

Sustainable Energy – without the hot air

David JC MacKay

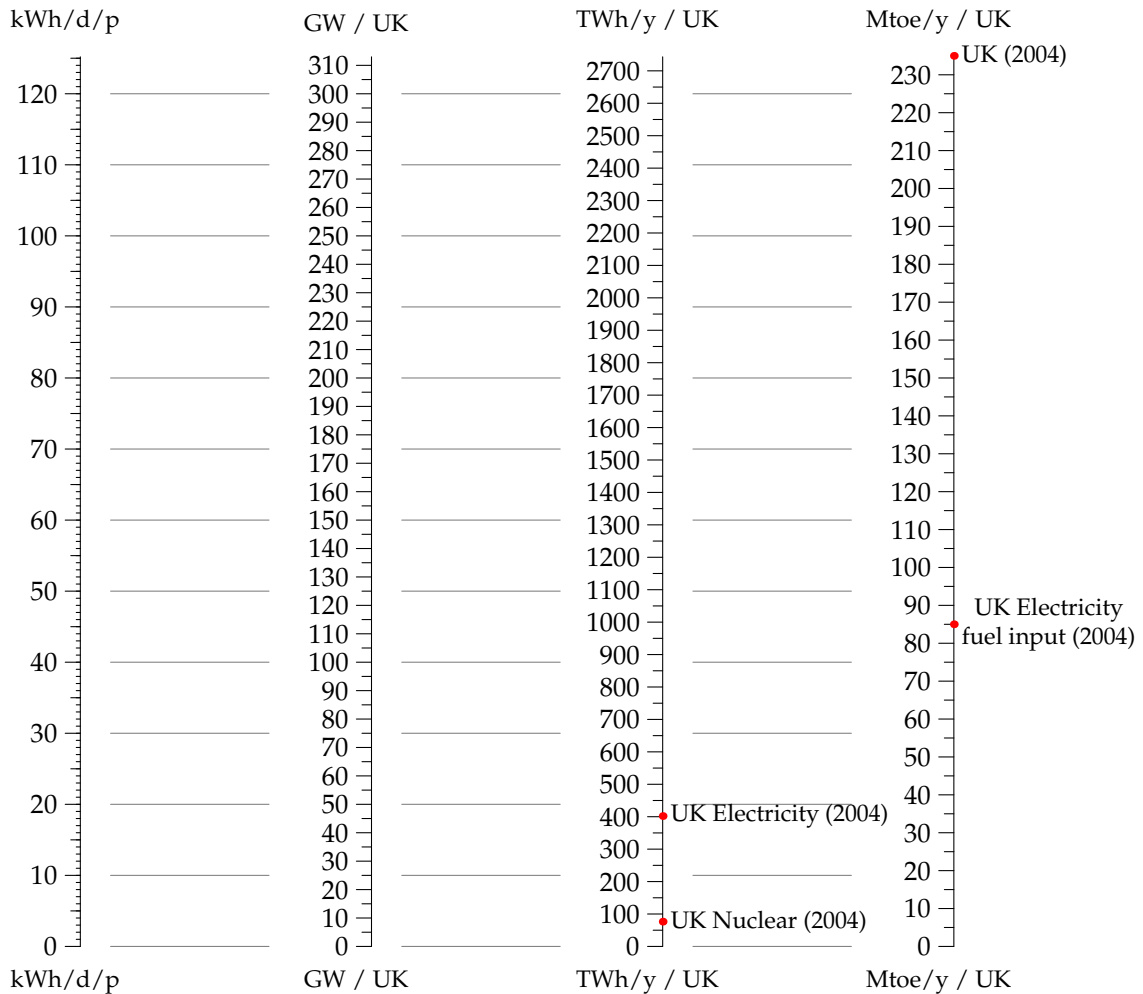
About the author

David MacKay is a Professor in the Department of Physics at the University of Cambridge. He studied Natural Sciences at Cambridge and then obtained his PhD in Computation and Neural Systems at the California Institute of Technology. He returned to Cambridge as a Royal Society research fellow at Darwin College. He is internationally known for his research in machine learning, information theory, and communication systems, including the invention of Dasher, a software interface that enables efficient communication in any language with any muscle. He has taught Physics in Cambridge since 1995. Since 2005, he has devoted much of his time to public teaching about energy. He is a member of the World Economic Forum Global Agenda Council on Climate Change.



The author, July 2008.
Photo by David Stern.

Power translation chart



1 kWh/d the same as $\frac{1}{24}$ kW

GW often used for 'capacity' (peak output)

TWh/y often used for average output

1 Mtoe 'one million tons of oil equivalent'

"UK" = 60 million people

USA energy consumption: 250 kWh/d per person

Europe energy consumption: 125 kWh/d per person

The most commonly used units in public documents discussing power options are:

terawatt-hours per year (TWh/y).

1000 TWh/y per United Kingdom is roughly equal to 45 kWh/d per person.

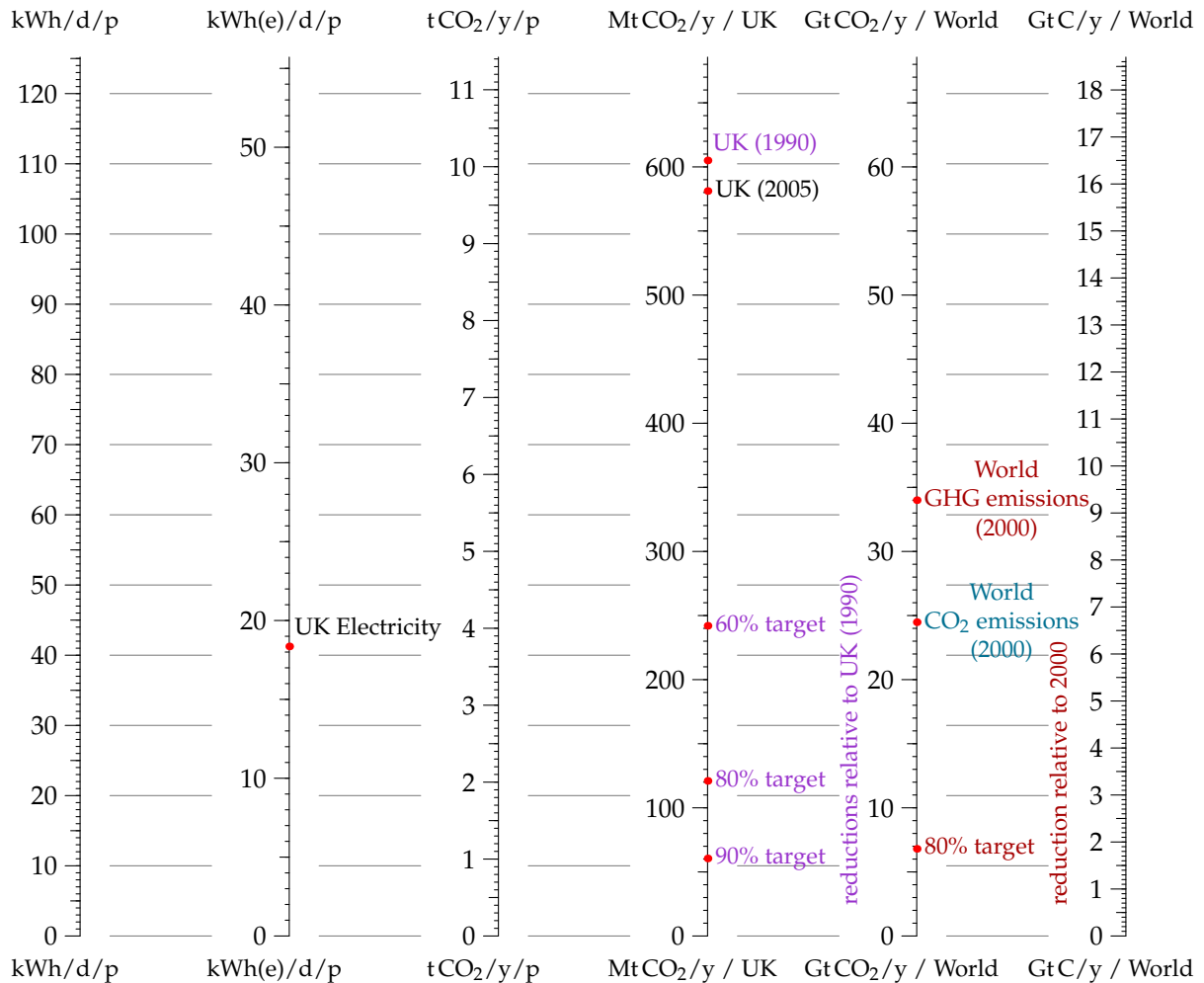
gigawatts (GW).

2.5 GW per UK is 1 kWh/d per person.

million tons of oil equivalent per year (Mtoe/y).

2 Mtoe/y per UK is roughly 1 kWh/d per person.

Carbon translation chart



kWh *chemical* energy exchange rate:
 1 kWh ↔ 250 g of CO₂ (oil, petrol)
 (for gas, 1 kWh ↔ 200 g)
 kWh(e) *electrical* energy is more costly:
 1 kWh(e) ↔ 445 g of CO₂ (gas)
 (Coal costs twice as much CO₂)
 tCO₂ ton of CO₂
 MtC million tons of carbon

“UK” = 60 million people
 “World” = 6 billion people

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