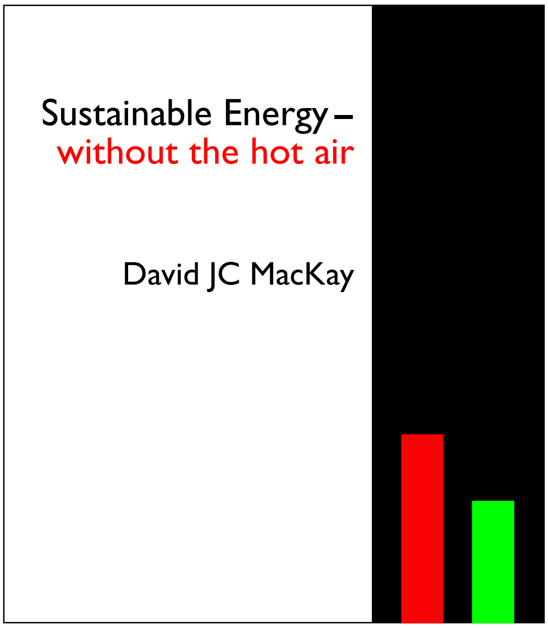


We have an addiction to fossil fuels, and it's not sustainable. How can we replace fossil fuels? How can we ensure security of energy supply? How can we solve climate change?

We're often told that "huge" amounts of renewable power are available – wind, wave, tide, and so forth. But our current power consumption is also huge! To understand our sustainable energy crisis, we need to know how the one "huge" compares with the other. We need numbers, not adjectives.

This book shows how to estimate the numbers, and what those numbers depend on. Taking the United Kingdom as an example, it asks first "could Britain live on renewable energy resources along?" and second "how can a country like Britain make a realistic post-fossil-fuel energy plan that adds up?" It answers these questions in detail, bringing home the size of the changes that society must undergo of sustainable living is to be achieved. It's not going to be easy to make an energy plan that adds up – but it *is* possible.

David MacKay is a Professor in the Department of Physics at the University of Cambridge.

384 pages, 196×223 mm
Full colour throughout
ISBN (paperback) 9780954452933
ISBN (hardback) 9781906860011

Try before you buy – the book is available for free download from `www.withouthotair.com`.

Sustainable Energy – without the hot air

David JC MacKay

This remarkable book sets out, with enormous clarity and objectivity, the various alternative low-carbon pathways that are open to us.

Sir David King FRS
Chief Scientific Adviser to the UK Government, 2000–08

For anyone with influence on energy policy, whether in government, business or a campaign group, this book should be compulsory reading.

Tony Juniper
Former Executive Director, Friends of the Earth

At last a book that comprehensively reveals the true facts about sustainable energy in a form that is both highly readable and entertaining.

Robert Sansom
Director of Strategy and Sustainable Development, EDF Energy

A total delight to read. Extraordinarily clear and engaging.

Chris Goodall
author of *Ten Technologies to Save the Planet*

. . . a really valuable contribution . . . uses a potent mixture of arithmetic and common sense to dispel some myths and slay some sacred cows.

Lord Oxburgh KBE FRS
Former Chairman, Royal Dutch Shell

Engagingly written, packed with useful information, and refreshingly factual.

Peter Ainsworth MP
Shadow Secretary of State for Environment, Food, and Rural Affairs

a delight to read . . . this fascinating book is a mine of quantitative information.

Dr Derek Pooley CBE
Former Chief Scientist at the Department of Energy,
Chief Executive of the UK Atomic Energy Authority,
and Member of the European Union Advisory Group on Energy

Started reading your book yesterday. Took the day off work today so that I could continue reading it. It is a fabulous, witty, no-nonsense, valuable piece of work, and I am busy sending it to everyone I know.

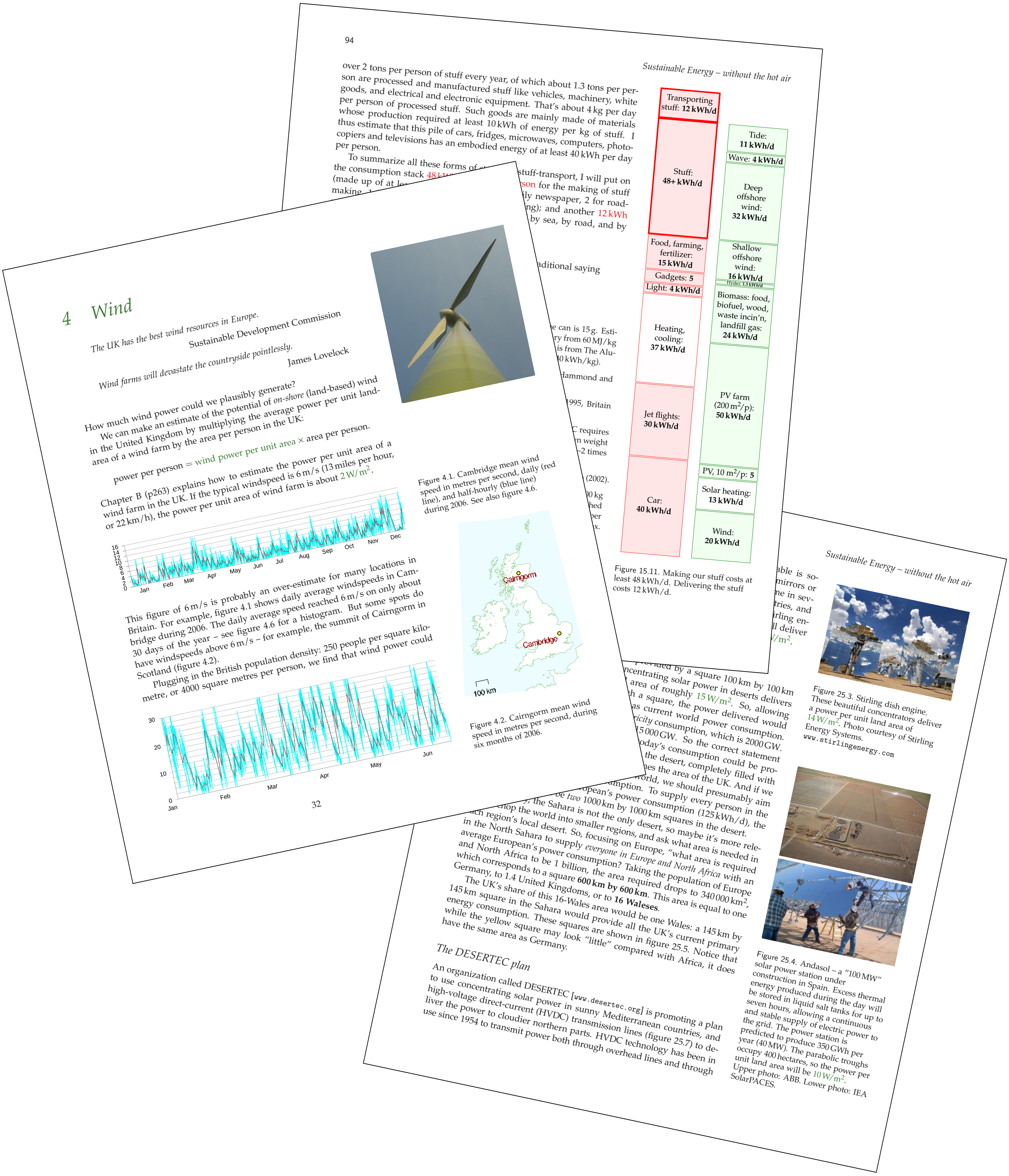
Matthew Sullivan
Carbon Advice Group Plc

David MacKay's book sets the standard for all future debate on energy policy and climate change.

David Howarth MP
Shadow Solicitor General, Liberal Democrats

Sustainable Energy – without the hot air

David JC MacKay



4 Wind

The UK has the best wind resources in Europe.
Sustainable Development Commission

Wind farms will devastate the countryside pointlessly.
James Lovelock

How much wind power could we plausibly generate?

We can make an estimate of the potential of *on-shore* (land-based) wind in the United Kingdom by multiplying the average power per unit land-area of a wind farm by the area per person in the UK:

power per person = wind power per unit area × area per person.

Chapter B (p263) explains how to estimate the power per unit area of a wind farm in the UK. If the typical windspeed is 6 m/s (13 miles per hour, or 22 km/h), the power per unit area of wind farm is about $2\,W/m^2$.

Figure 4.1. Cambridge mean wind speed in metres per second, daily (red line), and half-hourly (blue line) during 2006. See also figure 4.6.

This figure of 6 m/s is probably an over-estimate for many locations in Britain. For example, figure 4.1 shows daily average windspeeds in Cambridge during 2006. The daily average speed reached 6 m/s on only about 30 days of the year – see figure 4.6 for a histogram. But some spots do have windspeeds above 6 m/s – for example, the summit of Cairngorm in Scotland (figure 4.2).

Plugging in the British population density: 250 people per square kilometre, or 4000 square metres per person, we find that wind power could

Figure 4.2. Cairngorm mean wind speed in metres per second, during six months of 2006.

32