Thermal Envelopes and Heating Systems

UCL, 29 November 2011

David Olivier

What I Shall Talk About

- **Greater Energy Efficiency in Heating**
- **Concern over Current Policy**
- **Case Studies/Proposed Projects, UK & Denmark**

More detail in the forthcoming report:

LESS IS MORE: *Energy Security After Oil.*

AECB, the Sustainable Building Association.

Greater Energy Efficiency - Heating

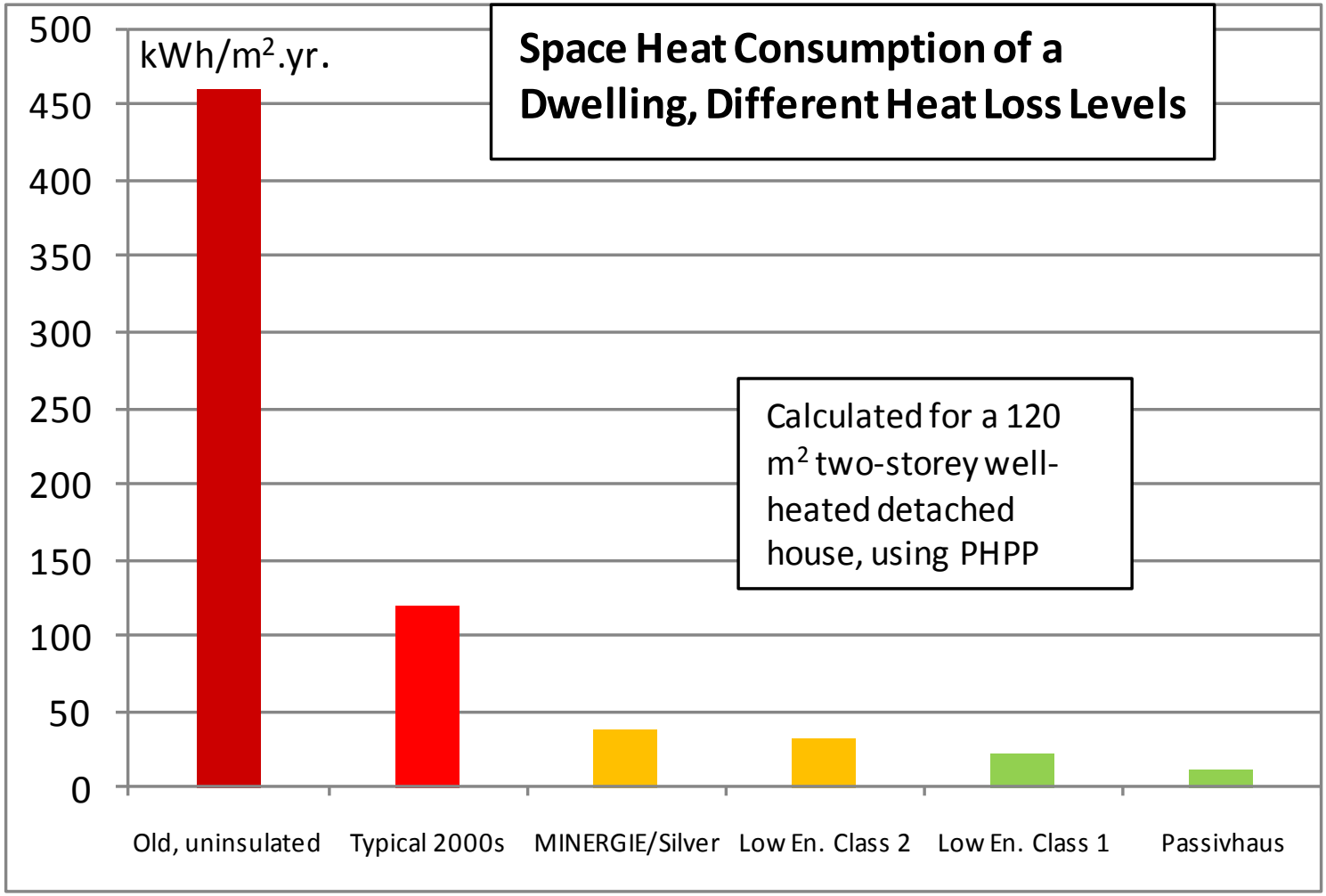
Reduce the quantity of heat consumed; e.g. insulate the walls, upgrade the windows and draughtproof a building to reduce its heat loss. *Some allowance in current policy.*

Match the quality of energy supplied to the demand; e.g., replace a gas-fired heat-only boiler or electric resistance heating by waste heat from gas CHP or perhaps heat pumps. But c*urrent policy stresses "decarbonisation of electricity".*

The combination. Can reduce consumption of high-grade energy and CO_2 emissions by 99%. But "just" 95% would be very satisfactory.

Lower Heat Consumption

Good and best practice reduces emissions 95-97% versus "worst practice", 70-88% vs. "2000s average practice".



Sources:

Old uninsulated and 2000s construction - author's estimate

MINERGIE - Swiss government standard, IP jointly owned by the 26 cantons

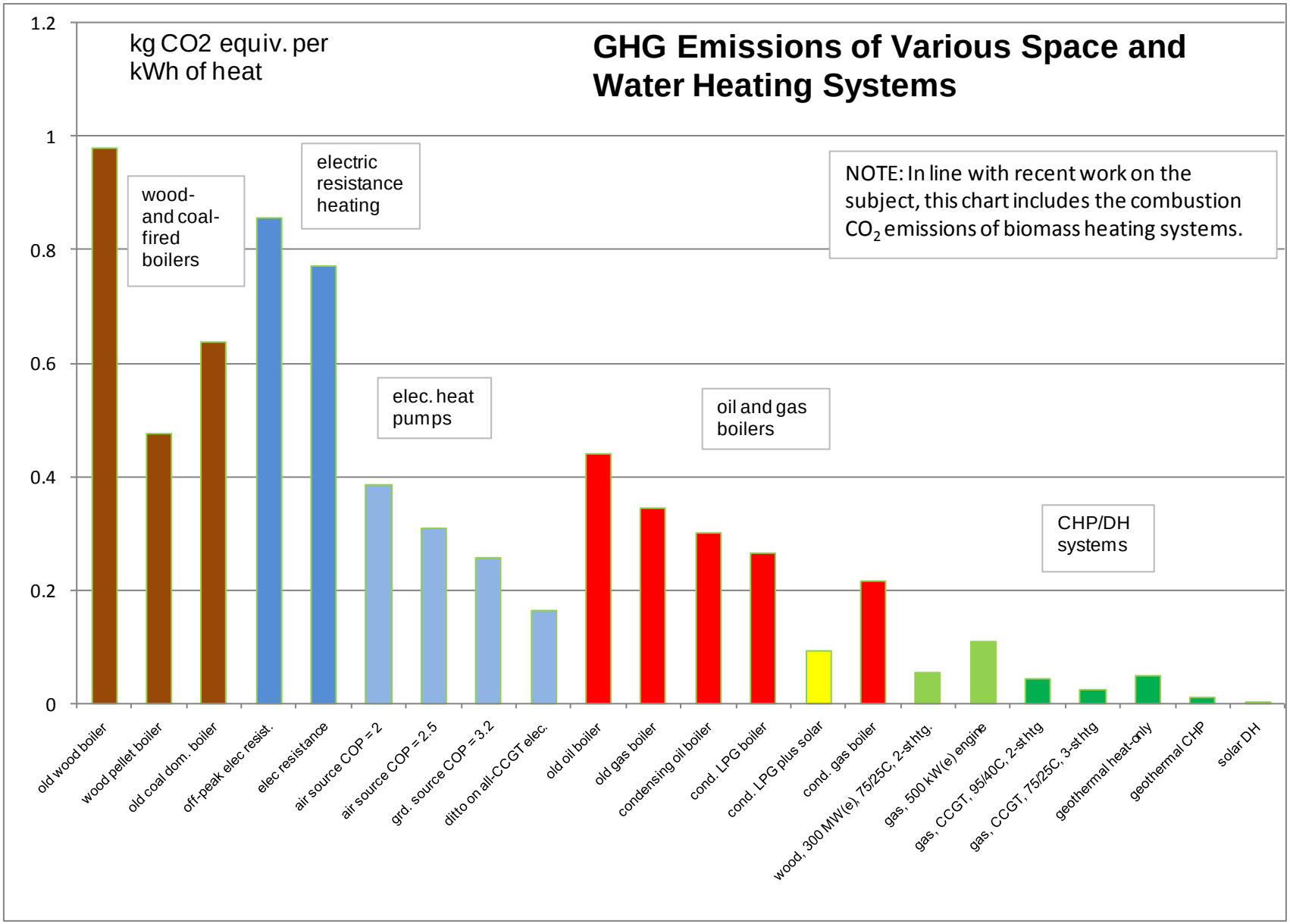
Silver - AECB, the Sustainable Bldgs Assocn.

Low Energy Class I and II - Danish government standards

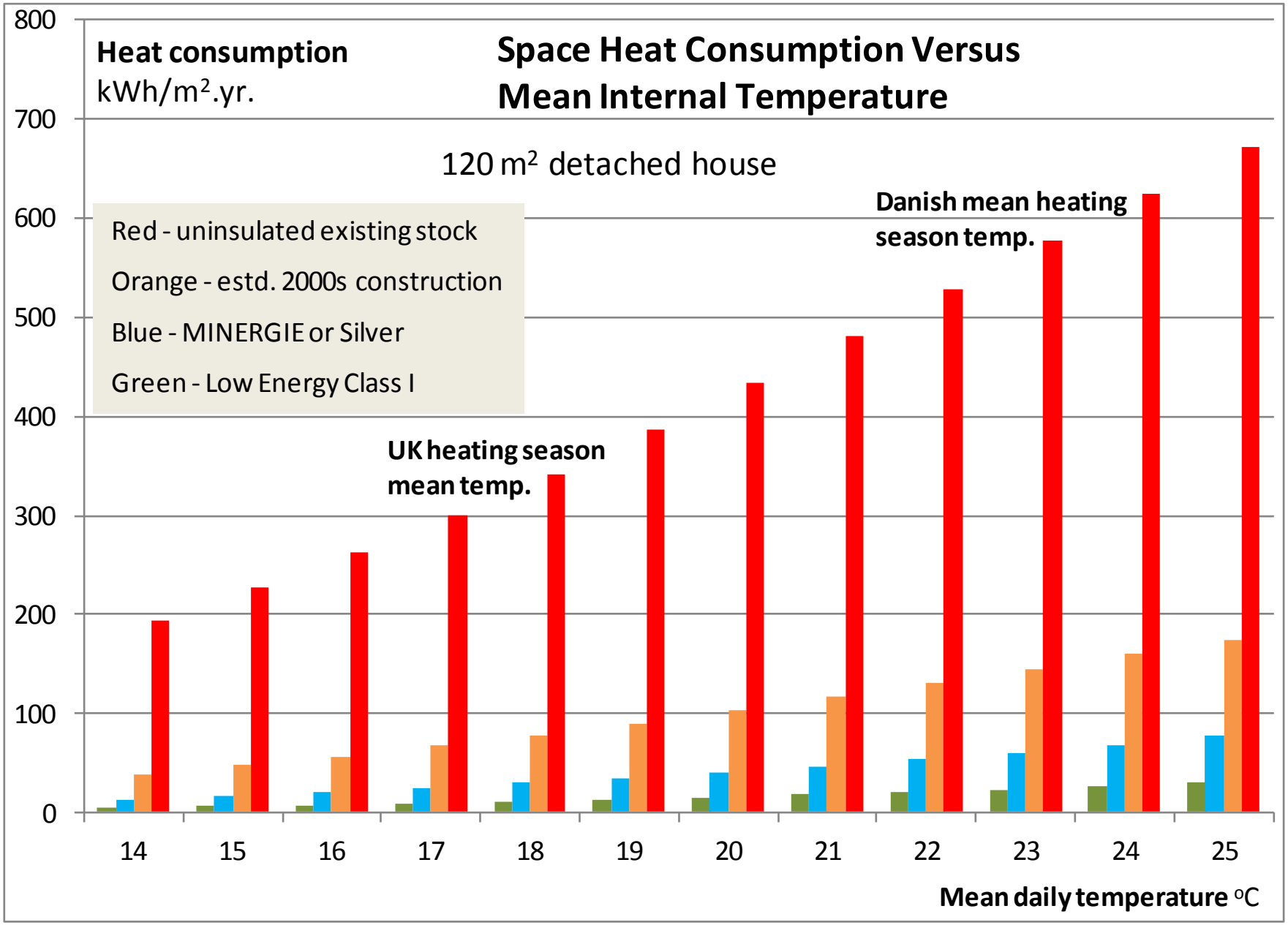
Passivhaus - standard - PHI, Darmstadt, Germany

Lower-CO_2 Heat

Good practice reduces emissions 80-90% versus current practice.

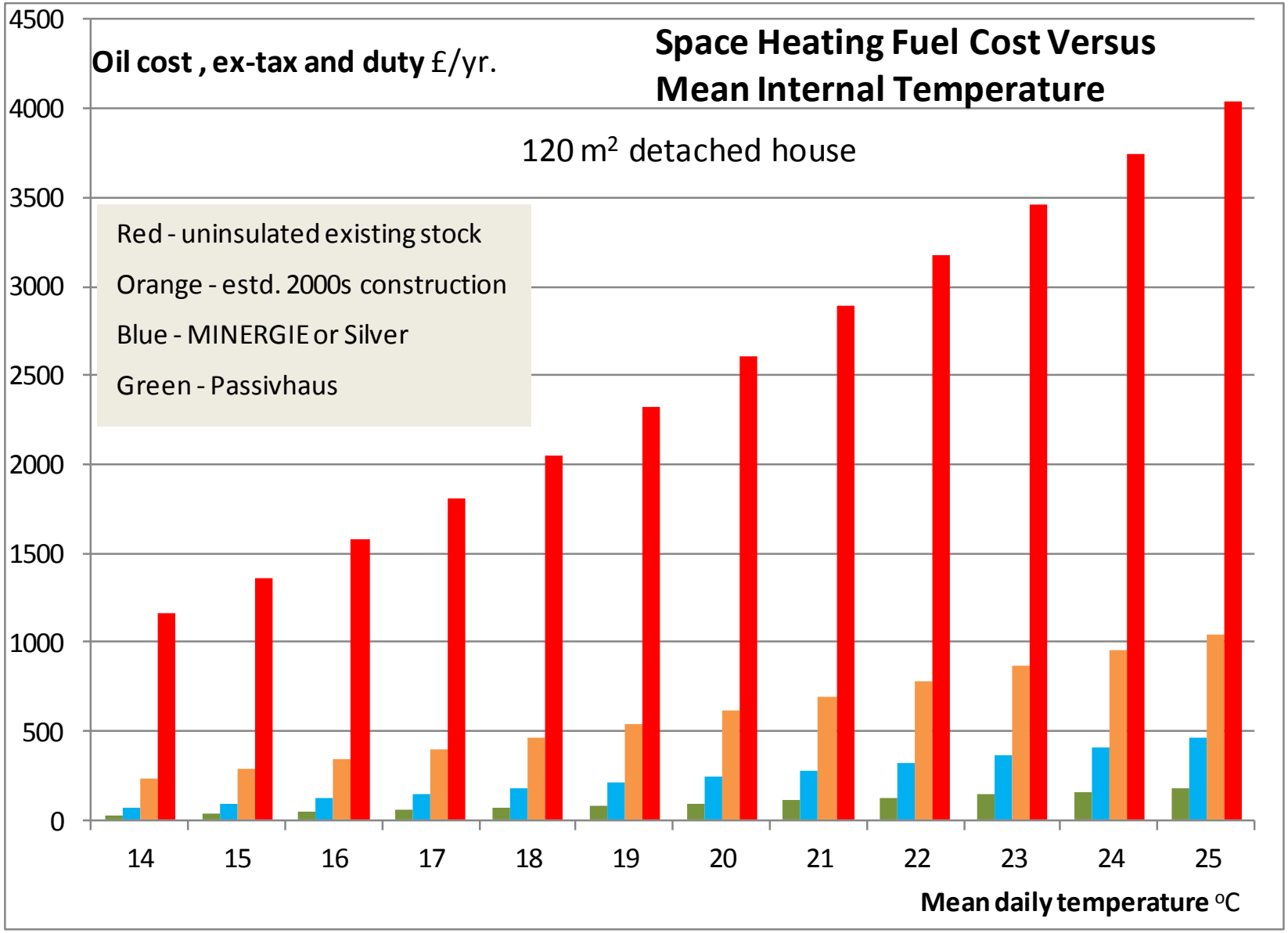


Scope for Enhanced Thermal Comfort



Rural Fuel Poverty?

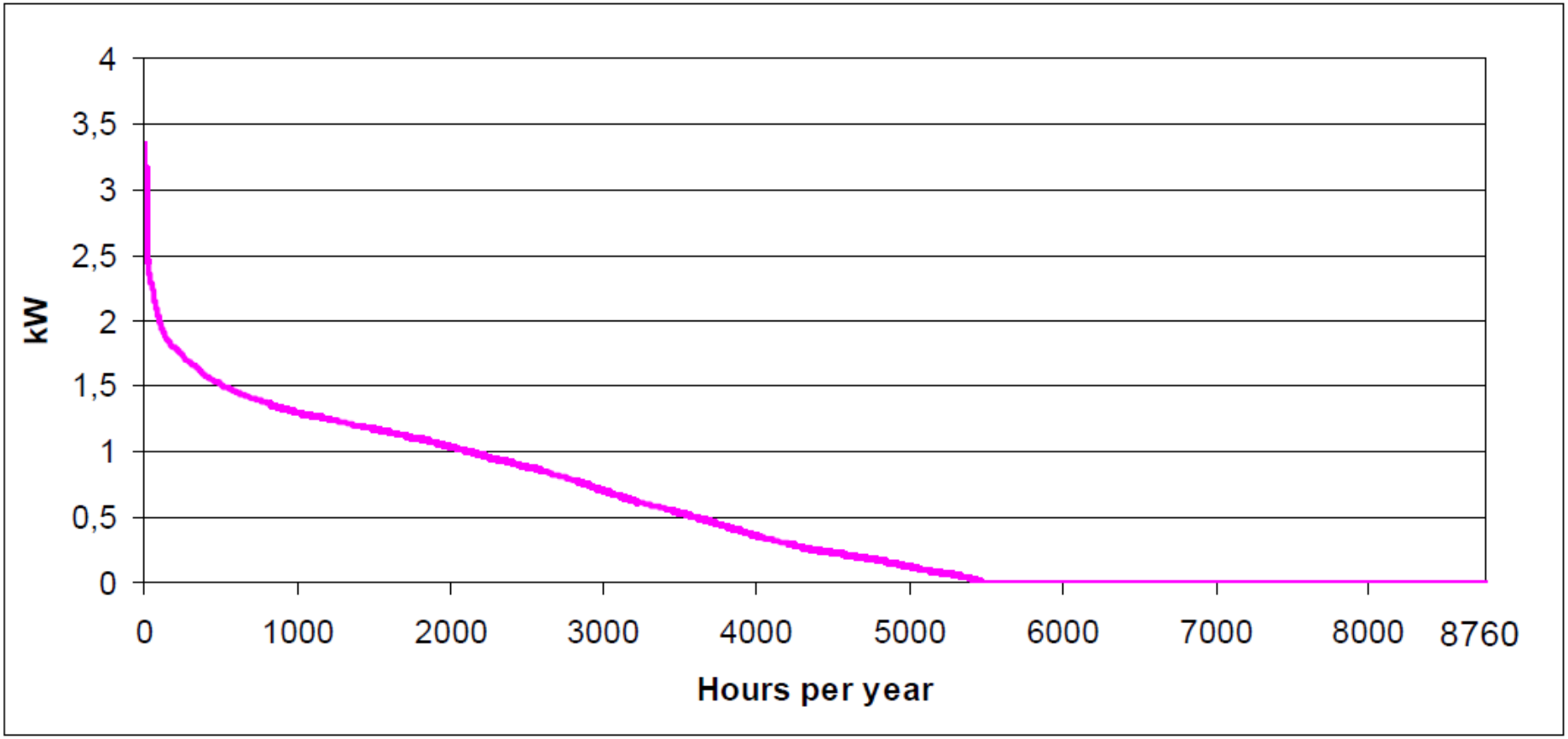
Fuel cost, oil condensing boiler. Excludes servicing/maintenance, DHW and household electricity costs.



Space Heating Load Duration Curve

Danish 145 m^2 detached bungalow. Low Energy Class 1; i.e., near to Passivhaus Standard.

All space heating load duration curves have the same basic shape. A lower specific heat loss, or lower cooling time constant, tends to reduce the load factor. These are close to daily mean values, *not* hourly values.



Concerns over UK Policy

Energy Economics - Money Meets Energy

The resource demands of different technologies vary widely. Energy options are being pursued which are up to 30 times more capital-intensive than today's offshore oil supply (£ per delivered kW).

"A senior oil industry representative ... stated that 2004 was the 'inflection point' when global conventional oil production plateaued and oil stopped being cheap. The speaker affirmed that the supply flow is more important than reserves and that we know that $150[/barrel] oil 'breaks the machine' so that the global economy cannot function above that price. 'It does not matter how much oil is left if we can't afford it.' " Account of 2010 peak oil summit.

Unless we are selective and invest promptly in ***high-EROEI*** resources, we may risk perpetuating the economic problems.

Money Meets Energy: An Exponential Economics Primer
http://www.tullettprebon.com/announcements/strategyinsights/notes/2010/SIN20101116.pdf (November 2010).

www.theoildrum.com.

Concerns over UK Policy

Future Network Stability

- 94% of domestic space heating is from natural gas, oil, LPG and coal - in built-up areas, mainly gas; in rural areas, mainly oil.

- The gas network allows considerable energy storage.

- Heat networks, if used, can increase the pumping rate *and* the flow temperature to meet peaks. Bulk heat storage is cheap; some small cities have 100,000 m^3 hot water stores on their DH network.

- With electricity networks, storage is costly and network losses rise with load.

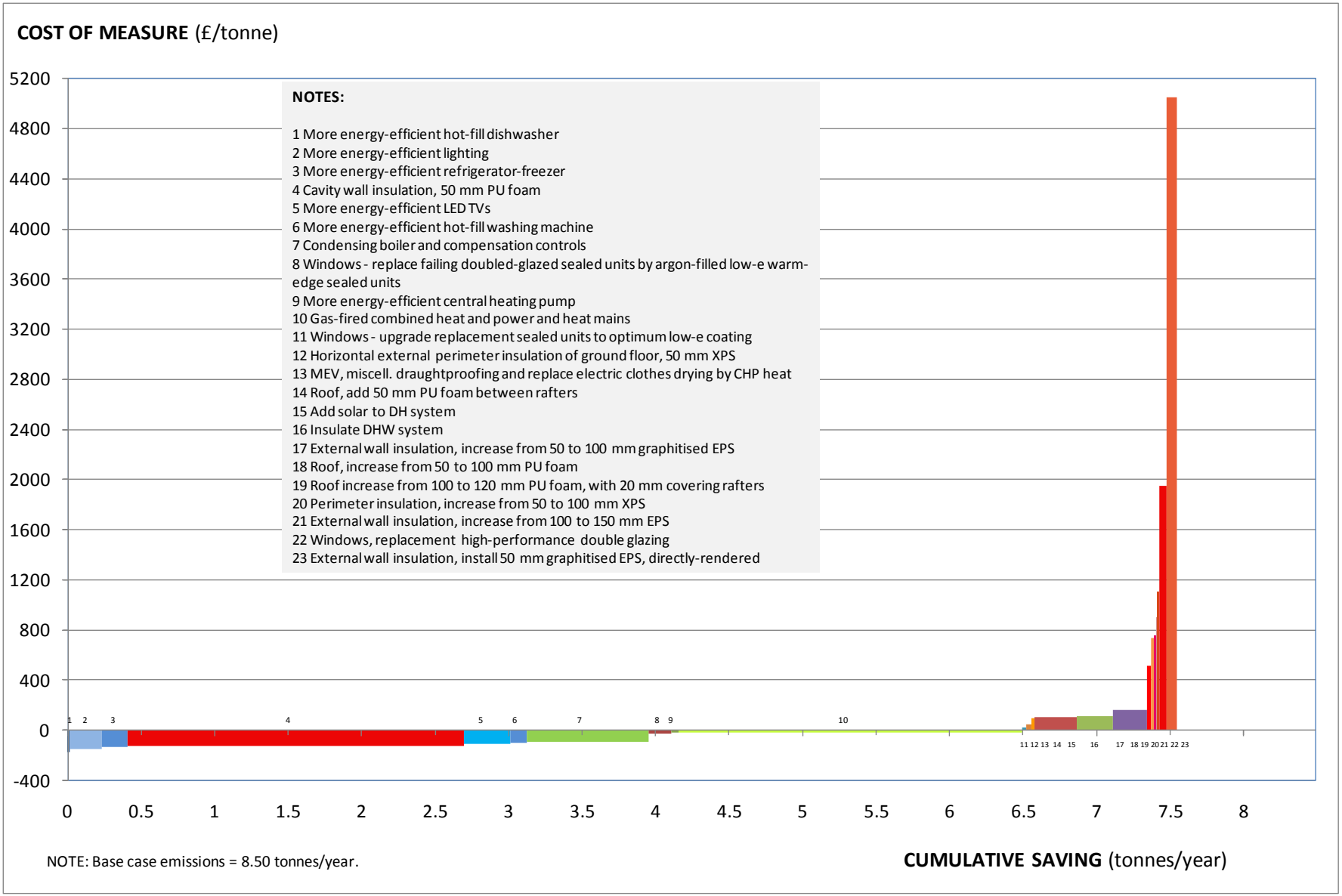
1970s Low-Rise Dwellings, London

Cavity-walled, solid ground-floored housing before and after proposed TSB RFF retrofit. CO_2 emissions would fall 82% at ~£10k per dwelling in widespread use for the thermal measures. Construction probably typical of 30-40% of existing dwelling stock.

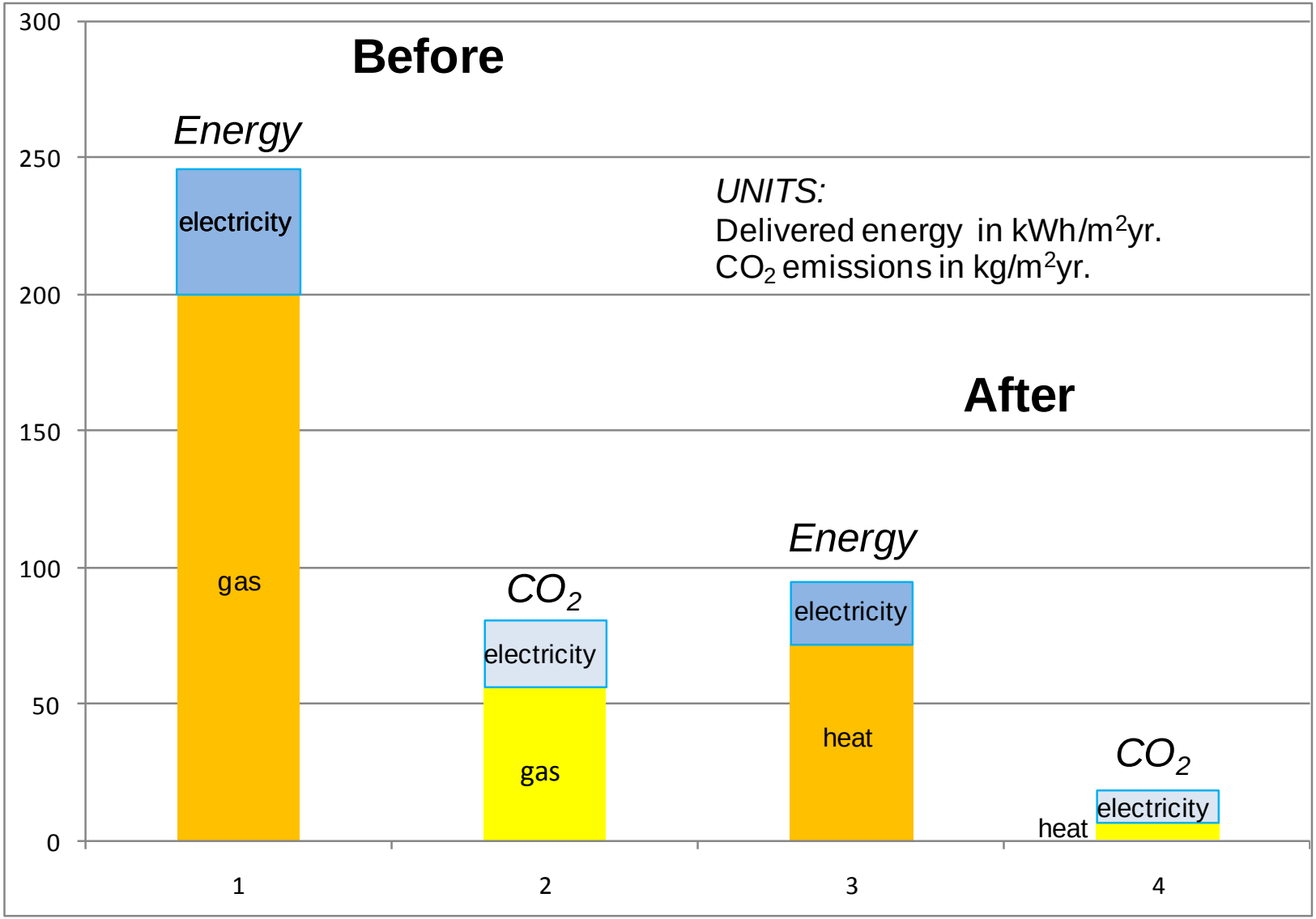
- CWI and roof insulation with airtight material
- Gas 500 kW(e) recip. engine CHP, extend existing scheme, add summer solar
- Reglaze existing windows when sealed units wear out
- MEV *not* MVHR
- Highly energy-efficient lights, A++ appliances & pumps, including CHP heat for clothes drying
- Highly-insulated new DHW tank and piping with improved heat exchanger

MACC for Measures Analysed

Existing Typical Urban or Suburban Semi-Detached House



82% Cut in CO_2 Emissions Before Allowing for "Electricity Decarbonisation"



The Small Town of Marstal

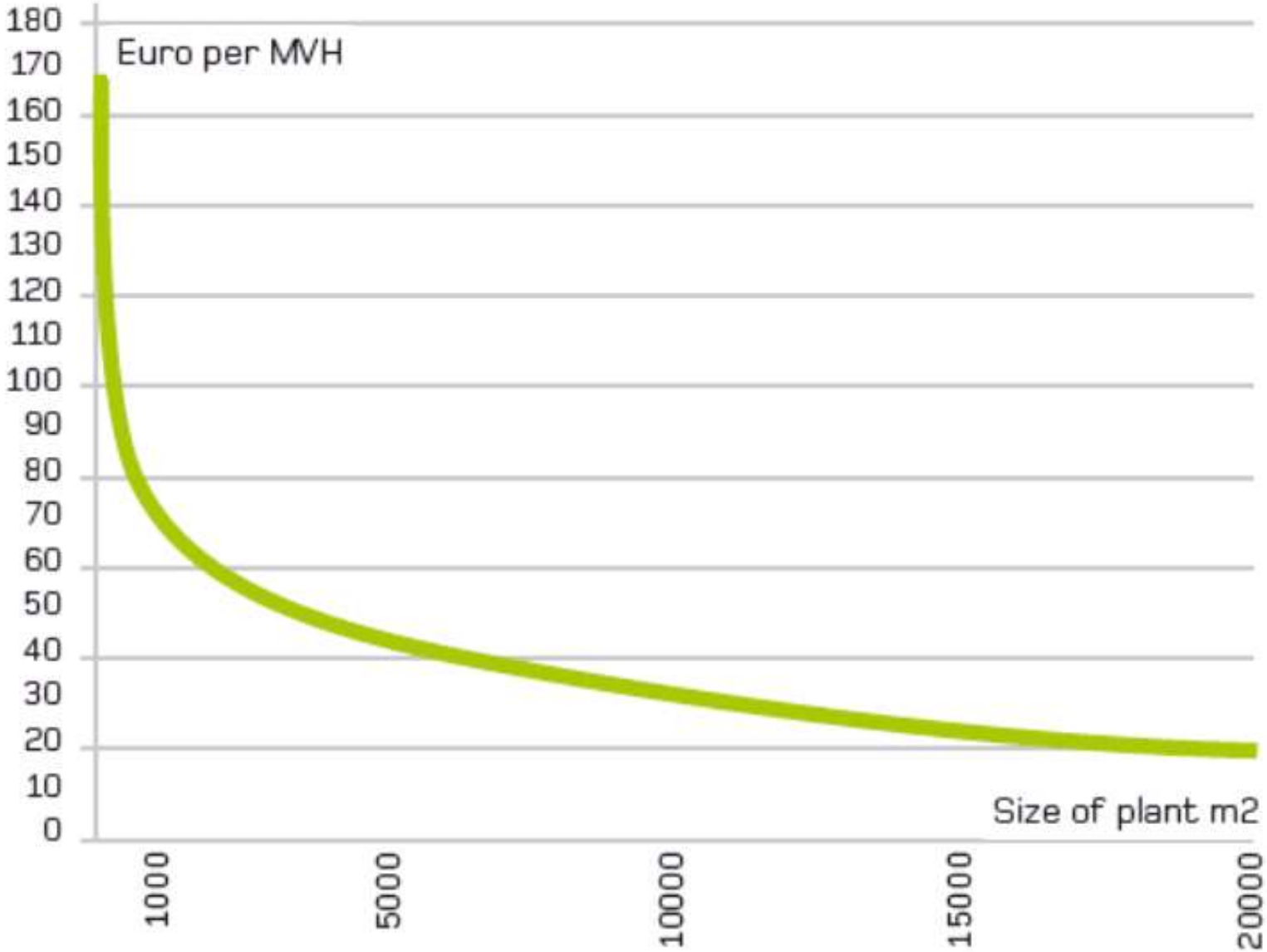
- 4,600 people, 2,000 houses
- Headed towards 33,000 m^2 of solar collectors in the DH system
- Plus sheep ....

Pictures:

Courtesy Marstal Fjernwärme AMBA.

Cost of Solar Heat Versus System Size

http://dbdh.dk/images/uploads/pdfbladet/EU%20aim%20at%20great%20expansion%20of%20large-scale%20solar%20thermal%20plants.pdf



Heat cost (FOB) falls from **17 to 1.6 p/kWh** as system size rises from 50 to 20,000 m^2. Refers to heat at 85°C, return at around 30°C.

For further information:

David Olivier, BSc MEI MASHRAE

Principal

ENERGY ADVISORY ASSOCIATES

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

Tel.: (01568) 780868.
E-mail: info[at]energyadvisoryassociates.co.uk
Web: www.energyadvisoryassociates.co.uk