or restaurants. Amongst the businesses consulted for the evaluation, a desire to be more environmentally friendly was the key reason for participating. Forty sites out of the 63 piloting fluttr were franchises or part of a chain. Ongoing customer interest: During the pilot, levels of engagement with fluttr were not as high as anticipated. According to tool analytics, approximately half of the 63 pilot sites used the app after downloading it;

	though amongst some of these users, engagement was limited. One factor which deterred engagement was the lack of live energy data,[19] though not all users considered it necessary to receive a live stream. Though the tool had been designed to enable multi-use access, most users were managers and they had not delegated use of / access to the app to non-managerial staff, because they considered staff would have little time or interest to use the tool. Active users found the tool accessible and simple, and liked the aesthetic design. Indeed, the simplicity and user-friendliness of the tool appears to have been a main driver of sustained use. The provision of half hourly data was also key to engagement, and the daily tips helped to keep energy consumption 'front of mind'. Behaviour change: At three out of five of the sites visited for the evaluation, users reported changes in behaviour that they assigned these changes to use of the tool. Managers used the tool to encourage staff members to use less energy and to make decisions about how and when to upgrade equipment. For example, one manager had introduced a change to their team's cleaning protocol after using the tool. At some sites, the daily tips had catalysed behaviour change; at other sites, the presentation of energy use each day as a comparison against the previous day (adjusted for how comparable levels of customers) had motivated users to reduce energy consumption on an ongoing basis.
GlowPro	Initial customer interest / pilot recruitment: Hildebrand recruited 75 businesses (across 120 sites) to participate in the pilot via its own network and through two energy suppliers and an energy advice initiative. These comprised independent and chain businesses in the small retail and hospitality sectors. Two-thirds of users consulted for the evaluation stated that they were attracted to use GlowPro because of an interest in saving money and increasing their green credentials. Ongoing customer interest: Amongst the 12 businesses consulted for the evaluation, 10 made regular use of the tool. GlowPro was used mainly by business owners or managers with decision-making powers. There was little interest in sharing the tool or its insights with non-managerial staff, as managers did not want to distract them from service delivery. The tool offering of equipment-level, temperature and sub half hourly or half hourly data (depending on the site) played a major role in sustaining interest. Pilot participants utilised the half hourly data to identify spikes in usage, to cross-check the time and source of spike occurrence, and to then pinpoint the cause of the spikes. Live data was not available to all users; however, this was not a critical feature for sustaining interest. Behaviour change: Eight out of the 12 businesses consulted through the evaluation had implemented, or planned to implement, at least one energy efficiency measure as a result of using GlowPro. For these businesses, the ability to track energy consumption out-of-hours was a key driver of change and was particularly valuable to managers not

[19] The app was designed to use live data from SMETS smart meters; however, none of the sites that participated in the trial had SMETS meters installed.

	usually on site (e.g. chain managers). For hospitality sites, indoor temperature tracking against energy use also enabled managers to tackle energy waste whilst still ensuring customer comfort.
Untapped	Initial customer interest / pilot recruitment: Hoare Lea signed up 69 primary and secondary schools to pilot Untapped. Most schools were recruited via their multi-academy trust and the remainder via Hoare Lea's own network. Users who signed up to pilot the tool did so because of a strong interest in improving energy efficiency in their school or because they had existing monitoring systems that they wanted to 'test'. Ongoing customer interest: Overall, Untapped did not achieve the engagement expected amongst users piloting the tool. Very few participants had accessed or used the tool and, amongst those which had, only one consulted had found Untapped beneficial. Users consulted had not benefited from Untapped either because they had existing energy management systems in place, which they preferred, or because Untapped did not meet their needs. The following factors limited school engagement: the complex onboarding process, technical issues (which delayed user access to data), a lack of engagement with teachers and pupils, and a low awareness amongst potential tool users of the complementary educational package, which could have increased use. Behaviour change: Overall, the evaluation found very limited evidence of Untapped contributing to behaviour change. The evaluation spoke to one user of Untapped who had been satisfied with the product and reported changes to behaviour resulting from their interaction with it. This user had received on-site visits and a summary report (of energy usage, with tips for reducing consumption) – however they had not accessed the online platform. Compared to three other schools consulted, this user did not have any alternative energy management system in place, and they had valued the insights that Untapped had given them.

Energy savings

Overall, the tools varied in the performance, but in **six out of seven cases (i.e. for AEMS, E-CAT, Energy in Schools, Energy Sparks, fluttr and GlowPro) there was evidence that the tool had already led to energy savings for some users**. In some schools (piloting Energy Sparks), the tool contributed to energy savings of between 10% and 20%, and for two businesses (piloting E-CAT), the in-depth quantitative energy consumption analysis also suggests savings of up to 11%.[20] The detail behind this assessment is presented in Table 6 overleaf.

[20] Based upon energy savings analysis which was rated of moderate or moderate to good quality.

Table 6: Summary of the extent to which tools achieved energy savings

Tool	Findings	Summary of evidence
AEMS	Evidence of energy savings was observed in a small number of sites. At two out of six sites visited, behaviour change was observed (inferred to lead to savings), which the user attributed to AEMS. At one of these two sites, monthly bill savings of £150 were reported and attributed (by the user) to use of AEMS. This was validated by quantitative analysis of energy consumption (which identified a 5% reduction). At the other site, a 1% reduction was observed.[21] Analysis of current engagement with AEMS at two further sites suggests energy savings could be realised in future. Quantitative analysis of energy consumption data across all participating sites showed an average of 0-1% reduction in consumption, though, it is not possible to firmly establish a relationship between this observed trend and use of AEMS. At other sites, low take-up of the tool meant that it could not impact on energy savings.	Confidence that tool contributed to savings in some sites: Medium Validity of evidence: Strong for two sites, where multiple sources of evidence converge. For other sites, evidence is mixed/less robust.
E-CAT (retail & hospitality only – no evidence of savings in schools was observed)	Evidence of energy savings was observed for half of all participating small businesses, with limited evidence of savings in schools. Half (eight out of 15) of survey respondents from retail and hospitality organisations stated that they had implemented (or had plans to implement) energy efficiency measures as a result of engaging with the tool whilst ten out of 15 retail and hospitality sites said they had tried to reduce energy use since engaging with E-CAT. Behaviour change (inferred to lead to savings), which the user attributed to use of E-CAT, was observed in three out of nine site visits.[22] At two of the sites, more than one user was consulted, and they converged in reporting energy efficient behaviour (two sites) and energy savings (one site). The qualitative evidence was validated by quantitative analysis of energy consumption for one retail and one	Confidence that tool contributed to savings in some sites: High Validity of evidence: Qualitative and survey data converge to provide strong evidence of behaviour changes (inferred to lead to savings). There is some quantitative evidence (of weaker quality) which supports this.

[21] Energy consumption analysis was conducted at a third site piloting AEMS, though the analysis found that energy consumption had not changed at this site over the four-month period observed.
[22] These three were all retail and hospitality sites. No behaviour change was observed at the two schools visited.

	hospitality site (which indicated potential[23] annual energy savings of between 5-10% for one business and 11% for the other). Quantitative analysis of energy consumption data across all participating sites showed average reductions in energy consumption for hospitality and retail sites of 7% and 1% respectively, though it is not possible to firmly attribute these observed savings to the tool without additional evidence.	
Fluttr	Evidence of energy savings was observed in a small number of sites. At three out of five sites visited, behaviour change was observed (inferred to lead to savings), which the user attributed to fluttr. At one of these sites the user also self-reported some small energy savings. A further three out of six survey respondents confirmed they had changed their behaviour, due to using fluttr, in ways that would be expected to lead to savings. Quantitative analysis of energy consumption data across all participating sites showed average reductions of 1%, though it is not possible to firmly establish a relationship between this observed trend and use of fluttr. One site had observed reductions in their energy consumption data over the trial period which (when triangulated with qualitative evidence) can confidently be attributed to use of fluttr; however some of the 15% reduction may be due to seasonal changes in energy use.	Confidence that tool contributed to savings in some sites: Medium Validity of evidence: Strong for two sites where qualitative data provides strong evidence of behaviour changes (inferred to lead to savings), supported (for one of the sites) by quantitative data. For other sites, evidence was mixed/less robust.
GlowPro	Overall, there is strong qualitative evidence of energy savings at some sites. Ten businesses (across 12 sites) were consulted either through interviews and/or the online survey. Evidence of behaviour change (inferred to lead to savings) was observed in two thirds (eight of twelve) of these sites, with two of these directly reporting bill savings. A further two sites indicated that the tool may help them to tackle energy waste in future. In the two remaining sites, no behaviour change was observed. A lack of historic energy consumption data limited quantitative analysis for this project, thus analysis of cross-project consumption trends was not possible. Quantitative analysis of energy consumption for a subset of sites suggested that consumption reductions had occurred, while in another site consumption patterns consistent with	Confidence that tool contributed to savings in some sites: High Validity of evidence: Qualitative and survey data converges to provide strong evidence of behaviour changes (inferred to lead to savings). Quantitative data is inconclusive.

[23] As the pilot data did not cover a full 12 months, these are estimated annual savings based on the observed reductions in energy use being maintained. These annual savings estimates account for seasonal weather variations.

	reported changes in behaviour were observed, though natural variation in energy use could not be ruled out as an explanation. At one out of eight sites, multiple users across the organisation converged in their perception that savings had occurred. This was the only site where multiple users were consulted.	
Energy in Schools	Evidence of energy savings was observed for most participating schools. At all six schools visited, behaviour change (inferred to lead to savings) was reported and attributed to Energy in Schools. At four of these sites, more than one user was consulted, and they independently reported the same behaviour change. Additionally, users at 13 out of the 20 pilot schools agreed (in their survey responses) that their school had tried to reduce the amount of energy used since engaging with the tool. Three out of six interviewees had not yet observed impacts on bills directly, with the remainder not having access to such information. Quantitative analysis of energy consumption data across all participating sites showed slight increases in consumption overall, though, due to notable data limitations, it was not possible to confidently conclude any relationship with the tool. Analysis of energy consumption data for three sites showed potential consumption reductions for one, though interpretation of impacts is limited by the same data gaps noted above. Samsung's own energy consumption analysis found savings in one school of 5.5% (electricity) and 5.3% (gas) in the year post-intervention and projected monetary savings for four further schools, including £5,500 annual electricity cost reductions in one secondary school.[24] However, it has not been possible to independently validate this analysis due to data sharing limitations.	Confidence that tool contributed to savings in some sites: High Validity of evidence: Qualitative and survey data converges to provide strong evidence of behaviour changes (inferred to lead to savings). Quantitative data is inconclusive.
Energy Sparks	Overall, there is very strong evidence that energy savings occurred at numerous sites. Most users (across four school site visits and a further six interviews with schools / local authorities) reported changes to schools' processes and equipment as a result of using Energy Sparks, with one interviewee reporting bill savings of £20,000 as a result of changed boiler controls. Amongst the 41 pupils surveyed for the evaluation, 68% reported they were doing new things to try and save energy.	Confidence that tool contributed to savings in some sites: Very high Validity of evidence: Very strong, with a convergence of multiple sources of

[24] Samsung and its partners had greater access to sites' energy consumption data than Ipsos MORI.

	At two of these sites, more than one user was consulted, and they converged in reporting the behaviour change. Quantitative analysis of energy consumption data showed that schools which had established an eco-club and implemented at least one learning activity had saved on average 4% in their average daily electricity consumption and 10% in average gas consumption.[25] A quantitative analysis of aggregate energy consumption across all pilot schools showed slight reductions in average daily consumption of electricity (1.6%) and gas (2.3%) likely to be driven by lower engagement across some schools within this wider group. At three schools, the quantitative analysis suggested that measures implemented (which users attribute to Energy Sparks) drove energy consumption reductions of 10% to 20% in electricity and gas.	qualitative and quantitative evidence.
Untapped	Overall, there is strong converging evidence that energy savings did not occur in participating sites. Broader project challenges relating to uptake meant that sample sizes for qualitative research were limited. Only one user interviewed reported changes to behaviour, which they attributed to use of Untapped; others reported no behavioural changes or attributed behavioural change to drivers unrelated to the tool. Quantitative analysis of energy consumption data across all participating sites, consolidated by a deep dive analysis into one case study school's consumption, suggests that Untapped broadly did not have an impact on energy consumption.	Confidence that tool contributed to savings in some sites: Low Validity of evidence: Strong, with a convergence of qualitative and quantitative data (alongside broader evidence of low take up) suggesting limited impact.

[25] Covers 19 schools which had logged at least one learning activity (beyond establishing an eco-club) in the Energy Sparks portal.

Chapter 5 The outcomes of piloting smart metering innovation in the small retail and hospitality sectors

This chapter builds on the findings presented in Chapter four to provide more in-depth information about the factors that supported or inhibited the effectiveness of the tools in small retail and hospitality businesses. The chapter gives an overview of how the tools compared, how they engaged users, and their effects on users' behaviour. Finally, it presents reflections on the implications of the lessons learnt from the four tools piloted in these sectors.

Four Competition Partners piloted tools at hospitality and retail outlets. Amongst these, three tools (AEMS, GlowPro and E-CAT) were piloted within both sectors, while fluttr was piloted only in the hospitality sector, in restaurants and hotels.

Overall, the Competition tools targeting the small retail and hospitality sectors aimed to provide small businesses with an improved understanding of their energy use to help them save energy. Some also had as specific aims to support business operations, help businesses increase staff and/or customer comfort, and to reduce energy bills.

Tables 1 and 2 in Chapter two provided an outline of the key features of these tools. In sum:

- The tools were aimed primarily at business owners and/or managers, though three (AEMS, fluttr and GlowPro) had multi-site (all) and multi-user (fluttr, GlowPro) functions.
- All four were piloted amongst business chains or franchises as well as independent businesses. In some cases, all the sites within a chain or franchise participated in the pilot, while in other cases only some outlets were involved in piloting the tools.
- Each tool provided half hourly or sub half hourly energy consumption data and allowed users to compare energy consumption with historical consumption trends. AEMS and GlowPro offered equipment-level monitoring, and GlowPro offered temperature monitoring.

Additionally, each tool had a distinctive 'selling point':[26]

- AEMS, which could be accessed online or via a mobile app, offered pushed alerts (via the app only) to users when their daily budget / typical energy consumption was exceeded.

[26] Although note that, while these features were anticipated as 'selling points', they were not always seen as such by users. For example, most AEMS users accessed the tool via the online portal and, as such, were unaware of the alert feature and fluttr users often felt they did not have the time to enter business data and, thus, didn't utilise this feature. In most cases, it was other features (e.g. equipment-monitoring, data visualisation) which were considered most useful by users.

- E-CAT offered a benchmarking feature, allowing users to compare their energy use to similar organisations' and offered energy saving tips to users which were categorised as 'maintenance', 'energy management', and those requiring investments.
- Fluttr allowed users to input business metrics that enabled the tool to calculate energy use per typical hospitality parameter such as room occupied/ number of tables covered.
- GlowPro could be used by different staff within businesses / chains, with different interfaces providing tailored information for the overall owner and site managers.

The below sets out the extent to which the tools managed to gain and sustain businesses' engagement. Within those businesses that engaged with the tools, it then explores the extent to which they drove increased awareness and prompted energy saving behaviours. It then discusses the key barriers to driving investment in clean technology, which typically has higher energy saving potential. The chapter concludes with a discussion around the tools' effects on overall attitudes to sustainability and the lessons that can be taken from the pilot.

How the tools engaged users

Gaining interest

The pilots used a mix of direct and indirect recruitment methods. Over 200 businesses participated in total, ranging from independent businesses and chains to microbusinesses and larger small businesses. For AEMS, 41 of the 66 pilot sites were branches of a single chain; nine chain organisations accounted for 48 of GlowPro's pilot sites; and 12 chains accounted for 40 of the individual sites piloting fluttr. The majority of the sites recruited for AEMS, GlowPro and E-CAT were hospitality businesses. Recruitment proved more difficult and took longer than expected for both AEMS and GlowPro, with developers turning to third parties to assist with recruitment. Customers for three of the tools (AEMS, GlowPro and E-CAT) were recruited through partnerships with energy suppliers and for two tools (AEMS, GlowPro) through energy efficiency advisors. E-CAT and fluttr gained users through direct marketing.

A variety of factors motivated individual sites to pilot the tools. **The most commonly mentioned reasons for piloting the tools were the potential to identify cost savings and environmental concerns**. While cost savings were usually the main motivator, environmental concerns were the priority for hospitality sites where sustainability was a core part of their brand values (this was the case for all fluttr pilot sites). Although many of the sites recruited to the pilots had a prior commitment to the 'green agenda', environmental concerns were also mentioned as a motivation by those with no pre-existing commitment.[27] Chapter seven provides some discussion on the implications of this.

The ability to manage energy use more easily also motivated sites to pilot the tools; in turn managers hoped to gain a greater sense of control over their business operations and enable them to operate more effectively. The perceived advantages of improved management ranged from a better ability to negotiate tariffs, to improved remote management of individual sites for

[27] None of the Competition Partners set out specifically to sell the tool to specific profiles of user other than organisations within the three target sectors of the Competition. However, the inherent nature or 'branding' of some of the Competition Partners designing the tools (i.e. fluttr and, for schools, Energy Sparks) meant that they did attract 'green' users. As Considerate Group recruited fluttr users to pilot the app through its existing customer base, this comprised businesses which were already trying to reduce their energy use to some extent before using the app (in several cases it is also what attracted the user to the app).

chain / franchise managers. Sites with no history of monitoring energy use were often curious to know more about their energy consumption.

In several cases, **sites piloted the tools because they felt they had 'nothing to lose'**, in that the tools were free, the sign-up process required little or no effort from them, and they were curious about what the data might show. This sentiment was most evident where tools were offered by third parties but also in a few instances where tools were offered directly (e.g. AEMS). A few users of E-CAT noted that the cash incentive offered for sign-up served to cement the sense they had 'nothing to lose' by piloting the tool. The extent to which such users might still be willing to buy and/or engage with smart energy management tools outside of a (free) pilot situation is – as yet – unclear. It is quite likely that their engagement will be, to some extent, dependent on the 'normalisation' of smart energy management tool use in the non-domestic sector. More discussion on this is provided in Chapter seven.

AEMS' direct recruits largely included local sites that the developers had a personal relationship with. Although users did not state that they were motivated by this **familiarity with the brand / innovator**, it may have been a contributing factor to their interest in the pilot. Future developers might exploit this motivation in the future by packaging the tool within a wider offer / branding with which potential customers are familiar and/or by providing tailored support to users when first starting to use the tool, to increase trust and confidence.

Some Competition Partners found they were able to attract new customers by presenting examples of how similar businesses had saved energy using the tool. When asked whether they would be willing to pay for the piloted tools, a key factor for users was whether the tool would be cost-effective and be worth the investment, and such examples helped to demonstrate the potential savings to be achieved.

Engaging customers to use the tool

This section explores the factors driving businesses to use the tools once they had expressed an interest in and gained access to the tools. The key factors were the support provided by Competition Partners and the utility and relevance of the tools' features. Another factor was the level of existing energy-management understanding of the business. This was a notable finding from the AEMS pilot: businesses which benefitted most from the tool were those which did not have existing energy management systems in place. This echoes findings from the school pilots also (see Chapter six) and reflects the finding, further discussed below, that users were more likely to engage with the tools, **where they considered that they were providing them with new information**. However, other users (e.g. within the fluttr pilot) which did have some understanding of how the business used energy, still found the tool useful for increasing their depth of understanding and enabling more precise action to be taken to make savings.

Support and advice

During the pilot the Competition Partners in all cases provided varying degrees of support to users. Broadly, two forms of support were available: support from developers to use the tool, including initial support to get users started, and ongoing advice from energy consultants or tool developers to help sites interpret their data and its implications.

The induction or 'onboarding' process was a crucial stage of engagement: the guidance provided needed to be **comprehensive enough to equip users with the confidence to use the tools, while still being digestible**. Such support was particularly impactful when offered by the tool developers and either face-to-face or over the phone. However, E-CAT and fluttr offered people-led modes of support which were also well received. A manual was developed to support induction onto fluttr, and E-CAT users were sent a series of short introductory emails, each covering one key aspect of the tool's functionality as well as an introductory video (embedded into the tool).

While the tools were praised as being intuitive and easy to use, **sites welcomed personalised guidance to help them get to grips with the tools and their functions initially**. Users of tools that were regarded as particularly easy to use, such as fluttr, still felt this type of support helped them to use the data.

> *"Yes, [the support] was really useful … the whole thing was, what's the word, intuitive. You didn't need too much help, but they gave us lots of instruction and they followed it up with phone calls." – Hospitality manager, fluttr pilot*

Consultancy advice when combined with equipment-level monitoring appears to have been highly effective in giving a deep understanding of energy use and prompting effective changes in processes to reduce energy consumption. Energy consultants provided some GlowPro customers with bespoke advice, often face-to-face, on energy savings opportunities; this was coupled with equipment-level monitoring (smart plugs) which allowed them to provide more detailed evidence of energy saving potential. This was effective in helping the managers to decide to implement energy saving measures and then ascertain the direct cost savings from it. The use of smart plugs also allowed them to ensure that the equipment was being turned on and off automatically at the designated times. Additionally, the equipment-level monitoring helped one business identify (then replace) a malfunctioning fridge. In the case of AEMS, the largest impact detected by the evaluation occurred in a site that had switched off ovens when not in use; in this case, AND TR had used equipment-level monitoring to identify how much running the ovens unnecessarily was costing.

Even where consultancy advice was not routinely offered, ad hoc advice was essential in a few instances to help sites interpret their data and identify how to conserve energy. For example, one site using E-CAT had contacted the developer to query why their energy use spiked overnight. The developer's support helped to identify that the boiler was switching on overnight to heat water; the site now switches the boiler off at night as part of their route practice. One site piloting fluttr explained that they had worked closely with the developer to help set an energy use reduction target to work towards, and actions to achieve it, that they could not have set independently.

> *"We aimed … following some advice that Considerate gave us, we aim to drop [our consumption] by 2% to 3%, if possible, on electricity. We had a meeting [with Considerate]. We discussed [our target] and they showed us data from other hotels as well, yes, and they were very helpful, very good with it. – Hospitality manager, fluttr pilot*

There are several examples of sites being able to use E-CAT, GlowPro and fluttr to improve energy management without consultancy support or further guidance. Among fluttr users, for example, the evaluation did not find any particular difference in outcomes between users recruited during the earlier and later phases of testing, despite the former being offered more intensive support (multiple telephone calls and emails).

However, there are indications that impacts may be more limited in the absence of direct support and that some sites would have liked more guidance to interpret their data and its implications. For example, some GlowPro users accessed the tool independently, while others were given consultancy support. The additional support seems to have led to process changes (equipment programmed to be turned on-off at designated times), while using the tool on its own led mostly to staff being more aware / managers monitoring equipment usage more closely. In line with this, two E-CAT users highlighted that they needed more support to engage with the tool more frequently and to realise savings, including one site interested in appliance-level monitoring:

> *"I'd like to reduce [my energy consumption], but I need somebody to tell me. … Even if it's just once a month, that they give you a quick call … We can have that chat and then if I know [how to reduce my consumption*]. *If you don't know, you're going to try and ignore it as much as you can." – Small retail manager, E-CAT pilot*

> *"If we could measure all of our appliances and how much power they are using on a daily or weekly basis, we'd be in a lot better position to prioritise our actions… that would be a very, very useful thing to be able to do." – Hospitality manager, E-CAT pilot*

Features of the tools most important for engaging businesses

This section describes the tool characteristics which had greatest effect in engaging users.

Data presentation: Staff working in the retail and hospitality sectors are often short on time and tend to have priorities other than energy management.[28] The tools which were most successful in obtaining and sustaining user interest were those which presented information in **visually appealing and easy to understand ways**. E-CAT and fluttr were particularly praised by the users consulted for this evaluation for their simplicity.

> *"It's so intuitive…It was just load it up, log in... It was idiot-proof, for want of a better word." – Small business owner, E-CAT pilot*

> *"Before we used this, we had no idea when, how much [energy was used], apart from receiving the bills at the end of the month." – Hospitality, chain organisation, manager, GlowPro pilot*

Data was more likely to be considered accessible and well-presented where it was presented:

- By amount of money spent. This helped managers to better communicate energy use to staff, and to quickly contextualise their energy use. Business owners still appreciated the information on energy consumption, however, as it allowed them to validate their energy bills, thus giving them greater operational control.
- In graphs showing energy use over time. This enabled businesses to build a profile of their energy use.
- As part of an 'alert', e.g. indicating a piece of equipment not functioning.
- As part of the daily routine – i.e. as part of an open / close checklist function.

Where usage was compared to that of other businesses (in the case of E-CAT's benchmarking feature) or to historical use (as with fluttr), this also helped users to contextualise – and better understand - their data use. However, as discussed elsewhere in this chapter, benchmarking was only considered useful where the businesses compared were of sufficient similarity. For fluttr, historical use comparisons were presented as faces which were 'smiley' when usage was the same or less than the previous day (by room occupied / table covered) or 'sad' when usage

[28] SME Market Transformation Workshop

was greater. Users who fed back on this feature found that it was helpful at providing an easily accessible indicator of usage, particularly for time-poor managers.

Data granularity (energy use monitoring by time-period) and equipment-level monitoring was key to the success of some pilots. The tools offered most pilot participants more information than they were currently receiving from their energy supplier. Most had only accessed monthly data from bills before using the tools and having energy data at this level of detail was a key attraction for pilot sites. Even users who felt they had a good understanding and management of energy data before benefited from the data the tools provided. One fluttr user, for example, who was already closely monitoring their own energy use before using the tool, stated that fluttr had enhanced their understanding of their energy use and would help them to monitor the energy impact of changes they intended to make to their business (the installation of a new terrace and outdoor heaters). A few sites, which already had energy management systems in place, disengaged from the pilot of AEMS because the data was less detailed than the data they already accessed, and because they had trialled the tool in order to access more fine-grained information.

> *"To me, a really interesting thing to look at is the temperature in the different parts of the building. [...] I want to make sure that [the customers] have not been having it too hot or too cold [...] [GlowPro] tells me that it's kind of normal throughout the entire day, and I'm happy with that." – Hospitality business manager, GlowPro pilot*

Live data feeds were considered very useful by users. Users described how it enabled them to test how specific pieces of equipment changed the profile of energy use. They also reported that live data feeds could alert them to unusual spikes of consumption, and thus enable them to identify (and take action to deal with) faulty equipment, blackouts, or energy surges as they happened. Users of E-CAT highlighted the live energy use data as the most useful feature of the tool. However, while some sites considered live data crucial to their understanding of energy use, others were still able to test usage at different times / under different contexts using historical data, suggesting that **data granularity is more important than live feeds**:

> *"One of the things we did have a look at was the whole time when we were shut, what the electricity usage was. [...] we realised how high it had been when there was nobody here at all." – Retail business manager, GlowPro pilot*

> *"…we've actually used it to, for example, switch something off for a period of time, and compare the usage on the day we did that to the equivalent day the week before, so we could see the impact." – Hospitality business manager, E-CAT pilot*

Daily tips served as useful prompts to check equipment and processes and help to keep energy management 'top of mind' for users. However, across the tools that issued tips, there were **mixed views as to their usefulness**, but most felt that at least some of the tips had been helpful. Tips appeared to be most successful when they:

- **Were directive** rather than describing energy use and recommended specific changes to implement. Tips that did not suggest specific actions to implement were viewed as less helpful.
- **Highlighted no-cost and low-cost ways to improve energy management**, as well as those requiring larger investments. E-CAT's categorisation of tips included no-cost, low-cost, and higher-cost recommendations.

- **Contained new information for users**. This may have been particularly the case for users who were less engaged in energy management prior to the pilot than users of other tools. Even tips that were not viewed as innovative could be helpful reminders - fluttr users found the tips served to remind them to check equipment for example.
- **Allowed users to set reminders**. E-CAT enabled users to schedule (regular or one-off) alerts to remind them to carry out maintenance and servicing activities. This meant that they would be prompted to carry out measures which they may not want to carry out immediately but might consider useful in the future. This feature was added in response to user feedback during the Phase 2 piloting stage.
- **Gave users an indication of the impact of changes**. E-CAT's users can mark a recommendation as 'complete' when implemented, and by overlaying the actions completed against timelines of energy consumption data, help in determining the impact.
- **Contained relevant information for users**. E-CAT asks users to 'like' tips they considered relevant and useful, to encourage peer-to-peer learning about the usefulness of different measures.

For some users, the tips had directly informed changes, including adopting more efficient refrigeration practices and cleaning windows to reduce lighting requirements.

Some tool features were less appealing to users. These included **tool features which required users to input information** (e.g. business metrics, budget / energy use targets) themselves as already time-poor users were not motivated to spend the time to input information. They were much more likely to input this information with technical support (e.g. from the tool developer or third party) as part of an induction process. The use of **budgets** was appealing to some users, but, without tailored help to set appropriate budgets, users were unable to take advantage of the feature. Some AEMS users noted that, in principle, they would be motivated to set and adhere to a budget; but felt the target set by the tool was either arbitrary or unrealistic. Others were not motivated by this feature, believing current consumption was justified by business need. Similarly, consultation with users suggests they would be more likely to use budget-setting features if provided with external support in setting them up.

Finally, the **format of the tool** also played an important role in engaging users. Having the tool accessible via a mobile phone appealed to users of fluttr. AEMS and GlowPro users also had the option of using a mobile version of the tool, but several GlowPro and AEMS users stated that they preferred to access the online platform version via a computer. Some users of fluttr also suggested that they might benefit from having the tool in a desktop accessible version (in addition to their mobile app version). In particular, management-level staff across pilots (who were typically office based or managed the business from a computer rather than a mobile) liked the ability to access data via an online portal, or to download data into a spreadsheet. In the case of AEMS, discrepancies in the online/mobile offer notably affected usability, since the alert feature which was an important feature of the tool did not function in the online version. This suggests that, where multi-media formats of the tool are to be offered, these need to be consistent in their offer.

Improved **employee and customer comfort** (i.e. through the improved controlling of temperatures) was an anticipated benefit of the tools. Users of E-CAT and AEMS had found the reports generated by these tools to be useful in supporting **business operations**, as they helped managers track equipment use and link this into maintenance operations and audits.

Several tool users reported that they had used the tools to better understand how business operations (timing, equipment) drove energy use and to identify potential cost savings. In this way the tools, in these cases, supported operational efficiency. Two of the piloted tools (AEMS and E-CAT) also expected to help businesses **to improve their green credentials** and thus their **branding** (leading to increased footfall and profitability), but these were longer-term outcomes which were not measurable within the timeframe of this evaluation.

Engaging multiple users

Features which allowed non-managerial staff to log into the tool also had limited success. Both GlowPro and fluttr were designed to allow use by managers and staff (shop-floor staff, waiters, chefs, cleaners, etc.) at participating sites, however, only senior staff and decision makers used the tool and they did not disseminate it to non-managerial staff. Some fluttr users explained they had been unaware of the multi-user functionality or wanted to learn more about the app themselves before disseminating it. However, it is striking that most reasons given suggest that users did not feel it appropriate to disseminate, including a belief that staff should prioritise other responsibilities, and scepticism that staff would engage with an app. These findings reinforce views expressed by business owners during the stakeholder workshops with industry and hospitality representatives.[29]

> *"[The staff] wouldn't use it in the shop. […] They're making money, they won't stand and look at that [the app]. If they had time to look at that, I'd probably be making them redundant" – Manager of retail business, GlowPro pilot*

The multi-site (i.e. chain store) model piloted by AEMS, fluttr and GlowPro similarly had mixed success in engaging businesses. AEMS and GlowPro took a top-down approach to this model, targeting the head store (with responsibility for paying energy bills and making energy management decisions), with the aim of disseminating energy efficient practices across the chain sites at once. However, the head companies did not consistently share the tool / learnings from the tool with all sites. For GlowPro, the multi-site model had some success: there was some evidence that the tool and the practices it suggested had been shared (though this was not observed for all chains within the timeframe of the evaluation).[30] With AEMS, the primary person given access to the tool (and responsibility for disseminating it) had not found the tool useful and had therefore acted as a gatekeeper to take-up within the wider organisation.

Another route to increasing engagement across multiple sites might be 'bottom up' dissemination through one of the sites of a chain venue. Within the E-CAT pilot, a Post Office was given a new piece of equipment (a counter), which was also given to other Post Offices nationwide. E-CAT showed them that they were using a lot of energy overnight compared to similar businesses, which they identified as linked to a new counter, which had a touch screen and bright lights. They then got in touch with the central post office team, who informed all Post Office branches of a turning-off policy overnight.

This positive impact appears to have been driven by the fact that the energy saving measure could be clearly linked to a piece of equipment used uniformly across all of the businesses. Where energy use is more variable across chains within a business (i.e. because they use equipment at different times / in different ways, have variance in customers and have different size businesses, etc.), it may be more challenging to achieve energy savings across all chains at once, even where energy is managed (and paid) centrally.

[29] SME Market Transformation Workshop
[30] And there were no clear indications at this stage as to whether they would be shared in the future.

Variation in tool engagement by sector

At the outset of the Competition, there was an understanding, based on previous research commissioned by BEIS,[31] that the extent to which organisations were actively managing their energy consumption (and seeking to make savings) varied across businesses. It found that the factors driving variability included the size of organisations, energy intensity, the importance of reputational drivers and the availability of skilled staff to undertake energy management. With this in mind, the Competition selected Partners who would target a range of businesses. The research also suggested that businesses may need tailored energy efficiency hints and tips and 'message hooks' to encourage take-up of the tools. By piloting the tools within two distinct sectors (small retail and small hospitality), the Competition aimed to test whether there was a need for and/or value in tailoring tools to particular sectors.

The findings from this evaluation support the theory that organisations are more likely to engage with smart energy management tools which provide some form of tailoring (the findings presented in Chapter six, in relation to schools, also support this theory by recognising the significance of shared culture, organisational structure, equipment use and other such factors). However, the evaluation has not found that such tailoring must fall neatly into sectoral boundaries for businesses. With regard to messaging, the evaluation has found that the same kinds of drivers motivate actors within both small retail and hospitality businesses, and therefore the same kind of messaging (around cost savings, operational benefits, greater control) are likely to benefit actors within both sectors. More broadly, the evaluation has found that tailoring features or energy efficiency tips towards sub-sectors of businesses (for example hotels, see below) may be a more useful way to segment sites as there is more commonality in energy use than across a sector as a whole. Therefore, whilst entire sectors may be a useful proxy for identifying businesses with similar characteristics, sector has not been found to be a primary driver of Competition outcomes in and of itself.

The nature and profile of the retail and hospitality businesses piloting the tools

A variety of businesses participated in the pilots of the Competition tools. Within the hospitality sector, participating businesses ranged from cafes and coffee-shops through pubs and bars to hotels for the hospitality industry. These businesses used energy in different ways: hotels were more likely to be concerned with heating and lighting and cafes and bars with use of specific machinery such as coffeemakers and ice machines. The retail businesses varied even more, covering businesses as diverse as woodworking studios, small-scale manufacturers (seating supply, micro-breweries), dog-groomers, small supermarkets and gift shops. The findings from the GlowPro pilot do suggest that some businesses within the hospitality sector (cafes, bars, restaurants) share similar heating and cooling needs (i.e. they all tend to have heaters, refrigeration, ovens, ice machines, coffee machines, etc.). Interestingly, some retail outlets (e.g. small supermarkets) may have very similar machine and energy use profiles to those within the hospitality sector.

In summary, the way these businesses used energy (and therefore the factors driving engagement with smart energy management tools, their experience of the tools and the benefits they could expect to get out of them) varied greatly within both the hospitality and retail sectors. A clear message coming from industry representatives consulted by the REP as part of this evaluation's action research conducted in early 2020, was that the small retail and hospitality sectors are not internally uniform and the way they use energy (and benefit from

[31] https://www.gov.uk/government/publications/smart-metering-in-non-domestic-premises-early-research-findings

management tools) is very likely to differ. This reinforces the notion that giving consideration to sub-sectors of businesses in the tailoring and marketing of tools might be useful for customers.

What our research has found is that the factors most likely to affect uptake of the tool (and behaviour change) amongst small businesses are:

- **The complexity of energy use within the business and the extent to which the tool accurately tells them how they can change their energy use** (e.g. through equipment-level monitoring). Businesses which have very little energy-intensive equipment will only be able to make savings / change behaviour if the tool is able to show them with granularity that they are using excess energy. Conversely, businesses using lots of energy-intensive equipment such as fridges or heavy machinery may only be motivated to switch the equipment off if the tool can accurately predict / demonstrate savings (so that the benefits of that can be weighed against operational costs or risks – e.g. risk of forgetting to switch the fridge back on or the costs of training up staff to switch off equipment).
- **The business's organisational structure and the extent to which changes to energy use need to be 'filtered down' onto other staff** or, conversely, the extent to which processes can be automated (i.e. this reducing the need for staff training and mitigating 'human error').
- **How motivated they were to making energy savings** (whether because of a green agenda and/or financial reasons).

User perspectives on sector-specific tailoring of tool functions

Amongst the tools piloted by businesses, E-CAT and fluttr tailored aspects of their tools to the sector in which it was piloted: E-CAT and fluttr offered tips and benchmarking tailored by business type and fluttr also presented information on energy use against business metrics, to show the amount of energy consumed by people served (for example). Users of E-CAT found the tips and benchmarking useful when it was tailored to the type of business. Here, business 'type' meant not only same sector, but also same energy use profile (i.e. type of equipment, time-of-day usage and energy intensity), as well as building and staff size. Similar feedback was given by fluttr users consulted for this evaluation. Where organisations did not find the information sufficiently tailored, they did not use it.

> *"I didn't find it helpful anyway, really…people are in different circumstances to me and the sizes of buildings and all this sort of thing, it all makes a lot of difference, doesn't it…" – Small retail business owner, E-CAT pilot*

> *"I don't think that's relevant…[…] we're a hybrid retail and restaurant operation […] So, the amount of refrigeration we have in the business is probably like nothing else…" – Large deli and restaurant business manager, E-CAT pilot*

This strongly suggests that tips and benchmarking need to reflect sub-sectoral characteristics of the businesses concerned. However, where these sub-sectoral nuances are harder to predict (i.e. for innovators wanting to target a broad base of clientele, or for third parties (TPIs, energy suppliers, Government) wanting to increase the uptake of such tools in particular industries), 'sector' may be a useful proxy for tailoring the offer / functionality and the marketing of tools.

The feature of fluttr enabling energy use to be presented by tables covered / rooms occupied, received mixed views amongst those piloting the tool. The evidence here is insufficiently weak to strongly conclude whether or not this type of sectoral tailoring within a tool might help innovators to attract new customers and generate benefits for users. Hotel managers using fluttr, consulted for the evaluation, reported that they found the feature beneficial, as it helped them to understand their energy use within the context of their sales. However, they had not made use of it as frequently as was expected (from fluttr's design). As the feature required manual input of occupancy, they would only enter it when they had additional time to use the app (as otherwise they were too busy to input data).

> "We*'ve used £233 this week, last week £243, and last week was a bit quieter, but [I've] never fully recorded room use [against energy consumption]." – Hospitality, Hotel, Owner*

How the tools increased knowledge and changed behaviour

Effects on energy efficiency knowledge and understanding

A primary outcome of the tools is their effect on upskilling and learning about energy efficiency. As discussed above, the extent to which tools offered users new information was critical to their engagement with the tool. Users across each of the tools piloted within businesses reported that the tools allowed them to monitor energy use more frequently than bills from energy suppliers enabled, and the fine-grained data provided by the tools gave a greater depth of understanding of energy use, enabling them to cut down on wastage.

Whilst, as described above, tools with multi-user access were rarely used beyond managers (because managers did not see value in this), in some cases, business managers did share learning and data from the tool with staff. The tools' provision of data in terms of both cost (£) and energy units (kWh) was useful in these communications, as cost information was more easily understood and more persuasive when trying to change staff behaviour. For example, one fluttr user commented that it was often *"very difficult"* to engage staff members in green policy objectives; but by using the app to demonstrate the monetary effects of using different appliances to staff, they had increased awareness.

> *"[The cleaning staff] put all the lights on in every room, and they may not be going back to that room for an hour […] When you show them fluttr and you show them that energy consumption has gone down because you'll let them behave their normal way one day, and then the next day you say, […] between eleven and twelve, you've saved £1.27 in energy [by turning room lights off]. They go, oh wow, £1.27." – Small hotel owner, fluttr pilot*

Effects on energy use behaviour (including operations and processes)

Users across each of the tools piloted within businesses reported that they made changes to their energy consumption behaviour, after learning about their energy use from using the tool. Around half the users in the E-CAT and GlowPro pilots reported changes to operations. Common changes included: turning off equipment when not in use; restricting the operating times of equipment; inputting timer plugs that automatically switched off equipment during non-business hours; and training staff to use equipment more efficiently.

The pilots highlight the value of including a range of features within such tools – such as tips, benchmarking, and budget-setting – because each feature will appeal to different users. While any given feature will only be useful to a subset of users, among those users it can help to drive energy efficiencies. As noted above offering enhanced support packages alongside the tools, in the form of equipment-level monitoring and tailored advice, can help to identify the potential for savings where businesses lack the time or knowledge to do this themselves, and in cases where businesses are unconvinced there is any potential for savings.

Effects on investments in equipment

In addition to behavioural change, the developers of the small retail and hospitality-focused tools expected that the tools would, in some cases, drive businesses to invest in more efficient technologies. This might include an energy-efficient fit-out when opening a new premise or refurbishing existing premises; the purchase or upgrade of equipment; improvements to heating / cooling systems and Building Management Systems (for larger sites); improvements to lighting systems (such as switching to LED lights); and fuel switching e.g. from electricity to gas to take account of lower costs for an alternative fuel.

Although there was limited evidence of the tools driving decisions to invest in new technologies directly, they had, in several cases, made energy efficiency a more prominent consideration when planning and making decisions around such equipment upgrades. For example, one site was phasing in new lighting to meet their own energy reduction target, using the tool to monitor energy use as they did so; and another site had established an energy efficiency fund to draw on when making upgrades to equipment as a result of using the tool.

In general, the short duration of the pilot meant that it was unlikely that the evaluation would observe equipment upgrades. In one case where larger-scale changes had been made, it was clear that the tool was introduced at an optimal point in equipment replacement cycles: in one case the tool had acted as a catalyst when upgrades were already planned for example, and another site highlighted that the tools would have been particularly useful to them as a start-up, to help guide early investment decisions.[32] This highlights how, in some businesses, behaviour change - especially process change - might take time, especially where changes to energy use might have implications for other business operations (e.g. health and safety procedures, business opening and closing processes, etc.).

There were no examples of investments being made or planned among users of GlowPro and only a few among users of AEMS, fluttr and E-CAT. Most changes were fairly small-scale in nature, such as replacing lighting. The main function of the tool in these instances was to check the energy consumption of new equipment. The findings from the pilots suggest that sites may need more tailored support to understand the potential savings associated with upgrading equipment, and support to identify solutions. One barrier to investment is sites' scepticism that the savings associated with upgrades would be justified by the outlay on equipment. Offering appliance-level monitoring more widely, coupled with tailored advice on the likely energy consumption of replacement equipment, may help to convince sites of the

[32] The interim evaluation report of the Competition provided insights into the times at which energy management and equipment purchase decisions might be made within schools and in the small retail and hospitality sectors. For example, in schools, planning and decision making is most frequently carried out at the start of the school year (i.e. October and November) or early in the year (i.e. January and February). The interim report is available here: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/827945/ndsemic-interim-report.pdf

potential for savings: some sites highlighted that they are not aware of how much energy individual appliances are using, or which appliances in their business are driving energy use.

Lessons learned from the piloting of smart energy management tools in small businesses and the implications for commercialisation

The discussion above explores factors that have facilitated behaviour change (and energy savings) within small businesses in the retail and hospitality sectors. This section summarises learnings that may be relevant for the commercialisation of such tools in these sectors, including the types of small businesses that may be 'early adopters' of smart energy management tools, as well as design features that could be most likely to engage customers when further tested and taken to market.[33] The following are key lessons learned related to **recruiting and engaging sites.**

- Key hooks for recruiting sites comprised the potential cost savings, environmental concerns, and improved business management. These motivations were found across both the small retail and small hospitality sectors and regardless of pre-existing green motivations. Many sites with no prior interest in the green agenda participated often because of the opportunities provided to increase operational control and save costs.
- Some participated in the pilots because the offer was free / incentivised (in the case of E-CAT) and they had 'nothing to lose'. In such cases, willingness to pay for these tools in a market context may not be universal; i.e. these users may only 'accept the offer' of such tools if they don't require an additional cost.
- Support to answer ad hoc queries (and ideally more tailored guidance) proved important in gaining (and maintaining) interest in tools (and therefore may also prove important commercially).

The following are key lessons learned regarding the **design of tools**:

- Business owners and managers with responsibility for energy bills were the primary users of the tools piloted. Non-managerial staff were unlikely to access energy data directly, although in some instances managers used the data to train staff and change processes. Providing data in ways that helped managers to communicate with staff proved helpful (such as cost metrics, tips that can be shared in team meetings).
- Most users lacked the time and motivation to manually input data into tools, such as business metrics (e.g. number of rooms occupied) to provide contextualised energy use data. Where used, such information did help businesses to better understand their daily energy use. Therefore, businesses may require support to enter this data in order to make use of such features, or innovators may need to find ways to automate these features.
- Management-level staff in particular liked the ability that some tools provided to access an online portal; therefore, access to a web-based tool may be an important tool feature even if the service is also available as a mobile application.

[33] Whilst it is not possible to generalise entirely from a pilot scenario to a real-world market context, it is possible to make inferences or hypotheses based upon this research.

- Non-managerial staff were less motivated to save energy than managers and energy use was not necessarily front-of-mind or a priority. Consequently, they may not always follow through on energy management policies. Insights from the REP's wider research suggests that staff turnover in these industries may also affect the extent to which staff can be trained to use energy efficiently. Automating staff inputs as far as possible, by linking tools with other business management systems, could therefore be helpful for users; alternatively, staff may be more motivated to input information themselves to meet customer service objectives, rather than energy efficiency objectives.

The following are key lessons learned regarding the **impact** of tools on behaviour change and energy consumption:

- While the tools did generally prove effective in prompting energy efficient action across pilots (particularly "quick wins" and action by businesses with less complex equipment), the pilots also suggested that personalised support and equipment-level monitoring may be necessary to support sites to make larger or more complex investments, for example substantial equipment upgrades.

- For those with an existing sustainability drive or who were already monitoring their energy use, tools only prompted action where they provided new information to the user, e.g. in the form of more granular data on use (by time or type of operation), or by equipment.

- Energy efficiency tips, alerts and advice were most effective when tailored to the organisation, though this did not always cut neatly across sectoral boundaries. Often sub-sectors (i.e. hotels), type of equipment, time-of-day usage and energy intensity proved more important ways of 'segmenting' customers than 'whole' sectors.

- Similarly, some other features of tools – including budget-setting and benchmarking – were more effective in changing behaviour when sufficiently tailored to the user's context or organisation. This was achieved where pilots offered people-led support to set up the tool to be optimally tailored to the profile of that business and/or where the tool was able to draw business-level information (e.g. from existing datasets) to make them more relevant.

- Effective energy management practices were sometimes disseminated to non-users of tools (i.e. the Post Office 'counter' example cited earlier in the chapter). This was particularly likely among branches of chains / franchise operations but was also evident among independent businesses. This suggests that not everyone needs to use the tool directly to benefit from it. An organisation's management could use such tools to identify practices which are then passed down to other staff within the business.

- Smart energy management tools were able to have an impact where their use and/or their recommendations became part of routine business practice. As such, automated controls such as smart plugs were highly effective ways of ensuring equipment was turned on / off appropriately; and reports and tips provided within tools were sometimes integrated into standard monitoring or meetings.

Chapter 6 The outcomes of piloting smart metering innovation in schools

This chapter builds on the findings presented in Chapter four to provide more in-depth information about the factors that supported or inhibited the effectiveness of the tools in schools. The chapter gives an overview of how the tools compared, how they engaged users, and their effects on users' behaviour. Finally, it presents reflections on the implications of the lessons learnt from the four tools piloted in these sectors.

Four Competition projects piloted their tools in primary and secondary schools, of which three were targeted at schools only (Energy in Schools, Energy Sparks, and Untapped) and one was targeted at both schools and small businesses (E-CAT).

The tools all aimed to help schools change their energy use behaviour to become more efficient, reduce their energy use and save on energy bills. Alongside the ability to monitor energy use, the three school-specific tools included learning materials, such as lesson plans, which aimed to educate pupils and teachers about energy use and climate change.

The school-specific tools aimed to engage different actors within each site, including senior decision makers or energy managers (responsible for energy monitoring and bills), teachers and pupils. Energy Sparks was also set up to be accessed by central local authority or multi-academy trust personnel who were responsible for monitoring energy use across several schools.

The tools aimed to engage different actors across schools through:

- **Differentiated access to dashboards** and tailored information. Energy Sparks and Untapped included different dashboards for different users / audiences so that, for example, data was presented in a non-technical way for pupils. In addition, Energy in Schools restricted access for pupils and teachers to certain areas of the portal.
- **Providing learning resources**, aligned to the national curriculum and across a range of subjects, which in some cases incorporated the school's own energy use data, to engage teachers and pupils. Samsung's Energy in Schools materials included lesson plans that made use of micro:bit computers. These were small computers that could be programmed (coded) by pupils and teachers to monitor and measure energy around the school. Samsung also offered materials that taught teachers and pupils to code, with the intention that they could both learn coding skills and use those skills to better understand energy use.
- **Gamification and competition** to motivate pupils to complete activities and compete against other schools. Energy in Schools, Energy Sparks and Untapped used league tables to compare energy use across participating schools. Energy Sparks also included gamification to encourage pupils to earn points on the scoreboard by completing activities across five categories: investigating energy usage, learning, spreading the message, acting around the school and whole-school activities. Samsung provided large TV screens to users of Energy in Schools which displayed energy use and leader board information to raise the profile of energy use across the whole school.

- The use of **Energy Champions** to improve awareness and encourage behaviour change across schools. Within Energy in Schools, the Champions were pupils and within Energy Sparks they were adults (teachers, governors, parents, etc.). Both pilots trained volunteer pupils in energy awareness and included activities to help identify and promote opportunities to reduce energy waste across the school, such as poster campaigns. These included materials to set up and run ‘eco-clubs’ – i.e. after-school clubs that teach and encourage children about how to act more sustainably.

How the tools engaged users

Gaining interest

Competition Partners used a variety of routes to recruit schools into the pilots:

- Energy in Schools was advertised via the consortium partners’ networks and an educational event: 60 schools expressed interest in piloting the tool, from which 20 (14 secondary and 6 primary) were selected.
- Energy Sparks recruited via local authorities and existing school energy initiatives: 65 schools were recruited, 50 of which were primary schools.
- The Hoare Lea consortium had greater difficulties in recruiting via their personal networks for the Untapped pilot, but ultimately recruited 49 schools, although 36 belonged to one of four multi-academy trusts.
- In addition to the small businesses piloting E-CAT, Element Energy recruited 11 schools via their energy supplier partner.

Across the pilots of Energy in Schools, Energy Sparks and Untapped, **many participating schools were attracted to the tools because of an existing interest in sustainability**. In these cases, the schools often linked their participation in the pilot to ongoing efforts to raise awareness and inspire pupils to have a sense of agency over energy use and environmental issues (e.g. as part of eco-clubs). For these schools, the opportunity to expand their repertoire of educational resources and gamification was particularly attractive.

Offering learning and educational resources appears to be critical in engaging schools. Users of both Energy Sparks and Energy in Schools found the package of learning materials and resources attractive and testing of Untapped showed that teachers were enthusiastic about the learning materials it included (though limited awareness of these features prevented use). E-CAT achieved very clear outcomes amongst smaller businesses but not amongst schools, and the lack of an educational element may help to explain the discrepancy.

The fact that Samsung offered technology to enable pupils to learn coding linked to the Energy in Schools tool and a TV screen displaying energy data had helped to gain the attention of teachers or school leaders in some cases, but it was the full package of educational resources and the energy saving potential that motivated their real interest.

> *“The bonuses of the freebies were amazing... The appeal was the TV screen, but also the ability to give students something that would empower them and help them change their futures.” – Primary school deputy headteacher, Energy in Schools pilot*

Competition Partners with an existing strong understanding of the school sector found recruitment easier: they were aware of school structures, who to target, and when to contact staff. Given the significant challenges in engaging the attention of time-limited staff in schools, the links and understanding of partners such as Energy Sparks and the Samsung team were critical enablers of success. For example, most schools involved in the Energy Sparks pilot heard about it through word of mouth, via parents, governors or headteacher meetings or through Energy Spark's partners. An **endorsement from a local authority** helped to promote Energy Sparks as one of the programmes that can help meet a surge in demand from pupils to tackle the climate emergency.

> *"There's been a massive increase in interest in Energy Sparks in [Local Authority area] in the last six months or so, since all of the climate emergency, and the youth strike activity. […] the staff in schools are getting a lot of demand from their pupils about reducing carbon emissions. I think Energy Sparks was presented […] as one of the three active supported programmes that there are currently available in [Local Authority area] that can help schools cut carbon emissions." – Local authority representative, Energy Sparks pilot*

The route for recruitment had a knock-on effect on engagement with the tools, as schools who were further removed from the developers (e.g. those recruited via a multi-academy trust for the Untapped pilot, or through an energy supplier for the E-CAT pilot) appeared to engage less well than those recruited directly. In some cases, those recruited directly were offered an enhanced induction, with personalised demonstrations of the tool (Energy Sparks) which further helped engagement.

Local authority staff helped to promote Energy Sparks across schools in their areas, which helped increase uptake of the tool, but often limited the way in which it was used. For local authorities that promoted Energy Sparks across their schools, the main value of the tool was the opportunity to help schools save energy and energy costs, or – where local authorities were responsible for monitoring energy use – to provide a consistent way of monitoring data across all schools under their remit. Schools introduced to Energy Sparks via their local authority tended to use it as an energy monitoring tool and were less likely to engage with the educational content.

Overall, more primary schools engaged with the programme than secondary. Local authority staff consulted as part of the evaluation speculated that this could have been due to the primary leaders and teachers spreading the news of the Competition within their sector more than across sectors. Other factors they considered might have played a role were the relative flexibility of the primary curriculum and the lack of formal assessments such as GCSEs that inevitably would be more of a priority in secondary schools.

Engaging schools to use the tool

Engagement with key actors

All tools except E-CAT targeted a range of users in schools such as pupils, teachers and energy managers (E-CAT only targeted energy managers). In the case of Energy Sparks and Energy in Schools, these different users were offered different experiences or functions of the tool.

The most commonly used features of Energy Sparks and Energy in Schools were those aimed at pupils and teachers. For example, teachers involved in eco-clubs would typically use Energy Sparks to explain the historical data (typically by day, week or month) and to discuss with pupils how energy use differed at certain times (i.e. class time) or on certain days (i.e. weekdays). Sometimes they structured the eco-club activities around Energy Sparks learning resources. Likewise, teachers involved in the Energy in Schools pilot used lesson plans and energy statistics in their lessons. The TV screen provided as part of the Energy in Schools package was viewed daily by staff and pupils across participating schools.

Engagement with the school-specific tools was more limited where schools were not aware of resources for pupils and teachers, which was often linked to recruitment occurring through third parties, e.g. multi-academy trusts (Untapped) or local authorities (Energy Sparks). This meant that the user was generally not given as much advice and support as those which had been inducted onto the tool by the Competition Partner.

The frequency of using the tool also varied. Some schools (users of Energy in Schools and E-CAT) used the tool fortnightly or monthly. In these cases, the frequency of use was consistent over time. Other schools (users of Energy Sparks) used the tool more frequently in the first months, but such usage was not necessarily sustained over time, decreasing to quarterly checks. This was the case when users felt that they had already made as many energy efficiency changes as possible. However, the evaluation also found that schools using the tool had a desire to maintain the energy champion role, which would suggest an ongoing use for the tool (as an energy monitoring resource).

Energy managers within schools engaged with the tools in similar ways to managers of businesses (see Chapter five), using the tools more frequently initially to understand energy use, then switching to regular (but less frequent) monitoring of energy use. **The evaluation found that knowledge about tools was not always transferred to the most relevant personnel in schools which sometimes limited their impact**. For example, decision makers were not always involved in using Energy in Schools which limited the implementation of energy efficiency and management measures in some instances. For other tools, there were instances where decision makers were not aware or did not make teachers aware of the educational resources on offer. This suggests that where tools aim to change behaviour across multiple users, they need to target these users individually (e.g. by providing tailored features) and ensuring users are aware of any aspects of the tool relevant to them. Energy Sparks may have had slightly more success in engaging multiple users within schools because it connected use of the tool to school-wide initiatives around sustainability, thus **embedding the tool within the overall school culture**.

Support and advice

A range of written, video, and personalised support via calls (all) and visits (Energy in Schools, Untapped) was offered to schools. Energy Sparks had some guidance features built in, such as an automated enrolment system that gave schools clear guidance on how to set up the admin account and how to link their data to the tool. The initial support aimed to familiarise users with the features of tools – and, in the case of Energy in Schools, associated equipment such as sensors and micro:bits, and the pupil Energy Champion role – and to promote their potential benefits. **Where manuals and videos were provided to enable school IT staff to set up the equipment independently, significant levels of personalised support were still needed initially, and during, the pilot** in the form of telephone or text support, emails and in some cases face-to-face visits. Indeed, the whole-school induction offered as part of Energy in Schools was noted as greatly supporting and encouraging tool uptake by most schools consulted for this evaluation.

As part of Energy in Schools, Energy Champions were also supported through an optional ‘National Grid’ webinar. One school visited talked very positively about the webinar:

> *"The way that the children could ask questions of them was absolutely fabulous because it was like going on a school trip where we didn't have to go on the school trip because it was all done through video conferencing. We were then able to have video conferences with other schools on the project as well so we could hear what they were doing," – Headteacher, Energy in Schools pilot*

Both Energy Sparks and Energy in Schools provided ongoing telephone and email support to aid in trouble-shooting issues. However, Energy Sparks is exploring third party partnerships as a way to provide more support, highlighting that **ongoing personalised support is likely to be important to ensure schools continue to engage in the full range of features offered by tools.**

Features of the tools most important for engagement

Those responsible for energy management reported the most useful features of the tools were the **half hourly or sub half hourly data readings**. This data allowed users to identify which equipment or processes used the most energy or to assess what amount of energy was used at certain times of the day. In cases where schools struggled to understand the data, a face-to-face interaction between the provider and the school, and a walk though of the app, seemed to have led to meaningful engagement.

Teachers used the **educational resources** provided within Energy Sparks and Energy in Schools, although in neither case were resources used across the whole school. Teachers used the educational resources either as part of standalone lessons e.g. maths, using the graphs the tool generated (those taking part in the Energy Sparks and Energy in Schools programmes) or as part of extra-curricular activities i.e. when participating in school eco-clubs (those involved in the Energy Sparks programme). However, activities carried out by eco-clubs helped to reach pupils across the school, such as posters encouraging more energy efficient use of equipment, and stickers on lights to remind pupils and teachers to turn them off. In some schools, additional activities had been carried out which involved pupils across the school, including an energy workshop, and activities to work towards sustainability awards (as part of activities developed by the school or charities working with the school).

Teacher engagement was supported by the educational resources provided, such as the lesson plans and energy champion activities. These fulfilled a need for those schools with an interest in developing this area of their teaching, plugging gaps in pupils' understanding of energy use and/or meeting pupils' demand for more teaching about energy efficiency. Overall, the educational materials were considered to be high quality, with school-specific energy use statistics especially appealing in prompting discussions with pupils. However, teachers with no prior experience of coding found the micro:bit coding lessons plans (as part of Energy in Schools) complicated which limited the extent to which these elements were implemented. Teachers and school staff across the four programmes quoted the lack of time to engage in the tools and integrate them into lessons as a key barrier to engagement, though there are lots of examples across both the Energy in Schools and Energy Sparks pilots of teachers fully engaging and making use of the tools.

Pupil engagement seemed to be particularly supported by:

- **The element of competition:** Energy in Schools and Energy Sparks played to pupils' competitive spirit by displaying leader boards for the most engaged or most energy efficient schools. For Energy Sparks, a gamification element helped engagement by encouraging pupils to earn points for energy-related activities or energy savings achieved, with points displayed on the leader board. The TV monitor that Samsung provided to schools displayed consumption data and the school's position on the leader board, though some users of the tool considered the league table demotivating where schools were visibly at the bottom of the table.

- **Empowering pupils to drive change in their schools**, through providing them with information and ideas via Energy Champions and eco-clubs, and through a focus on behaviour change activities that could be driven by pupils. Pupils across the Energy in Schools and Energy Sparks pilots were empowered by the sense of responsibility it gave.
- **Accessible, easy to understand data** e.g. the presentation of energy consumption as a relatable equivalent (e.g. number of kettles boiled – Energy Sparks) or visualised in a way appealing to children (e.g. as penguins and polar bears - Energy in Schools).

Barriers to engagement in schools

A number of factors acted as barriers to engagement in schools:

- Recruitment by local authorities and multi-academy trusts was associated with lower levels of engagement in some cases, partly because they were not sufficiently equipped to properly introduce all key features of the tools at the on-boarding stage. As local authorities and multi-academy trusts are likely to continue to be important gatekeepers in recruiting schools, developers should consider ways to offer support directly to schools to ensure they are aware of the full range of benefits tools can offer, how to use them, and how to access further support if needed, e.g. by ensuring that the support package can be offered by third parties effectively.
- Low awareness among some users of the full range of functions offered by the tool meant that schools did not always realise the full benefits intended. This was also linked to recruitment by local authorities / multi-academy trusts.
- Information not being disseminated throughout the school – this was the case for Untapped. As Energy in Schools and Energy Sparks had group-specific functions and features tailored to their needs and as, in the case of Energy in Schools, the induction process had stages at which each user was inducted, they were more successful in reaching a wider range of users within the school.
- Tool-specific issues e.g. delays to the induction or log-in process.

The tools' effects on user knowledge and behaviour

Across the participating schools, the tools had a varying impact on schools' energy management practices.

Most schools using Energy Sparks surveyed for the evaluation had either changed their processes and equipment as a result of using the tool or used the data from Energy Sparks to mobilise staff / pupil support for new processes. There were several examples of the tools having an impact on schools managing energy more efficiently, including:

- **Frequency of monitoring**: More frequent monitoring (in some cases even weekly or hourly at times) which allowed users to identify anomalies, measure the impact of any changes to their practices and check their spending on energy.

- **Taking action**: Applying the knowledge acquired relating to energy efficiencies. For example, turning off or limiting the operating time of different equipment or engaging in reviewing different tariffs.
- **Adopting more energy efficient technologies**: A few schools had or were planning to upgrade / change their equipment to save energy.

Importantly, pupils taking part in the Energy in Schools and Energy Sparks programmes applied their learnings and engaged in behaviours such as turning off lights and discussing energy usage following their participation in the programme. Similarly, feedback suggests that across several of the schools that piloted Energy Sparks, there was evidence that pupils had actively encouraged teachers and energy managers to increase energy efficiency in the school. According to staff, pupil efforts had successfully led to changes in staff behaviours, although in most cases the scale of impact was confined to specific teachers or to those involved in the eco-club.

Effects on overall attitudes towards sustainability

Unsurprisingly, schools which were already seeking ways to reduce energy consumption and support pupil outcomes related to climate change and sustainability *before* engaging with the pilots, also showed promise in continuing such efforts beyond the pilot.

Arguably, these schools might have continued their efforts regardless of their participation in the pilots. However, there is anecdotal evidence that the programme might have driven small scale investments or encouraged decision makers to give higher priority to energy efficiency when deciding on a new investment. Since schools generally do not have budget for up-front investment, a dedicated member of staff, for example, an energy champion, with time to identify and apply for relevant funds, was a key enabler.

Further, all schools taking part in Energy Sparks suggested that they will continue offering eco-clubs. However, in the future, the scale of the impact of the programme through such extra-curricular activities could be larger; some schools which did not offer eco-clubs, reported their interest in introducing them, if they were able to staff them.

Importantly, some schools were already starting to implement a more thematic approach to their curriculum and were introducing Energy Sparks and Energy in Schools activities into their curriculum (e.g. maths lessons). These schools also expressed an appetite to enhance their efforts to integrate / embed activities from the pilot into their curriculum going forwards.

Several users interviewed during site visits for the Energy Sparks and Energy in Schools pilots referred to the knowledge they had gained in a way that suggested this had changed their attitude towards energy use more generally (in such a way that it might affect how they use energy at home and elsewhere). Interviewees also made references to different children's application of learning from the tools at home. One child piloting Energy in Schools had actually borrowed a micro:bit to use at home; another had thought about the lessons over the school holidays, conducted more research and had come back suggesting the school take part in a 'switch off day' (when all appliances are switched off for the day). There is also evidence, for one school, that the tool contributed to a cultural shift (towards greater sustainability):

> *"It has made us go on to try and get the Eco Schools Bronze Award. That's what we're trying to do now as a whole school, because that's obviously much more of*

a whole school thing, because you have eco-monitors in every class. That's the idea." – Headteacher, Energy in Schools pilot

It is very likely that that the multi-modal / multi-stranded programme offered via Energy in Schools was one of the factors which has helped it to reach these outcomes. The fact that pupils and staff were exposed to the outputs of the programme not only in lessons, but also in communal spaces (when schools had placed the TV and/or monitoring equipment there) and through assemblies, webinars, poster campaigns, etc. encouraged full-school participation.

Lessons learned from the piloting of smart energy management tools in schools and implications for commercialisation

The discussion above provides some useful indications of the factors that have facilitated behaviour change (and energy savings) within the school sector. This section summarises learnings that may be relevant for the 'scale up' or wider commercialisation of such tools across schools, local authorities and/or multi-academy trusts, including the types of tools that may be effective in supporting carbon reduction objectives and targets[34]. This is explored further in Chapters seven and eight.

First, on the **types of school likely to benefit** from smart energy management tools, the evaluation found that schools with an existing sustainability "infrastructure" were more likely to take up the tools. In several cases, there was a single individual within schools whose enthusiasm for energy efficiency led to schools adopting the tools, and whose commitment to using and championing the tool underpinned any successes achieved.

On **recruitment and engagement**, the evaluation suggests that:

- It is crucial for developers to have an **understanding of the school sector**, including school structures and staffing, so that development teams know who to talk to in schools, how to engage them, and when they should be approached. School staff are time-poor, and effective communications will be essential. Engaging the right personnel to use tools, and champion their use within schools, is critical to both initial engagement and realising improvements in energy management and consumption in the longer-term. This may be someone with existing responsibilities for monitoring energy use / paying energy bills, such as a headteacher or business manager, or a teacher running eco-clubs with pupils with an interest in the energy agenda. Effective 'energy leads' would need to support pupil activities, monitor the school's energy use, and act as the tool's account administrator for the school.

- A **full package of features** proved helpful in engaging schools alongside the basic energy use portal, with educational resources particularly important in motivating schools to take up the tools initially. Pilots found it easier to target primary rather than secondary schools with educational resources.

- **Models that involved pupils** as a user of energy monitoring data helped to increase take-up of tools and improve results. Several schools highlighted that they were

[34] Whilst it is not possible to generalise entirely from a pilot scenario to a wider context, it is possible to make inferences or hypotheses based upon this research.

motivated to pilot tools because they helped to fulfil a need to respond to pupils' interest in energy management and/or plug gaps in pupils' knowledge in this area.

- Schools that received **hands-on inductions** appeared to be more likely to use tools effectively, and to make use of the full range of features that the tools offered. This suggests that when scaled up it would be helpful to offer support directly to schools where they are recruited via a third party to ensure they are aware of tool features and benefits. As it is likely that local authorities and multi-academy trusts will continue to be important gatekeepers in recruiting schools, developers should consider ways to offer support directly to schools to ensure they are aware of the full range of benefits tools can offer, how to use them, and how to access further support.
- A **significant degree of ongoing support** to trouble-shoot problems and maintain school and pupil engagement appeared during the pilots to be necessary. Moving forward, Competition Partners are now exploring ways of using community volunteers, and linking with other eco initiatives, to ensure that face-to-face support can be provided in schools.
- Energy managers and teaching staff did not always share their knowledge, including knowledge of features of tools that would benefit each other. This suggests that **tailored tool experiences for different types of user** are more likely to be successful than a single portal, and it will be important to ensure that users are aware of the features relevant to them.
- Climate change emergency declarations from local authorities acted as a key driver for schools' interest in some cases. **The support of local authorities** for particular programmes / tools also helped to drive interest in some of the piloted tools. In the future, innovators might consider how the tools they develop and promote might facilitate ongoing school action and how they might **'ride the wave' of the sustainability drive within schools** to increase the market for smart energy management products.

On the **impact that tools had on behaviour and energy consumption**, the evaluation found that:

- Once engaged, pupils acted as effective agents of change within their schools, driving behaviour change among other pupils, school staff, and more efficient energy management processes.
- Elements that encouraged competition were highly effective in engaging pupils. Leader boards showing schools' energy use compared with other participating schools, and/or the number/type of energy savings actions they have completed compared with other schools, were extremely effective in enthusing pupils.
- A display screen presenting data from the tool in ways that are relevant and engaging for both pupils and adults helped to engender a culture of energy efficiency across pilot schools and kept energy efficiency front-of-mind.

Chapter 7 Learning about market development

The effectiveness of the pilots in achieving the Competition's intended short-term outcomes[35] (i.e. customer engagement, behaviour change and energy savings) was the subject of the preceding three chapters. Looking forward, this chapter summarises learnings about the Competition's intended longer-term outcomes, i.e. factors that may affect the development of a market for non-domestic smart energy management services and the type of market that may emerge. It has been co-authored by Ipsos MORI and the Department for Business, Energy and Industrial Strategy (BEIS) and is underpinned by research theory on the processes involved in market transition.

The Competition's market development theory of change

Figure 2.1 (page 4) sets out how the Competition outcomes were expected to be achieved. It presented a 2030 vision of what a transformed non-domestic energy market could look like and involve, if a market for smart energy management solutions is to emerge at scale. This included the emergence of new business models, market actors and partnerships, supportive initiatives and routes to market; strengthening of the market and spill over to new sectors, leading to a sustainable market. The vision is also dependent on other factors that influence the development of a sustainable market, such as wider government policies and regulation supporting a culture of better energy management and the normalisation of energy management as a standard business practice.

Market development activities during the Competition

To support the achievement of this 2030 vision, BEIS implemented (as part of its support for the Competition) various activities aimed at developing and strengthening the market for energy management products and services for smaller non-domestic sites, such as:

- Using action research methods to support Competition Partners with problem solving, partnership development and evidence gathering. These included workshops, literature reviews and investigation into specific research topics.
- Raising awareness of the potential market for energy management products and services within the SME and school sectors by holding networking and market awareness events and by developing and publishing consumer benefits case studies highlighting the success stories of the pilots.
- Competition Partners' own support for market development by disseminating to / consulting with target customers and sector stakeholders.

Box 1 below provides examples of the events and support activities run during the Competition to further market engagement and learning. Learnings from these activities, in combination with those from the evaluation, have informed the remainder of this chapter.

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[35] See Competition's theory of change in Chapter two, page 4, Figure 2.1

Box 1: Example events and support activities aimed at wider market engagement

Four REP-led workshops involving stakeholders to encourage shared learning, were delivered on the following topics:

“Complementary Interventions”: A workshop to share learnings on the types of supporting services or resources that could drive engagement and behaviour change.

“Educational complementary interventions and behaviour change”: A workshop to learn about schools’ organisational structures and effective ways of engaging schools.

“User-centric Design”: A workshop with Competition Partners to give guidance on best practice principles, methodologies and analysis techniques for user testing.

“Data Access”: A workshop to understand barriers to achieving access to data.

Two series of market awareness and engagement **webinars:** The first one provided an overview of the programme to trade bodies and business associations. The second aimed to identify and engage trial sites for the pilot phase.

Two local authority events on ‘Innovation solutions for energy management in schools’ targeted at a regional level (one in Manchester, one in Hampshire) with decision makers and local authorities to help Competition Partners to identify and engage target schools and stakeholders for pilot sites.

One matchmaking event from across Government, retail, hospitality, education and energy sectors to provide a preview of the Competition Partners’ innovations, to facilitate partnerships between Competition Partners and energy suppliers, and to introduce Competition Partners to potential customers and Trade Associations / sector bodies who could provide a connection to customers.

Presentations and exhibition stands at **key sector events**, including the Schools & Academies Show, School Commercialisation, Future of Utilities, National Convenience Show and a HOSPA members event.

Four sector-specific workshops: Two workshops were focused on the school sector (one in London, one in Cardiff), and one each focused on the small retail and small hospitality sectors (both held in London). The workshops brought together policy makers, Competition Partners and other innovators, industry representatives (e.g. Trade Associations), school representatives (e.g. local authorities, energy managers, teachers), energy supplier representatives and relevant charities and activists (for schools). The workshops explored in-depth the different barriers and enablers to market development within these sectors and considered what policy developments and other factors might influence market development.

Progress in the commercialisation of the piloted tools

At the close of the Competition, the market for innovative energy management tools that the Competition sought to develop is still at a relatively early stage. It is, therefore, premature to reach definite conclusions about longer-term commercial viability of the tools it piloted. However, there are some **positive indications that four of the tools piloted have reached a**

degree of commercial readiness with partnerships being formed and plans being made for commercialisation before the end of 2020.[36]

Such partnerships include those with suppliers, Data Communications Company (DCC) 'Other Users' and school authorities, to provide routes to market and access to energy data. In two other cases, the Competition Partners have been successful in obtaining follow-on funding to further develop their proposition, by supporting and financing energy efficiency improvements.

However, there remain several dependencies to market growth, as will be discussed throughout this chapter.

Customer willingness to pay for tools

Whilst customers piloting the tools as part of the Competition were offered the tool for free (thus customer willingness to pay was not 'tested' in a real-world environment), customers were consulted on this topic during evaluation interviews. After the pilot period, a majority[37] of customers across sectors were open to the idea of paying for a tool (on the assumption that it was a small cost) including some customers who did not have an existing sustainability commitment. Actors in small retail[38] businesses were generally less open to paying than hospitality businesses and schools, which may be related to perceptions among these customers that their energy use was very low and thus any cost-savings would be minimal.

Customers indicated that the decision over whether to pay for a tool (e.g. by a one-off fee or monthly payment) would be based on **an assessment of whether, and how quickly, the perceived benefits were likely to outweigh the cost**. Additionally, in schools the return on investment was considered not only in energy savings but also whether it could be used in the classroom as a teaching tool.

Hence, whilst some small non-domestic sites may with the right consumer offering and payment model be willing to pay for smart energy management services, the Competition found that this may not be universal, particularly where consumers lack confidence that the benefits will outweigh the time and cost required. In those circumstances[39], alternative business models such as bundled services may be required to mitigate this willingness to pay challenge, as the cost of the tool is 'hidden' in the supplier contract or tariff.

Types of market development process

Research suggests that sustainable markets for technological innovations take time to develop and involve a variety of processes which take place within an overall 'innovation system'.[40] These processes involve broader societal and institutional changes, as well as interactions in the marketplace. Smart energy management tools are a type of technological innovation, so it can be expected that similar processes will occur in this area.

[36] As of February 2020, when the research activity informing these findings was conducted.
[37] Based on a tally of responses from 61 qualitative interviews. It is acknowledged that stated preferences may be subject to bias.
[38] This could also be in part due to the size of businesses interviewed as part of the evaluation, which were generally larger in the hospitality sector.
[39] See the insights for innovators note (*'Developing smart energy management services for SMEs - NDSEMIC insights for innovators')* published alongside this evaluation.
[40]https://www.researchgate.net/publication/286025108_Innovation_timelines_from_invention_to_maturity_A_rapid_review_of_the_evidence_on_the_time_taken_for_new_technologies_to_reach_widespread_commercialisation

Market development can be seen as taking place on a number of different levels, similar in scope to the existing theory of change described above, including: 1) alignment between customer demand and innovators' offerings; 2) alignment between innovators' offers and wider markets; and 3) alignment between innovators and the governance and regulatory regimes. The first of these levels deals with how products and services evolve over time to meet users' needs (which themselves change over time). The second level concerns interactions of innovation in energy management with wider markets, in particular the energy retail market. The third concerns how governance and regulatory regimes, such as on metering and data access, affect the viability and direction of innovation.

Developing sustainable markets is seen by some researchers as a **series of processes of alignment**[41] **between these three levels**, taking place alongside each other; this perspective is used to structure this chapter. The following three sections of this chapter set out learnings from the evaluation around factors involved in each of these three levels.

Alignment between customer demand and innovators' offers

A sustainable market needs there to be both effective supply (i.e. innovators developing tools in a way that both attracts and engages users and developing business models or packages that reflect customers' appetite and willingness to pay) and **effective demand** (i.e. customers wanting and engaging with tools and (where relevant) being willing to pay for them). This section deals with how innovator offers, and user requirements interact in the development of a market.

This covers aspects such as the types of users who may be attracted to products initially; those most likely to benefit from products and services; how customers can be reached, including through partnerships and networks; and how customer value may be increased through energy management products and services being built into e.g. business management systems and curricular and extra-curricular activities within schools.

Reflecting the interests of early adopters

Early development of markets usually involves preferential uptake by 'early adopters' who are predisposed to take up new technologies, followed later by wider uptake (as the technology becomes normalised).

Findings from the Competition provide some evidence about such factors at play. According to these, environmental motivations (where users see tools as a way of identifying pathways to reducing carbon emissions) and financial motivations (where users consider the tool could help them better monitor, and potentially reduce, energy bills) have tended to be the most common motivators amongst users piloting the tools:

- On **energy cost saving**, the Competition found that users were typically motivated at least in part by the opportunity to make financial cost savings through reductions in energy consumption. This was a key reason given for participating in the pilots, particularly for sites in the retail and hospitality sectors (though this was also a strong motivational factor for schools participating in the pilots), and the main tool user was

[41] For the theoretical background, see e.g.: Schot, J.W., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda and policy. Technology Analysis and Strategic Management 20, 537–554.

often someone with an understanding of, a role in, or a pre-existing interest in energy management.

- On **environmental concerns**, Competition findings have also demonstrated that mitigation of environmental impacts was a typical driver for engagement with the Competition products at some sites. In some circumstances, engagement with the products was successful where consumers had underlying 'green' motivations,[42] suggesting such motivations might have contributed to sustained engagement.

The Competition findings therefore seem to suggest that early adopters of smart energy management products and services, might be those who are driven by either financial savings (or which are sufficiently large to have staff dedicated to energy management), and greater environmental concerns and 'green' motivations.

Future market development is therefore likely to depend, in part, on smart energy management products which can 'pull' on these different motivations, and the opportunities and circumstances which encourage target users to engage with them. It is also possible that product offerings may synergise and optimise opportunities deriving from the emergence of a market for 'green' energy products and services, and other initiatives and trends linked to net zero.

Identifying routes to reaching customers

Different routes and business models, developed by the Competition Partners and explored in the action research and support activities, involved partnerships with key market gatekeepers. These have had varying degrees of success within different contexts, and the findings provide evidence about likely approaches to reaching customers in the future.

The types of entities that Competition Partners worked with during the Competition included actors providing access to a customer base (e.g. energy suppliers, energy brokers, (for businesses) head offices of chain businesses and industry representatives, and (for schools) local authorities or multi-academy trusts).

Partnering with energy suppliers was found to allow an innovator to **reach customers and secure data access** at scale at lower cost. The same opportunity was afforded in the Competition by partnerships secured between innovators and local authorities (for schools) where local authorities were able to offer access to data (where they had in place a centralised energy data management platform) and a customer base (i.e. the local authority's schools).

In relation to hospitality and retail businesses, trade bodies may be influential in raising awareness and disseminating information such as case studies on the benefits of new products and services.

Some innovators in the Competition developing innovations for schools secured partnerships with charity-based organisations leading initiatives to **drive environmental sustainability** in schools to help customer take-up. These organisations helped to promote the innovations to schools and encouraged them to use the energy management tools on an ongoing basis as part of wider environmental sustainability ambitions.

[42] This includes, for instance, a reputational concern around being perceived as a green brand or school by customers or parents of pupils. Across the SMEs participating in the Competition pilots, this trait was most common in the hospitality sector, although it was also observed in a few retail sites as well.

The sectoral design of the programme had an impact on the scope for networks and gatekeepers to support customer recruitment by narrowing the range of end-users and relevant partners. For Competition Partners, it encouraged organisations who specialise in servicing particular non-domestic sectors to participate in the Competition by building on their existing, tailored products and services, and enabling them to focus on sector-specific partnerships and routes to recruitment. It also reduced – to some extent – the number of variables that might affect engagement, behaviour and energy consumption, thus enabling them to think more deeply about bespoke and responsive design.

In summary, the Competition showed that partnerships played an important role in linking up innovators with users, reducing costs of customer acquisition and addressing other barriers such as data access (discussed in more detail in the next section) and promoting the use of solutions. In the school sector, this included partnerships with environmental bodies, thus leveraging environmental motivations (as described in the previous section). Partnerships are likely to play a role in the next stages of market development, e.g. as ways of reducing costs of reaching customers and providing services.

Broadening solutions beyond energy management

The Competition was designed so that the solutions piloted could serve purposes broader than solely energy management, so long as the primary design purpose was energy saving. Competition Partners investigated how energy management data solutions could, in the future, be integrated into other IT-based systems and developed uses of data which went beyond energy management.

Online tools and apps play an increasing role in the hospitality sector, including those designed for customers (e.g. booking accommodation and tables) and for hospitality staff – for example, providing accounting services, managerial and operational services (e.g. to ensure specific tasks have been completed by staff, such as cleaning), human resourcing services and staff training. Competition Partners explored how such tools could integrate with energy management, for example, by building energy management activities into operational services, publishing data on environmental performance or using booking data to generate energy benchmarking data linked to throughput of guests or covers.

As shown through the findings of Chapter six, solutions in the school sector were tailored for different types of school users and to support climate change engagement and educational functions in addition to energy management. Such solutions were found to be much more likely to deliver value and be used by schools.

To summarise, **integrating energy data and energy management tools into solutions supporting other activities** may be one future element in market developments in smart energy management tools in some sectors, for example where it delivers greater functionality to users (especially where this relates to their core business functions).

Alignment between innovators’ offers and the energy market

The Competition’s REP activities explored with stakeholders some of the emerging trends in the energy market which may shape the development of a market for smart energy management services.

The Competition targeted the use of data from smart / advanced energy metering, which energy suppliers already use to meet a duty to give non-domestic customers access to their own consumption data on request. Some energy suppliers have already developed means of access, such as data portals and in-home displays.

In the early stages of SMIP, it was envisaged that suppliers would develop their offers in this area, either directly or indirectly through their intermediaries, for commercial purposes such as customer acquisition and retention, e.g. by developing more complex / engaging energy feedback tools or bundling energy management services into energy tariffs.[43] **Bundling as part of energy supply contracts or other energy services may be important** if consumer willingness to pay directly for these types of more complex / engaging tools is low.

Energy suppliers might offer an energy saving app – either developed by the energy supplier itself, or via a partnership between a supplier and a smart energy management innovator – as part of their supply contract, or as part of a new tariff. For innovators, this approach may open access to a large customer base and access to smart meter data.

Some users who piloted Competition tools, especially within the retail and hospitality sector, reported an initial expectation that energy suppliers would be the providers of smart energy management tools (just as energy suppliers provide in-home displays to domestic smart meter customers). These users acknowledged that a supplier-led model of provision may mean that the cost of the tool would be incurred through their energy tariff but noted that this was a trade-off they would be happy to make, especially if there was a trial period.[44]

However, the extent to which this happens will depend on suppliers' motivations: for example, whether it enhances their existing offer to customers and fits with broader strategy, and in the case of some solutions, whether they are interested in segmenting their customer base in order to promote tools which are sector-specific or aimed at environmentally conscious customers. In turn, this will be dependent on customer expectations and the appeal of this offer relative to existing energy supplier offers. For example, some users suggested that they would be sceptical that energy suppliers - as organisations focussed on selling energy – would also actively help them reduce their energy use. However, there was also an acknowledgement that energy suppliers may currently be under more pressure to 'do their bit' for the environment, which may help to alleviate some scepticism. Other possible market actors who may provide these tools suggested by users included (preferably local) independent companies, which some suggested could be more trustworthy; charities; and local authorities (where tool-users were schools).

Bundling with other energy services may also involve other actors in the energy market, such as Third Party Intermediaries (TPIs) offering smart energy services as part of a broader energy service offering. Bundling with non-energy services could involve combining energy services with broader services that customers contract or pay for (which are unrelated to energy) – for example, Internet access, supply of other utilities such as water, and financial, administrative or management services and systems.

The emergence of new product types such as smart plugs and smart thermostats in the energy market raises the question of how, and whether, smart energy management tools for the non-domestic sector could become part of this trend. Two of the Competition pilots (GlowPro and Energy in Schools) tested packages combining such smart products with the tool and found

[43] Smart Metering Implementation Programme Consumer Engagement Strategy consultation April 2012
[44] Only a minority of users interviewed mentioned the concept of paying for the tool through an energy tariff; it is therefore not possible to quantify the proportion who would be willing to pay in this way.

that these generated user benefits, especially when combined with tailored support to set up and explain how the systems should be used.

An **emerging business model is Energy-as-a-Service**[45] (EaaS). EaaS may, in the future, mean energy is seen as a 'service' rather than a supply contract. This could mean energy suppliers or others may be paid by customers to ensure their business is heated, powered, efficient and comfortable to a certain specification (for example, temperature level). Spread of such a business model could also shape or influence the development of a market for smart energy management tools.

In summary, energy suppliers' existing engagement in this area and the commercial potential for them to develop new, bundled products, to offer additional benefits to their customers at large-scale and potentially for no additional charge, appear to be significant factors in the future development of a sustainable market. However, under the existing governance and regulatory regime (see below) outcomes will depend on suppliers' assessments of the value this will deliver to them. Competition Partners formed partnerships with three energy suppliers and discussions are in progress with another eight suppliers (as of end of March 2020). Other energy (e.g. TPI) and wider market actors could also support market development.

Alignment between innovators and the governance and regulatory regimes

Smart energy management tools as defined in the Competition rely on access to consumption data from **smart / advanced metering**, and innovators are therefore currently obliged to access this within the framework of relevant industry Codes and obligations on parties.

Competition Partners explored several **different routes to accessing non-domestic energy consumption data**: from different meter types, at different levels of granularity, and with or without the use of live data feeds. The REP also undertook an action research theme to explore the resourcing and commercialisation implications of different data access routes from the perspectives of Competition Partners. The detailed findings from this theme are described in the separate '*Developing smart energy management services for SMEs - NDSEMIC insights for innovators*', published alongside this evaluation, and are broadly summarised as follows:

- There is currently a mixed metering landscape in non-domestic settings, where schools and small retail and small hospitality businesses may have Smart Metering Equipment Technical Specifications (SMETS), Automated Meter Reading (AMR) or pulse metering.[46]
- Throughout the Competition, Partners had **mixed success in securing access to energy consumption data via pulse meters**. Where it was possible to extract and transfer energy data, this typically required a resource-intensive approach by the

[45] Energy tariff offerings based on selling a set level of comfort, rather than units of energy
[46] UK non-domestic settings use two types of smart metering: AMR, considered 'advanced' meters and which provide one-way communication of data from customers to energy suppliers; and next generation meters which conform to the SMETS standards, which permit two-way data flow between parties. Non-domestic sites which do not have (AMR or SMETS) smart metering rely on traditional 'pulse' meters. More information is provided in '*Developing smart energy management services for SMEs - NDSEMIC insights for innovators*' published alongside this evaluation.

Competition Partner (for example, a member of staff visiting the site) which may not be a viable option at commercial scale.

- At the Competition level, **AMR data access in some circumstances entailed lengthy processes** to secure consent to access energy consumption data and to secure data in a meaningful format. It has also at times been contingent on Competition Partners securing partnerships with third parties.

- The experiences of Competition Partners suggested that, for them, **SMETS data access routes may potentially offer a more streamlined, lower cost route to accessing data** than for AMR and pulse metering.[47] However, this was relatively unexplored in the Competition due to the challenges of identifying SMETS meters in the Competition's non-domestic target sectors. The findings from this evaluation do suggest that live, granular breakdowns of data were helpful in keeping energy front of mind to users and in supporting more complex equipment upgrades. Therefore, as this market develops, the availability of such data for innovators to develop and test enhanced product functionalities which are successful at encouraging behaviour change may be important.

The next section considers how further developments in the governance and regulatory frameworks could influence the technological infrastructure that a future smart energy services market would need to function. This technological infrastructure may impact upon the nature, pace and scale of the market that emerges.

Factors linked to the balance between SMETS and AMR

The mixed non-domestic metering landscape is in part due to the roll out of AMRs to larger non-domestic sites between 2008 and 2014,[48] as well as the smart meter 'consumer choice' policy, which enables energy suppliers to offer a choice of AMR or SMETS metering to non-microbusiness SME customers, for example, if they wish to maintain a consistent metering portfolio. This regulatory requirement, and other regulatory drivers, may affect:

- **The nature of the services that innovators and energy suppliers / TPIs could offer** (e.g. tools using SMETS data could potentially make use of more granular data, available more quickly, than through the AMR landscape. This may enhance tools' 'live' energy consumption monitoring capability if built into the design).

- **The market 'reach' of products and the expected timings for a market to emerge**. SMETS-based offerings would potentially reach a smaller proportion of the market in the shorter term than innovations that use AMR data. However, SMETS-based offerings may have greater scalability in the longer term, particularly if initial insights from this Competition regarding lower cost and more streamlined SMETS data routes prove generalisable across the market.

[47] SMETS data can be accessed via the Data Communications Company (DCC). More information is provided in '*Developing smart energy management services for SMEs - NDSEMIC insights for innovators*' published alongside this evaluation.

[48] https://www.ofgem.gov.uk/publications-and-updates/suppliers%E2%80%99-advanced-meter-roll-out-performance

Factors affecting data availability and ease of data access

Regulatory and energy governance drivers and enablers may potentially influence the future energy data landscape and how innovators may be able to access consumption data, possibly from new sources. These drivers and enablers include:

- The extent to which energy suppliers are incentivised, or obliged, to make consumption data readily available to their non-domestic customers, or third parties acting with customer consent.
- The extent to which the processes and formats through which consumption data are made available are conducive to the development of meaningful, engaging, data-driven services.
- The extent to which government innovation programmes and wider policies drive demand for smart meter consumption data.
- The extent to which non-domestic data innovation is prioritised by industry and driven forward through policy intervention or engagement.
- The extent to which polices drive the development of new means of data access. For example, the possible development of new data systems for accessing half hourly data for the Office of Gas and Electricity Markets (Ofgem)'s settlement programme.

In summary, regulatory and energy governance drivers are likely to critically influence pathways of innovation and market development in this area.

Chapter 8 The longer-term potential for market transformation

Chapter seven summarised learnings from the evaluation concerning market development, building on the Competition's theory of change. This chapter explores how the market transformation required to normalise these products and services may be supported by wider net zero policy making and by leveraging emerging new social models of energy management and climate change engagement linked to net zero. It has been co-authored by Ipsos MORI and the Department for Business, Energy and Industrial Strategy (BEIS) and is underpinned by research theory on societal transitions.

Changing contexts for market development during the energy transition to net zero

The wider context of government policies was recognised in the Competition's theory of change as likely to influence longer term outcomes to 2030 around developing a sustainable market in smart energy management products and services. Policies around net zero are a critical such area.

Likely net zero developments and impacts

The steps that Great Britain needs to take towards delivering net zero, and their implications for different parts of the economy, are the subject of ongoing work[49] and currently best considered in terms of **future scenarios rather than a single set of expectations**. One such set of scenarios[50] proposes that decarbonising the energy system will involve progress (within the context of a growing economy) through a combination of:

- **Policy support** (including tax and incentive regimes, market frameworks and other subsidies such as for technology innovation and support for consumers to choose low-carbon solutions).
- **Consumer engagement** (choosing low carbon alternatives, such as electric cars and alternative heat solutions, as well as engaging with ways to manage their energy demand (e.g. through digital solutions and smart vehicle charging)).
- **Technology development** (rate of progress for proven technologies moving to large-scale deployment (e.g. electricity storage solutions (batteries) and new digital solutions)).
- Demonstration of **other technologies that have high potential for decarbonisation** (e.g. carbon capture, usage and storage).

[49] E.g. https://www.gov.uk/government/publications/net-zero-review-terms-of-reference/hm-treasurys-review-into-funding-the-transition-to-a-net-zero-greenhouse-gas-economy-terms-of-reference
[50] Based on National Grid ESO (2019) Future Energy Scenarios, July 2019 p18 – see: https://www.nationalgrideso.com/future-energy/future-energy-scenarios

- **Energy efficiency** (accessibility and adoption of energy efficient products and services (e.g. thermal insulation) for existing buildings; quality and regulation of new build thermal efficiency).

Each of these areas could potentially change the context for developing a market in smart energy management products and services. For example:

- Customer engagement may be influenced by broader policies concerning energy efficiency, carbon reduction and climate change. For example, public commitments to tackling climate change and reducing carbon emissions can motivate energy efficient action in schools. This was evidenced by schools in local authorities which have declared a climate emergency – in some cases this acted as a key driver of interest and engagement in the pilots.
- Future policy changes could change the role of energy suppliers and other market actors in driving energy efficiency measures, including the uptake of smart energy management tools.
- Smart metering / smart energy management tools might become embedded or culturally accepted as one way in which landlords and smaller businesses can meet possible new obligations on energy efficiency standards and reporting, and also drive forward their wider environmental motivations and strategies.

Theory on how innovation occurs during transitions

The expected shift to a low carbon economy is widely regarded as an example of a sustainability transition - large-scale disruptive changes in societal systems that emerge over a long period of decades.[51] Given the long-term nature of this ambition, it is useful to consider the processes that may be involved and how these may provide opportunities for the normalisation of smart energy management services.

Some researchers of sustainability transitions theory[52] argue that, rather than taking place in a diffuse and generalised way, such transitions involve distinct **shifts in 'socio-technical regimes'**. These refer to the ways in which user practices and behaviours interrelate with technologies, supporting policies and infrastructure, preferences and culture. These regimes are usually relatively stable (resistant to change).

According to this view, **changes to the status quo begin within 'niches'**, which are often small networks of actors who are supporting innovation due to their future expectations and visions. These networks work together to develop innovation and learning across their organisations. This includes learning about new 'socio-technical (ST) configurations', i.e. how organisations organise their production or service activities in terms of human resources and technologies.

Innovation starting off within niches is seen as developing and stabilising into dominant designs for new ST configurations, and then gaining momentum and spreading due to external influences, such as networks and stakeholder expectations. Eventually the new configuration breaks through, often taking advantage of a window of opportunity, as a new or modified regime.

[51] Loorbach et al Sustainability Transitions Research: Transforming Science and Practice for Societal Change 2017

[52] E.g. Schot and Geels, op. cit.

Using this perspective, **some elements of the Competition may be seen as representing innovation activity aimed at developing niches**, for example, solutions for schools which had a particular sustainability focus and have sought to mobilise action on climate change mitigation, working alongside pupil and environmental networks against a vision of zero carbon. Some hospitality tools have also sought to develop solutions which would support niche activity focusing on sustainability.

Based on this perspective, the next section explores just one area where initial learning from the Competition could aid understanding of potential changes in ST configurations which might support/lead to regime shifts in the future.

New ST configurations contributing to net zero

Smart energy management tools are used by people: this use has to **align with organisational structures and responsibilities and linked constraints to behaviour change** (for example, time and skills). Hence the ST configurations within which smart energy management tools are introduced, and the scope for innovating within niches and stabilising new configurations over time as a result of external influences (linked to net zero), are important.

The Competition pilots have shown that skills and structural factors are already having an impact on the types of innovations (specific forms of feedback) which are likely to achieve their objectives in different organisational contexts. For example, in relation to hospitality businesses, clear differences were observed between:

- Small hospitality businesses which manage energy according to rules that are pre-specified in a hierarchical fashion – i.e. employees are discouraged from taking time ‘away from their day job’ to make energy-related decisions or deviate from pre-set ways of managing energy efficiently; and
- Small hospitality businesses where there is an expectation that employees will be committed to a company-wide vision of sustainability, and which encourage staff to act autonomously to fulfil that vision as part of their everyday responsibilities.

Solutions have been developed through the Competition to enable employees to participate in energy management e.g. via phone apps, but these apps may have less value in the type of organisation listed in the first bullet above. If these represent the dominant type at present, significant shifts are needed to enable some of the opportunities from energy management to be realised. Such shifts could include changes in industry values, norms and practices, e.g. recognition of broader roles for operational staff, and inclusion of energy management within industry training schemes.

These shifts could be catalysed by the actions of industry and/or Government, for example widespread awareness raising of existing niche activity (e.g. case studies shared with trade organisations) may impact industry values and norms, whilst policies can incentivise organisational change (i.e. polices that incentivise the integration of energy management into general staff training programmes).

Similarly, the Competition has demonstrated the potential for new ST configurations to develop in the school sector, with suggestions of ‘co-evolution’ between innovation in smart energy management and increasing schools’ engagement with energy and climate change facilitated by this innovation.

For example, smart energy management tools have shown potential to deliver savings where they empower pupils using eco-clubs and activities based around energy data, motivate school communities using league tables / gamification to take action on climate change, and exploit the use of energy data to fit with the curriculum.

Organisational structures and skills are another example of an emerging ST configuration in schools. The Competition has shown that where there is no specialist energy manager on site, energy management is often neglected due to lack of time and skills, and because it is not integrated into job roles or delivering the school's core objectives. However, workshops identified the value of creating school 'energy leads', who can engage with energy management tools, and also support the wider activities described above.

It may be possible to develop and expand such approaches, through further learning within niches, and the development and testing of new socio-technical configurations (for example, it may be valuable to develop ways of better recognising teachers leading school energy initiatives, to encourage wider teacher involvement).

Through such experimentation and learning, it may be possible to integrate and leverage the value of smart energy management tools within the forthcoming shift to a low carbon economy, so normalising their use and increasing their value and contributing to the broader net zero context.

Chapter 9 Conclusions

This report has set out the findings of the evaluation of the NDSEMIC Competition. It has explored the extent to which the Competition met its short-term objectives by 2020, i.e. whether it developed tools that were effective in using energy data to support small retail and hospitality businesses and schools to better manage their energy use. In parallel, it has investigated in-depth the factors that helped or hindered tool effectiveness, as well as factors which may affect their future commercialisation and longer-term success.

The later chapters of the report have explored findings with regards to the Competition's intended longer-term outcomes. In doing so, it has identified dependencies that may affect the development of a market for non-domestic smart energy management tools and the type of market that may emerge moving forwards.

Key findings

Overall, there is clear evidence that, with sufficient engagement from the consumer, smart energy management tools and services can help small businesses and schools to become more energy efficient in their behaviours and save energy. Where tools appealed sufficiently to users' motivations, provided information in tailored, novel and timely ways, provided actionable advice (and in some cases, meaningful support to 'take' such action), consumers across all three target sectors showed evidence of reducing their energy consumption and better managing their energy use.

This is supported by the fact that, for six out of the seven tools piloted, there is evidence that energy savings were achieved. The evaluation's confidence in the strength of this evidence ranged from very high (Energy Sparks) through high (E-CAT, Glow-Pro, Energy in Schools) to medium (AEMS, fluttr). In some cases, savings were substantial: evidence indicates that Energy Sparks contributed to energy savings of between 10% and 20% in some schools whilst two small businesses piloting E-CAT reached savings of up to 11%. Therefore, the Competition's hypothesis that smart energy management tools can add value to smart meter data for smaller non-domestic sites has proven valid.

However, the evaluation has also identified dependencies to this occurring. Behaviour change was not universal across sites; where this did not occur, it was either because of disinterest in the tool, a lack of motivation (i.e. prioritisation of other business concerns) or a feeling that changes in energy use were not possible (e.g. where the tool did not clearly demonstrate the costs and benefits of particular changes in usage). Therefore, for tools to be successful at market, or when scaled up, they would need to overcome such challenges. Chapters five and six have explored dependencies that may affect the extent to which such challenges are addressed.

Drivers of early adoption

Thinking beyond the Competition, this evaluation has inferred, based on findings, the types of small businesses and schools that may be 'early adopters' of smart energy management solutions in a market-led scenario. A pre-existing interest in environmental sustainability was not a prerequisite for engagement in the pilots; whilst some participants were driven by 'green' motivations, others (particularly in the retail and hospitality sectors) were driven by potential cost savings and opportunities to improve business management. In schools, educational benefits have proved both an important driver of pilot participation and tool impacts, with pupil engagement proving particularly effective. Where schools had an existing sustainability “infrastructure” this also motivated them to take up the tools. Therefore, the evaluation has shown that smart energy management tools can leverage upon these wider motivations and existing structures to generate demand.

Similarly, the evaluation has found that there is a clear difference in energy management contexts of schools, compared to small businesses (though the differences between the retail and hospitality sectors are more complex). In terms of the ongoing development of the market, the strong findings of the Energy Sparks and Energy in Schools pilots confirm the value of tools tailored to schools specifically, with features aimed at ‘whole school behaviour change’ (i.e. energy data presented to different users across a school in different ways). For small businesses, findings have confirmed the value of tailored energy efficiency features (including tips, benchmarks and data presentation). However, messaging and features tailored towards sub-sectors (i.e. hotels within the hospitality industry), or those with common equipment or organisational cultures, may be more important than tailoring to ‘whole sectors’, given the variation in energy use profiles within the retail and hospitality sectors. Where this is not possible, ‘sector’ (as in small retail, small hospitality) may remain a useful proxy of tailoring.

Market-wide adoption

Overall, the Competition did what it set out to achieve: it tested and generated lessons around ‘what works’ in terms of developing, marketing, and embedding smart energy management tools within organisations, as well as in terms of engaging users (within different settings) and encouraging behaviour change. Widespread adoption of these tools is yet untested, however this evaluation, supported by research theory on market transitions, has identified a number of dependencies to the Competition achieving it’s longer-term (2030) ambitions and has therefore informed the evidence base that may contribute to market development.

Taken as a whole, the findings suggest that a wider shift in culture or ‘normalisation’ of such tools (or broader shifts in energy market regimes and/or governance and regulatory frameworks- see Chapter seven) may be required in order for uptake to expand across the market. Without changes to either of these, it may be unrealistic to expect immediate voluntary take up and widespread demand for these types of tools, across all types of organisations (i.e. beyond ‘early adopters’).

Within the small business sector, this is likely to require an evolution in business attitudes to energy efficiency or changes in the market and policy landscape. To be profitable, those on the supply side (developers and their commercial partners) may need to target their solutions to businesses with an existing motivation, such as an ongoing interest in sustainability. For this group, the evaluation shows these tools can deliver real benefits, and that there may be some willingness to pay for these types of tools. This has held true even for smaller sites. For some businesses, especially those motivated by ‘green concerns’ and/or looking for specific operational solutions (i.e. tools that will help them to easily track the energy use of specific equipment / across multiple sites), adoption of these tools may be quicker. However, for demand to be generated at the scale at which a ‘market’ will flourish, the evaluation has shown the importance of businesses understanding the benefits of the tools and trusting in the information they provide.

Within the school space, there is already a wider ‘sea change’ underway in school-level motivations for reducing energy consumption. The growth and trends in eco-clubs, climate strikes and local authority declarations of climate emergencies etc. have contributed to a cultural shift within schools that has meant that climate change is no longer a 'niche' issue. This may mean that wider uptake of smart energy management tools may be more likely to naturally occur in the school space than amongst small businesses.

As discussed in Chapter eight of this report, where cultural shifts occur, the 'target market' for smart energy management tools becomes much less niche, and the potential for widespread voluntary take up increases. Thus, as the British public becomes increasingly concerned with achieving net zero, the market context for smart energy management products is likely to become more favourable. In the meantime, those on the supply-side, as well as Government and other actors (such as the Smart Energy Great Britain campaign), who want to engage organisations that do not have pre-existing green motivations, are going to need to design and launch smart energy management tools that leverage other organisational motivations such as cost-saving and operational benefits. They may also need to do more to make organisations aware of these wider benefits (including the ability to change your business practices, retrain staff, save costs).

Similarly, the findings from this evaluation show that support alongside a tool (including meaningful inductions, guidance and ongoing customer support) have proved important drivers of both engagement and impacts for smaller organisations across all three target sectors. This does suggest that market actors may need to consider how to make such support commercially viable. In addition, some pilot participants during the Competition only took part because the offer was free / incentivised, and they had 'nothing to lose'. In such cases, willingness to pay for these tools in a market context may not be universal, i.e. these users may only 'accept the offer' of such tools if they don't require an additional cost. Possible avenues to addressing these challenges explored in this report include smart energy management products and services being bundled as part of broader energy and non-energy offerings or establishing partnerships to combine innovative technologies and people-led support (such as consultancy or advice services). Here, wider government policy and programming (or initiatives led by the market) may facilitate the testing and trialling of this approach.

Government action may also impact the scale and nature of market development moving forwards. Policies relating to the metering landscape, as well as the way in which non-domestic consumers and innovators acting on their behalf access energy consumption data, could all impact upon innovator target markets and motivations. Partnerships between innovators and other market actors such as energy suppliers and DCC 'Other Users[53]' (and the extent to which Government facilitates these) may also be important to facilitate access to potential customers and their energy consumption data.

More broadly, policies concerning energy efficiency, carbon reduction and climate change may change the world in which small businesses and schools operate, generating momentum towards net zero. For example, public commitments to tackling climate change and reducing carbon emissions have been shown during this Competition to motivate energy efficiency action in schools and catalyse engagement with energy efficiency products and services. Research and learning will be key to understanding how this transition can be leveraged in future, and there may be value in testing how novel and different combinations of technologies, policies and behaviour change interventions can most effectively facilitate a step change in take up and engagement with smart energy management solutions for smaller non-domestic sites.

[53] See the Insights for Innovators note '*Developing smart energy management services for SMEs - NDSEMIC insights for innovators*' published alongside this evaluation.

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