# Policy and Technology Solutions for India and the UK

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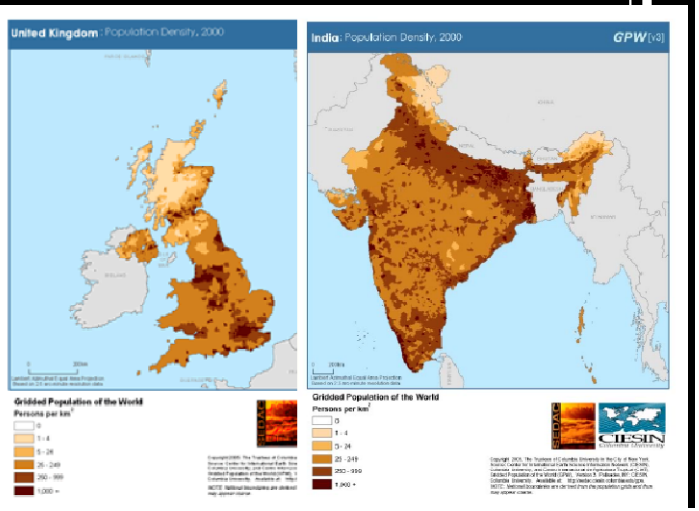
# Introduction

- As has been said by the previous groups:
- Shared by both countries:
  - Increasing price of fuels
  - Global warming
  - Increasing energy demand

# Problems: Population

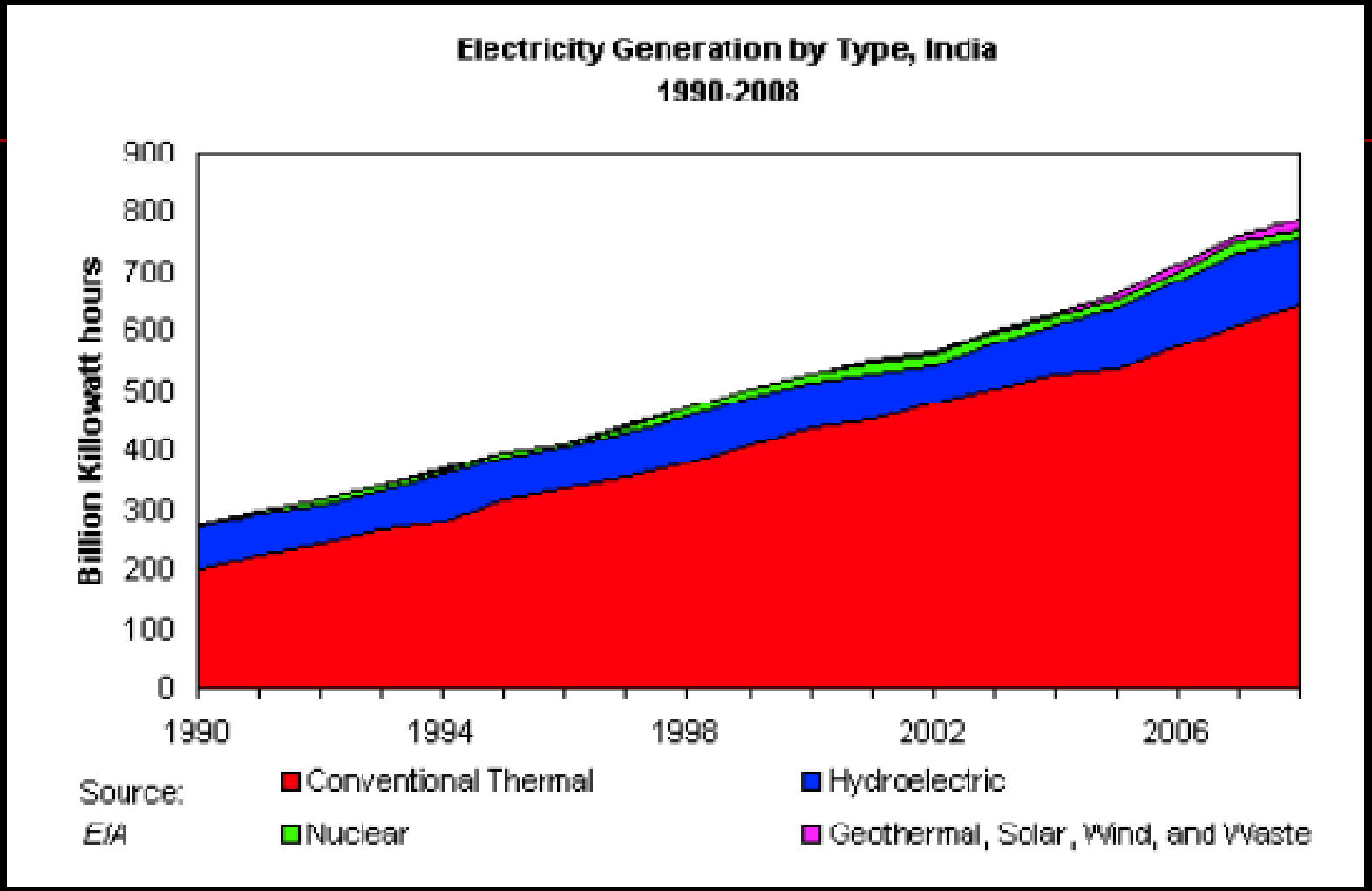
- India
  - Population increasing in India, already up to 1,140,000,000 [U.S Energy Information Administration]
  - >58000 villages still without power. Access to electricity and poverty are closely related [1]
- England
  - Population of 61,000,000
  - Aging




[1] Hiloidhari, M., Baruah, D.C., *Energy for Sustainable Development*, 2011, doi: 10.1016/j.esd.2011.05.004

# Fuel Prices / Availability

- Higher demand for coal, gas and oil is increasing  the price
- Fuel shortages in power and agriculture lead to power cuts and food shortages


Electricity Generation by Type, India
1990-2008
Billion Killowatt hours
900
800
700
600
500
400
300
200
100
0
1990
1994
1998
2002
2006
Source:
EIA
Conventional Thermal
Hydroelectric
Nuclear
Geothermal, Solar, Wind, and Waste

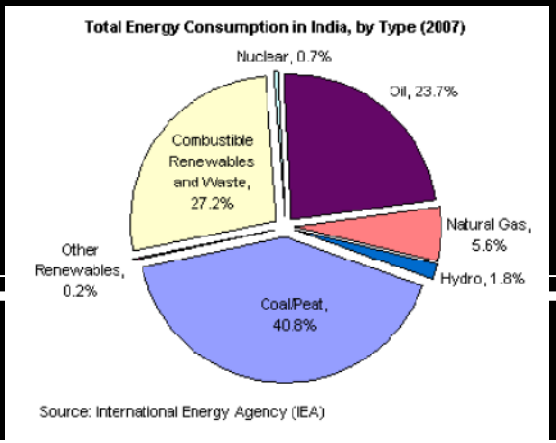
# Electrification of rural areas

- India
  - Electricity needed for agriculture such as pumping water, minimizing harvest losses
  - Electricity also improves health and education
  - 2012 target for electrification has not been met
- UK
  - Rural areas not connected to gas network and suffer  from power cuts more than urban areas

# $CO_2$ emission

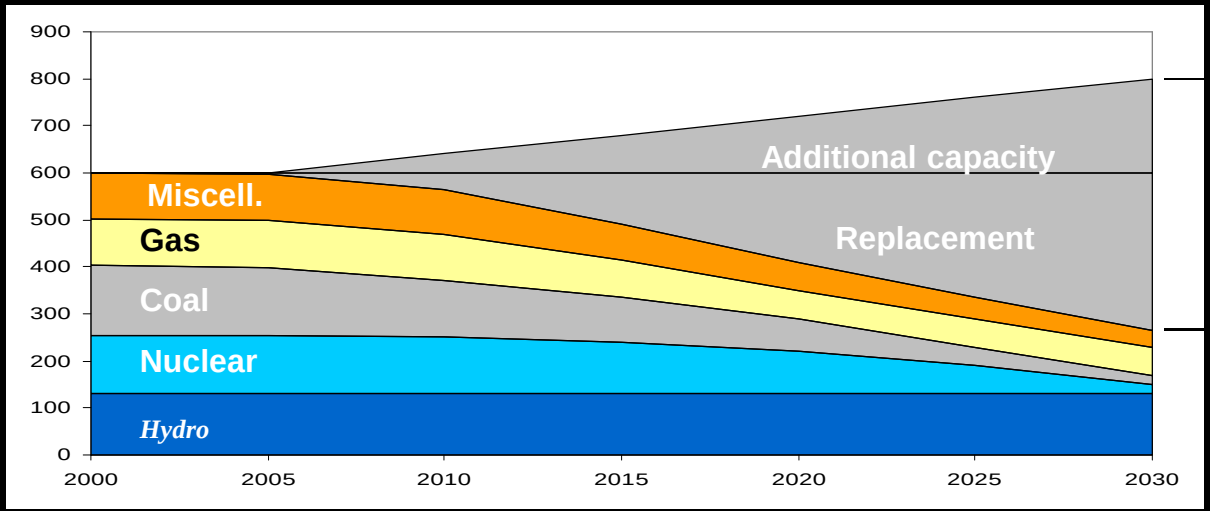
- Causes global warming
- Consequences shared by all countries

- UK: 31% of $CO_2$ emitted by power stations
- India: Reliance on coal power is leading to increasing emissions



# Growth in demand

- Both India and UK have a growing energy demand for electricity and transport
- UK faces shortfall in the future (the energy gap)
- Indian demand all ready outstrips supply by ~10% (2007) [1]




[1] Energy Policy Volume 38, Issue 3, March 2010, Pages 1519-1528 Security, Prosperity and Community – Towards a Common European Energy Policy

# Location specific resource availability

- Non-uniform distribution of renewable energy sources.
- Solar, wind, hydro, biomass technologies are an attractive alternative to fossil fuel energy.

# Possible solutions to problems

# Population

- India – education, population control (e.g. one child policy)
- UK – Selective immigration of young people to change average age ranges. Encourage emigration of retired people.

# $CO_2$ emission reduction

- CCS for industry
- decarbonise transport
- improve heating efficiency
- add more renewables to the grid
- increase use of biomass co-firing

# Fuel Prices

- India – More use of biomass, altering power plants to burn different coal, more exploration for fossil fuels, improve efficiency of plant, securing resources from neighbours
- UK – Switch to renewables, diversify energy sources, plant efficiency, reduce transport consumption of fossil fuels

# Rural Electrification

- India
  - More off-grid generation: biomass, solar, small scale hydro, wind
  - Continued grid expansion
- UK
  - Policy shift to force energy suppliers into action, energy efficiency improvement, off-grid generation: CHP, solar

# Increasing Demand

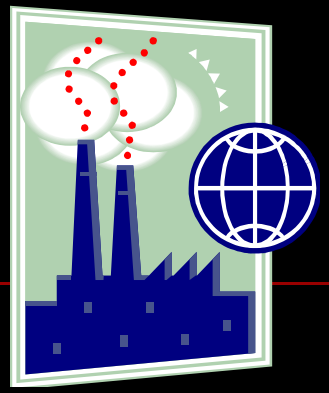
- UK – Energy efficiency, replace old plant, install new power plants
- India – Can also improve existing plant significantly

# Policy and Solutions

- Case Studies: London and North East India

- London: highest electricity use and $CO_2$ emissions in UK
- North East India: Representative of rural areas and opportunities for renewable power

# International Collaboration



- Technology trading
- Knowledge sharing – this summer school!
- Power grid connections
  - London: Link to EU super-grid
  - NE India: Link with Bangladesh
- Gas links with neighbouring countries
- Water sharing
- Environmental Planning committees
  - E.g. dam commissioning, dispute settlements

# Improve Education

- Increase awareness of genetic modification, nuclear power, environmental issues

- India – increase quality of life, likely to stabilise population growth as it becomes a developed country (e.g. Italian population is decreasing)

# Renewables : Solar

- Solar water heating (currently used in China). Costs lowered by manufacturing in India.
- Government incentives to open solar cell manufacturing plants, can also sell the product to other countries
- Consider desert based centralised solar electricity generation, tender for demo plant
- Not a key technology in UK, recent cancellation of FiT

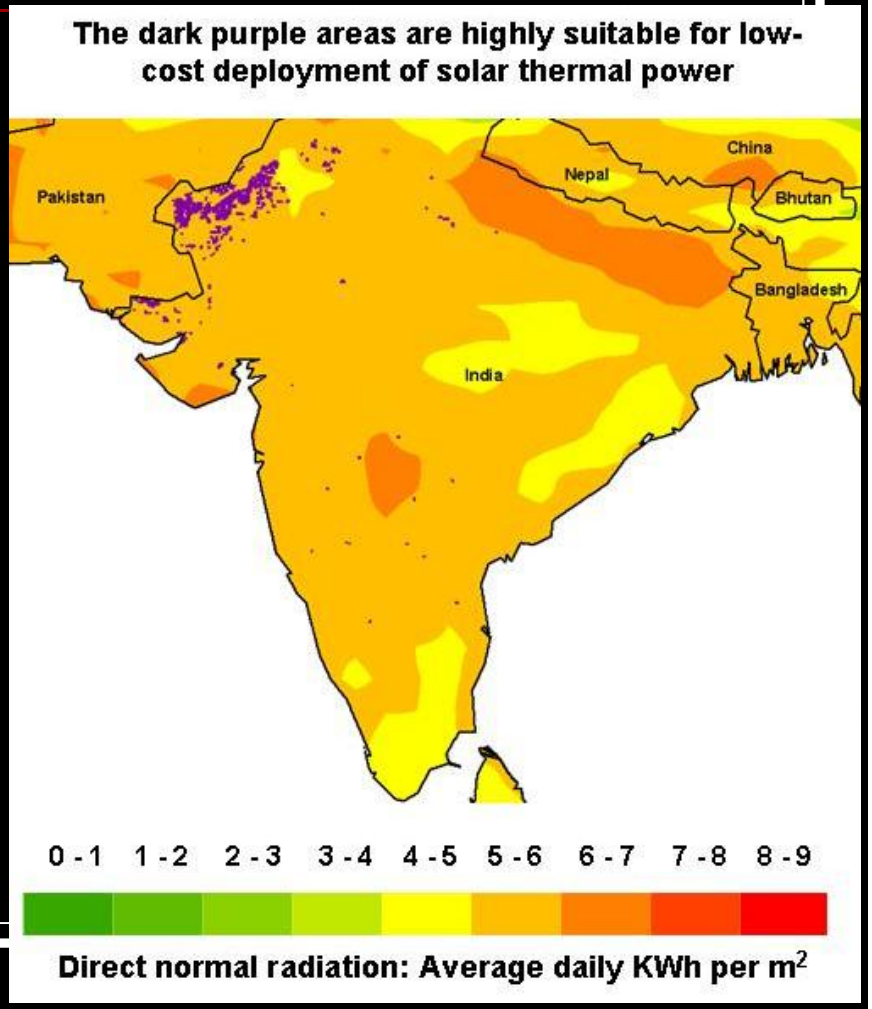



Image source: http://www.cgdev.org/userfiles/image/blog/Indiasolarpotential.JPG

# Renewables : Hydro

- India: Mixture of large scale and small scale projects
  - Small scale in difficult to reach areas for off-grid power
  - Large scale projects for power generation and water management
- UK: No hydro resources left to develop. More research into tidal power generation and government tenders for demo projects in Scotland

# “Renewables”: Nuclear

- 2% of Indian electricity (2007)
- 18% of electricity in UK (2009)
- Earthquake risks limit implementation in NE India
- Used along coast in southern regions.
- India should begin work on waste reprocessing and storage sites.
- UK has some waste re-processing capability. This should be increased. Plants should be constructed regardless of protest.

# Efficiency

- Both UK and India can improve the efficiency of their thermal power plant fleet.
- Government policy should support improvement and modernization in existing plant.
- Policies in both UK and India should set limits for the efficient use of electricity.
  - e.g. household appliances must use less energy

# CCS implementation

International research needed to develop and implement new ways to capture $CO_2$. e.g. - Microbial fixation, Adsorption, Absorption, Oxyfuel combustion

India – Can implement technology once it is proven and more cost effective

UK – Well suited to CCS. Must lead way in CCS research. Change policy to accelerate demo plant construction. Long term support and legal framework.

# Transport

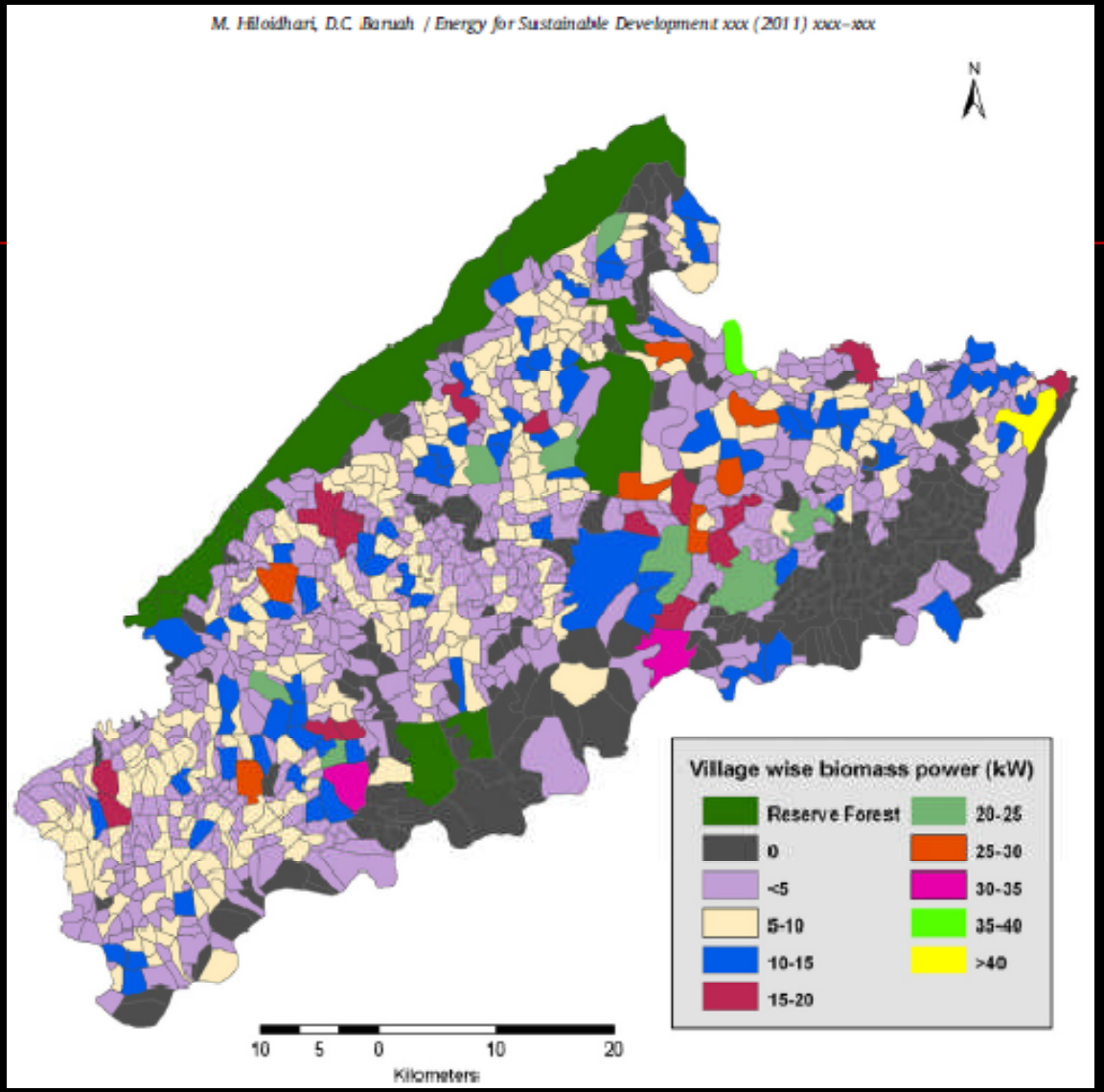
- Reduce oil dependence and $CO_2$ emissions
- London: Rickshaws, bicycle lanes, nationalize train and bus services, LPG fuels
- NE India: More train lines / Metros, cheaper and more efficient vehicles to encourage switching, congestion charges to subsidise public transport

# Biomass in India

- Uniform availability: Over 500 million tonnes in India, of which 120-150 million tonnes is waste
- Rice stalk waste often burnt in the open, releasing methane
- Could be used to fire biomass plants in relatively remote areas, with short distances between the fuel and the plant (unlike the UK). Good supply chain minimises emissions
- Opportunity to introduce co-firing and reduce fuel cost of power plants

# Assam Biomass Case Study

- 7.04 million tonnes of rice stalk waste in Assam alone
- Government could implement localised ‘hubs’ for collection. Farmers could trade waste for electricity.
- Local community involvement, can see how their efforts make a difference


N
Village wise biomass power (kW)
Reserve Forest
0
<5
5-10
10-15
15-20
20-25
25-30
30-35
35-40
>40
10 5 0 10 20
Kilometers

# Rural Development

- UK – government pays for installation of ground source heat pumps and efficiency enhancements. Fines/incentives for National Grid to reduce power cuts.
- India – Education for improving farming practices/energy efficiency, continued grid expansion, off grid projects when necessary

# Summary

- Biomass could be a good alternative source of energy in India
- UK must lead R&D efforts into CCS, Tidal energy and fuel efficiency
- International collaboration is vital to develop and implement new, clean energy technologies

## Table 5B: Electricity sales 2008

| | Domestic sector sales (GWh) | Number of domestic customers (thousand) (1) | Industrial and commercial sector sales (GWh) | Number of I & C customers (thousand) (1) | All consumers sales (GWh) |
|---|---|---|---|---|---|
| Greater London | 13,410 | 3,327 | 28,404 | 406 | 41,814 |
| South East | 16,513 | 3,635 | 23,943 | 333 | 40,456 |
| North West | 12,417 | 3,063 | 22,151 | 235 | 34,568 |
| Scotland | 11,578 | 2,733 | 16,732 | 221 | 28,310 |
| East of England | 11,321 | 2,494 | 16,201 | 214 | 27,522 |
| West Midlands | 9,903 | 2,339 | 15,946 | 196 | 25,849 |
| South West | 10,634 | 2,373 | 14,932 | 246 | 25,566 |
| Yorkshire and the Humber | 8,900 | 2,304 | 16,350 | 178 | 25,250 |
| East Midlands | 8,095 | 1,958 | 14,180 | 157 | 22,276 |
| Wales | 5,307 | 1,339 | 10,960 | 123 | 16,267 |
| North East | 4,224 | 1,178 | 8,537 | 81 | 12,761 |
| Unallocated Consumption | 229 | 62 | 3,756 | 18 | 3,985 |
| Sales direct from high voltage lines (2) | | | | | 4,244 |
| Great Britain | 112,530 | 26,805 | 192,094 | 2,407 | 308,869 |
| Northern Ireland (3) | | | | | 7,994 |
| Total | | | | | 316,863 |

(1) *Figures are the number of Meter Point Administration Numbers (MPANs); every metering point has this unique reference number.*
(2) *Based on estimate provided by Ofgem.*
(3) *Northern Ireland data are based on data for electricity distributed provided by Northern Ireland Electricity.*

Source: DUKES 2010 electricity report