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**Demand reduction and demand response – we  
need joined up policy : some comparisons  
between Australia and the UK**

# Sustainability First GB Electricity Demand – realising the resource

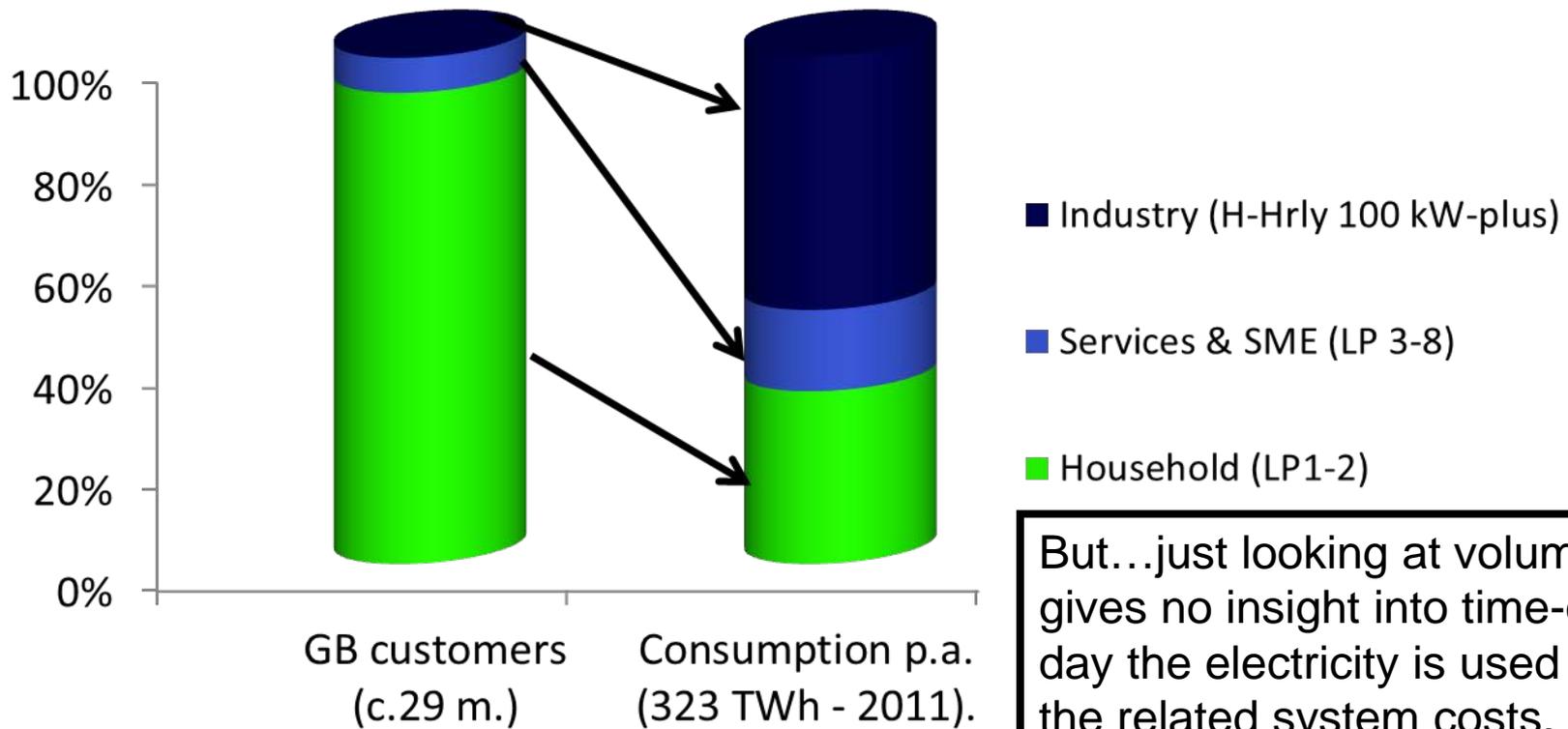
- SF is a small charitable environment think-tank.
- **Three-year project - GB electricity demand-side - sectors of the economy.**
- **Demand reduction & demand response – inc Distributed Gen.**
- **Economic value** - to customers & market actors. 10-15 year horizon.
- **Main focus** : customer, consumer, commercial, regulatory and policy issues.
- **Smart Demand Forum – Sponsors** – Northern Powergrid, Scottish Power Energy Networks, UK Power Networks, National Grid, British Gas, E.ON UK, EDF-Energy, Cable & Wireless, E-Meter, Elexon, BEAMA, Ofgem. ; **Consumer bodies** – Energy Intensive Users Group ; Which ? ; Consumer Focus; National Energy Action & **DECC**
- **All published project papers** – [www.sustainabilityfirst.org.uk](http://www.sustainabilityfirst.org.uk)

# Outline of presentation

- Household electricity demand
- Demand response and demand reduction
- Peak demand issue in Australia
- Potential impacts of switch to electric heating and vehicles in UK
- Integrating demand response and demand reduction
- **Focus in this presentation on the household sector**

# GB Electricity Consumption Volumes by Customer Group

Share of annual GB consumption by main customer group



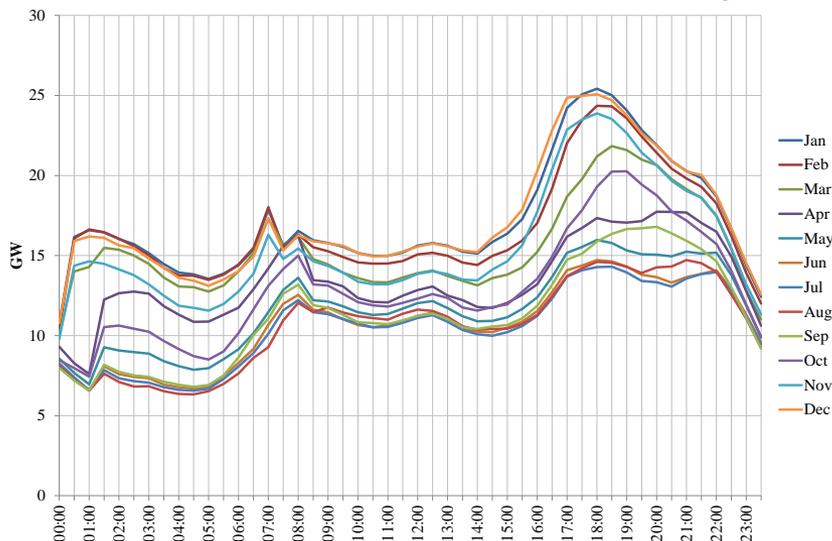
But...just looking at volumes gives no insight into time-of-day the electricity is used – & the related system costs.

# Peakiness of demand by sector

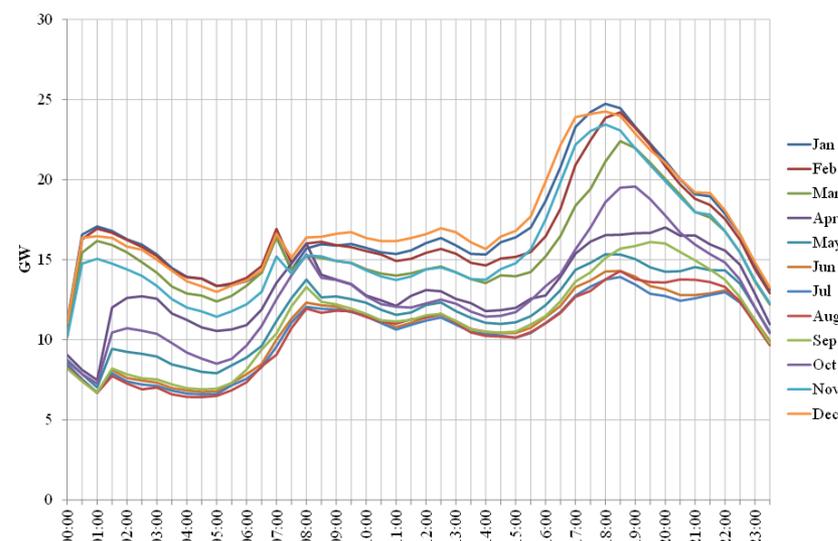
- Different sectors of the economy have different load-profile characteristics – some are more ‘peaky’ than others
- Industry - fairly flat across day, night & seasons. Likely to vary substantially by different sectors - but no data.
- Commercial – morning ‘rise’ but thereafter relatively flat through the day. Slowly tails off into evening. Profile will vary by type of activity but very little ‘real’ data (Ofgem paper. 2012. Element Energy).
- Households – morning & evening peaks. Significant contribution to total evening peak (around 50% (Ofgem 2010)). Lights, cooking, electronics.

# Generic household load profiles (daily)

## Household - Weekdays



## Household - Weekends



- ~ 27 million customers – ~93% of all customers. Consume around one-third of annual electricity by volume.
- **Household load profile** – Distinctive morning & evening peak. **Significant contribution to total evening peak (around one-half (Ofgem 2010))**. Lights, cooking, electronics.

Source : Brattle Model.  
Sustainability First. Paper 2

# Demand response and demand reduction policies

- Many policies to reduce energy demand e.g. Green Deal and ECO.
- Policies for renewable electricity and heat – feed in tariffs and RHI.
- Australia has similar schemes
- Discussion in both countries about scope to reduce costs in the electricity system by reducing peak demand.
- But policies being developed in parallel so may be unintended consequences.
- Lack of joined up policies already raising issues Australia, but could be similar in GB in future – if we electrify heat and transport on the scale some are envisaging.

# Demand response and demand reduction – definitions

- **Demand response** - changes in electricity use by customers from their normal consumption patterns – e.g. to shift electricity use from peak to off-peak periods.
- **Demand reduction** - an actual reduction in the overall amount of electricity used, not just a shifting from peak periods.

# Why do DR or DSR ?

- Within the electricity system the purpose of demand reduction or demand response is to help reduce wholesale costs (short and long run), improve system reliability, or reduce network reinforcement costs.
- This is the main focus of this presentation
- May be other reasons for reducing electricity use **overall** (i.e. energy saving or demand reduction) – e.g. reducing emissions, reducing fuel poverty
- Reducing costs and these other objectives may not always align – will say something about this towards the end of presentation

# Peak demand and electricity system costs

- Costs in the electricity system (and impacts on electricity bills) driven by overall demand (total amount of electricity consumed) and peak demand (maximum amount consumed at any one time).
- However, peak demand is a particularly important driver of costs - infrastructure effectively unused for much of the time, yet the companies who built it need to recover the high fixed costs.
- Thinking about peak demand is important because if we reduce overall demand but peak demand stays the same or increases we will increase costs in the system that will have to be recovered
- **We need to tackle peak as well as overall demand to reduce costs**

# Value of demand reduction – not all equal

- All electricity demand reduction presently delivers the same value to most consumers (on flat tariffs, saving a kW at night = same bill reduction as saving a kW between 5-7 pm)
- But not all demand reduction has the same value for the electricity system. For example, reducing lighting-use between 5-7 pm in winter (more efficient lighting), will provide more value to the electricity system than improving the efficiency of electric hot water heating overnight in summer
- Not a big difference in value of saving electricity off-peak and peak at present in GB – but this differential will increase post 2020

# Peak demand – how much of a problem ?

- Peak demand is already a big issue in Australia – despite some respite in recent years with cooler summers
- Not a peak demand problem in GB at present
- But with increasing intermittent wind on the system
- And potential increases in electricity demand at peak times (electric vehicles and heat pumps)
- The need for and value of demand reduction and demand response in the electricity system is likely to increase post 2020
- So we should be starting to get customers ready for a world where we will need to reduce demand at peaks as well as overall

# Peak and overall demand growth in Australia

- Australian Government estimates that 25% of retail electricity costs are derived from peak events that occur over a period of less than 40 hours per year
- The rapid growth of peak demand relative to overall (or average) demand has been a major factor influencing costs in the Australian electricity system.
- Between 2005 and 2011, peak electricity demand increased 1.8 per cent a year, while total electricity demand grew at 0.5 per cent a year.
- Maximum summer demand increased by between 20% and 38% (varies between states) between 2001 and 2012.
- During the same period, average electricity demand increased by only 15%.

# Air-conditioning in households in Australia – impact on peak demand

- Households - 25% of total electricity demand but contribution to peak can be up to 45% on peak demand days across the system.
- Peak demand time 4-8pm - when business demand still high and household demand rises as people get home from work and school.
- One of the most significant drivers of peak demand is use of air conditioning.
- Growth in the installation and use of air conditioning by households has been particularly rapid in recent years.
- 73% of households in Australia had an air conditioner in 2011 compared to 59% in 2005.

# Tackling peak demand in Aus

- AEMC (Ofgem equivalent) advocating moving towards time varying network charges to incentivise more time of use pricing (network charges are 50% of the bill in Aus)
- Growth in uptake of solar PV may also be having an impact (1 million homes) on demand for electricity in daytime as people use their own rather than network electricity (so some reduction in peak)
- But a concern is that as so much investment has already been made in networks in recent years (to meet forecast peak demand growth), reductions in demand may not reduce costs – the “sunk” investment has to be recovered

# Could electric heat be the UK's equivalent of Australia's air conditioning problem ?

- To de-carbonise heat, envisaged that heat pumps may become widely used – and being supported through RHI
- Where heat pumps installed in properties that previously used other heating fuels, will cause a significant increase in electricity demand.
- Heat pumps typically operate most of the time producing low heat levels so will be running at peak demand times.
- Redpoint/Element for DECC modelled demand response for heat pumps – could reduce demand in 5-8pm peak but would increase demand in the afternoon I&C peak (so this could reduce the value of demand response)

# Is storage a solution ?

- Heat pumps can have a storage option that could help overcome the risk of increasing peak demand
- However, current storage units for heat pumps are large, heavy and expensive (CLNR experience), so the technology will need to develop
- Should we look again at elec storage heating ? New generation ?
- Heat pumps (like all forms of electric heating) also need to be installed in well insulated buildings to avoid excessive electricity demand (and impact on bills) - problem of solid walled properties

# Electric vehicles

- Similar issues if everyone with an electric car plugs it in to charge when they get home between 5-7 pm !
- Distribution networks already noticing some impact of EVs in areas where several people on the same street have one.
- At present most people who buy an EV would not face any price incentive to avoid charging it up at peak times (flat tariffs).

# Risk of increasing peak demand in GB

- Beware unintended consequences – e.g. large numbers of heat pumps and EVs could increase peak demand
- If this looks like happening the networks will be looking to Ofgem to allow them a lot more investment – which everyone will have to pay even if they are reducing their demand or responding to a time of use signal
- So we need some thought about how policy now will impact on costs in the system later in the decade and beyond

## Development of demand response

- Smart meters will facilitate DSR via time varying pricing .
- Suspect we won't see much on TOU etc until smart meters widely rolled out, networks start to develop time varying charging to all customers and settlement system also uses data from smart rather than profiles – so post 2019,.
- But will see trials in the meantime.

- **Some policy suggestions**

# USE GD, ECO and RHI to tackle on peak elec heating

- Focus of GD and ECO is reducing space heating energy - so main impact on gas rather than electricity use.
- 500, 000 households in GB main heat source is on-peak electricity
- Use GD and ECO to assist households and small businesses using on-peak electric heating to switch to off-peak electric heating (new generation storage heaters or heat pumps).
- Less of a problem for the electricity system than installing heat pumps in properties that currently use other heating fuels (because electricity already being used for heating at peak times)
- Also could use Renewable Heat Incentive to target these households.
- Would need to install insulation in these properties as well.
- Likely that many with peak electric heating as main source are on low incomes/fuel poverty.

# Insulation always makes sense !

- One policy which can confidently be pursued is increasing levels of insulation.
- At present this mainly reduces gas demand (as most homes gas heated)
- But if we were to move towards widespread use of electric heating, all homes would need to be much better insulated than at present to keep bills manageable and avoid major increases in peak demand – some growth unavoidable, but we can at least contain it.

## Heat pumps need good insulation

- RHPP at present requires only loft and cavity wall insulation where feasible – this means heat pumps could be installed in solid walled properties with poor thermal performance – risks of high bills and adding unnecessarily to peak demand
- Need to join up RHPP/RHI and GD/ECO so that heat pumps only installed along with insulation

# Lighting – still seems to be potential

- EST 2012 study found relatively low penetration still of CFLs – despite the millions given out under CERT !
- CFLs account for 24% bulbs installed, compared to 31% for halogen and 40% incandescent
- Picture even worse when we look at lighting demand - incandescent accounted for 50% of lighting demand ; CFLs 7%; halogen 38%
- In winter, much of this lighting demand will be in the evening peak
- Lighting accounts for about 15% of household electricity use
- Presumably should improve now incandescent lighting banned
- Do we need any further action on lighting ? Incentives ? Regulation ?

# Link EV incentives to signing up to demand response

- Technical solution for EVs is relatively simple – DLC option so that cars are mostly charged overnight (could be offered a lower price for this electricity)
- Customers could over-ride but might have to pay a very high rate to charge between 4-7pm.
- Main question will be how to get customers with EVs onto DLC and peak pricing – incentivise or compel ?
- Should EV incentives (grants or loans) be conditional on signing up to a demand response tariff ?

## Conclusion – can policy be fully joined up ?

- May be public policy reasons to support demand reduction and renewable energy solutions that do not reduce electricity system costs – e.g. for social (tackling fuel poverty) or environmental (carbon reduction) purposes.
- However, we should at least be aware of the potential impacts on electricity demand
- Policy can never be fully joined up – there are different objectives – but need to be aware of the trade offs to try to identify where we can avoid the risk of unintended consequences