Distributed and combined energy generation in Greater London (GL) – past experiences and future prospects

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Outline of the presentation

- Introduction to Greater London (GL), definition of distributed and combined generation,
- Different scales and fields of policy influencing the uptake of distributed and combined generation in GL (top down)
- Comparison of data on distributed and combined generation (global to local), historic trends of energy demand in GL
- Outlook, anticipated changes in energy demand and CHP potential
- Proposed policy measures

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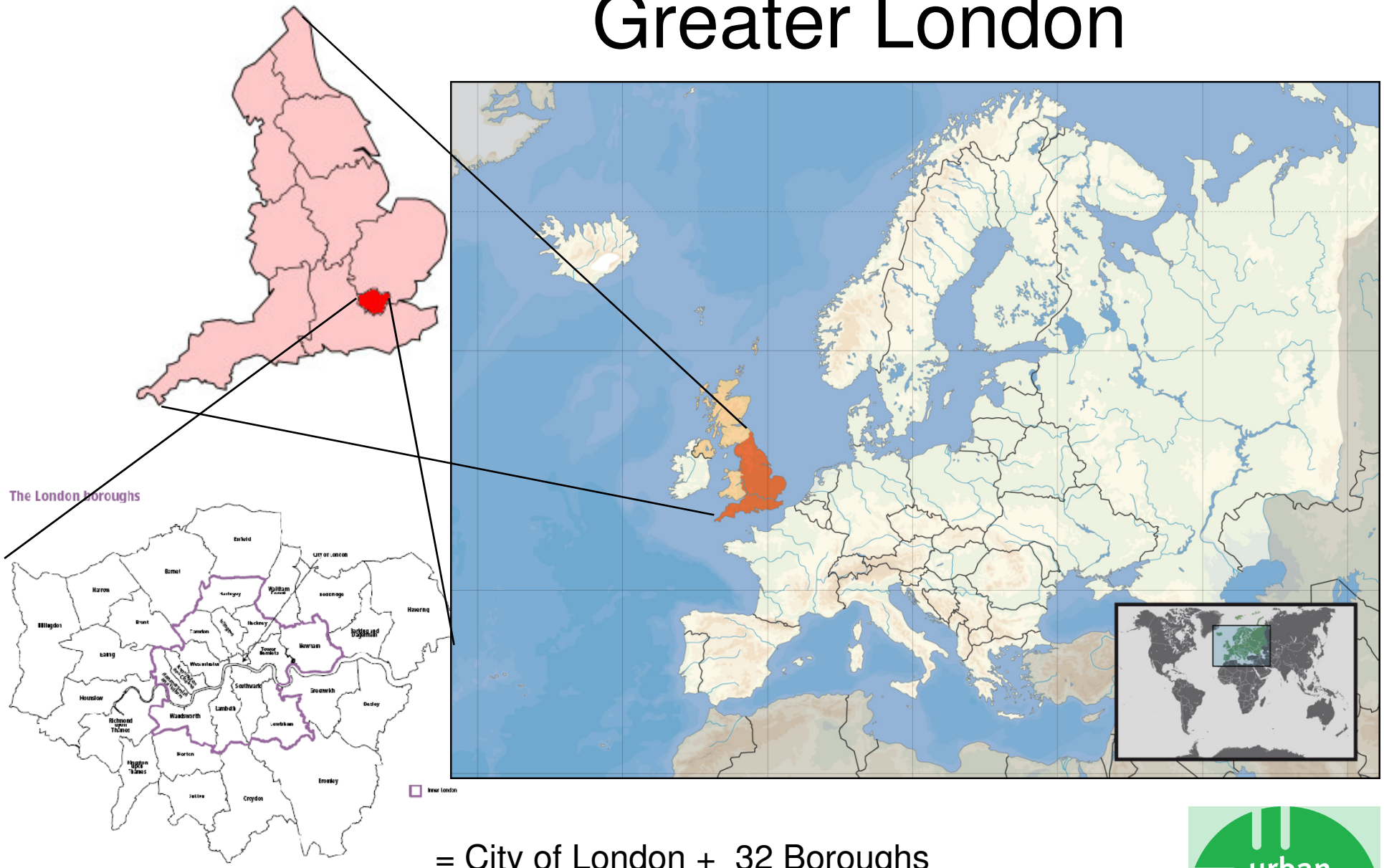
Greater London



= City of London + 32 Boroughs
1,579 km2, 7.5 Million residents in 2006,
5 Planning regions, energy demand like Portugal

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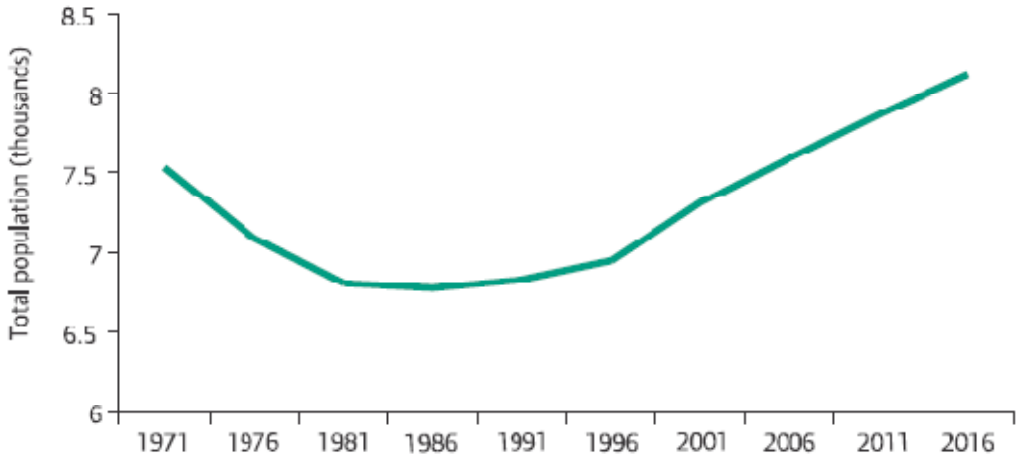
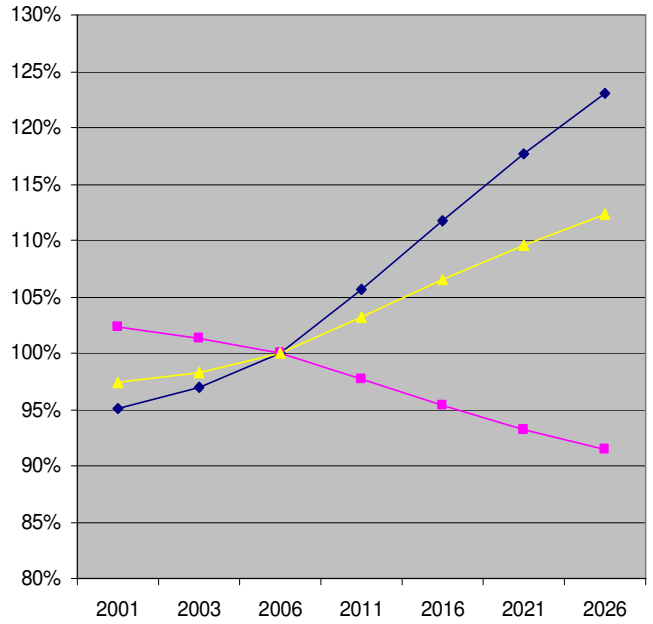
demographic dynamics





3.9 million

8.5 million

2.1

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Scales of policy affecting distributed and combined generation in GL

- International level
- EU level
- UK national level
- Greater London level
- Borough level

Involved policy fields include:

- Planning and building regulations
- Energy policy
- Environmental policy
- Social policy

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Distributed and combined generation

Aims at decentralised (often small scale), embedded generation close to centres of demand (reducing transmissions & distribution costs & losses)

Includes cogeneration of various energy quality (integration of electricity generation, heating and cooling)

Is not necessarily based on renewable fuels

Technologies include:

- Combined heat power (CHP)
  - Fuel cells
  - Stirling engines
  - Reciprocating engines
  - Micro combined heat and power (MicroCHP)
- Biogas systems
- Energy from waste (e.g. pyrolysis)

- Microturbines
- Photovoltaic Systems
- Small Wind power systems
- Air or ground based heat pumps
- Geothermal
- other

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International and EU Level

- EU signed UNFCCC, the Kyoto protocol in 1998, ratified it in 2002, entry into force in 2005
- As Annex1 signatory it committed itself to reductions of -8% by 2008-2012
- EU: observed reductions 1990-2005 -1.5% excluding LUCLUF, -1.5 including LUCLUF

- UK signed UNFCCC, the Kyoto protocol in 1998, ratified it in 2002, entry info force 2005
- As Annex 1 country it committed itself to reductions of -12%
- Observed reductions 1990-2005 were - 15%, (LUCLUF contributed less 1%)

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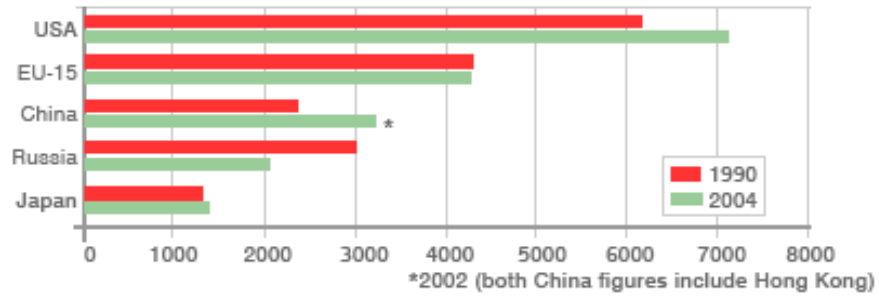
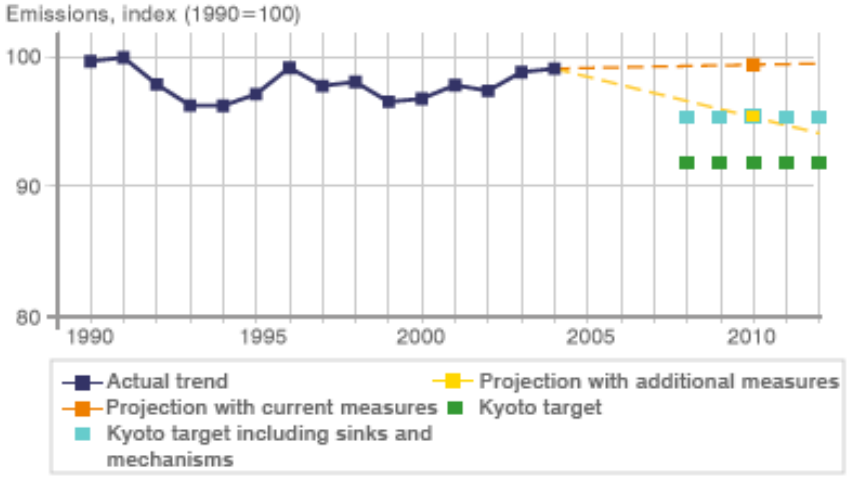
GREENHOUSE GAS EMISSIONS (MILLION TONNES OF CO_2 EQUIVALENT)



*2002 (both China figures include Hong Kong)

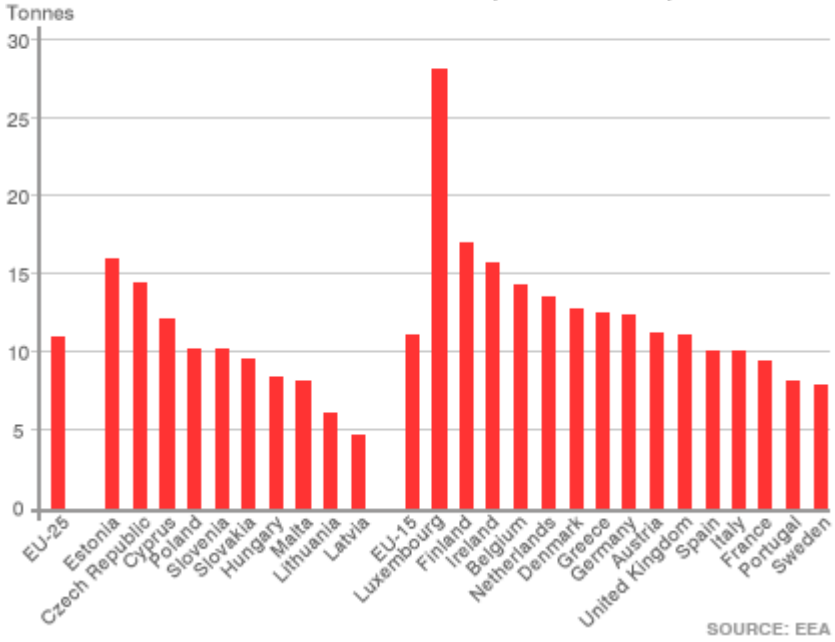
SOURCE: UNFCCC (China figures from IEA)

ACTUAL AND PROJECTED EU-15 GREENHOUSE GAS EMISSIONS COMPARED WITH KYOTO TARGET 2008-12



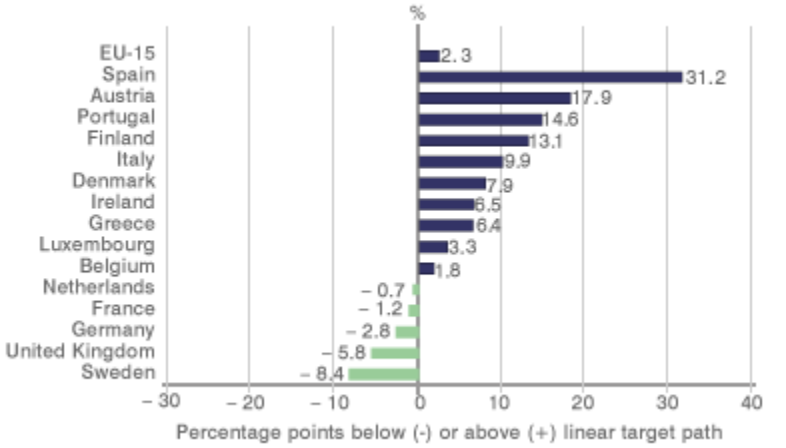
SOURCE: EEA

GREENHOUSE GAS EMISSIONS PER CAPITA, EU-25 STATES, 2004



SOURCE: EEA

DISTANCE TO KYOTO TARGETS FOR EU-15, 2004



SOURCE: EEA

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EU targets beyond Kyoto / 2012:

- EU targets: at least -20% GHG by 2020, up to -30% if US, China and India also commit
- GHG at least -50% by 2050
- 20% renewable by 2020 (up from 6.5%)
- 10% transport bio-fuels by 2020

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Relevant EU directives

Since 40-50 % of gross energy consumption in the EU are related to building construction, operation maintenance an Energy Performance Building Directive **(EPBD)** was issued in 2002 (adapted and implemented by member states by jan2006)

- Gives general framework for calculation of energy performance and certification including: heating, cooling, ventilation, hot water supply, lighting, all expressed in primary energy
- But excludes real lifecycle emissions for embodied energy, maintenance, end of life

In 1997 the EU commission outlined a co-generation directive aiming to double electricity from cogeneration to 18% by 2010 (would save 65 Mt CO_2)

- Led to directive for promotion of cogen in 2004
- Commission decision in 2006 on harmonised efficiency reference values

Further relevant EU regulations include:

- **End-use Efficiency & Energy Services**
- **Eco-design of Energy-Using Products**
- **Energy Labelling of Domestic Appliances**

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UK energy policy

- Until early 1980s: nationalised utility companies in UK (British coal, British gas etc.)
- During late 1980s and early 1990s: market liberalisation and privatisation of nationalised energy markets:
- Regulation now through OFGEM (office of gas and electricity markets) – UK was leading this de-regulation trend in Europe
- Splitting of energy production companies and network operators (unbundling) – giving customers choice of provider
- UK energy policy works now largely indirect through influencing market operation (taxation, subsidy, incentives, planning controls, market entry restrictions, underwriting liabilities, grants, research funding)
- Recent presentation of new plans for expansion of nuclear power

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UK energy policy beyond Kyoto (2012)

- UK energy white (May 2007) paper outlines goal of more than 60% GHG reductions by 2050

- UK- wide installed CHP capacity:
  - about 6.3 GW = 7.8% of total capacity
  - Industrial CHP: 2.7 GW
- About 5.4% of e-generation is currently from CHP
- Target for CHP: 10 GW capacity at national scale by 2010
  - unclear if it will be met.

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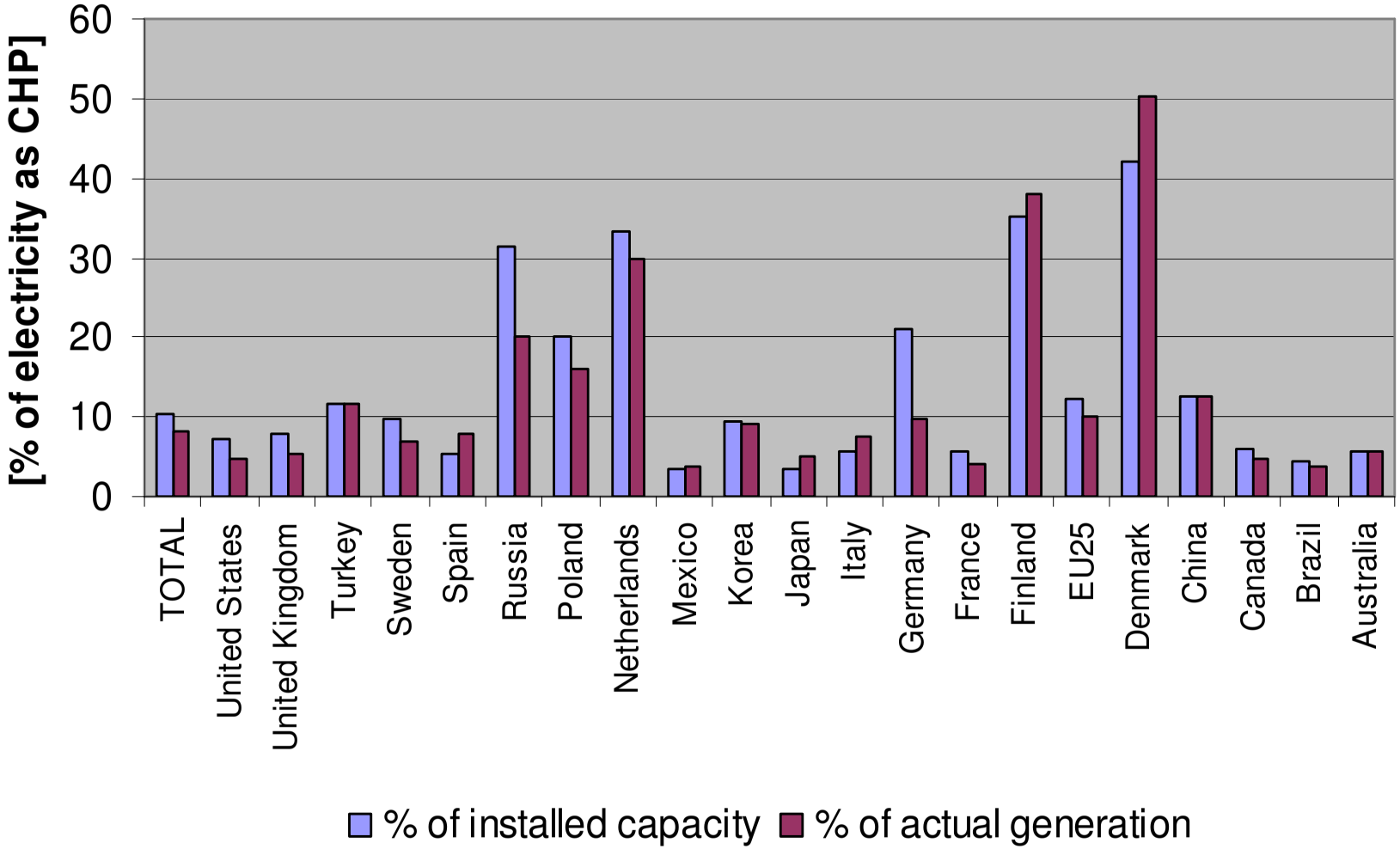
Global comparison of CHP



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Source: IEA [total = 80% of global electricity generated]

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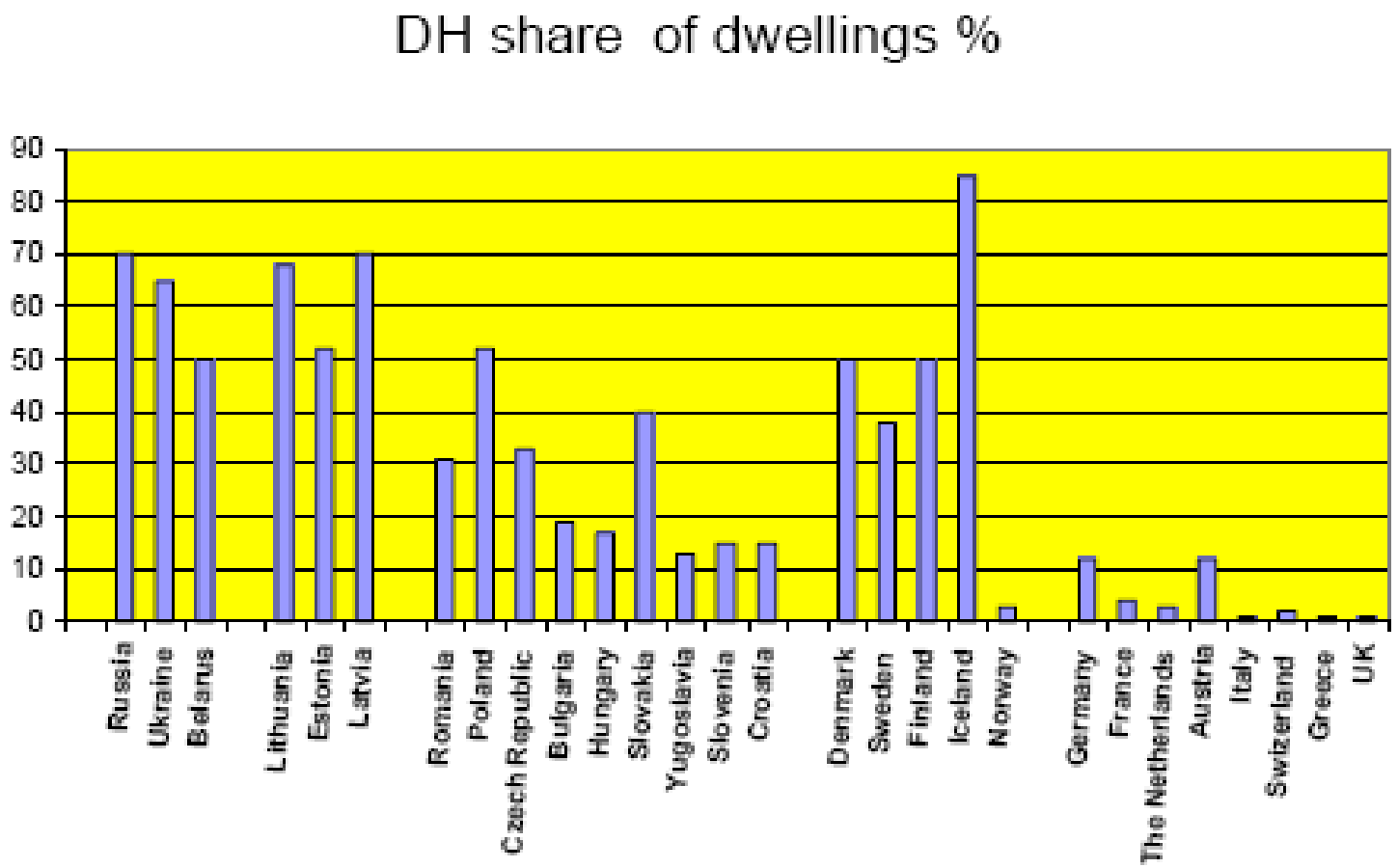
District heating in Europe



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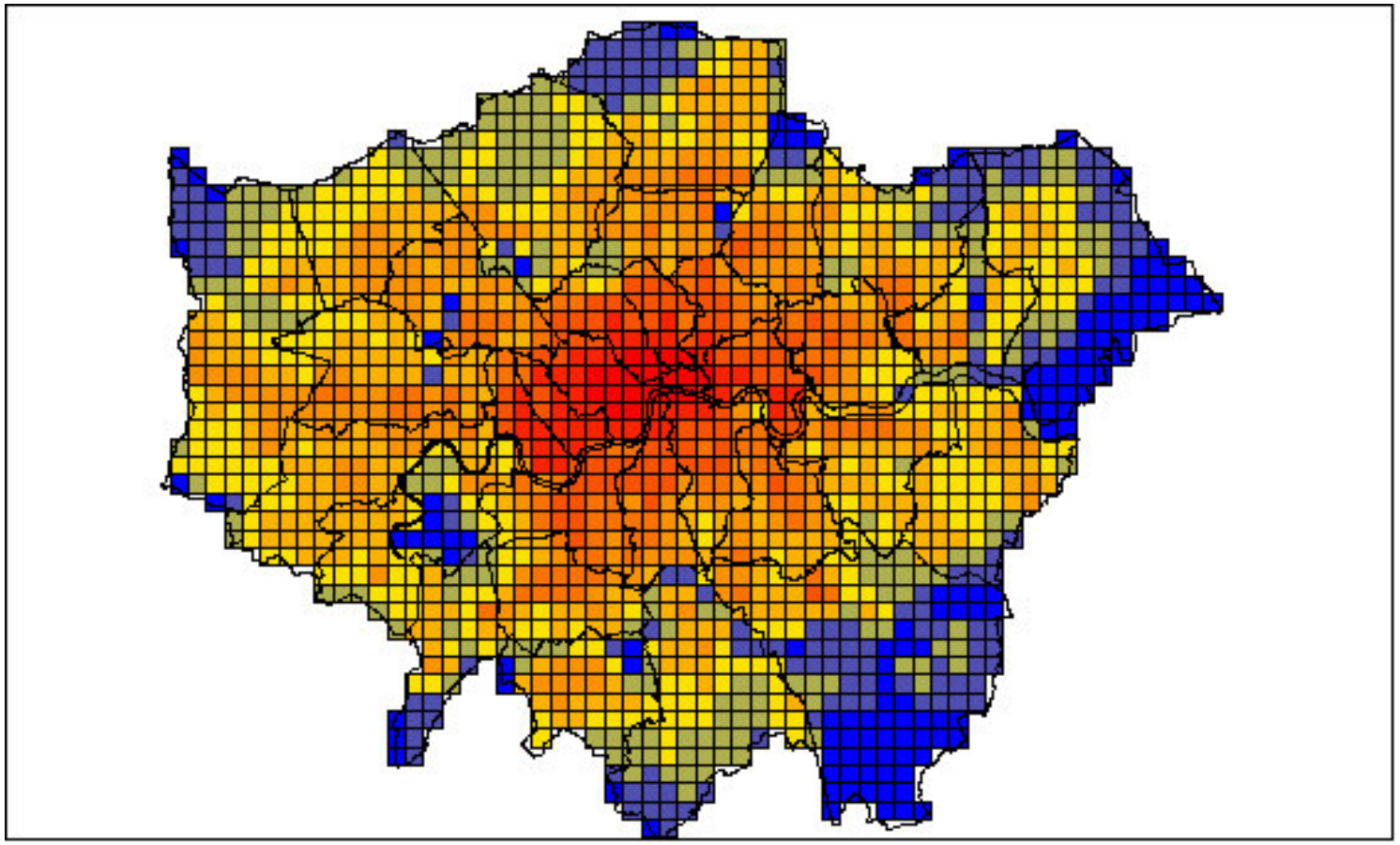
London: Electricity consumption



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Source: London Energy and Co2 Emission Inventory 2003

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Greater London

- Institutional framing changed historically:
  - Greater London Council 1965 - 1986, then: abolition & devolution of GLC government.
  - Since 2000 Greater London Authority with directly elected Mayor
- Current Mayor: high priority on energy savings and efficiency

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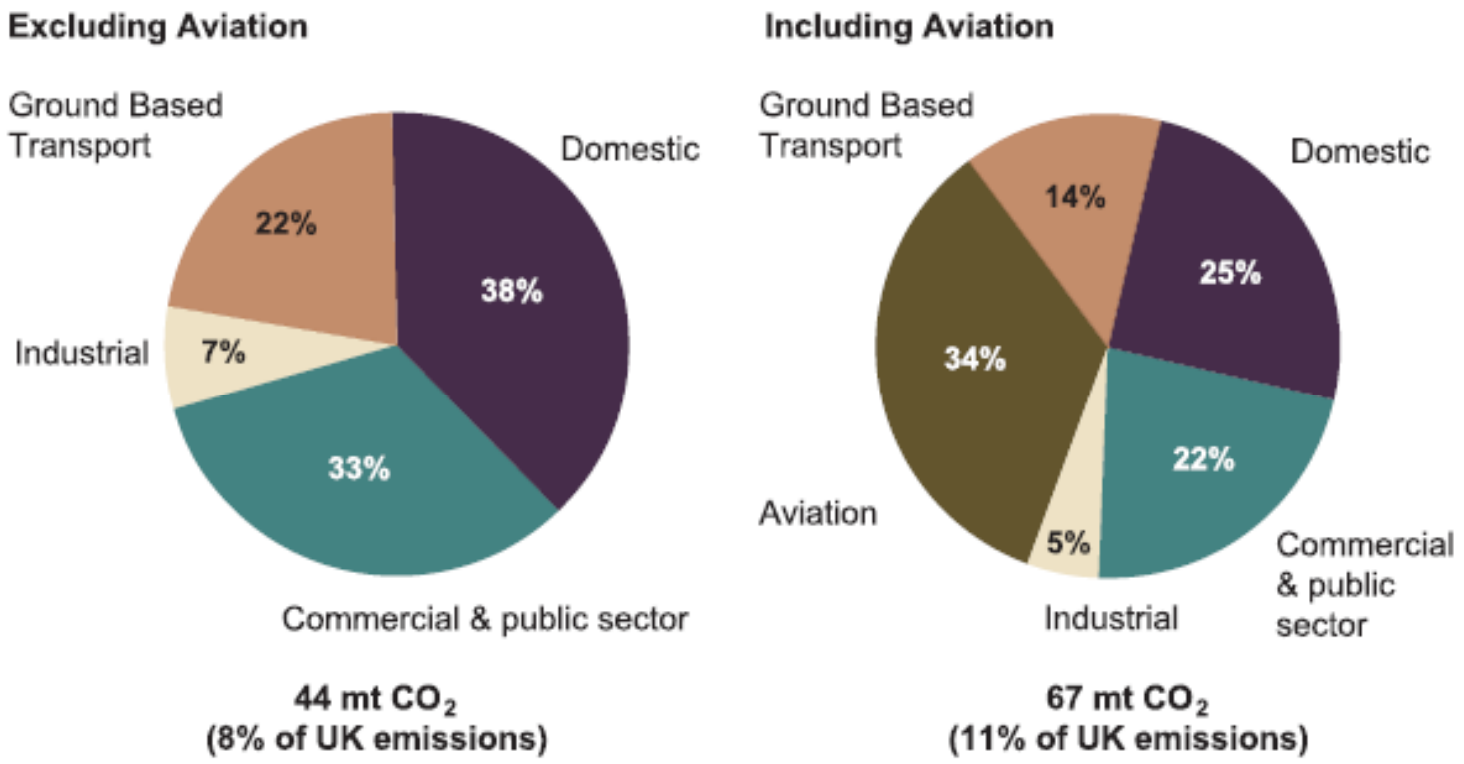
London CO2 emissions 2006



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London Energy and CO2 emissions inventory; Defra

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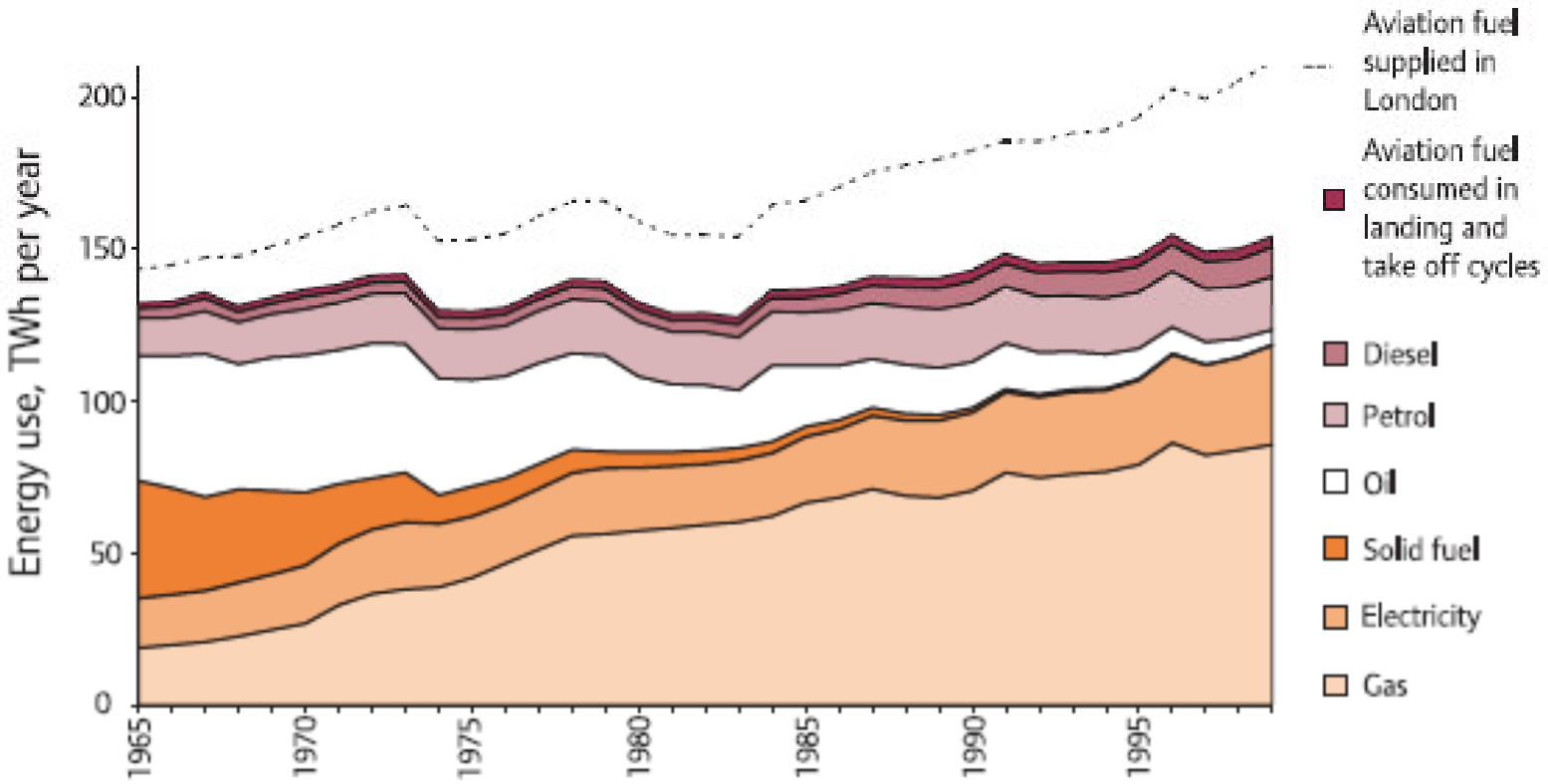
London final energy consumption by energy carrier



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Source: London Energy Strategy 2004

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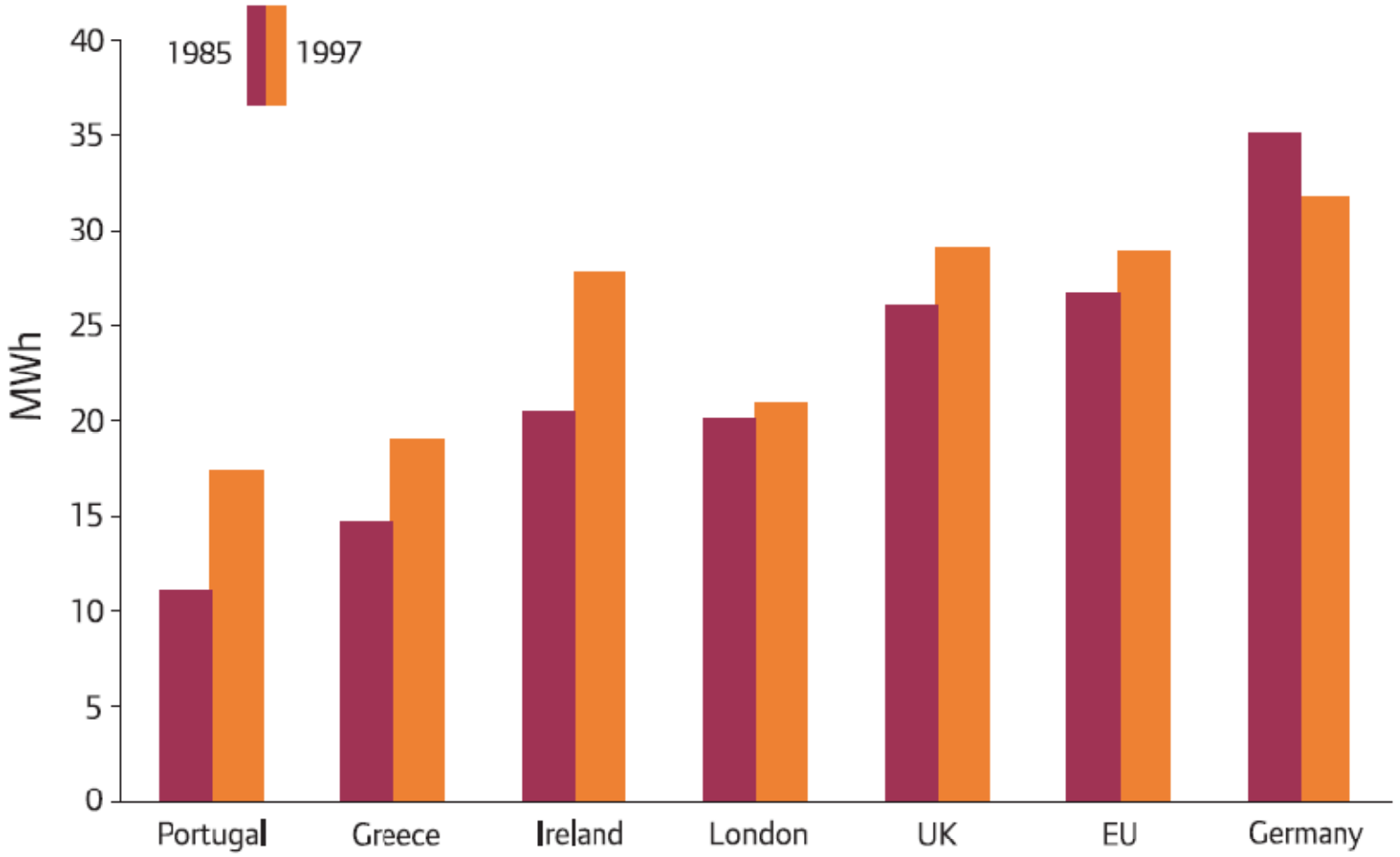
Per capita energy use in London and EU



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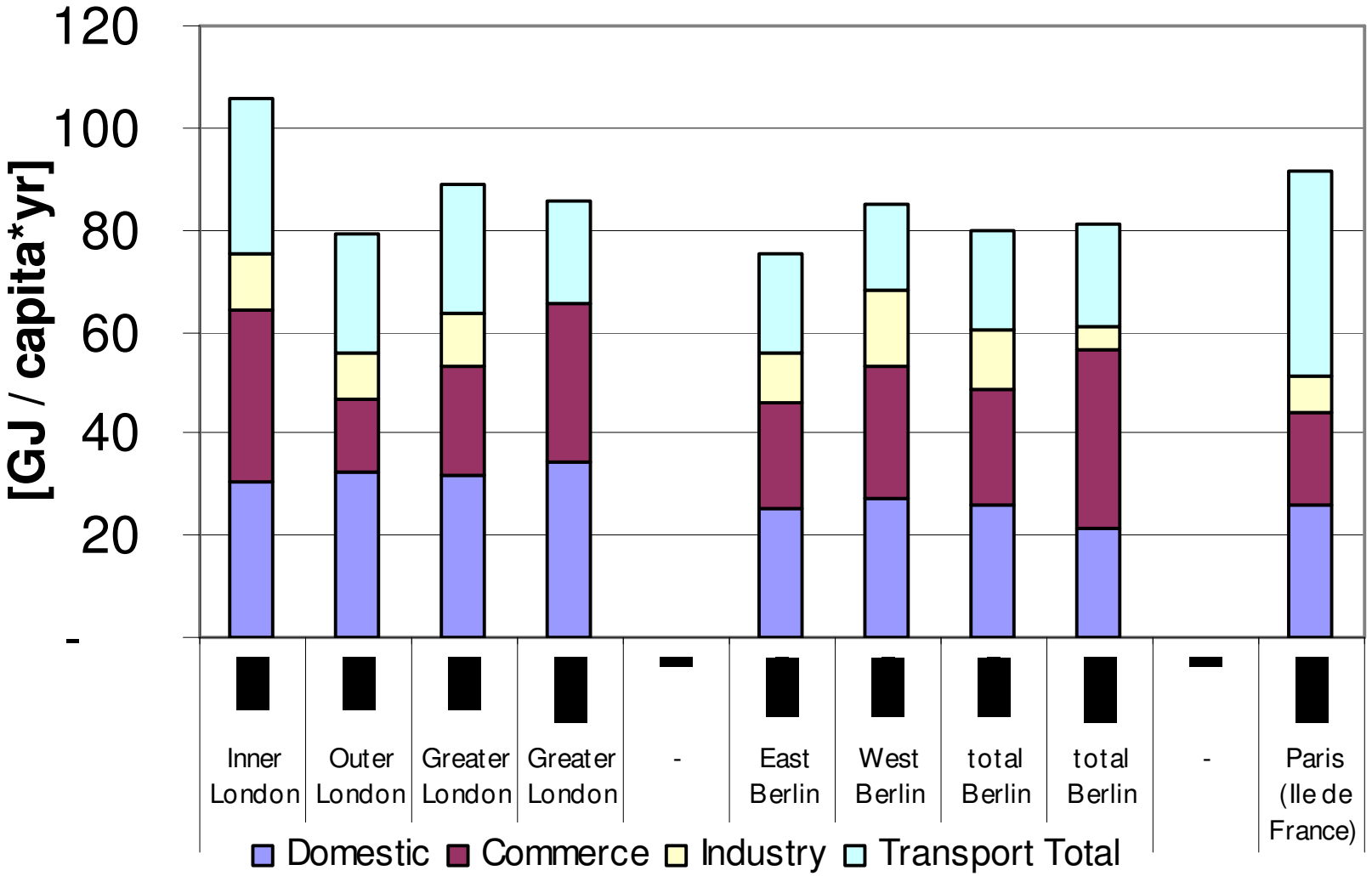
Energy use in European cities



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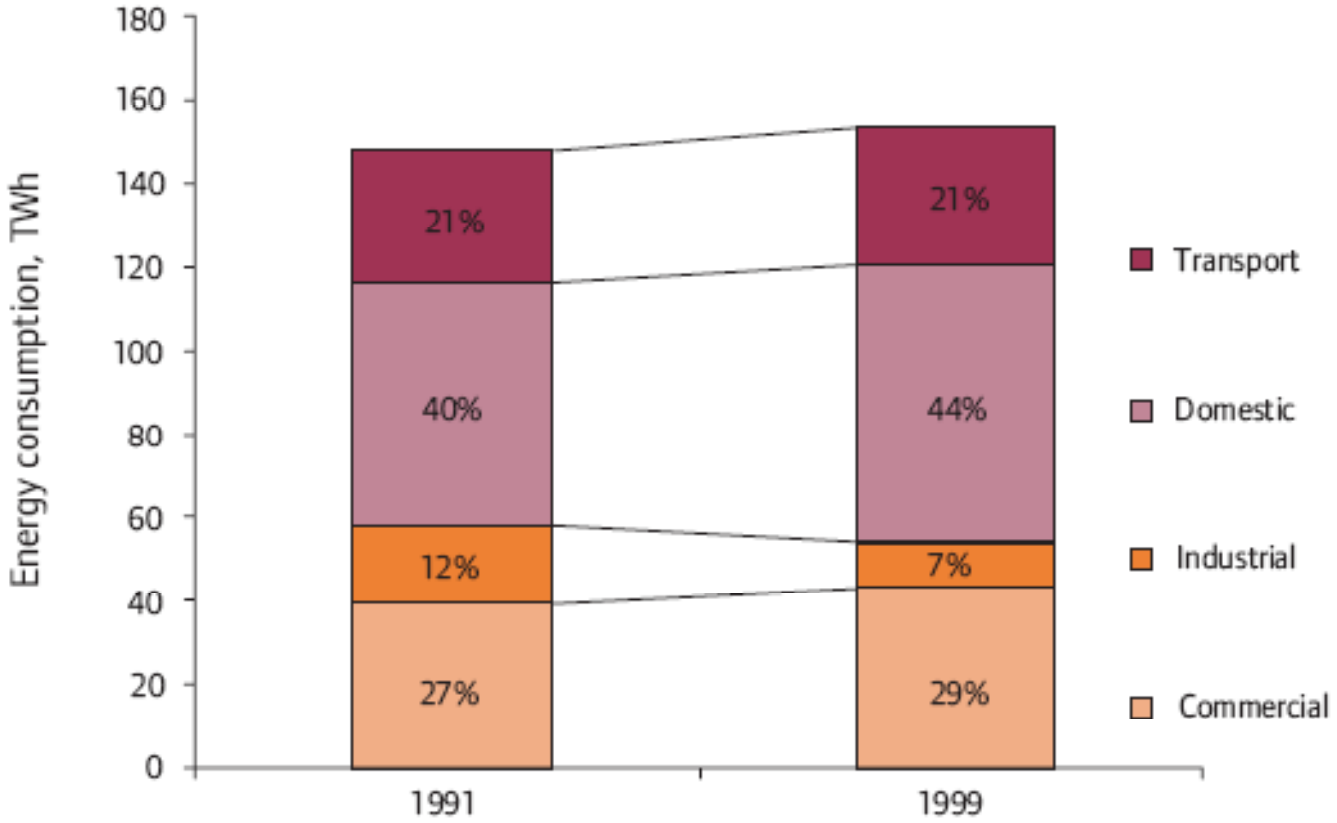
London: energy consumption by sector



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Source: London Energy Strategy 2004

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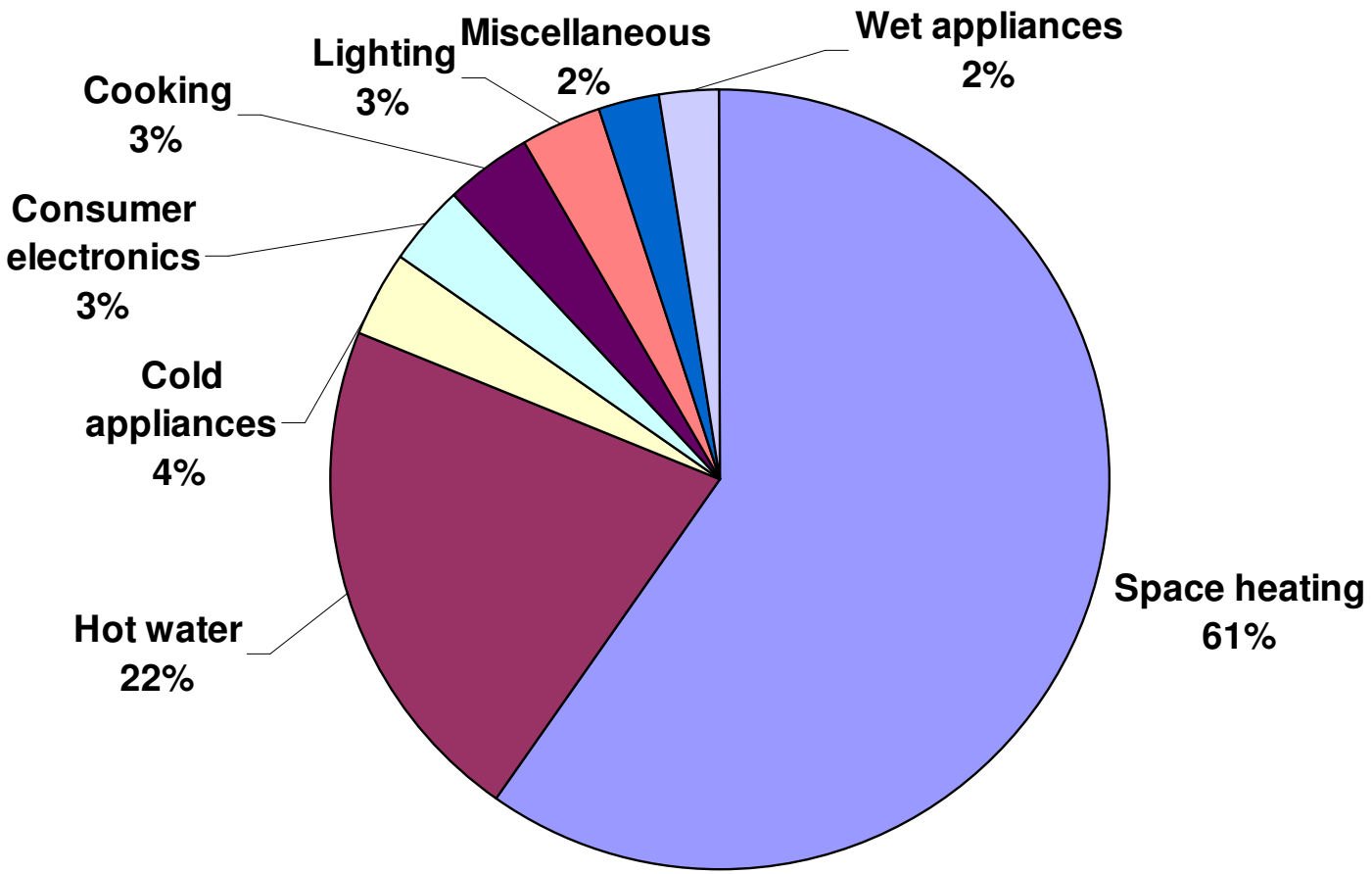
Household energy end-use



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DTI Energy consumption tables 2004

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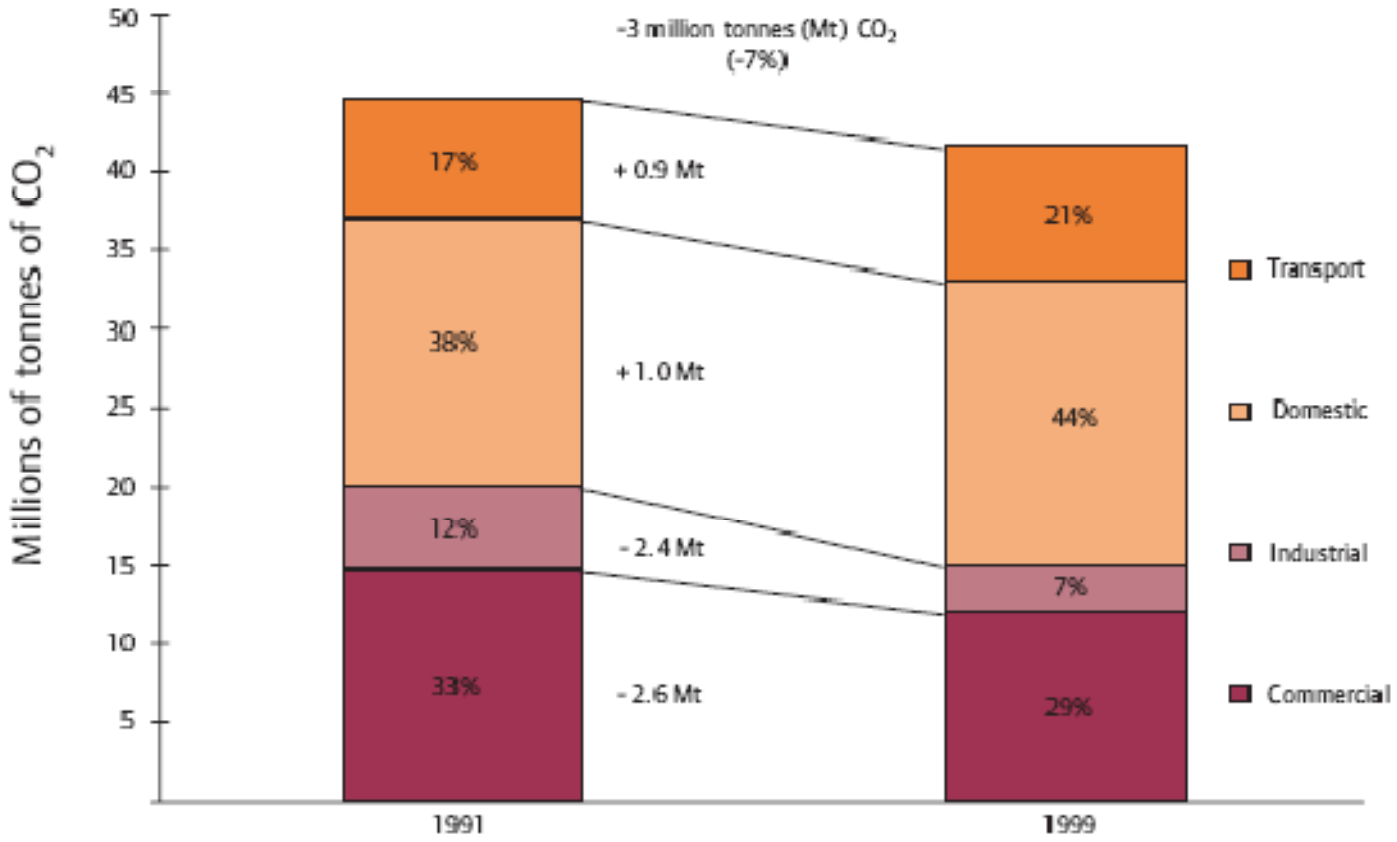
London: CO2 emissions by sector



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Source: London Energy Strategy 2004

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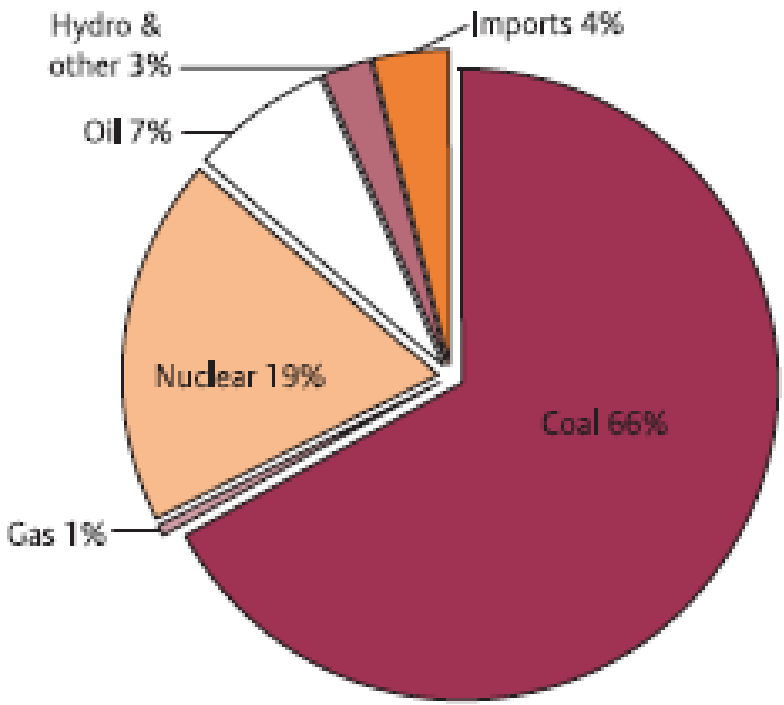
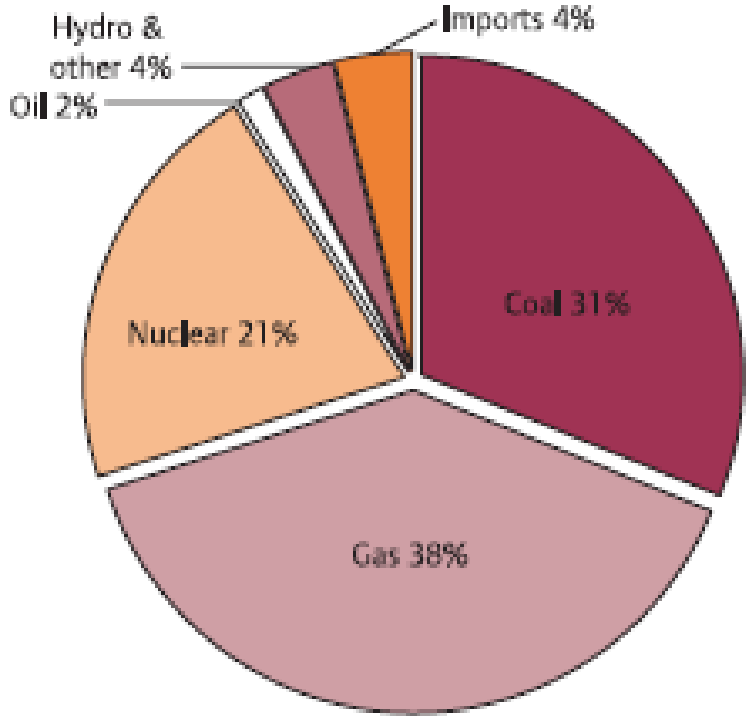
UK electricity fuel mix



1990



1999

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Source: London Energy Strategy 2004

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GL: supply side

- In 1999 about 40 % of London's electricity consumption was generated at 17 locations within Greater London. These include 1GW at Barking and 350MW at Enfield, as well as the 180MW plant at Lots Road
- Approximately 140 CHP schemes operating in Greater London, with a combined primary energy consumption of about 7TWh from gas and gasoil. Total electrical output in 1999 was 2TWh, roughly equivalent to 6% of electricity consumption
- London's electrical CHP capacity is about 175MW, which is four per cent of the UK total. This is disproportionately low because the majority of UK CHP capacity is on industrial sites, while London is no longer a major industrial centre. However, 27 per cent of the UK's non-industrial CHP plants are in London.

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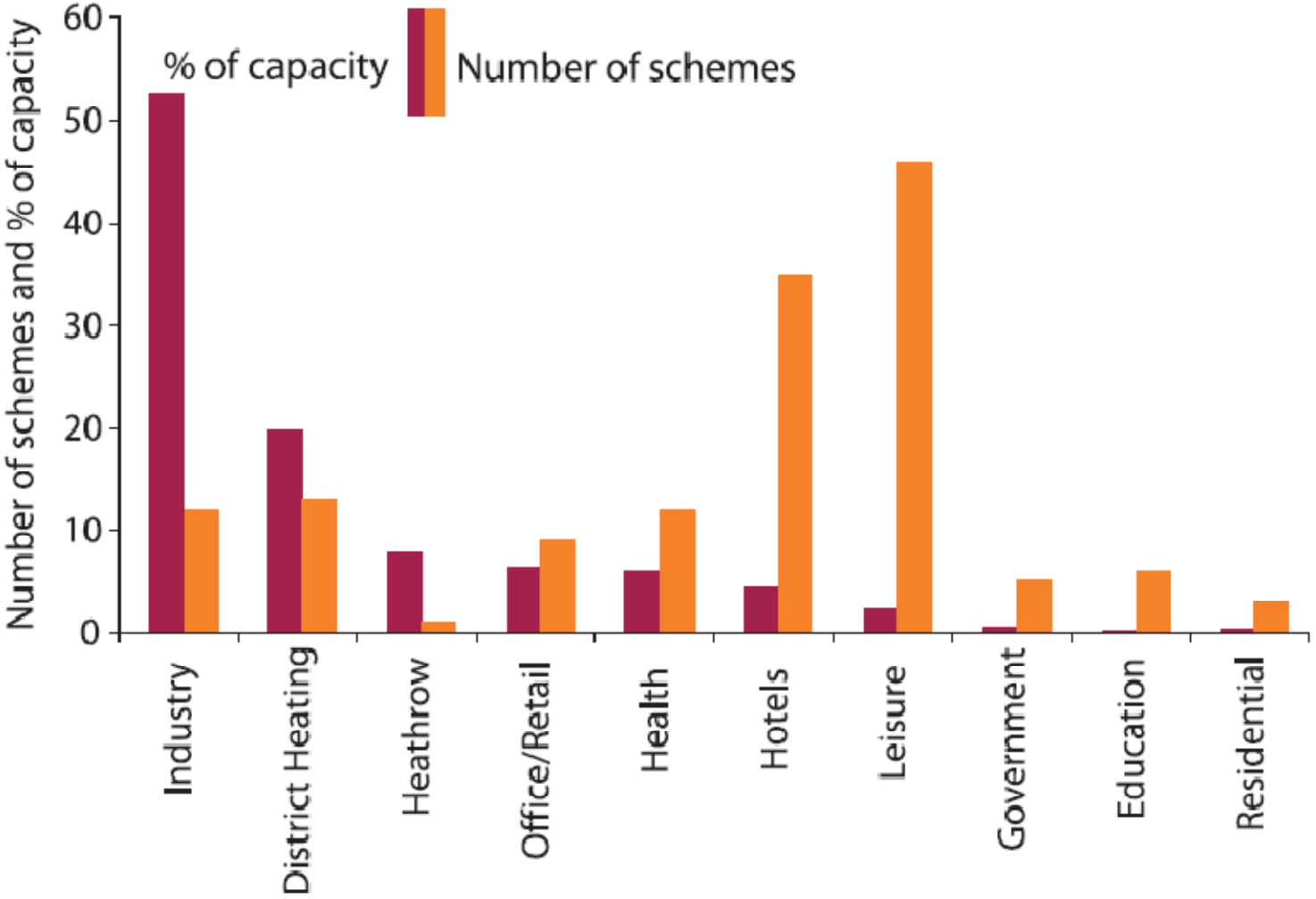
CHP in London by sector



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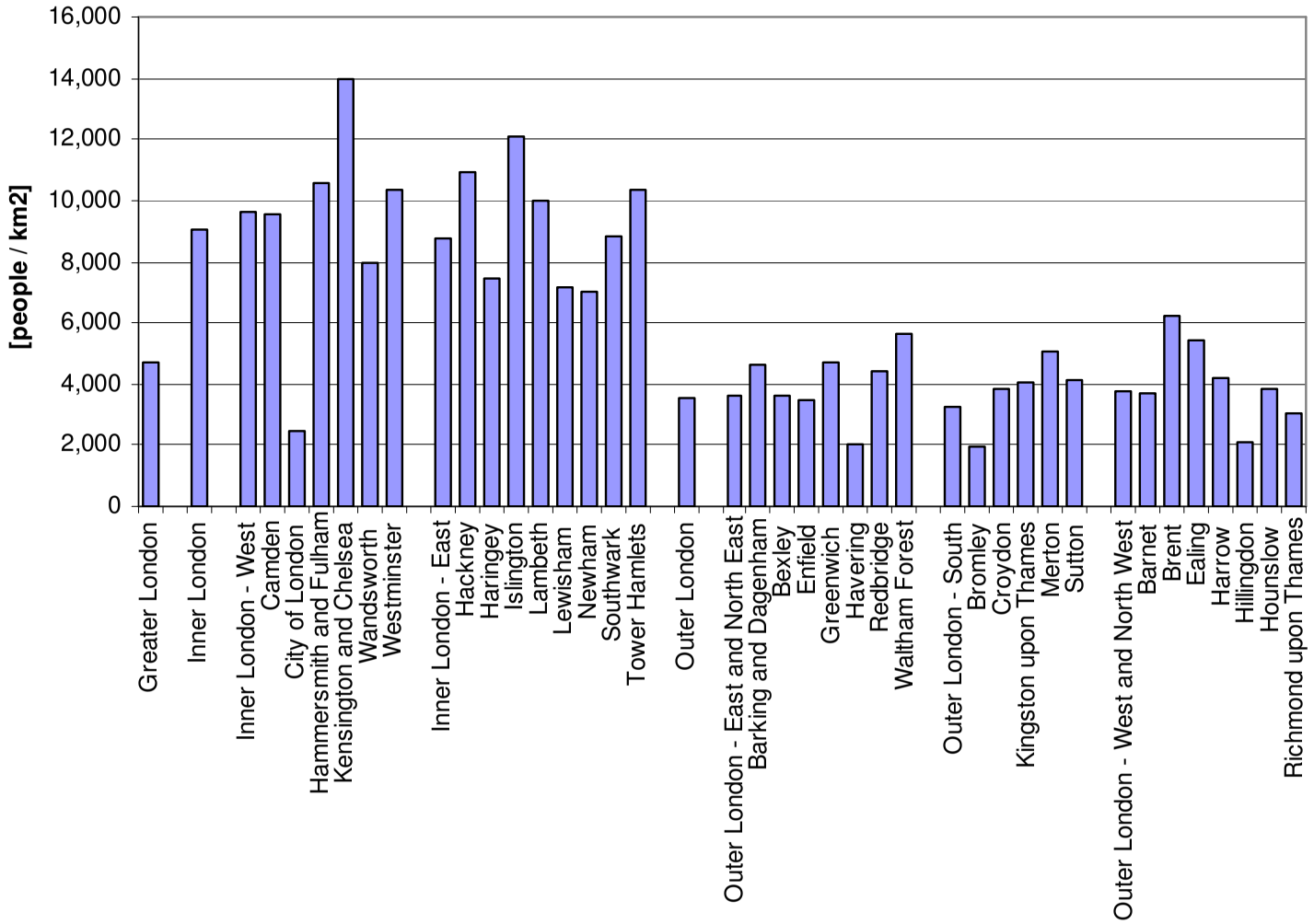
GL: population density



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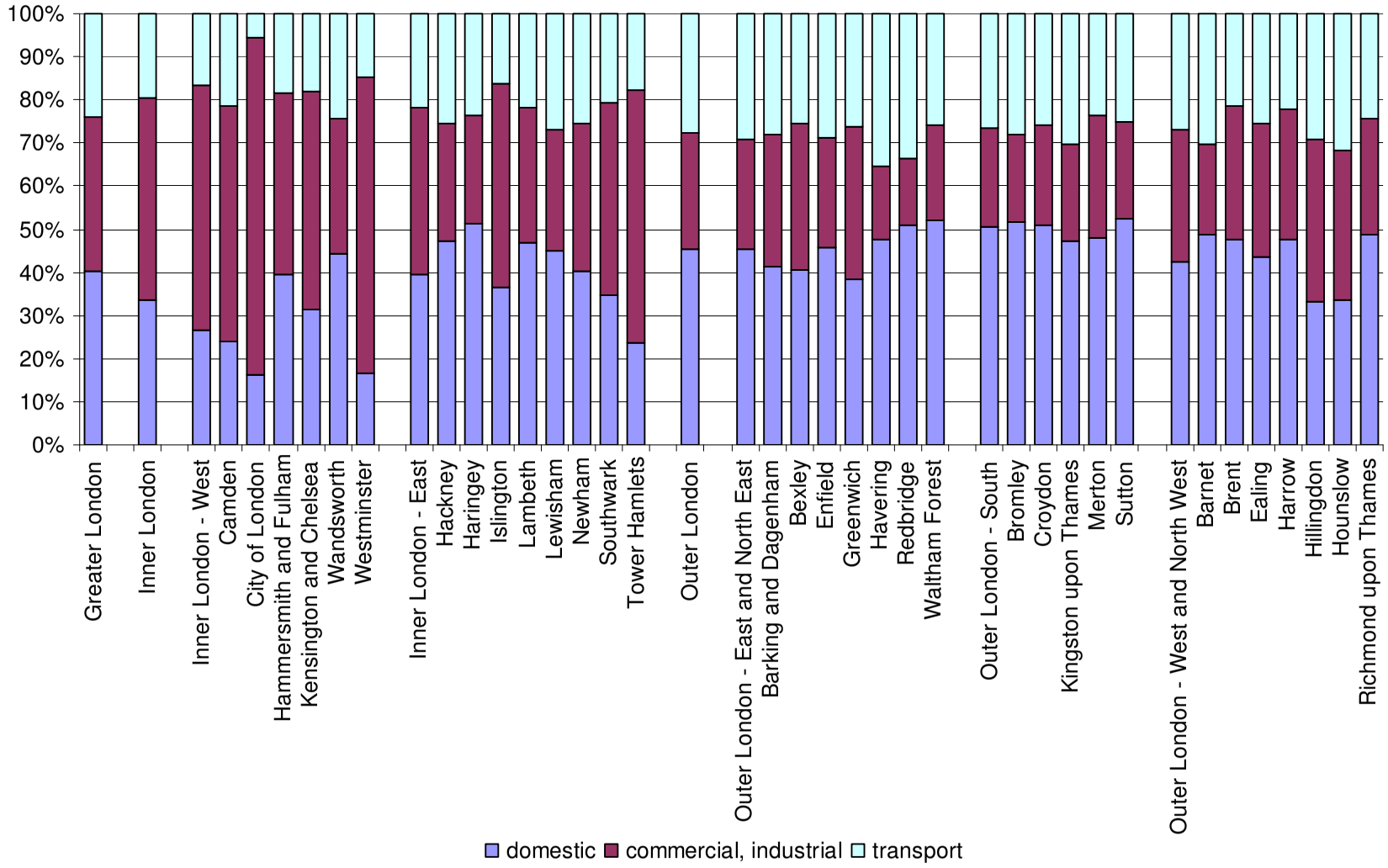
GL: technical energy use by sector



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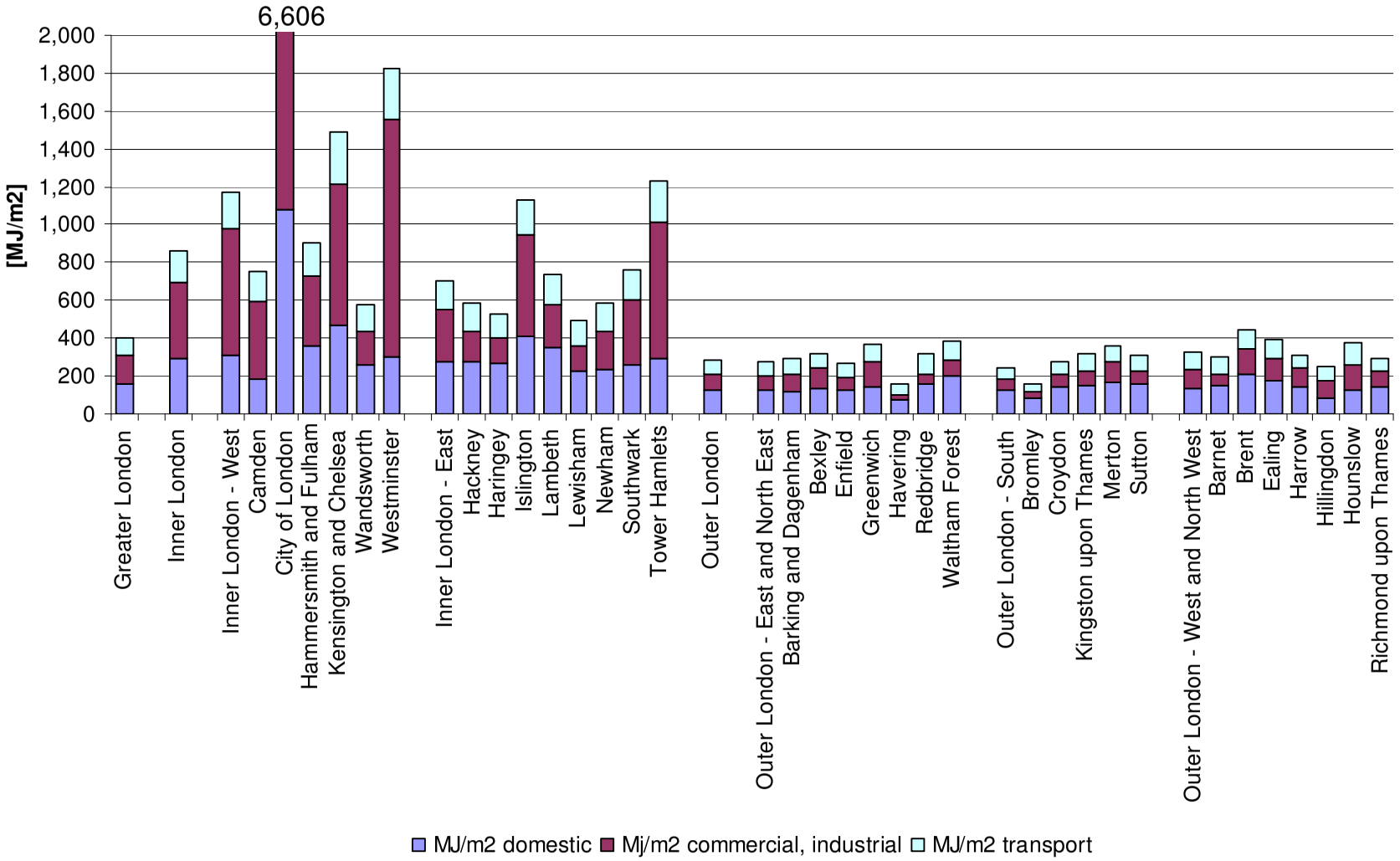
GL: energy dissipation by area



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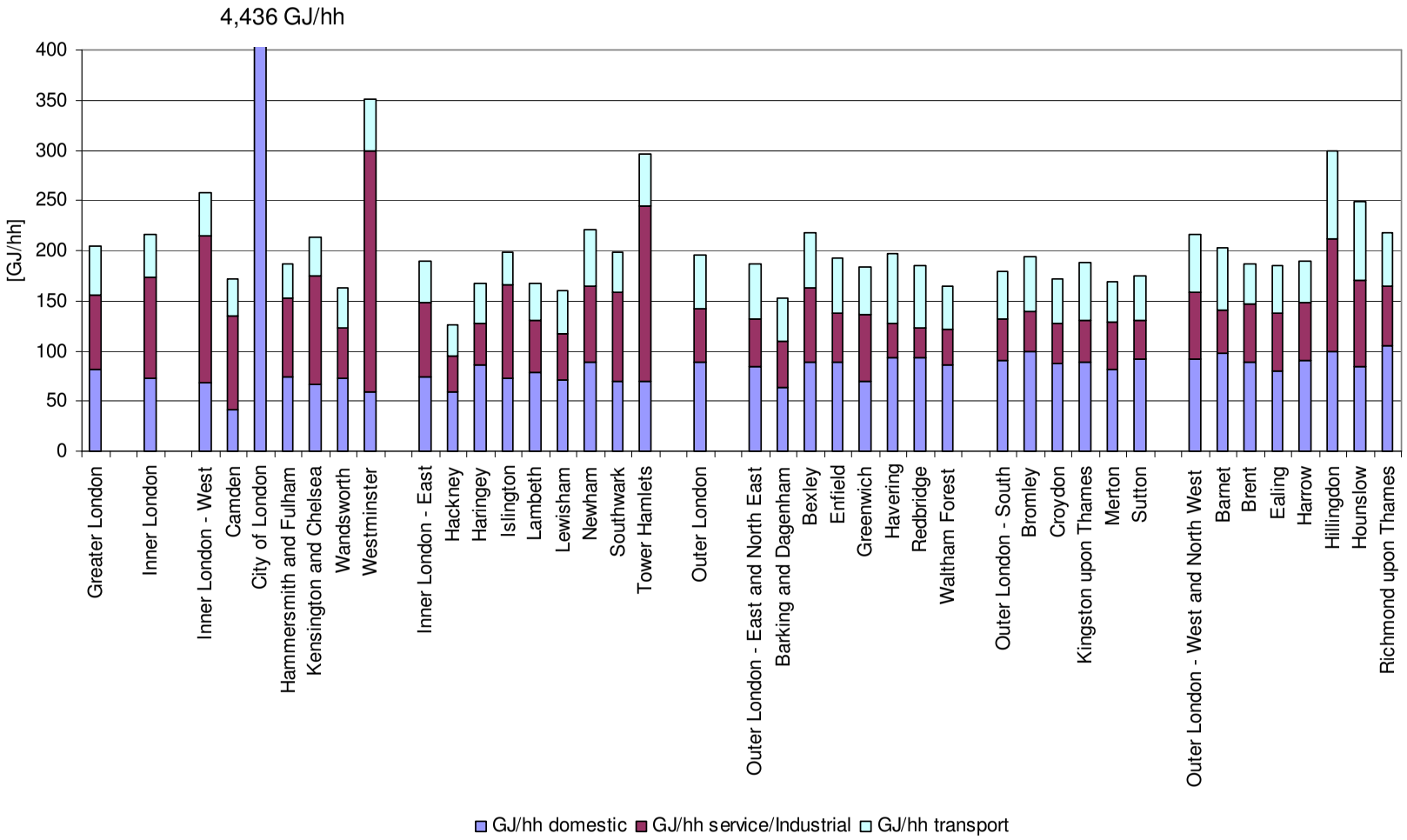
Energy dissipation per household



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Energy policy at the level of GL

- Key publications: GLA Energy Strategy, London Plan (+additions), Climate Change Action Plan
- Several new institutions were founded, often as public-private partnership (London Energy Partnership, London Climate Change Agency, London ESCO with EDF)
- Best practice examples were celebrated, energy action areas were designated in urban redevelopment areas (e.g. neighbourhood hosting the London Olympics 2012)

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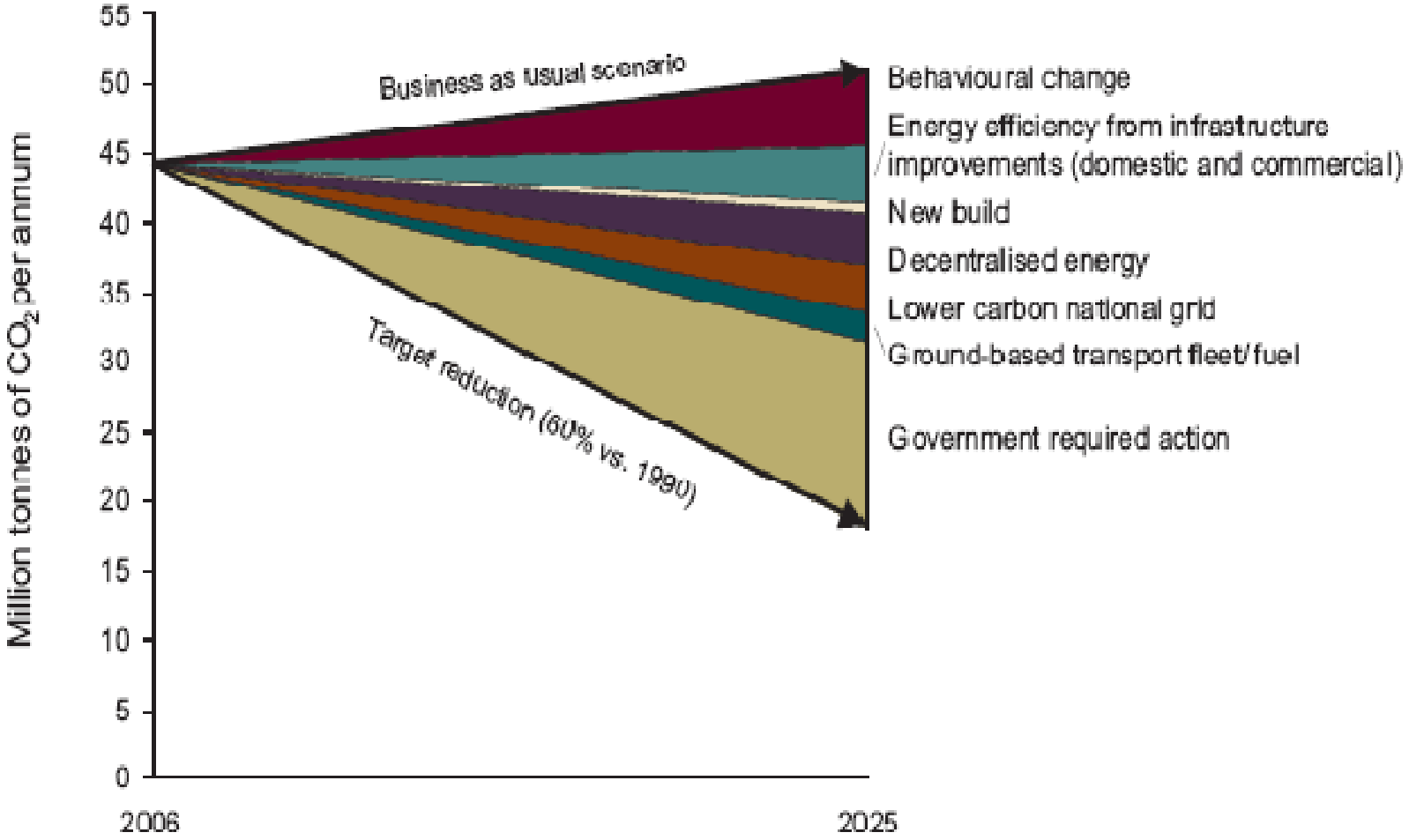
Climate change action plan



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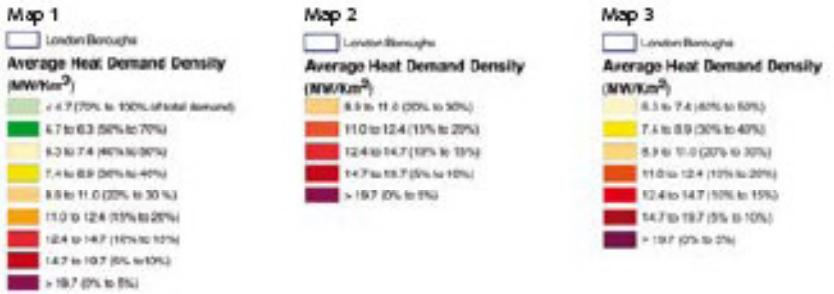
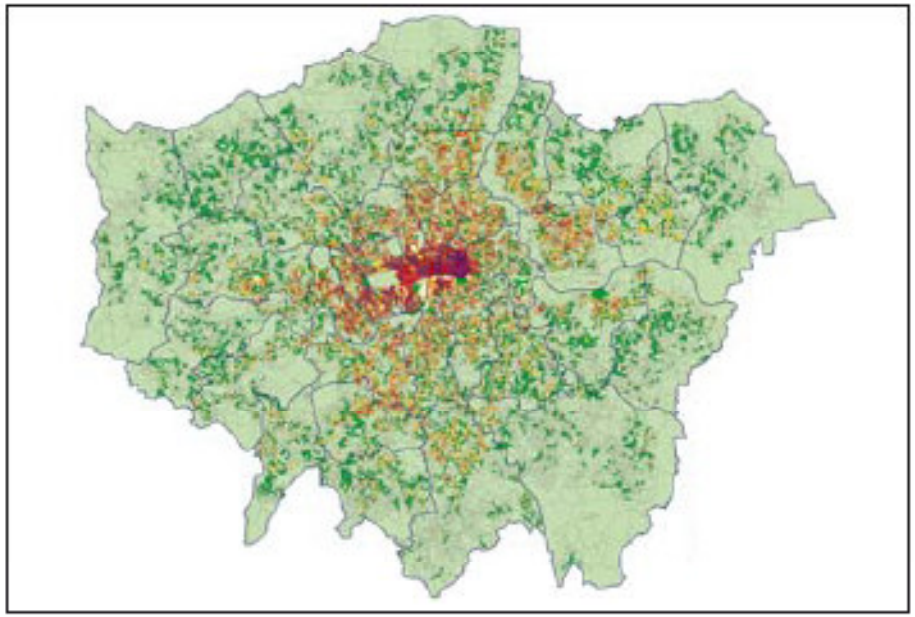
Studies on potential of distributed generation





Map 1:
The heat map for London as mapped by The Community Heating Development Study for London (GLA 2005).
It shows the density of the heat loads within the city.

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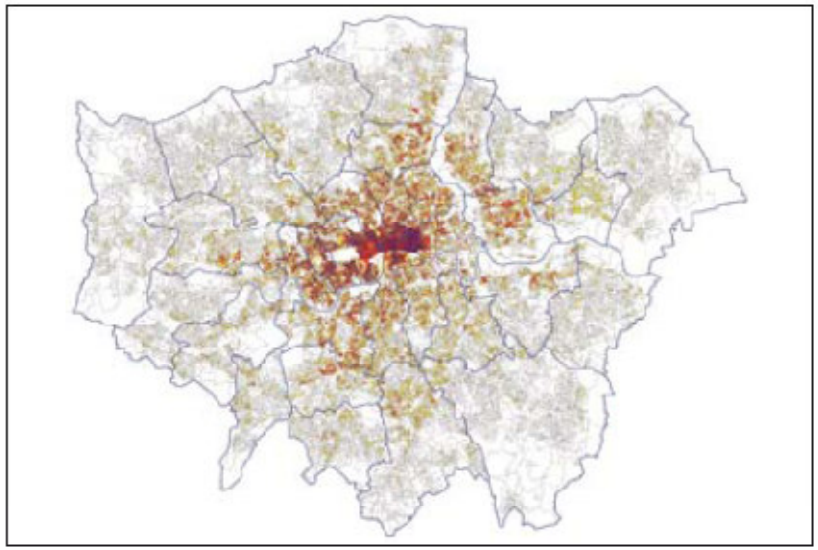
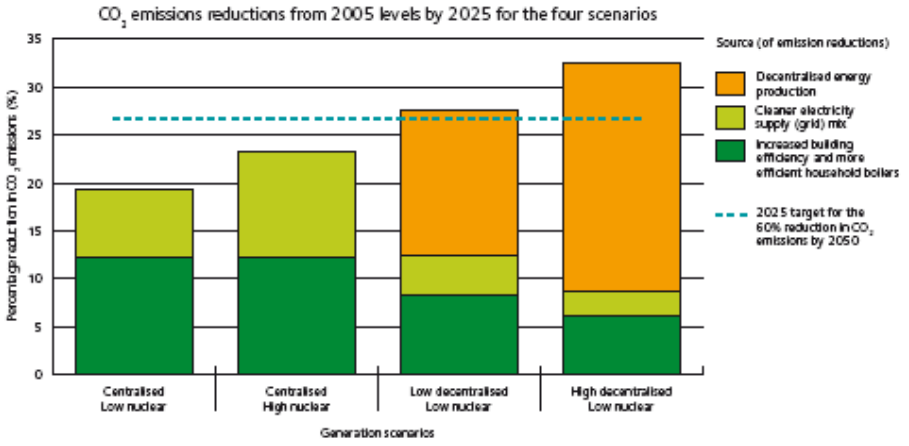
Map 2:
The reatively small areas of high-density heat demand in London are highlighted here: they amount to 30% of the city's total heat demand.



Map 3:
A more extensive application of CH networks and the associated CHP technologies would meet around 50% of London's total heat demand.

- Current capacity of CHP generation in London: 175 MWe
- Targets are for 350 MWe by 2010
- Together with other measures towards distributed generation carbon savings up to 34% by 2025 are projected



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London Energy Partnership

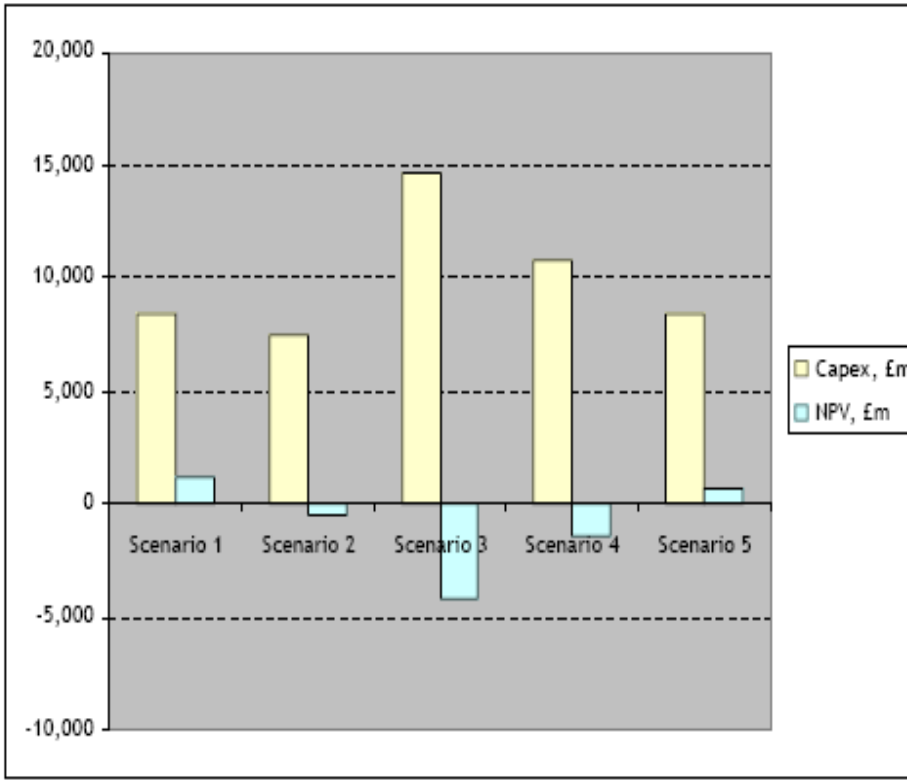
London Carbon Scenarios to 2026

SEA/RENUE November 2006

Table 1: Summary of results for the Carbon Scenarios

Scenarios	Description	Heat (GWh/y)	Power (GWh/y)	CO_2 Savings (ktpa)	Capital Cost (£m)	NPV (£m)
Scenario 1	Large CHP	30,296	23,587	10,442	8,392	1,192
Scenario 2	Building & micro CHP	58,478	22,799	10,285	7,455	-531
Scenario 3	Renewables	21,852	13,380	10,414	14,591	-4,237
Scenario 4	Insulation and Energy Efficiency	38,177	14,526	10,362	10,797	-1,429
Scenario 5	Hybrid	29,843	18,184	10,344	8,427	678

Figure 1: Capital costs and NPV for the different scenarios



Policy initiatives at the borough level

- One interesting bottom up initiative for increased energy efficiency is the "Merton rule" (requesting at least 10% carbon reduction through on site generation)
- It was taken up by the GLA and even increased to 20% level
- Although it affects only new-builds or mayor redevelopments and does not look at absolute targets of maximum emissions per area

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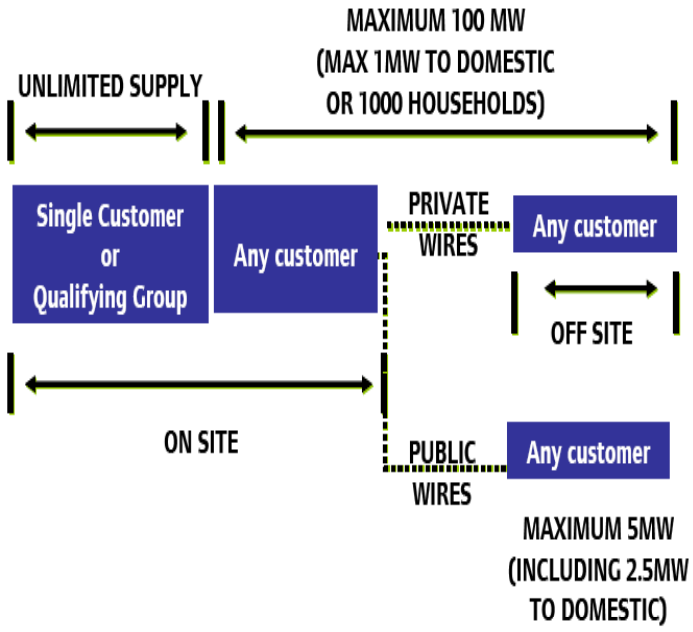
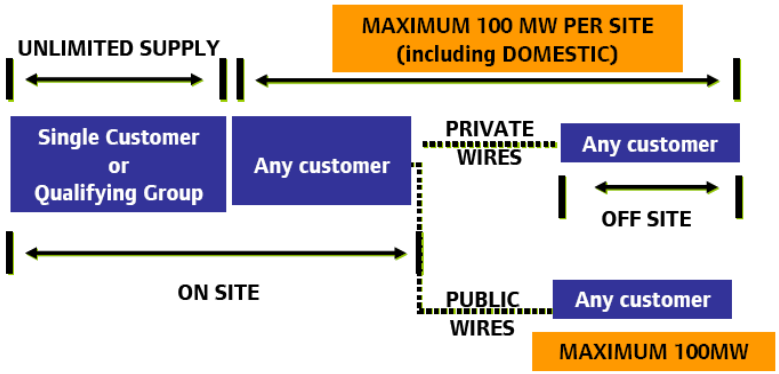
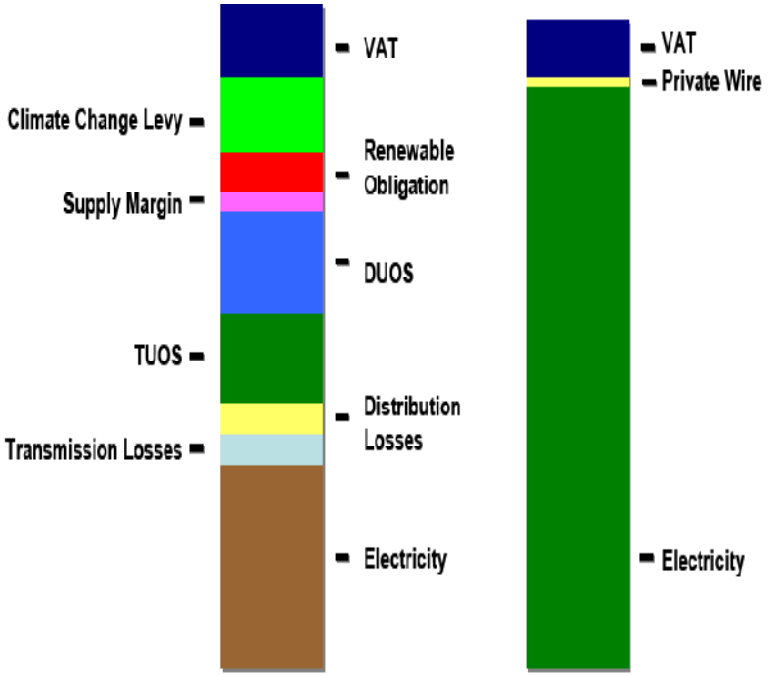
Proposed changes to the supply exemption order





Composition of electricity prices



Current electricity price composition

Price composition under supply exemption

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To summarise and conclude:

- The energy infrastructure of London is influenced by policy decisions at a range of scales
- It is difficult to analyse and predict how those policies interact and multiply
- CHP is a particularly promising and cost effective technology which is barely utilised in the UK and GL
- Given the devolved governance structure of the UK planning system it is not certain if the potential of CHP will be used to it's full extend

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