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KEEPING THE LIGHTS ON

Towards Sustainable Electricity

Walt Patterson



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KEEPING THE LIGHTS ON

PREFACE

This is not the book I thought I was going to write. In the autumn of 1998, when I completed my book *Transforming Electricity* and delivered it to the publishers, the next stage of the work appeared to be straightforward. It would be a follow-up book called *Keeping The Lights On: Public Service in Liberalized Electricity*. In mid-1999 Chatham House published my briefing paper entitled *Can Public Service Survive The Market?: Issues For Liberalized Electricity*. It asked whether electricity could be at once liberalized and reliable, liberalized and universal, liberalized and sustainable. The answers, however, were far from obvious. Worse still, the questions too expanded with alarming speed. The longer I analysed them the more difficult they became. I soon realized that I did not understand either the questions or the answers well enough to produce a book I'd want my name on.

Meanwhile, as my colleagues at Chatham House waited patiently, electricity issues were evolving at a breakneck pace. Electricity decision-makers, swept along by events, seemed unlikely to take time to read an entire book. Instead I drafted a succession of shorter pieces, partly to disentangle the issues for myself and partly because shorter pieces, published immediately on the Chatham House website, might actually find readers. Every now and then I tried again to pull the analysis together into book form; but it was still too fuzzy.

Then, in 2005, to the astonishment and bemusement of many, nuclear power re-entered the policy agenda. Politicians, journalists and even environmentalists, knowing no history, listened to nuclear promoters and accepted recycled arguments that had been comprehensively demolished two decades earlier. The thought of starting the whole debate all over again numbed my brain. But my wife Cleone took a more practical view. She pointed out that I had devoted the 1970s and 1980s to an exhaustive refutation of the purported case for nuclear power – that the necessary evidence was right there on my study shelves. Within a few weeks she had scanned and digitized four books and a lengthening catalogue of other material. In February 2006 we launched a website archive of some 35 years of work – Walt Patterson On Energy, www.waltpatterson.org. The website archive included extensive

commentary on nuclear issues, some dating back to the 1970s, still often dismayingly valid, indeed more so. By the end of 2006 it had received well over 100,000 hits, from more than 60 countries. But the site also included a sequence of analyses and presentations on energy and electricity in society, with what seemed to me profound implications for reliable, equitable and sustainable services. The successive pieces tracked my evolving understanding from first principles into some fascinating, radical and exhilarating territory.

Surveying the growing archive, I realized that I could now present the entire narrative between two covers, telling a coherent story I could call *Keeping The Lights On: Towards Sustainable Electricity*. That is what you are now holding. I hope it makes as much sense to you as it does to me. If it does, please help us to make sure our decision-makers hear about it. As we grapple worldwide with looming threats to climate and energy security, we don't have much time to get this right.

Walt Patterson
Chesham Bois, Buckinghamshire
January 2007

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My colleagues at Chatham House in London have been very patient. During the gestation of *Keeping The Lights On* I went from being senior research fellow to retirement to associate fellow, in what was the Energy and Environment Programme, became the Sustainable Development Programme and is now the Energy, Environment and Development Programme, a span of more than seven years. I am grateful not only for their forbearance but for their support and encouragement. My thanks in particular go to Head of Publications Margaret May, to Programme Heads Duncan Brack and Richard Tarasofsky, to senior research fellow Valerie Marcel and to Programme staff Lorraine Howe, Gemma Green and Inge Woudstra-van Grondelle, who never once asked me, as they well could have, 'Are you ever actually going to write this book?'

Jonathan Sinclair Wilson and Tamsine Green of Earthscan gave me the opportunity to pull the story together and put it between two covers, my first-ever title not only in hardcovers but with a dust jacket; my warmest thanks to them both, and to Bob Faherty of the Brookings Institution, the US distributor.

Many colleagues around the world, some listed in Annex 4, 'Further Information', are now engaged in developing these exciting ideas. I'm grateful for the stimulation and insights they are providing. In particular, to Keith Barnham, Bill Frost and Becky Willis, who read drafts and offered valuable comments, my thanks.

Putting together our website Walt Patterson On Energy, www.waltpatterson.org, provided the impetus to prepare the book you're now holding. GreenNet, www.gn.apc.org, our long-time hosts for email and internet access, made the website almost effortless. For their unfailing support and cheerful reliability we thank them heartily, and recommend their services without reservation.

My long-time assistant Karen Lawther continues to keep me from disappearing under source material – my warmest thanks to her.

My family learned at last that when I wander about the house with a furrowed brow, ignoring them and bumping into things, I'm not angry or sulking – I'm writing. They put up with my lowering presence with

remarkably good grace. Their endless forbearance, staunch support and buoyant companionship is my astonishing good fortune. To our delightful daughters Perdy and Tabby, and to my beloved Cleone, my gratitude and my love.

To Cleone, who lights up my life

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Introduction

TOWARDS SUSTAINABLE ELECTRICITY

Electricity should be easy. Of all the urgent energy issues we face world-wide, electricity offers the richest possibilities. Yet we seem determined to choose the toughest, the slowest, the riskiest. Can't we do better at keeping the lights on?

The answer of course is yes. But we need to understand what we're doing. What we think we know about electricity is now obsolete and dangerous. What we need to know is still emerging, disconcerting but exciting. This book tries to show how our understanding might evolve. Starting from everyday experience, challenging traditional assumptions, it proposes an innovative approach that offers us abundant opportunities to upgrade our use of energy, especially electricity.

Part 1 sets the stage. It describes what we mean by 'energy', what we might mean by 'sustainable energy', and how we might go about 'Making Energy Sustainable'. 'Making the World Work' discusses what we want from energy, how we get it, and how we might do it better. 'The Energy Dilemma' revisits the reasons why this matters. 'Rethinking Energy' offers a starting point.

Part 2 sharpens the focus, from energy in general to the particular form of energy we call electricity. It shows how readily we might go about 'Making Electricity Sustainable'. 'Full Circle' suggests we might start by recalling Thomas Edison's original business plan. 'The Electric Challenge', 'Generating Change' and 'Networking Change' explore the implications for electricity systems, generation and networks. 'Decentralizing Networks' pursues a key theme in more detail.

'Getting the Story Right' proposes a new narrative for electricity, more accurate and more useful than the traditional story we've been telling for a century. 'Getting Energy Right' reiterates key ideas for emphasis and takes them further, showing how getting electricity right might help us to tackle broader energy issues, including energy security

and climate change. 'Sustainable Electricity: Changing Minds' describes how we can start making electricity sustainable by changing the way we think about it.

Annex 1, 'Running the Planet', surveys the larger context within which we live. Annex 2, 'Discussing Energy: A Style Guide', is a guide to how we talk about it, how we get it wrong and how we could get it right. Annex 3 is a glossary of terms used in this book, from electric jargon to the many generating technologies now available. Annex 4 points to further information.

Transforming electricity will not be easy. But it will be essential, and profitable. It will be a key to energy security and climate security. If we do it right it might even be fun.

Part I

MAKING ENERGY SUSTAINABLE

MAKING THE WORLD WORK

This is embarrassing. Many years ago I wrote a book called *Energy and Purpose*. ‘Purpose’ meant ‘what we humans want from energy, and how we try to get it’. A reputable publisher gave me a modest advance. I worked on the book for two years, eventually accumulating about 100,000 words of text. But the longer I worked on it the less I liked it. I finally had to confess to myself that I didn’t know what I was talking about. I didn’t understand enough about energy and purpose to say anything really useful or persuasive. I gave the publisher back the advance, piled the typescript in a cardboard box and stashed it in the archive, along with the unpublished novel, the unpublished textbook and the unproduced musical.

In the coming pages I am returning to the scene of my failure so long ago, to write again about energy and purpose – what we humans want from energy, whether we can get it and, if so, how. I have an alarming sense of *déjà vu*, knowing I have been here before, and wondering whether I can do any better this time. Wish me luck.

Why write about energy and purpose? The short answer is that we’re making a mess of it. The world isn’t working well enough. More than two billion people, one-third of humanity, have no access to the kinds of energy benefits the rest of us take for granted; and the proportion of ‘energy have-nots’ is increasing, not decreasing. Worse still, the key fuels and energy technologies of the ‘energy haves’, like us – fossil fuels, large dams, nuclear power – all face problems that look insuperable. Worst of all, doing what we do with energy is disrupting the climate of our only planet. If that doesn’t worry you, it should.

What do *you* want from energy? You probably never thought about it. That’s as it should be. Almost everything you get from energy you

get without even noticing. It doesn't involve a meter; you don't get billed for it. You get surroundings whose temperature mostly stays within limits your body can tolerate. You get sunlight processed by green plants, which store up the solar energy in a form you can eventually eat, for your muscles to use. As a by-product from the green plants you get the oxygen you breathe to process the food; and so on. You are immersed in, indeed you are a part of, natural energy systems of astonishing complexity and variety; and you take them all for granted.

You are also, however, immersed in energy processes that you yourself, and other people, initiate and control – what we can call human energy systems. Some you take for granted as completely as you take natural energy systems for granted. You probably can't remember the last time you turned on a light. Some human energy systems you notice, at least some of the time, particularly when they fail. When you turn the key in the ignition, or flip the light switch, and nothing happens, you notice. You also notice when you get a bill. That may be part of the problem. In the past three decades we have come to think of energy as something you get a bill for. That must change.

Using energy

Start with this word 'energy'. When you think of energy, you probably think of oil, coal, natural gas, electricity. You shouldn't. The language we now use to talk about energy is not just wrong – it's actively misleading. If we can't even describe the issues and options correctly we'll never get the policy right. How many times have you heard or read some energy specialist refer to 'energy production' or 'energy consumption'? These people are supposed to be experts. Surely they ought to know one unbreakable law, the First Law of Thermodynamics, the law of conservation of energy. *No one* produces energy. *No one* consumes energy. The amount of energy in *the whole universe* remains the same. That's what makes energy such a valuable and important concept to understand how the world works. We don't have to conserve energy. Nature does it for us.

Why, then, do we talk this way? The answer is simple. When we talk about energy production, energy consumption and energy conservation, we don't mean 'energy'. We mean 'energy carriers' – that is, fuels and electricity. The confusion dates back less than 40 years. Until the

early 1970s governments had ‘fuel policy’. They had Ministries of Fuel, or perhaps of Fuel and Power – ‘power’ meaning electricity. Then, in October 1973, the Organization of Petroleum Exporting Countries (OPEC) suddenly quadrupled the world price of oil, plunging the world into a panic. Governments everywhere launched a frenzied search for a ‘substitute’ for oil. Within weeks all the different fuels, plus electricity, were swept together and called ‘energy’, as if they were all potential substitutes for one another, all more or less interchangeable. ‘Fuel policy’ became ‘energy policy’. Governments exhorted their citizens to ‘conserve energy’. Ministries of Fuel became Departments of Energy. Oil companies, coal companies, gas companies and electricity companies all became ‘energy companies’. In the UK the Institute of Fuel became the Institute of Energy; much the same happened all over the world.

But of course everyone knows that specialists talking about ‘energy’ really mean ‘energy carriers’ – oil, coal, natural gas, electricity. Lumping them all together and calling them ‘energy’ is just a convenient shorthand. Does this quirk of language really matter? Yes, it does. It distorts our understanding of what we are actually doing with energy; that is, ‘energy’, not ‘fuels and electricity’. Worse still, this misleading language obscures crucial options we now have, ways for us to use energy much better.

Note that phrase, ‘using’ energy. That’s what we do with energy. We don’t consume it, we use it. Humans have been using energy on purpose since long before the beginning of recorded history. Our human ancestors began using energy by intervening intentionally in natural energy flows, or what we can call ‘ambient energy’ – energy that is there for us to use, with no meter and no bills to pay. The first ‘energy technologies’ that our human ancestors hit upon were clothing and shelter. In cold weather, clothing reduces the loss of heat energy from your body; in hot weather, it protects you from too much solar energy. Shelter provides an enclosed space, reducing energy flows and keeping the temperature inside more stable than that outside; inside the shelter you are more comfortable. You may not usually think of clothing and shelter as energy technologies. But if you really want to understand how we humans use energy, clothing and shelter are fundamental. Note, too, that clothing and shelter are physical materials. You don’t measure or pay for the energy flows involved. The clothing and the shelter manage the energy flows for you.