

**LESS IS MORE?**

**Energy After Oil**

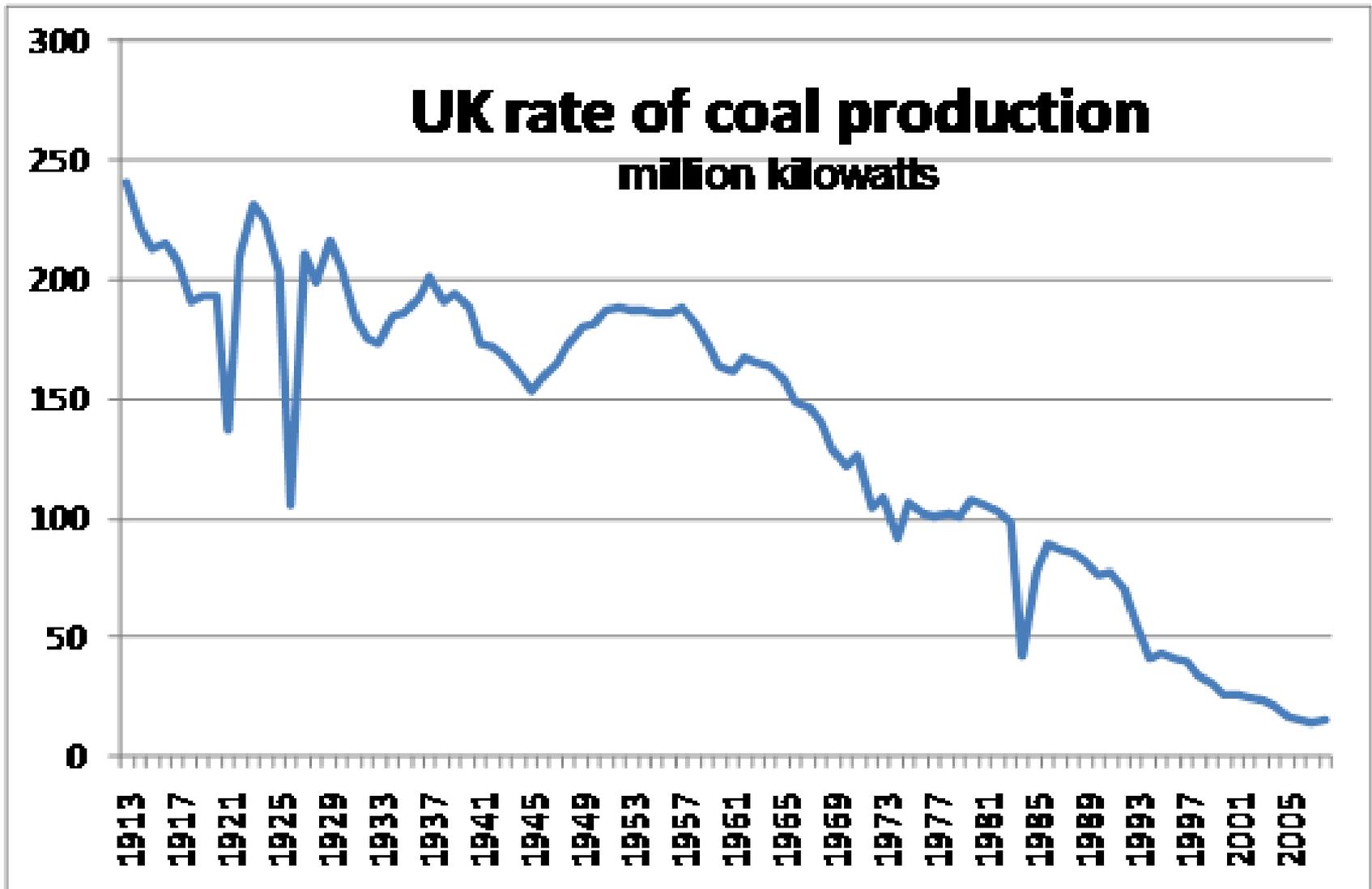
**David Olivier**

# Less Is More?

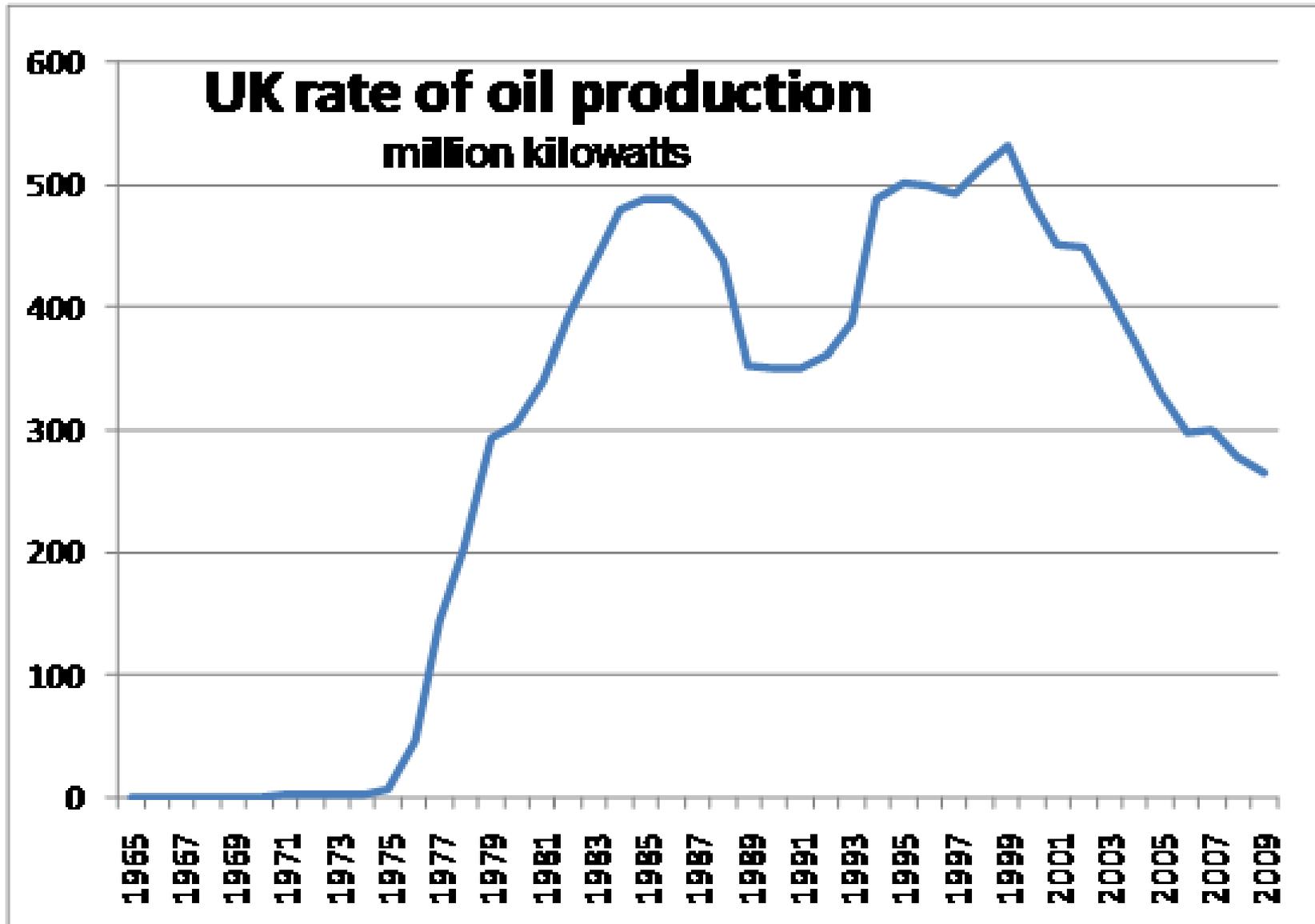
## *AECB report - in preparation*

- A sustainable energy future after oil - using less energy, more productively.
- Climate change policy. What must we do to return atmospheric CO2 levels to 350 ppm and safeguard world climate?
- The UK has had its peak coal, oil and gas. What next?
- How do the costs of different future energy systems, including energy efficiency, compare to fossil fuels?
- The coming age of scarcity; why we must arguably plan for an absolute decline in energy availability.
- Increased energy productivity; what has the UK achieved, what must it achieve? Thermodynamic realities.
- Changes needed to UK energy policy to deliver a sustainable *and affordable* energy system.

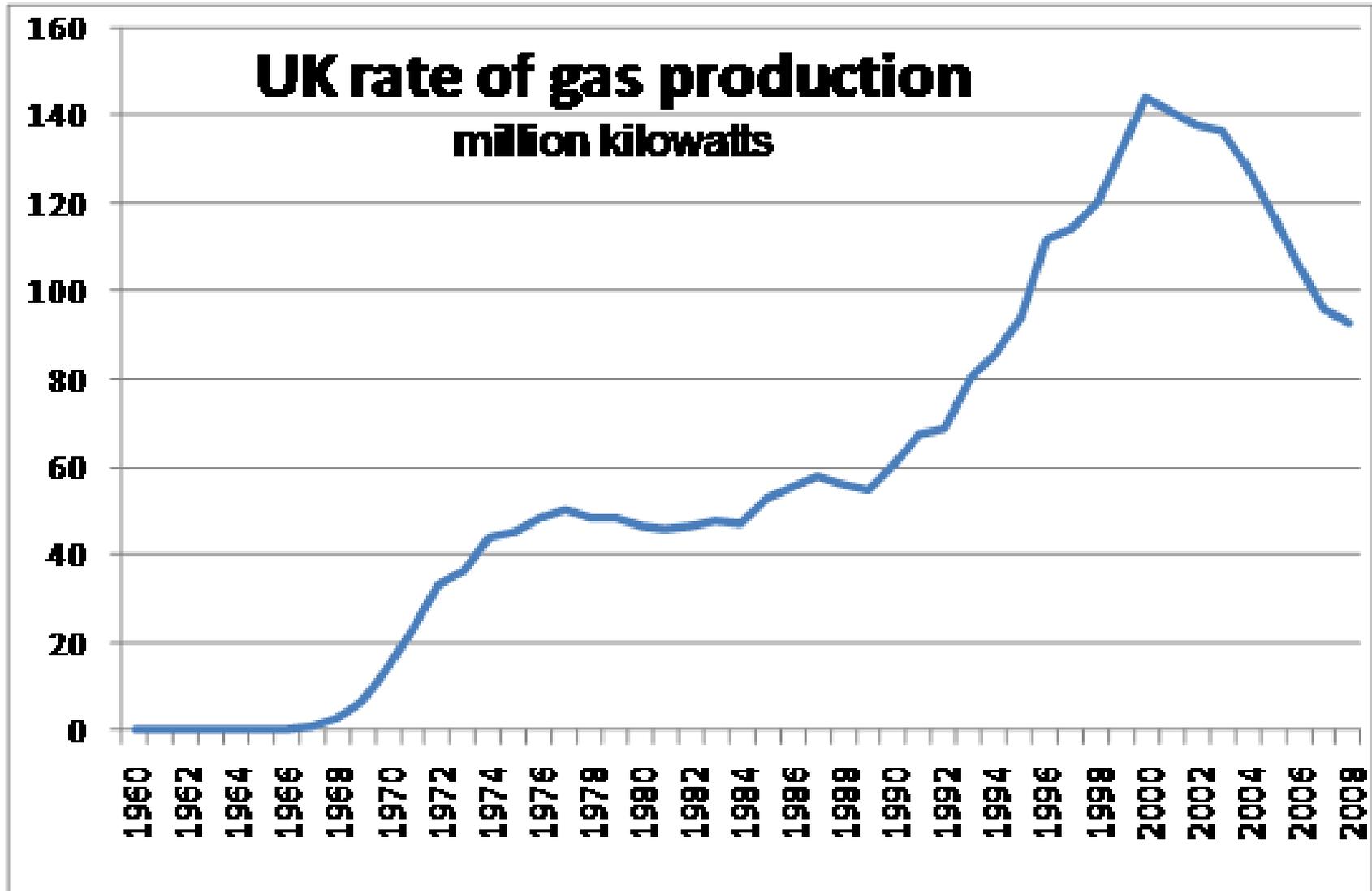
# UK Peak Coal Was in 1913



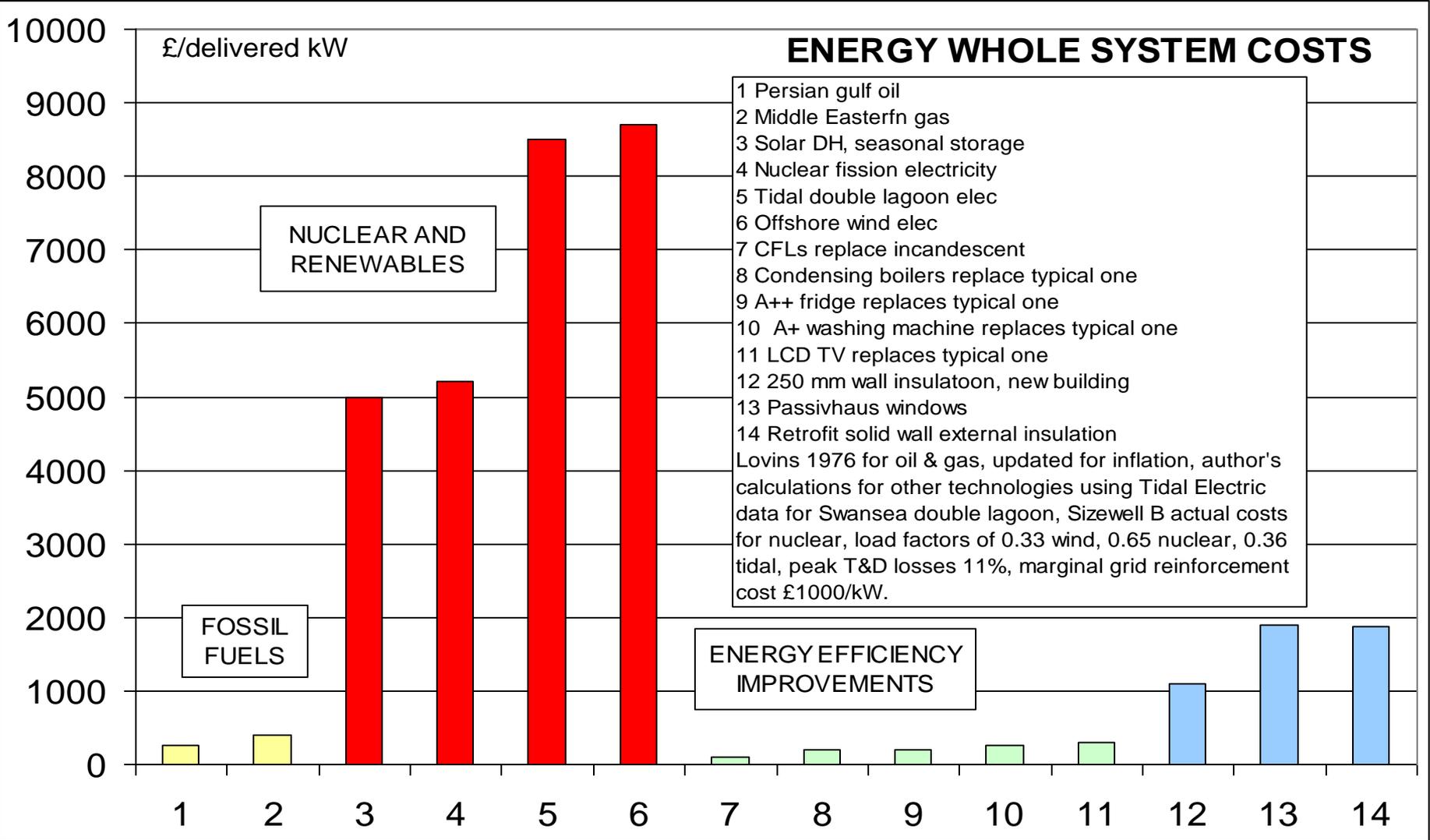
# UK Peak Oil Was in 1999



# UK Peak Gas Was in 2000



# Energy Economics: The High Costs of Future Energy Supply



# Worked Example

- External solid wall insulation is utilised to save heat in a well-heated low-rise detached house in the Birmingham area; i.e., a fairly typical UK climate.
- Done *en masse*, in a mass market, work is assumed to cost £50 per m<sup>2</sup> of wall area. 75 mm phenolic foam reduces the U-value of a plastered solid 215 mm brick wall from 2.1 to 0.24 W/m<sup>2</sup>K.
- Calculations with PHPP show that, if done “in order”, this measure saves 230 kWh/yr.m<sup>2</sup> wall area.
- Cost to “deliver” an average kilowatt of heat to final consumers  
= £ 50x8766/230 = £1,900/delivered kilowatt.
- Illustrative only; not a definitive study.

# The Problem

- Future energy sources are more resource-intensive and costly than fossil fuels. (Note that the world market price of oil and natural gas is weakly-related to the cost of extracting and transporting the fuels).
- Electricity supply systems used at low load factor; e.g. for heat, have particularly high costs, expressed in £ per delivered kilowatt or pence per kWh of delivered energy.
- With the rising cost of new energy supply systems, energy supply costs per unit GDP could rise by an order of magnitude, with adverse economic consequences.

# Potential Ways Forward

- Unlike new supply, many energy efficiency measures studied to date compete with the resource cost of oil, let alone the market price of oil.
- Lavish, but selective, investment in energy efficiency could keep annual costs at acceptable levels, despite the rise in energy supply costs per kWh.
- We need to give energy efficiency priority over more costly options, otherwise we shall face great economic difficulties.

# Improving the Existing Building Stock

1960s cavity-walled, solid ground-floored terraced housing in London, before and after proposed retrofit. Gas-heated.

CO<sub>2</sub> potentially down 82%, without many renewables. Modelled with PHPP. Most measures cost <£40/tonne now, others projected to be <£40 in mass market.

NOTE: Funding request declined in late 2009. Seeking support from other sources.





## The Starting Point

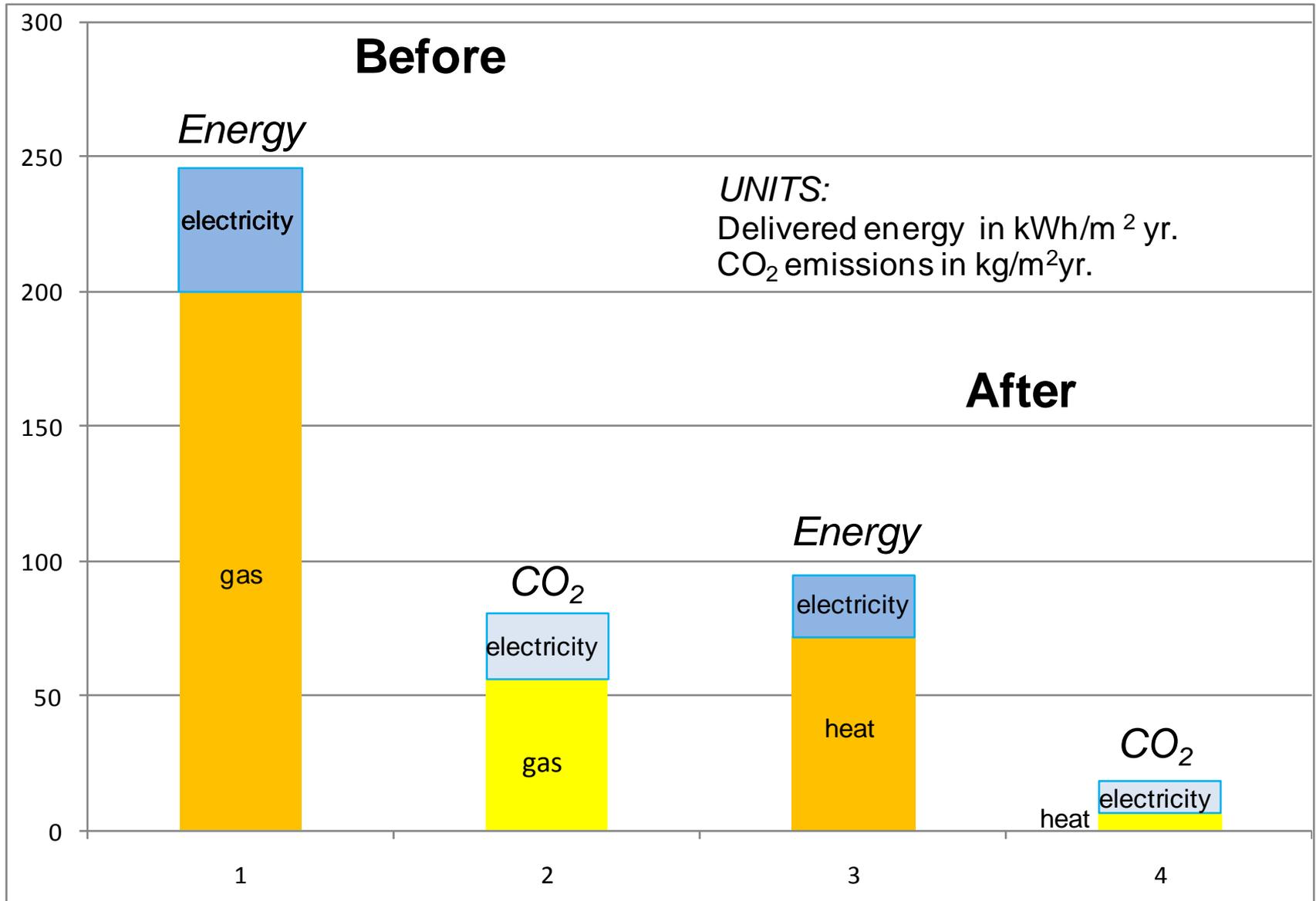
### TARGETS:

Space heat down from 200 to 72 kWh/m<sup>2</sup>yr

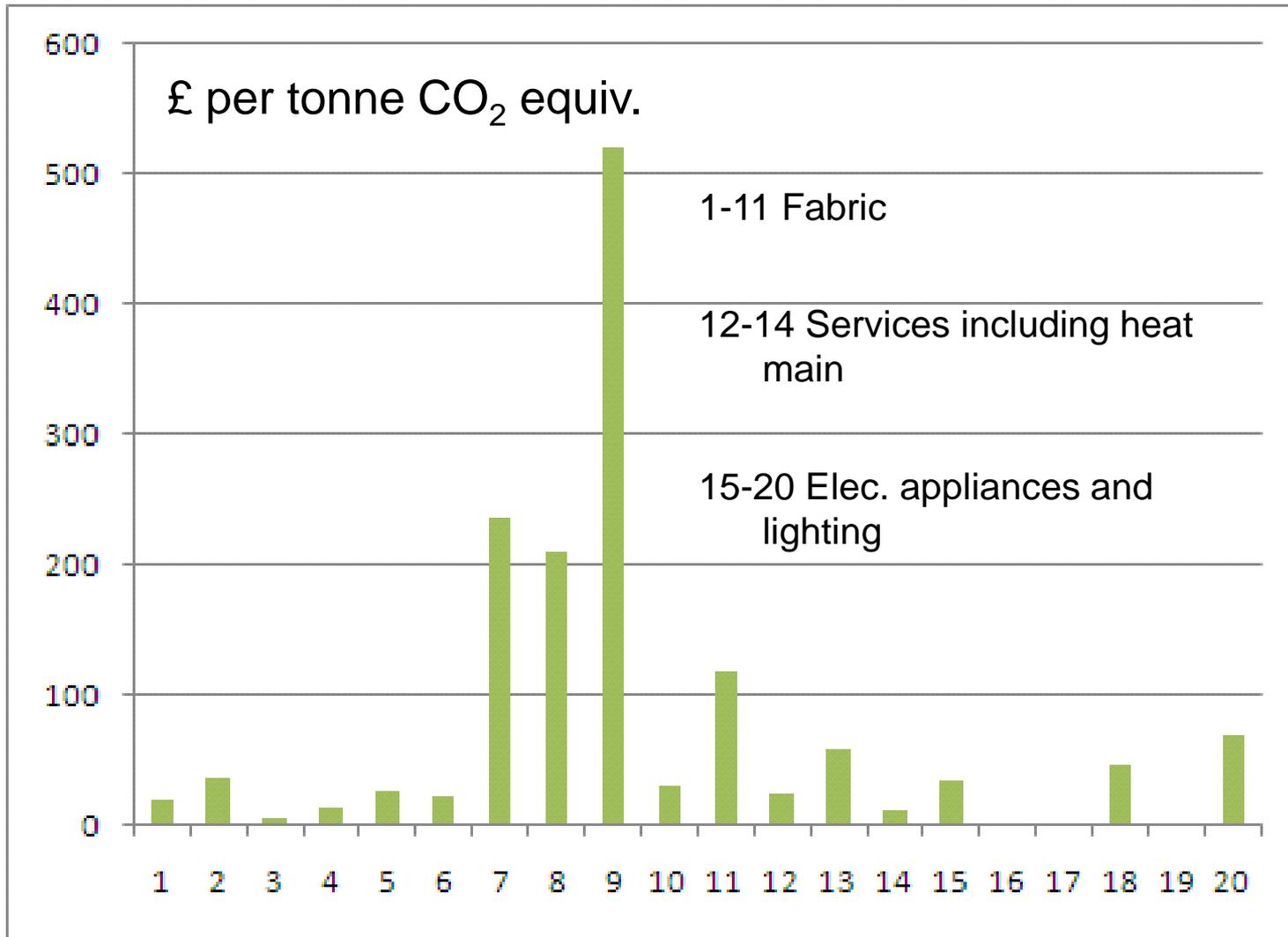
CO<sub>2</sub> emissions per unit of heat down from  
0.28 to 0.09 kg per kWh

Electricity for lights and appliances down  
by 50%.

# Delivered Energy and CO<sub>2</sub> Emissions



# Cost of Some Measures Analysed



# CHP and Elec. Heat Pumps

Pictures courtesy  
[www.logstor.com](http://www.logstor.com),  
[www.pipesystems.com](http://www.pipesystems.com)  
[www.isoplus.de](http://www.isoplus.de) and  
John Cantor Heat  
Pumps Ltd.

Bottom left - Danish heat transmission line  
Centre - PEX twin pipe, low-cost technology  
permitting DH in low rise housing areas  
Top right - Italian geothermal DH  
Bottom right - Welsh heat pump, see  
evaporator coil in ground.



# Solar Collectors, Denmark



1996/2002 - 18,000 m<sup>2</sup> of ground-mounted solar collectors and heat storage helps to heat the small coastal town of Marstal. Distribution temperatures were dropped to 70/40°C to raise the solar fraction.

Large collectors produce heat at *one-fifth* the cost of heat from collectors on house roofs and are being widely connected to Danish district heating systems.

Pictures courtesy Leon Miller.

# More Solar Collectors, Denmark



Top - 8,000 m<sup>2</sup> of ground-mounted solar collectors help to heat the small town of Strandby, Jutland.

Bottom right - solar collector field being craned into place.

Pictures courtesy  
<http://www.solartermalworld.org/node/766>





# Biomethane CHP, Germany

The picture shows a gas production and storage system, not the CHP plant

Picture courtesy

[http://www.farmworldonline.com/general/meggi\\_egermanyblog.asp](http://www.farmworldonline.com/general/meggi_egermanyblog.asp)

# Energy-Efficient ‘Cold’ Appliances

*Below left* - energy-efficient 259 litre larder refrigerator, USA, 76 kWh/yr. Plus optional external condenser. **Old UK models about 500 kWh/yr. Saves 85%.** *Below right* - A++ 195 litre chest freezer, Europe, 113 kWh/yr. **Old UK models about 700 kWh/yr. Saves 84%.**

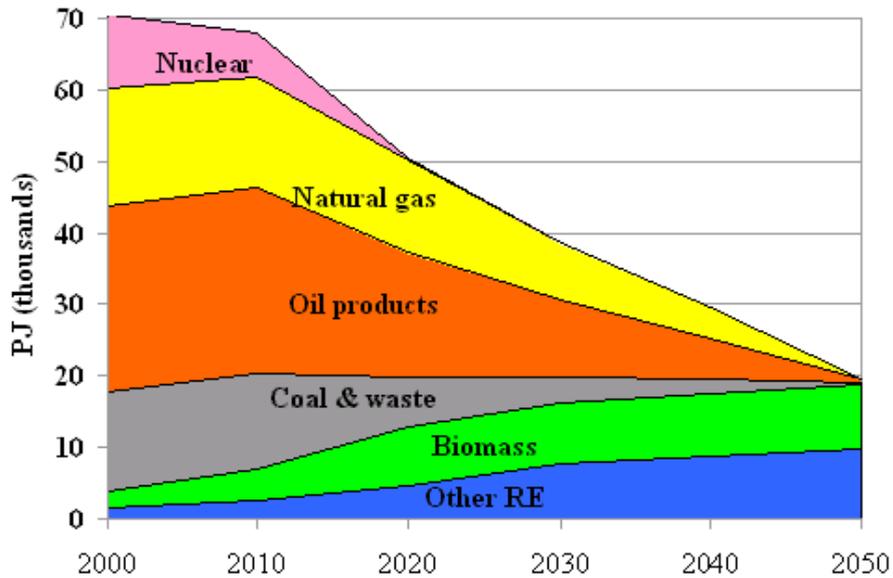
Typical cost of saved electricity to go from so-called “good practice” to above levels = 2 p per kWh.

Results of US test at 32°C and 21°C are interpolated linearly to calculate consumption in a CEN test at 25°C.

Pictures courtesy [www.liebherr.com](http://www.liebherr.com) and [www.sunfrost.com](http://www.sunfrost.com)



**Total Primary Energy Supply, EU-27**



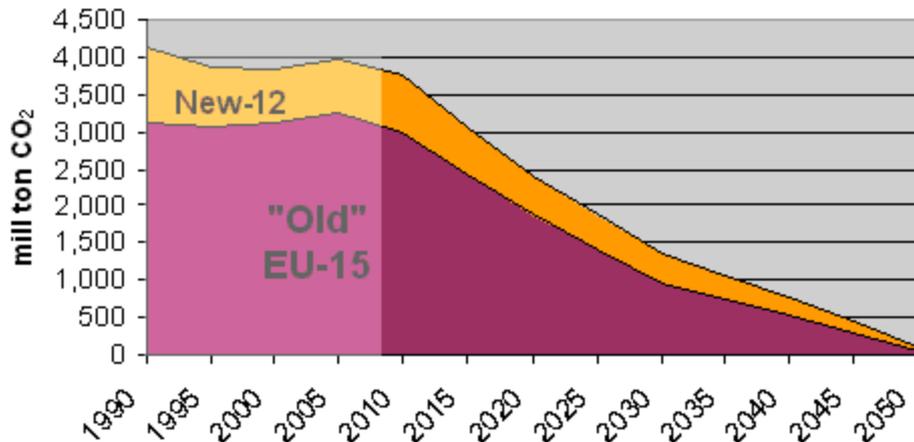
# Energy Scenarios for the EU-27

“Vision 2050”

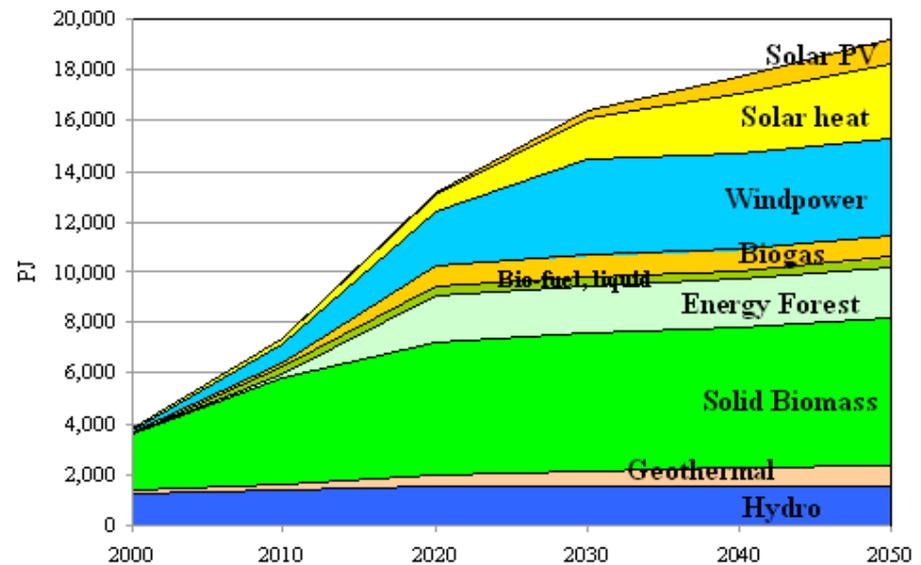
Reproduced by courtesy of

<http://www.inforse.org>

**EU27 CO<sub>2</sub> Emissions from energy, Vision2050**



**Renewable Energy Supply, EU27**



# Denmark's Vision 2050

## Summary

- Consumer electrical and electronic equipment - best available technology of 2008 is in universal use.
- Existing buildings - space heating useful energy is reduced from an EU-wide average of 150 to 60 kWh/m<sup>2</sup>yr. *No* reduction in internal temperature because that would conflict with social policy.
- New buildings - in Denmark, space heating useful energy falls to 36 kWh/m<sup>2</sup>yr by 2010, 27 kWh/m<sup>2</sup>yr by 2015, etc, as per their Building Regulations. (Total heat = ~20 kWh/m<sup>2</sup>yr more than space heat).
- Extensive use of very large and therefore efficient heat pumps in the heat distribution networks which supply 60-65% - soon 75% - of Denmark's space and water heating. Enables the electric grid to be kept stable while accepting more windpower than today's 209%.
- With its well-developed sustainable construction and energy sectors, Denmark could phase out fossil fuels by 2030, not 2050.

[www.ove.org](http://www.ove.org); [http://www.inforse.org/europe/pdfs/Vision\\_DK\\_2009.pdf](http://www.inforse.org/europe/pdfs/Vision_DK_2009.pdf)

David Olivier, BSc MASHRAE

Principal

## **ENERGY ADVISORY ASSOCIATES**

1 Moores Cottages, Bircher, Leominster,  
Herefordshire, England, HR6 0AX

*T: (01568) 780868.*

*E: [d.olivier@energyadvisoryassociates.co.uk](mailto:d.olivier@energyadvisoryassociates.co.uk)*

*W: [www.energyadvisoryassociates.co.uk](http://www.energyadvisoryassociates.co.uk)*

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