What is the potential availability of DSR ?

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&
Judith Ward. Sustainability *First*.

Ofgem DSR Workshop. London.
20 November 2012.

Sustainability *First*

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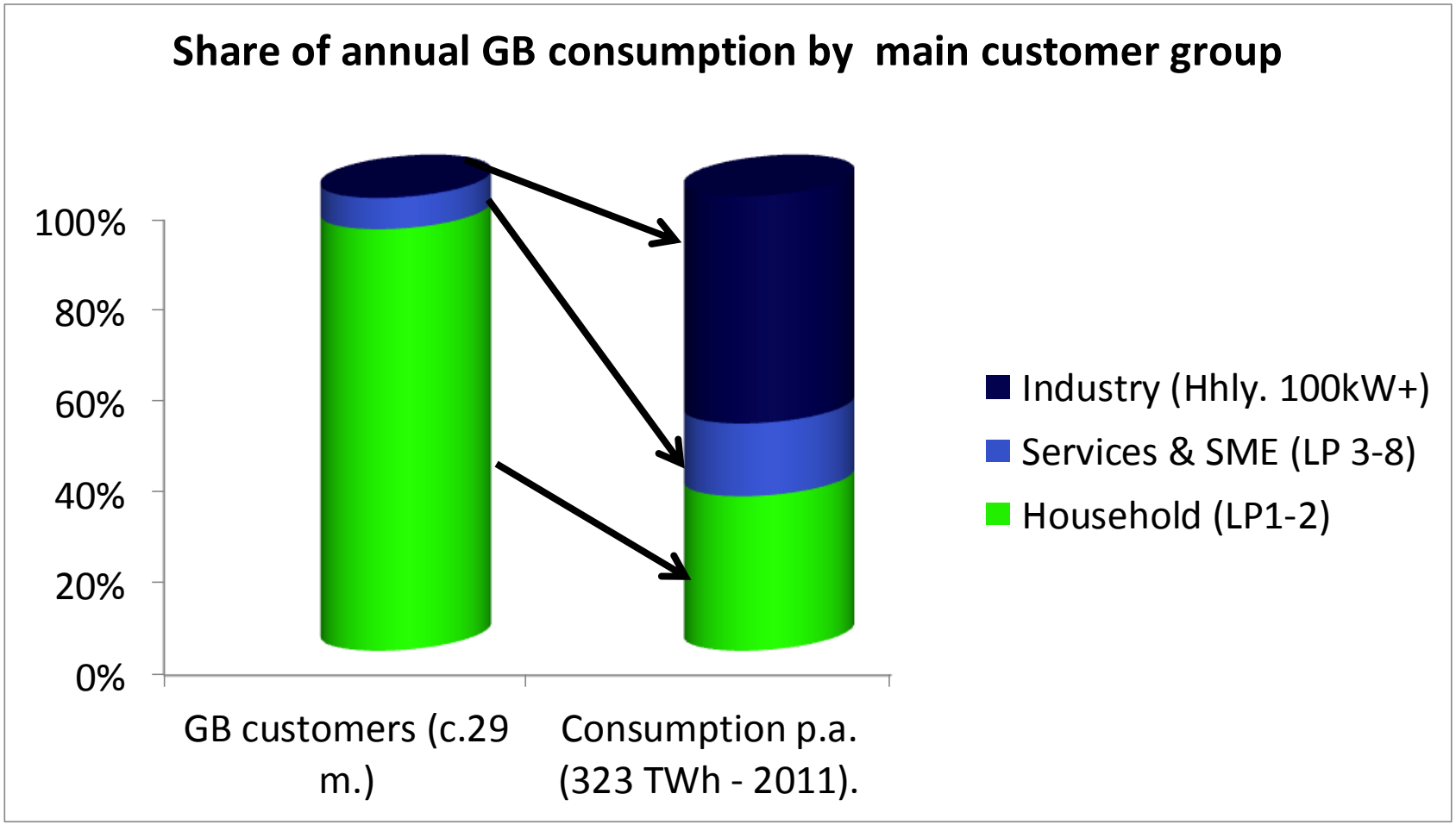
Today

1. **Demand-Side Response in the Commercial & Public Sector.**
   Element Energy.

2. **Industry & Household Demand-Side Contribution.**
   GB Electricity Demand Project.
   Sustainability First

GB Electricity End-Use Today









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Commercial & public sector Demand Side Response

The potential for DSR in the commercial and public sectors has been assessed

Published national (and regional) level data

Data from a variety of sources (including consultees)

Input from sector experts (via consultation)

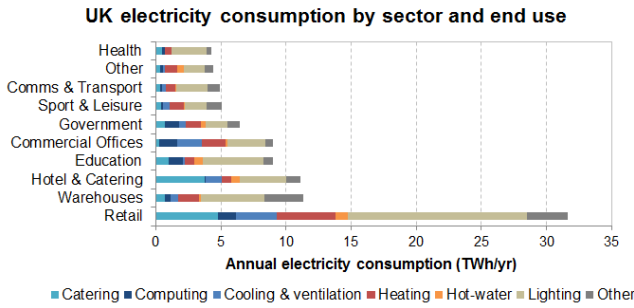
Electricity consumption by sub-sector

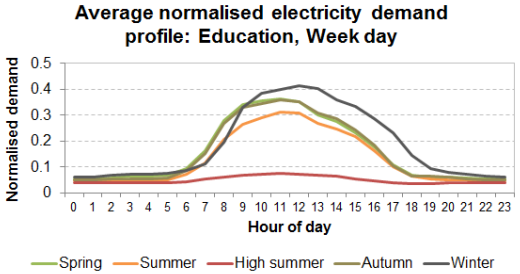
Half-hourly demand profiles for wide range of buildings

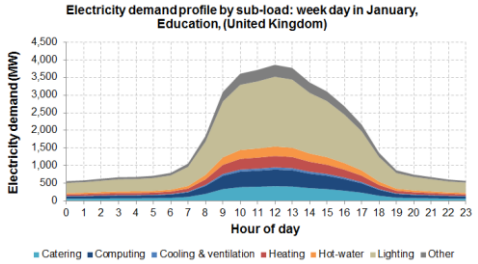
Sector demand profiles (average for all buildings in sector)

Characterise demand profiles by sub-load components

Assess potential for DSR



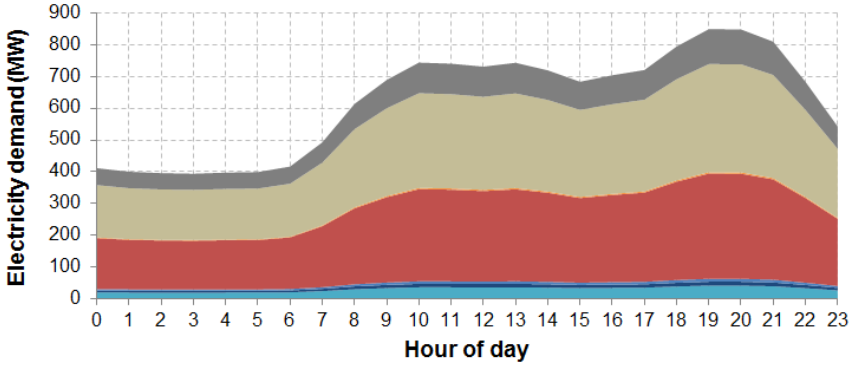




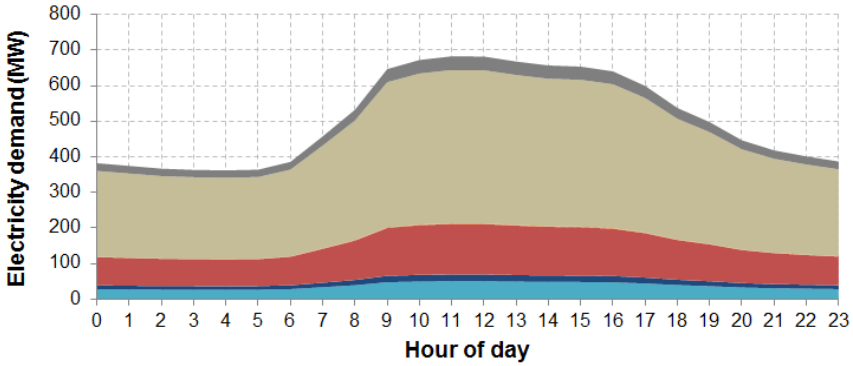
Amount of flexibility by sub-load, potential reduction in peak demands (GW) etc.

Averaged load profiles have been developed for a range of sectors, based on combination of metered and published data

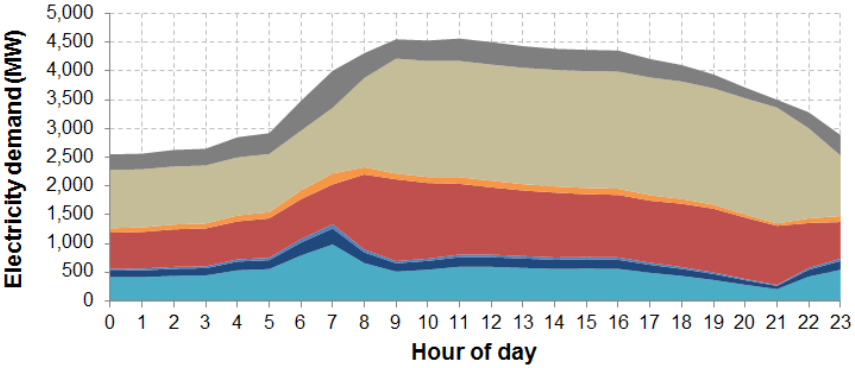
Sports & leisure



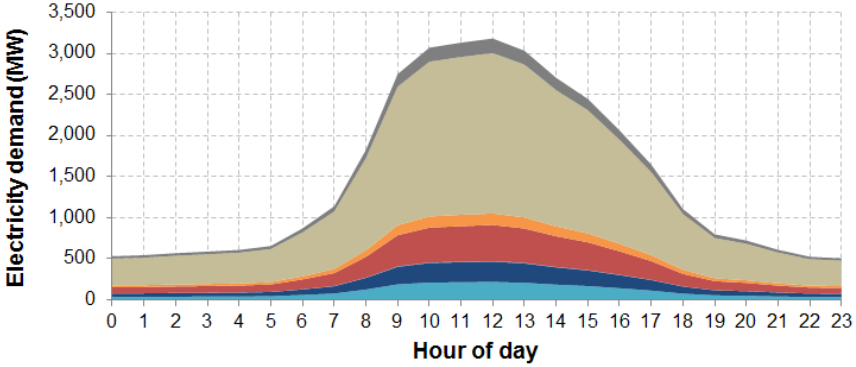
Health



Retail

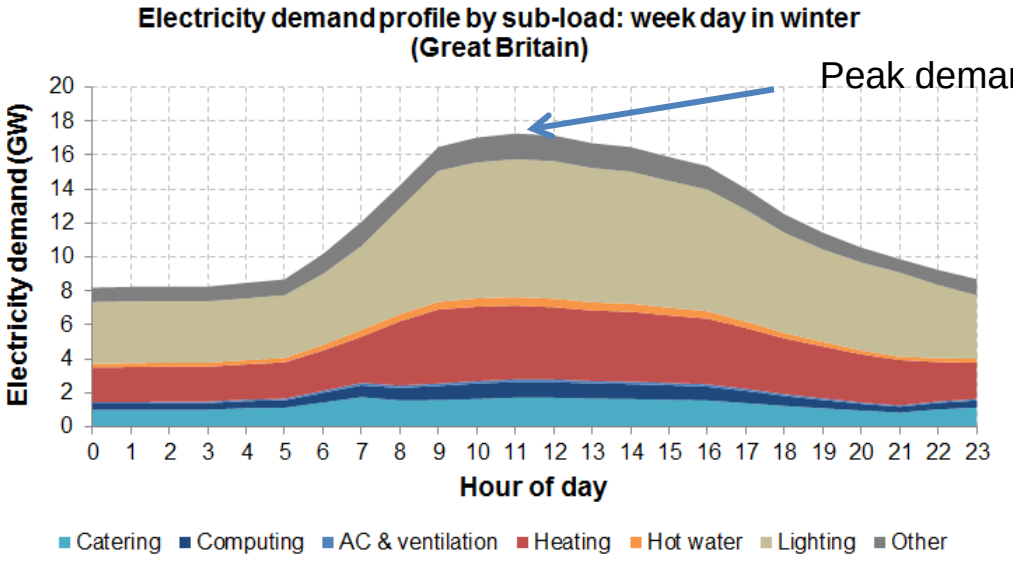


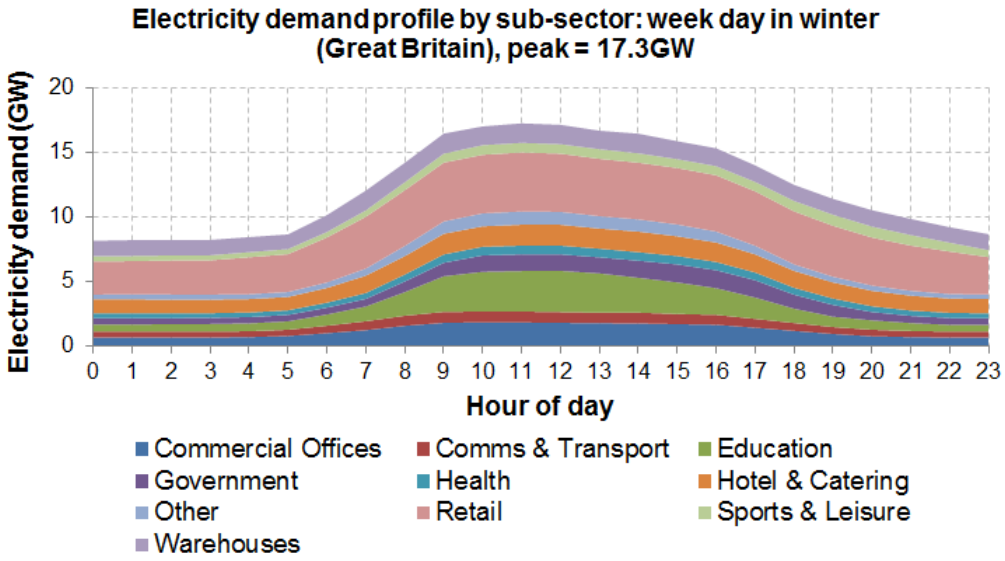
Education



Catering Computing AC & ventilation Heating Hot water Lighting Other

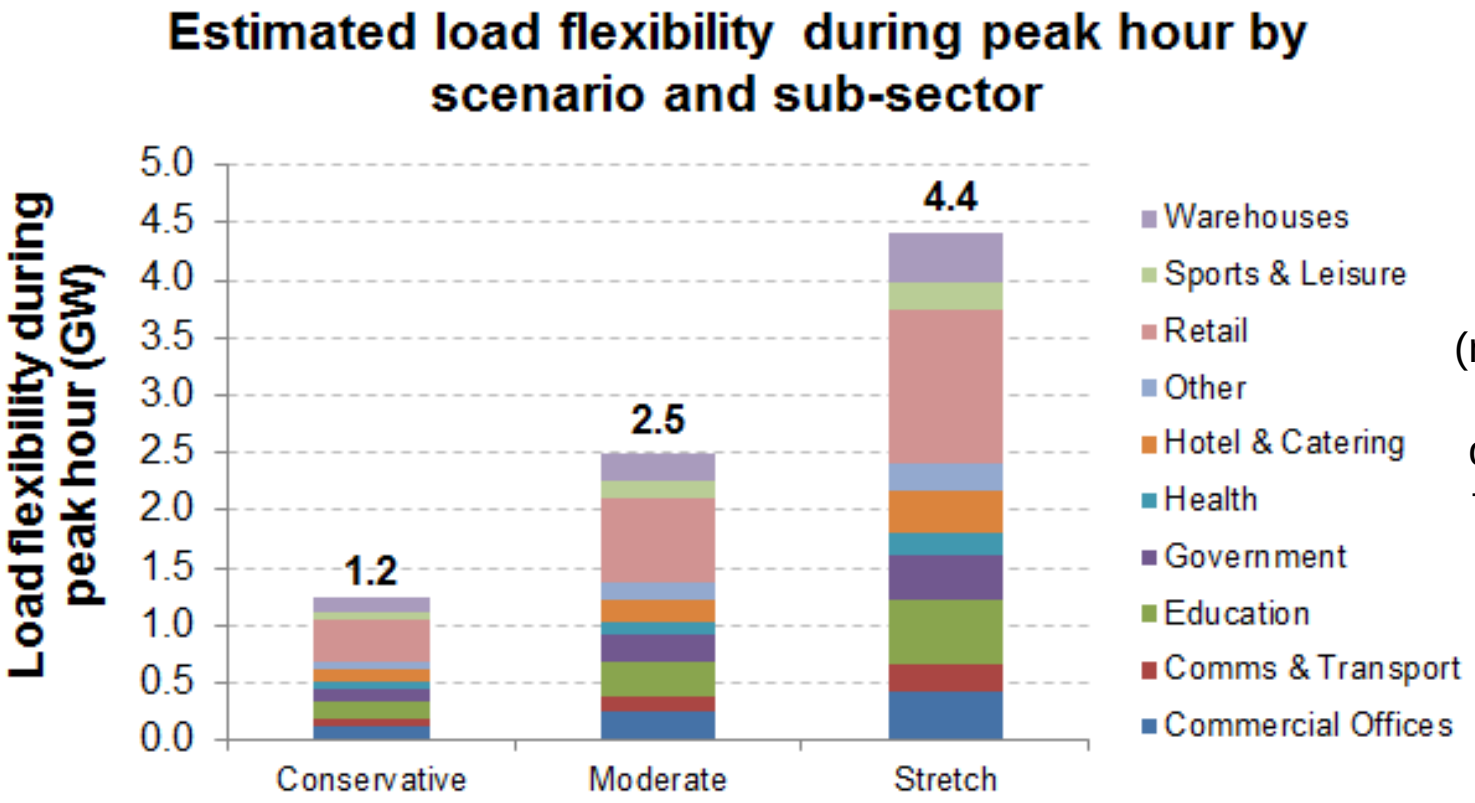
An overall load profile has been developed by combination of each sub-sector load profile





- Compared to total peak demands on the grid (all sectors), we find that commercial and public buildings account for around **30%** of the total.
- The retail sector is the largest component of the overall commercial / public sector load.
- In terms of the electricity end-uses that make up this demand, lighting is the largest component.

Based on our understanding of the load profiles, we have estimated the amount of load that is flexible under various scenarios

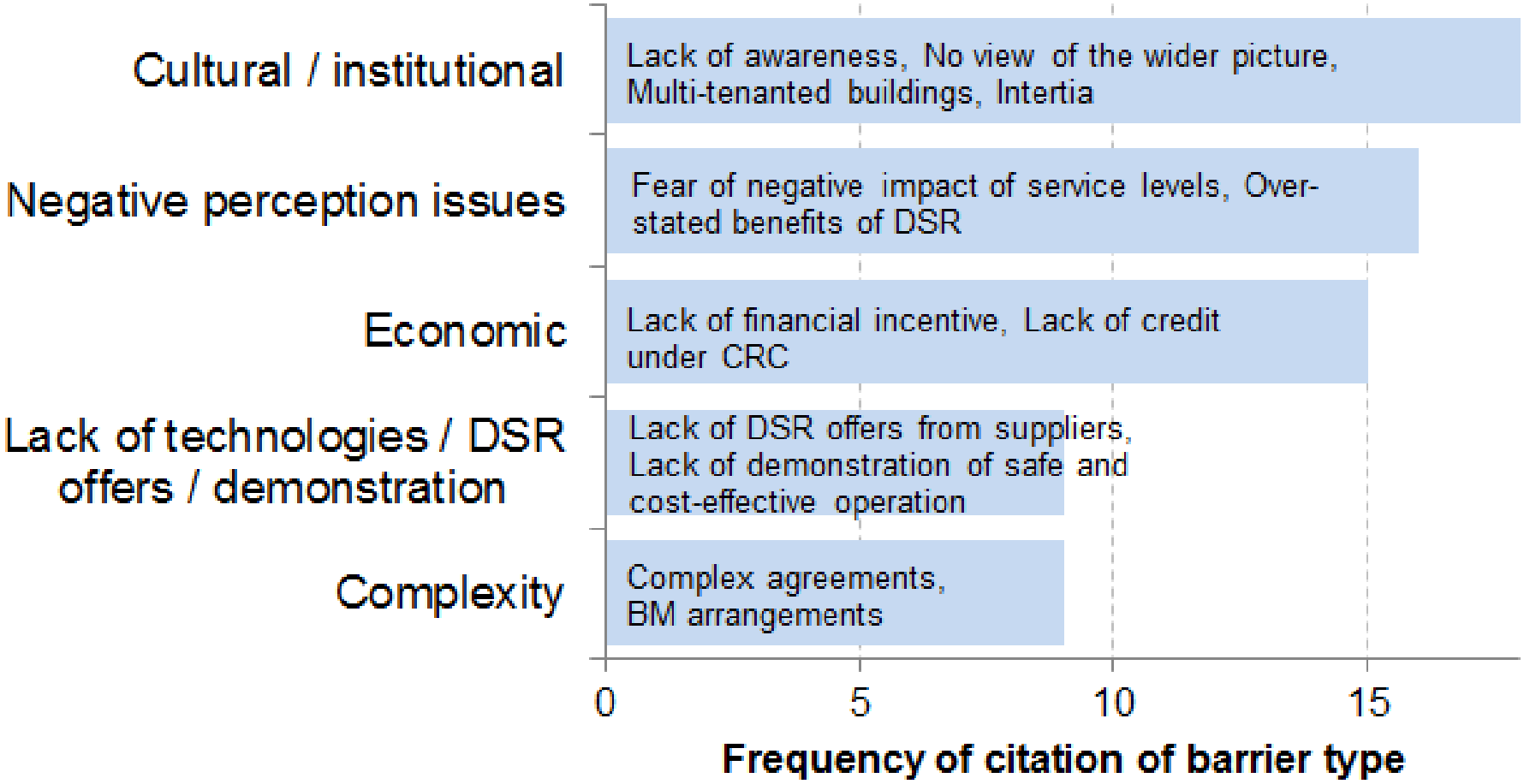


The top three sub-sectors (retail, education, commercial offices) account for >50% of the total flexibility.

- From these scenarios, we conclude that there could be from around **1–4.5 GW** of demand flexibility at peak periods within non-domestic buildings.
- Numerous barriers would have to be overcome to access this technical potential.

Organisations across the sectors were consulted to understand the barriers to engaging with DSR

Barriers to DSR cited by consultees during telephone interviews



The consultation provided insights into attitudes towards DSR in the non-domestic sector

Key insights

- Energy issues in general and DSR in particular do not feature highly on the agenda of many businesses.
- There is a significant amount of inertia (resistance to change) and concerns about negative impact on business operations.
- Few organisations in the sector are currently employing DSR measures and further demonstrations are required to provide evidence of the economic case and no negative impacts on service levels.
- The economic benefits of implementing DSR measures are perceived to be low and / or uncertain.

"Businesses don't take energy issues seriously enough"

"Demand side response is not a priority..."

"Facilities managers are very risk averse and won't do anything unless they're told to"

"DSR uptake in this sector is exceptionally low...TOU tariffs as rare as hens' teeth "

"Trials are needed but no one wants to be a guinea pig "

"It all comes down to economics and levels of service"

Conclusions

- Non-domestic buildings contribute approximately **17GW** (30%) to peak demands on Great Britain's national grid (which occur during the early evening on winter week days).

- The total technical potential for peak demand reduction via DSR measures in non-domestic buildings is estimated to be from around **1–4.5GW** (or 0.6–2GW if no flexibility can be provided from lighting). The three sub-sectors that may contribute most to delivering this potential are retail, education and commercial offices.

- Awareness of and engagement with DSR measures in the non-domestic buildings sector is currently low. The principal barriers restricting the DSR market in this sector include:
  - Lack of focus on energy issues and lack of awareness of DSR.
  - Concerns over negative impact on services.
  - Unclear / uncertain economic case.
  - Complexity of DSR offers.

- Significant further uptake of DSR is likely to require a range of enabling mechanisms:
  - Awareness- raising and education.
  - Trials, guarantees, certification.
  - Simple, tailored DSR offers.

Industry & Household DSR

Paper 3

GB Electricity Demand Project – GB Electricity End-Use Today

- We aimed for a **systematic overview** of how different sectors presently use electricity across the day, week & seasons (Industry, Services, Households).
- **Electricity end-use data** – turned out to be somewhat limited & historic. So instead, we have aimed to build a **'Best Picture'.**
- This draws on : official UK data ; our own end-use model - developed by Brattle ; an Industry survey ; a review of household data and trials. Increasingly, new empirical end-use data from trials.
- Without a clear grasp of how customers use their electricity today :
  - **Efforts to engage customers in the demand-side risk being poorly focused.**
  - **Decision-making on policy, on measures - & priorities – also risk being ill-informed.**

Industry 1 - Potential availability of DSR ?

- **~117,000 half-hourly settled, 100kW-+ customers :** consume ~50% of all electricity p.a.
- **Demand reduction potential** – many cost-effective electricity efficiency measures already taken.
- **Fairly flat profile** - across the day, night & seasons. Chemicals, food & drink, & paper industries ~40% total sector consumption.
- **DSR potential** - fairly 'bespoke' - shaped by process needs.

Industry 2 – What Sustainability *First* has done

- Reviewed official data for industry sector (DUKES & ECUK) - three short-comings :
  - ***Half-hourly data*** **for large 100 kW-plus customers** – does not feed into official energy statistics.
  - **So, no 'typical' load-curves for different industry sub-sectors** - i.e. no clear view of daily / weekly usage-patterns by e.g. chemicals, steel, food, paper industries.
  - **End-use 'process' data** (e.g.high-temperature heat, drying etc) – derives from old models & surveys (DECC ECUK).
- **Sustainability First - Small Survey** : 19 large industrial customers (mostly 100kW-plus, half-hourly settled) ; 4 trade bodies.
- **Sectors** : steel ; chemicals ; industrial gases ; food ; brick–makers & ceramics ; cement ; & water.
- We discussed:
  - Current electricity use & key industrial processes
  - DSR activity today
  - Unexploited DSR potential - & barriers.

Industry 3 – Current Electricity Use

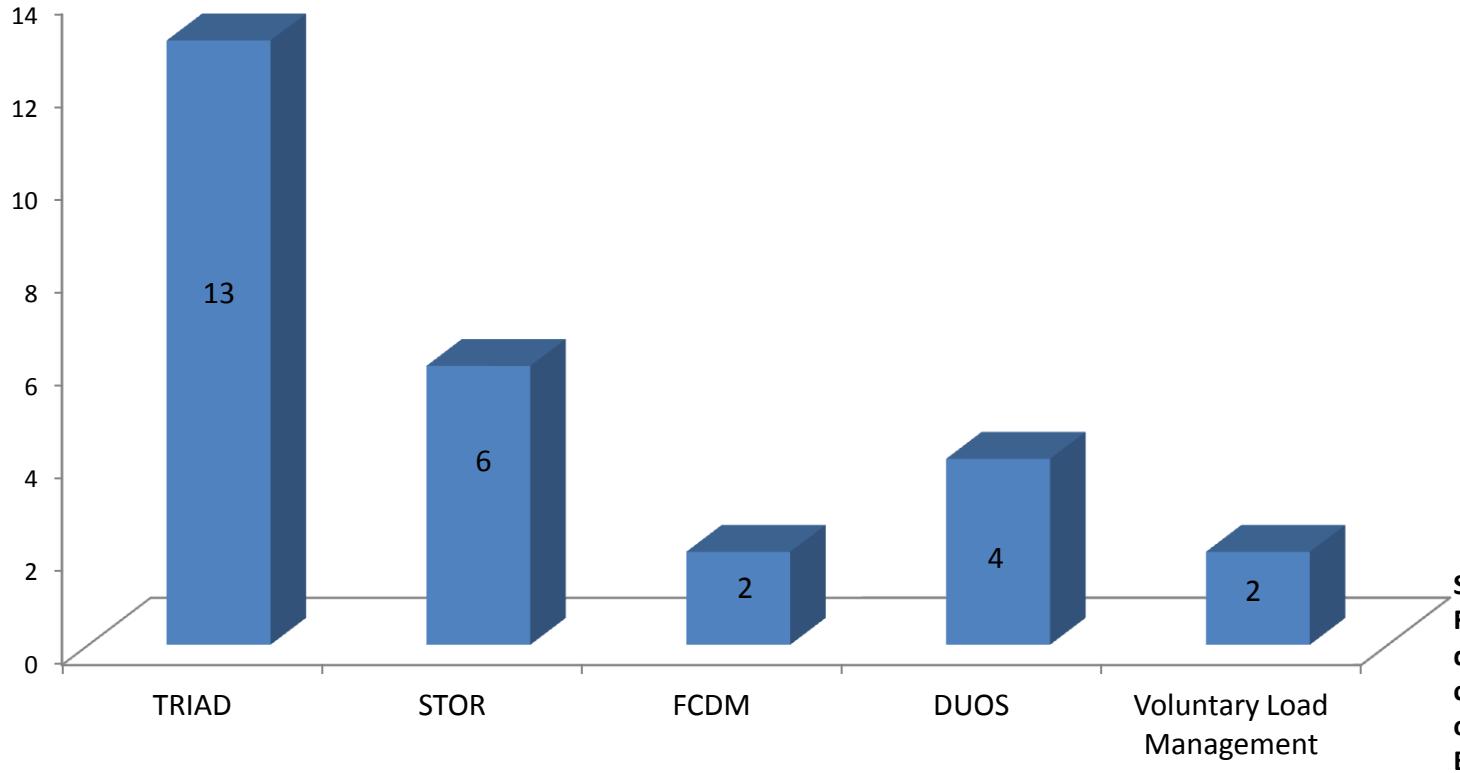
	Electro intensive?	Gas intensive?	Specific processes accounting for main electricity load	General processes contributing to electrical load	Technical potential for DSR?
Sector					
Food	No	Yes	Refrigeration	Pumps, fans, motors	Limited
Paper	No	Yes	Paper production	Pumps, fans, motors	Limited*
Chemicals	Yes (some sectors)	Sector-dependent	Electrolysis	Fans, motors	Good/moderate
Steel Primary steelmaking: Basic Oxygen Steelmaking **Electric Arc Furnace** Secondary: Steel mills	 No Yes	 Yes No	 Fans and motors (no specific large electric load) Furnace	 Fans, motors Fans, motors	 Poor Good/moderate
Cement	Yes	Yes	Grinding raw materials, cement grinding	Fans, motors, compressed air	Good/moderate
Industrial gases	Yes	No	Air compression unit (compressor, refrigeration), gas liquefier	Motors	Good / moderate
Ceramics	No	Yes	Materials crushing & mixing	Fans, motors	Good/moderate**
Water	Yes	No	Pumping, water & wastewater treatment	Motors	Good/moderate
Retail	Yes	No	HVAC, refrigeration, lighting	Fans, motors	Limited

Electricity consumption characteristics across industry sectors. Source: Sustainability First, Paper 3.

*Some potential but from a small electrical load.
**Good potential, but from a smaller electric load.

Industry 4 – Survey. DSR Today

Current participation in DSR schemes (19 respondents)



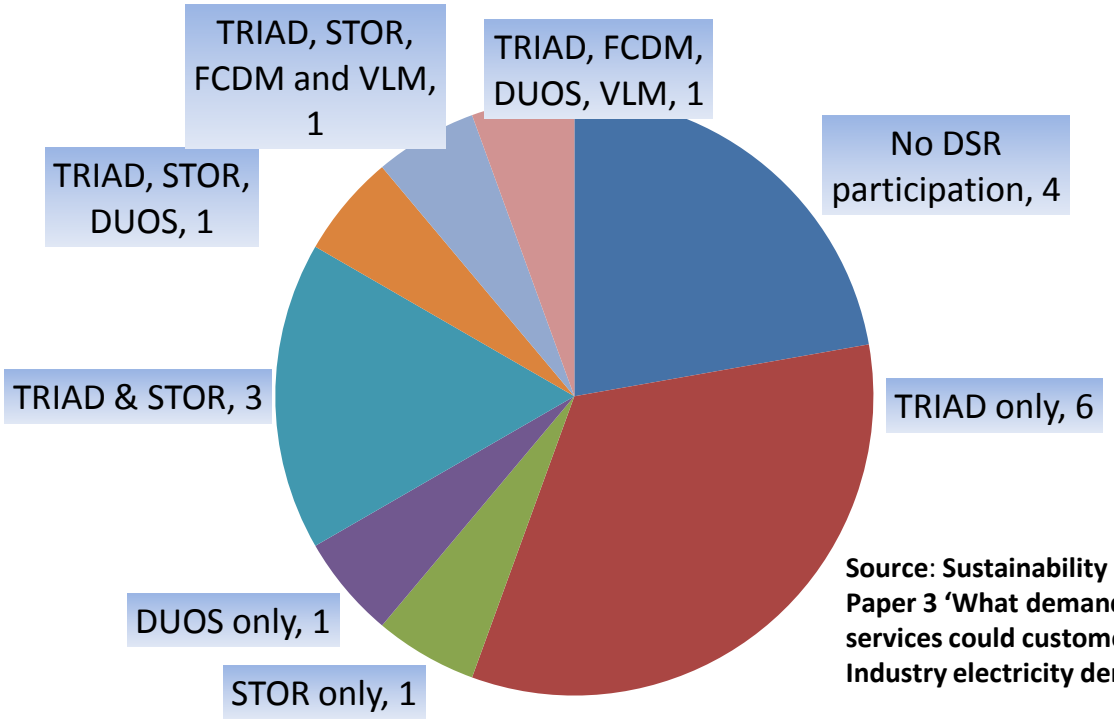
Source: Sustainability First, Paper 3 'What demand-side services could customers offer? Industry Electricity Demand'

Industry 5 – Survey. DSR Today

Engagement levels with DSR schemes:

a clear link to size of electricity bill as %-age of overall operating costs (e.g. >10%).

Participation in DSR schemes among 19 Industry respondents



Source: Sustainability First, Paper 3 'What demand-side services could customers offer? Industry electricity demand '

Industry 6 – Survey. Unexploited DSR Potential?

Several businesses felt they may have scope for further DSR, but some obstacles noted :

- **Business-led** – core business drivers were over-arching priority – process-risks, food-safety (refrigeration, chillers) etc.
- **Financial –** available incentives insufficient.
- **Technical** – non-interruptible processes ; unpredictable processes ; lack of automation ; mis-match on required notice periods.
- **Contractual / commercial –** timelines for DSR tenders ; unable to commit 'ahead' (esp where uncertain order-book); compatibility in providing DSR services to one or more market actor (& possible contractual conflicts).

Industry 7 – Survey. Some Initial Findings

Not definitive – but :

- **Balancing** - potential to expand frequency response / fast-reserve type services (opportunity due to technology).
- **Unexploited peak-related potential** - e.g. 10-20 TRIAD responses p.a.
- Economic downturn – some DSR interest (new revenue).
- Interest in more information about DSR opportunities – incl available revenues and what expected in return.
- A wish for more engaged relations between Industry and energy market actors.
- Industry DSR is largely 'bespoke'. Top-down estimates of potential for DSR in industry are problematic.

Households 1 - Potential availability of DSR?

- **Demand reduction potential** – mostly : lighting efficiency ; product standards.

- **Large household contribution to winter evening peak ~50%** – lights, cooking, electronics. Limited 'shiftable' load at evening peak (incl wet-appliance use) ? Some 'on-peak' heat. **Also, morning peak.**

- **Daily load-curves for households – incl appliance-level break-down** : patchy, out-of-date. Some new empirical data – e.g. DECC & DEFRA 'Household Electricity Survey'. **LCNF projects** - will give far better end-use data for households & SMEs.

Households 2 - What Sustainability *First* has done

(Paper 3)

- Reviewed : official data ; trials ; surveys. Focused on 2010 - to establish 'base-line'.
- Aimed to understand more about today's household load which :

  (1) might perhaps shift or reduce – or (2) has already shifted.
- So, focused on (1) electric space-heating and (2) electric water-heating – both 'peak' & 'off-peak'.
- ~14% (~16 TWh) of all electricity used by households is for space-heating – peak and off-peak.
- Broadly, 50 : 50 end-use split betw. 'peak' & 'off-peak' electric heat.

(DUKES & Elexon – est range : off-peak – 47-55%; peak - 45-53%. 2009).

Households 3 - On-Peak Electric Heat

- **'On-peak' electricity as main heating source – ~ 8 TWh p.a.**

  562,000 GB households (2.4%)

  - 'On-peak' electric heating - means **all** usage betw. 7am – 11pm (so, incl. 5-7pm).
  - Smaller homes – esp flats (older & new-build) ; private rental / owner-occ. ; single households ; lower incomes (EHS 2009).
  - **May be scope to shift some electric 'on-peak' heat to off-peak** – e.g. to Economy 7 (& so reduce winter evening peaks). But, would need good insulation - as well as 2-rate meters & new heating system.

- **'Top-up' electric 'on-peak' heat** - not likely to shift.

  D/k how much of 8TWh 'on-peak' heat - is 'top-up'.

Households 4 - Electric Heat & Economy 7

- **~5 m.** household 'Economy 7' meters out there (Elexon).
- **~3 - 3.5 m.** households on an Economy 7 Tariff ? our estimate - supplier info. (Consumer Focus (2012) – lower estimate).
- **~2 m. GB households (8%) have electric storage heating as their main heating source** (so, Economy 7 or similar). Many of whom - also have off-peak electric hot-water (but not necessarily all).
- Elexon estimate that ***night-time units supplied*** (betw midnight and 7am) for Economy 7 customers may be **~7-8% of all household units**. (So, ~8.5 TWh in 2011 – via LP2 meters). Also, **highly seasonal** (see Brattle model).
- **Radio Teleswitch** – **~2 m** GB meters. Remotely switches household load in 'blocks' (large, small) – with flexibility / scope to 'stagger' switching.
- **Some Economy 7 load already tele-switched for DSR** : (1) Balancing Services and (2) DNO constraint management.

Households 5 – Challenges for DSR ?

- **Smart meters –** await more scale
- **Households : ~ one-half of winter evening peak load – but limited flexibility –** (lights, cooking). Some 'on-peak' heat may shift (but not all).
- **Limited value in peak-avoidance today**. Also, value difficult to realise from many small individual savings.
- **Settlement reform** : More load-profiles – and / or half-hourly settlement - to incentivise suppliers to offer ToU tariffs at scale.
- **Market actor need for DSR may well be *locational*** - eg for avoided network investment. How suited are households ?
- **Automation / remote switching** – will need more electric heat & hot water. Tariffs for wind-twinning, PV & HP : may make long-run difference for household DSR.

Potential availability of DSR from customers today : Overview

(Paper 4)

Looked across today's GB electricity system to paint a picture of :

- **Which demand-side services market actors buy today** – and why.
- **Which customer groups** provide those demand-side services today.
- **The degree of 'fit'** - betw. the needs of market actors - and what services customers are able – or willing - to offer.
- **Where customers can obtain most reward in value-chain** for providing their demand-side services to market actors? **Both today - & for future.**

Ofgem Smarter Markets Review : helpful next-step in greater understanding of markets for DSR.

'£' – indicative relaitive earnings available to GB DSR *today*	NG Balancing Services			TRIAD	DNO		Wholesale
	Freq-uency	**Fast Reserve**	**STOR**		**EHV/LV Fault Insurance**	**LV** Peak Avoid-ance	
Industry Half-hourly settled customers	√ £££	√ ? £££	√ ££ Via Aggtrs	√ £	√ ££ locational	X	√ £ Via broker / supplier
Commercial LP 5-8 (Non H-Hly settled).	√ ? £££ Trials	?	√ ££ Via Aggtrs	X	?	X	?
Households / SMEs LP 1-4	X	√	X	X	√ £	X	Econ 7 – otherwise no. £

Sustainability *First*

GB Electricity Demand Project – *realising the resource*

Project Papers at www.sustainabilityfirst.org.uk

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