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SMART TECHNOLOGIES IN THE SME AND DOMESTIC SECTORS: Evidence and policy options

BIEE Annual Conference

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21-22nd September 2016

Department for Business, Energy & Industrial Strategy

Presentation Outline

1) Definitions and importance of smart energy
2) Definitions and importance of small consumers
3) Current government research and policy on smart energy
4) Potential of smart technologies in SMEs
5) Potential of smart heating controls in the domestic sector
6) Conclusions

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1) Definitions and importance of smart energy

- Smart technologies refer to the increased use of information and communications technology based on signals, often linked to the internet
- Smart energy systems utilise these technologies to more efficiently manage the supply and demand of energy
- BEIS has a smart energy policy team supported by smart energy analysts, which focus on demand-side response, energy storage, smart appliances and smart energy innovation – a smart energy call-for-evidence will be published soon
- BEIS has a whole directorate allocated to the rollout of smart meters to all houses and SMEs by the end of 2020 to meet the EU's Directive 2009/72/EC

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1) Definitions and importance of smart energy

Reduce the cost of our future low carbon energy system, ensuring customers' bills are lower and **supply is secure**

Defer or avoid investment in network reinforcement Potential Saving: up to £12bn of savings by 2050	**Reduce the need for conventional generation**, including peaking plant Potential Saving: £0.5 - £5bn lower in 2050, cumulative benefits in the magnitude of tens of billions	**Meet binding targets with lower renewable capacity** Potential Saving (DECC): Included in £0.5 - £5bn	**Maximise the use of low carbon, inflexible generation** Smartening the energy system, renewables curtailment: up to 100TWh a year by 2050	**Optimise balancing of the system on a minute by minute basis** Size of the prize of smarter balancing: £1bn per annum (NG)
Smart could: reduce the stress on network infrastructure by, for example: - Smoothing demand - Making renewable generation more predictable	**Smart could:** reduce the need for back up gas plant by: - Shifting demand away from the peak - Storing energy when demand is low and low carbon electricity is available	**Smart could:** increase proportion of electricity supplied that is renewable without increasing total renewable capacity.	**Smart could:** Store renewable energy when it's not needed Shift demand to periods of renewable energy generation	**Smart could:** provide a diversity of more efficient balancing options to National Grid

Source: DECC (2015) *Towards a Smart Energy System*

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2) Definitions and importance of small consumers

- BEIS uses the European Commission's definition of SMEs:
  - *Organisations with <250 employees and a turnover of ≤€50 million or a balance sheet total of ≤€43 million*
  - *Micro = 0-9 employees, Small = 10-49 employees, Medium = 50-249 employees*
- However, definitions vary across the world

China:

Category	Employees	Turnover AND Total Assets	
Medium	≤2000	≤ RMB 300 m	≤ RMB 400 m
Small	≤300	≤ RMB 30 m	≤ RMB 40 m

India:

Category	Investment in Machinery
Medium	5-10 crore rupees
Small	25 lakh rupees – 5 crore rupees
Micro	≤25 lakh rupees

USA:

Category	Employees
SME	<500

New Zealand:

Category	Employees
SME	<20

Source: IEA (2015) *Accelerating energy efficiency in SMEs*

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2) Definitions and importance of small consumers

- **Employment**:
  - 99% of enterprises globally are SMEs
  - SMEs contribute to 60% of private sector employment globally
- **Economic growth:**
  - SMEs contribute 16-80% of GDP depending on the country's economic structure (e.g. 30% of GDP in the European Union)
- **Energy consumption:**
  - 13% of global energy consumption
  - 30% of global industrial energy consumption
  - 25% of UK business energy consumption
- **Innovation:**
  - USA: SMEs carry out 20% of R&D and represent 35% of all transnational patents that are filed
  - China: SMEs account for >60% of domestic patent applications
  - Australia: SMEs represent 90% of the businesses engaging in innovative activity
  - EU: SMEs carry out 20% of R&D

Source: IEA (2015) *Accelerating energy efficiency in SMEs*

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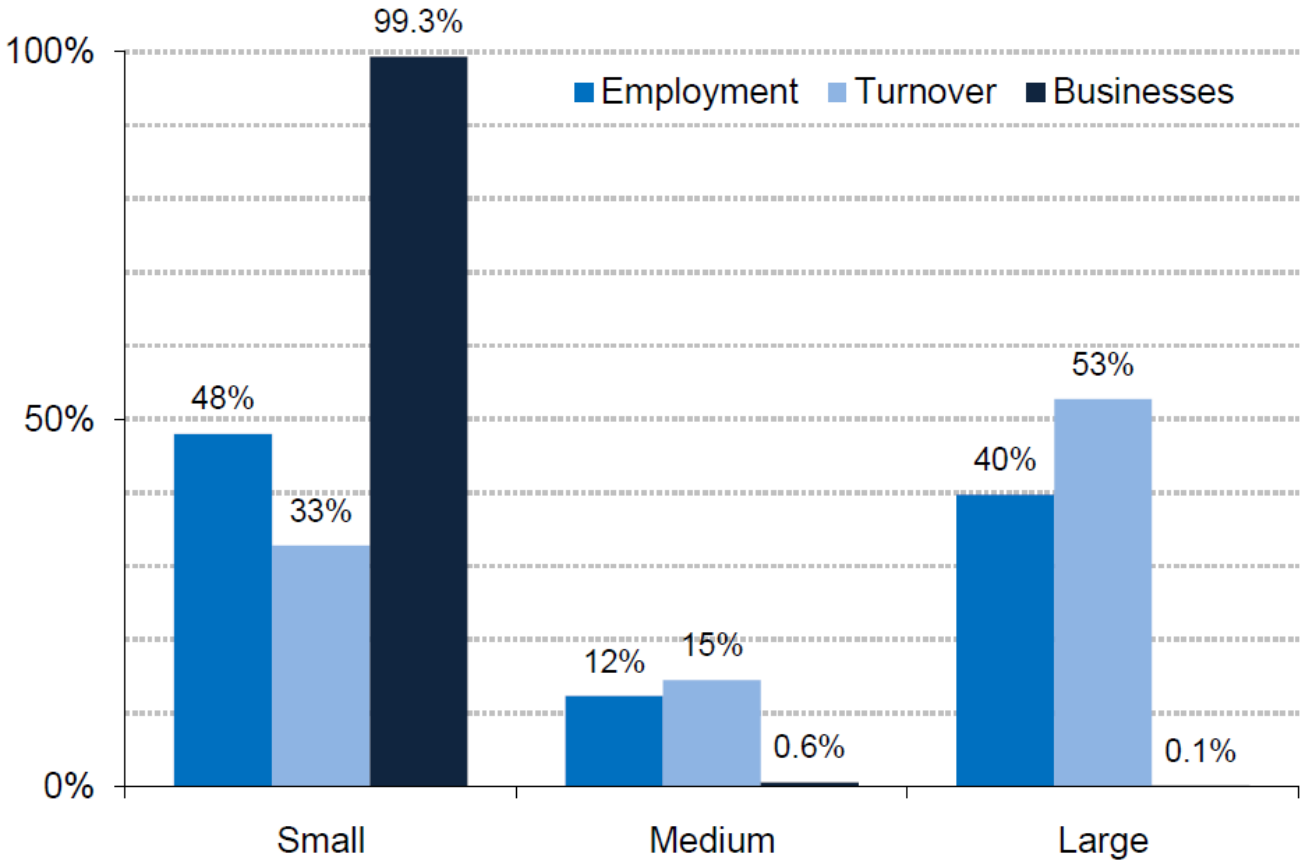
2) Definitions and importance of small consumers

Contribution of different sized businesses to total population, employment & turnover in the UK (2015)



- *Innovation:* 50% of all patents are obtained by SMEs in the UK

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2) Definitions and importance of small consumers

Sector	Number of SMEs	Share of total businesses (%)
Commercial Offices	1,761,471	33%
Construction	956,105	18%
Wholesale, Retail, Transport and Storage	795,935	15%
Arts and Other Services	591,020	11%
Human Health and Social Work Activities	370,632	7%
Manufacturing	274,463	5%
Education	267,550	5%
Accommodation and Food Services	182,447	3%
Agriculture, Forestry and Fishing	153,207	3%
Mining, Quarrying and Utilities	29,302	1%
Total	**5,382,132**	**100%**

Source: BEIS (forthcoming) *Potential of smart technologies in SMEs*

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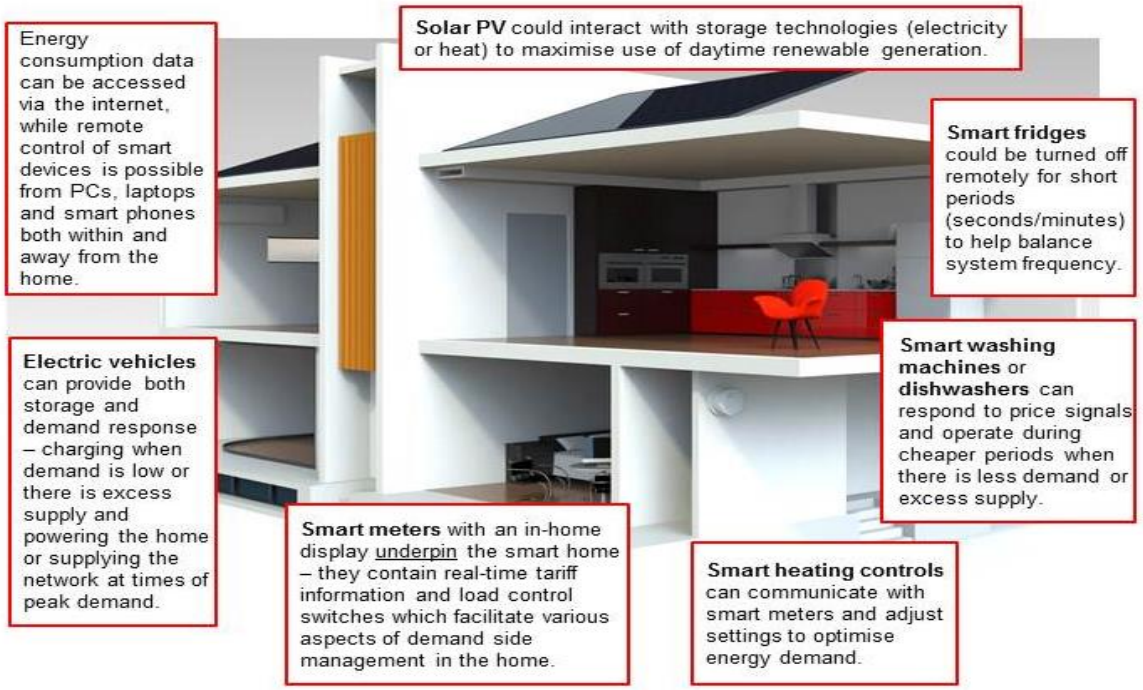
2) Definitions and importance of small consumers

- **Domestic sector**:
  - Represents 27% of UK greenhouse gas emissions (DECC, 2015)
  - Historically UK policies have focused on energy efficiency and micro-generation – there is increasing policy interest in the role of smart technologies
  - For example, the role of demand-side response, smart appliances, smart meters and the Connected Home



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3) Current government research and policy on smart energy

Vast amount of innovation and fast-evolving markets in smart technologies – thus, there is a crucial need for evidence on their potential energy and carbon savings, impacts on consumers and contribution to energy security

Forthcoming BEIS smart energy and small consumers research reports:

- Smart Energy Call for Evidence (to inform policies on demand-side response, energy storage, smart appliances and smart energy innovation)
- Business Energy Efficiency Survey (BEES)
- Small Business Survey
- Potential of Smart Technologies in SMEs
- Scoping Review of Heating Controls

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3) Current government research and policy on smart energy

Key barriers:

- Business priorities
- Upfront costs and perceived lack of finance (average £8,600-18,800 per SME)
- Split-incentives issues
- Lack of senior management engagement and commitment
- Lack of employee engagement and commitment
- Lack of relevant expertise (and finance to obtain expertise)
- Perception of limited savings from measures
- Challenges in quantifying and understanding financial savings (limited performance records)
- Payback period not a key barrier (1.5 years on average from measures)

Key success factor:

Engaging the CEO/General Manager (often directly deals with strategy, finance, facilities, human resources, etc.) – but how to do this from a government perspective?

Sources: DECC (2014) Research to assess the barriers and drivers to energy efficiency in SMEs; Warren, P. (2010) *Uptake of micro-generation in small organisations*, UCL

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3) Current government research and policy on smart energy

Over the past year, BEIS has been working with Ofgem on a programme of work intended to manage the transition to a smart energy system:

Removing barriers to storage and DSR

- **Clarify role of aggregators** in the market, explore the need for **policy intervention and regulatory oversight**
- Consider **barriers to ownership and utilisation of storage**, and how to address these

Improving price signals

- Consider ways in which we can **encourage consumers** to offer their flexibility (e.g. half hourly settlement, smart appliances, etc)

Catalysing innovation

- Ensuring that DECC innovation funding supports those areas critical to the development of a smart energy system. We will also look at how innovation in this area can be supported best by the public sector more broadly.

Assessing changes to roles & responsibilities

- Considering what **institutional and market frameworks** may be required in a future smart energy system to **maximise benefits** while managing the risks; and how roles and responsibilities may need to change in light of these (e.g. from DNO to DSO).

Developing our analysis and evidence base

- Considering the **costs and benefits** in more detail; how much flexibility might be '**least regrets**'; and identifying **evidence gaps** more broadly in this area.

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4) Potential of smart technologies in SMEs

Aim	To estimate the potential savings for UK SMEs by better understanding the technical potential of smart technologies currently available to them
Method	➢ Quantitative top-down study building on the qualitative bottom-up barrier and drivers to energy efficiency in SMEs DECC study in 2014 ➢ Involved reviewing the quality and extent of publicly available evidence ➢ Energy savings potential estimates are based on estimates of energy expenditures and energy consumption (using turnover as a proxy) mapped onto estimates of the number of SMEs in non-domestic sectors in the UK ➢ See paper for full details
Data	❖ BIS Population Estimates (BIS, 2015) ❖ Energy Consumption in the UK (DECC, 2015) ❖ Digest of UK Energy Statistics (DECC, 2015)

Source: BEIS (forthcoming) *Potential of smart technologies in SMEs*

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4) Potential of smart technologies in SMEs

	Industry (£m)	Domestic (£m)	Other final users (£m)	Total Expenditure (£m)
All businesses	12,715	33,435	79,875	126,025
SMEs (%)	38%	51%	61%	56%
SMEs	4,872	16,951	48,768	70,591

With 5,349,589 SMEs in the UK in 2015, average expenditure on energy was ~£9,227 per business but varies greatly by sector

Smart Technology	Max Saving (£mil)
Smart Heating Controls	£292m
Smart Meters	£526m
Integrated Building Management Systems (IBMS)	£935m
Smart Lighting Systems	£326m
Demand Responsive Energy Management	£216m
Big Data in Logistics and Transportation	£293m
Fleet Management	£6,051m
Total	**£8,639m**

Greatest energy savings potential from smart technologies by sector:

- Wholesale, Retail, Transport and Storage sectors (£3.0 billion savings)
- Education (£1.3 billion)
- Accommodation and Food Services (£1.1 billion)
- *Largely due to Fleet Management and IBMS*

Industry Segment	Scale	Integrated building management systems	Smart lighting	Demand response	Smart heating controls	Big data in logistics and transportation	Fleet management	Smart Meters
Wholesale, Retail , Transport and Storage	Micro				x			x
	Small		x		x	x	x	x
	Medium	x	x	x		x	x	x
Education	Micro				x			x
	Small		x		x		x	x
	Medium	x	x	x			x	x
Accommodation and Food Services	Micro				x			x
	Small		x		x		x	x
	Medium	x	x	x			x	x

Greatest energy savings potential per SME:
£12,369/year in Accommodation and Food Services

Source: BEIS (forthcoming) *Potential of smart technologies in SMEs*

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5) Potential of smart heating controls in the domestic sector

Smart functionalities include:

- Optimisation
- Learning algorithms
- Occupancy sensors
- Remote control through smartphones
- Automation
- Weather compensation
- Zonal control

Key players: Nest, Hive, Tado, Wave, Netatmo, Honeywell Evohome, Heat Genuis, Climote, Heatmiser Neo

Average costs: £200-250 including installation

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5) Potential of smart heating controls in the domestic sector

Aim	To review the energy savings, cost-effectiveness and usability of different types of heating controls
Method	➢ Evidence review (using systematic techniques) of the UK evidence ➢ Quality of the evidence assessed ➢ See paper for full details
Data	❖ Academic databases ❖ Grey literature sources

Source: BEIS (forthcoming) *Heating Controls Scoping Review*

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5) Potential of smart heating controls in the domestic sector

Control Type	Energy Savings	Cost-effectiveness	Usability	Confidence
Programmer/ timer (including digital)	*Lack of robust evidence*	*Lack of robust evidence*	*Lack of robust evidence*	*N/A*
Room thermostats	Single test. 12% gas saving compared to boiler thermostat only. Unrealistic 'weather' and house temperatures	*Lack of robust evidence*	*Lack of robust evidence*	Very Low
Thermostatic Radiator Valves (TRV)	Single test. 30% gas saving compared to room thermostat only. Unrealistic 'weather' and house temperatures	*Lack of robust evidence*	*Lack of robust evidence*	Very Low
Weather compensation	*Lack of robust evidence*	*Lack of robust evidence*	*N/A*	*N/A*

Control Type	Energy Savings	Cost-effectiveness	Usability	Confidence
Time Proportional Integral (TPI) controls	Large field trial. TPI in place of standard thermostat. No effect on efficiency of modulating condensing boilers	*Lack of robust evidence*	*N/A*	Good
Zonal control	Series of trials in one house. 12% gas saving compared to a Building Regulations compliant system	Acceptable payback for cheaper systems	*Lack of robust evidence*	Modest
Automation (including self-learning)	Two homes only. Learning zonal control 8%-18% gas saving	*Lack of robust evidence*	*Lack of robust evidence*	Very Low
Remote control	*Lack of robust evidence*	*Lack of robust evidence*	*Lack of robust evidence*	*N/A*

- Limited evidence relating to the energy savings, cost-effectiveness and usability of heating controls
- Not just limited robust evidence but limited evidence generally
- Quantitative evidence has been generated from models, test houses, individual occupied homes and large-scale field trials of occupied homes

Source: BEIS (forthcoming) *Heating Controls Scoping Review*

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6) Conclusions

Smart Energy

- BEIS is currently conducting research into smart energy systems and is **gathering evidence** on the energy and carbon savings, consumer impacts and contribution to energy security of smart technologies, such as demand-side response (facilitated through the use of integrated building management systems), energy storage, smart meters, smart appliances (such as smart heating controls), amongst other innovative technologies. This will inform its future smart energy policies

Gathering Evidence

- The paper argues that smart technologies have the potential to have a positive impact on energy and carbon savings, consumer bills and energy security, but the **evidence base needs to be significantly strengthened** before smart energy policies are implemented
- This is to **prevent unintended consequences**, such as rebound effects (increased energy consumption), lack of consumer acceptance and negative market disruption (such as reduced competition)
- This is an area that is fostering large amounts of **innovation** that will have important impacts on the future energy system

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Questions/Comments?

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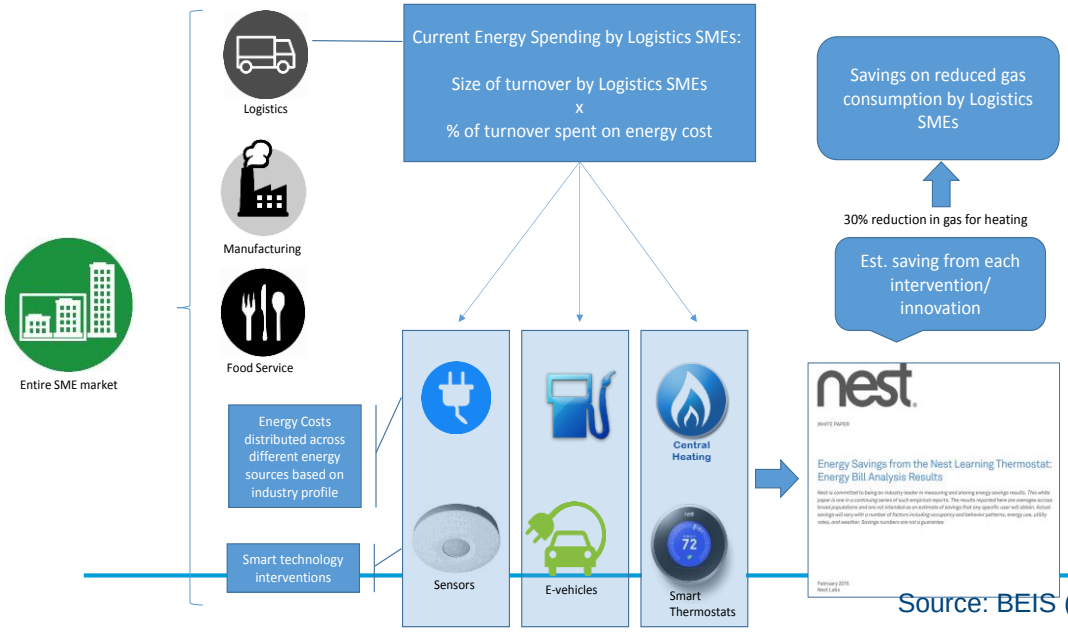
Appendix: Potential of smart technologies in SMEs

Scenario	Number of SMEs	Smart Heating Controls	Smart Meters	Integrated Building Management Systems	Smart Lighting Systems	Demand Responsive Energy Management	Big Data in Logistics and Transportation	Fleet Management	Total
Accommodation and Food Service Activities	182,447	£35m	£57m	£73m	£33m	£17m	£0m	£865m	**£1,081m**
Agriculture, Forestry and Fishing	153,207	£24m	£33m	£18m	£17m	£4m	£0m	£432m	**£527m**
Arts and Other Services	591,020	£8m	£12m	£8m	£6m	£2m	£0m	£160m	**£196m**
Construction	956,105	£8m	£10m	£9m	£5m	£2m	£1m	£8m	**£44m**
Education	267,550	£46m	£72m	£83m	£41m	£19m	£0m	£1,06m8	**£1,330m**
Human Health and Social Work Activities	370,632	£25m	£42m	£58m	£25m	£13m	£0m	£645m	**£808m**
Manufacturing	274,463	£54m	£131m	£386m	£94m	£88m	£18m	£141m	**£912m**
Mining, Quarrying, and Utilities	29,302	£1m	£1m	£4m	£1m	£1m	£0m	£0m	**£7m**
Professional Services	1,761,471	£22m	£37m	£54m	£22m	£13m	£0m	£580m	**£728m**
Wholesale, Retail, Transport and Storage	795,935	£68m	£129m	£243m	£83m	£57m	£274m	£2,153m	**£3,007m**
Total	**5,382,132**	**£292m**	**£526m**	**£935m**	**£326m**	**£216m**	**£293m**	**£6,051m**	**£8,639m**

Arup analysis based on data from DECC, Energy Consumption in the United Kingdom (EC UK), 30 July 2015 and BIS Business Population Estimates 2015, 14 Oct 2015



BIS SME classification	No. private businesses (000s)	Percentage of SMEs	No. Employees (000s)	Percentage of employment among SMEs
Micro (0 to 9 employees)	5,146	96%	8,461	54%
Small (10 to 49 employees)	204	4%	3,967	25%
Medium (50 to 249 employees)	33	2%	3,183	20%
Total SMEs	5,382	100%	15,611	100%

Source: BEIS (forthcoming) *Potential of smart technologies in SMEs*