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.

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
4 Wind

The UK has the best wind resources in Europe.

Wind farms are destined to be an offshore portfolio.

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:

\[ \text{power per person} = \frac{\text{power per unit area of a wind farm}}{\text{area per person}} \]

Chapter B explains how to estimate the power per unit area of a wind farm in the UK. It is usually wind in a 13 miles per hour (22 km/h), the power per unit area of wind farms is about 12 W/m².

The figure of 12 W/m² is probably an overestimate for many locations in Britain. For example, figure 4.1 shows daily average windspeeds in Cambridge, during 2008. The daily average speed reached 9 m/s on only about 30 days of the year. An area of 1 ha is a square hectometre. But some squares have windspeeds about 6 m/s. For example, the average of Cambridgeshire for 2009.

Farming the British population density: 250 people per square kilometre = 400 square metre per person, we find that wind power could contribute about 6000 kWh per ton finished steel.