

A Renewable World

Introduction and executive summary

It's time for the human race to enter the solar system.
– Dan Quayle

The living planet we inhabit has effectively become a *disposable* world. We have been using resources as though there were no tomorrow. We have been dumping our wastes in the air, on land and in the sea, with little concern about the consequences. We have been living off nature's *capital* rather than its annual *income*. It is time to take the right steps to make it a *renewable world*.

In this book we are trying to address a number of urgent issues in a holistic way, acknowledging that those alive today have a greater responsibility to future life than any generation before – because of our unprecedented numbers and the enormous global impacts of our ubiquitous uses of energy and technology. These issues prompt questions such as:

- **How can we decarbonize the global economy by implementing enabling policies and business practices as well as changes in personal behaviour patterns?**
- **How can we make clean, efficient, renewable and decentralized energy the basis for a new, sustainable global economy?**
- **How can we prevent run-away climate change, assure secure livelihoods for all, and restore the world's natural life-support systems?**

In recent years climate change has received much international attention. Al Gore, Nicholas Stern and the Intergovernmental Panel on Climate Change (IPCC) have all told us about the urgent need to minimize carbon *emissions*. But now leading climate researchers such as Jim

Hansen are saying that the challenge is no longer just to reduce annual carbon emissions, but to reduce their actual *concentrations* in the atmosphere.

The evidence of the 'earth emergency' facing us, that has presented itself clearly in recent years, is simply too compelling to ignore. This is a time for bold thinking, about doing everything possible to build a new, positive and sustainable relationship between people and planet.

In this book we have attempted to draw together strands of thought and action to indicate that *another world is possible*. The good news is that in recent years the earth has acquired a sort of nervous system, with millions of people on every continent seeking to share knowledge about ways of dealing with the climate crisis and other urgent matters. As scientists link up with journalists and NGOs, and as politicians and business leaders are presented with the evidence, new options for creating a renewable world are emerging.

The primary focus of this book is on turning the quadruple crisis facing us – of climate, energy, finance and poverty – into an opportunity for building a new, global green energy economy, and for renewing the earth's living systems. This is closely linked to improving the environmental performance of our cities – now the primary human habitat – and to a dramatic increase in the use of renewable energy. It is a book about turning vision into practical reality.

The overarching theme of this book is to clearly define climate stabilization as a fundamental necessity for long-term human security, and also as an opportunity for creating a more just, peaceful and sustainable world for present and future generations.

First and foremost, we seek to sketch out what measures are necessary, what is actually possible today, and beyond this, how we can extend the boundaries of what is politically,

economically and culturally feasible to achieve the desired outcomes.

Dealing with climate change – and its environmental, economic and social consequences – is the greatest challenge for human security in the 21st century – especially when one takes into account tackling poverty and truly sustainable development at the same time. There has been a great deal of research and much recent publicity about the huge problems facing us, but plausible proposals on how to deal with these are, so far, woefully inadequate. A few reports have given some indication about what can actually be done about climate change, but very little has so far been written about *how* the necessary changes can be brought about. This book deals with its chosen subject as an ethical problem that needs to be addressed on behalf of future generations, as well as those alive today.

Chapter 1 – Energy Change, Climate Change

For hundreds of thousands of years relatively small numbers of humans led a relatively modest existence on Planet Earth, using only the renewable energy income available to them. The tools they used for supplying their necessities were limited in scope. Then, 300 years ago, the industrial revolution changed everything. For the first time, people were able to exploit the rich stores of subterranean fossil fuels that had accumulated over some 300 million years. The exponential growth of human power, human numbers, and economic and urban development that resulted, and the impacts of the ever-greater range of human activities, qualitatively changed the human presence on earth.

At the start of the 21st century, we are burning the earth's fossil-fuel deposits at the rate of some two million years' worth every year.

Until recently, air pollution in the form of urban smog and acid rain has been treated as a local or regional problem, and carbon dioxide was not even regarded as a pollutant.

Now the transfer of carbon from the earth's crust into the atmosphere, combined with a pronounced reduction in the earth's vegetation cover and the carbon content of the world's soils, is known to significantly contribute to climate change. Thousands of scientists across the world have been piecing together an increasingly irrefutable case that climate change is an immediate threat.

The process of fossil-fuel combustion has recently been accelerating rapidly as industrial and urban development has spread across the planet. To deal with the increased combustion of fossil fuels, and to stop the earth from becoming an uninhabitable planet, all kinds of technical options are being proposed, such as Carbon Capture and Storage (CCS) or geological sequestration of carbon dioxide in underground caverns. Whilst this may succeed in a few places, there is little evidence that it can be made to work effectively or cost-efficiently for the thousands of power stations that already exist or that are being planned.

Chapter 2 – Carbon and the Biosphere

The main argument of Chapter 2 is that carbon dioxide should be regarded not simply as a *bad*, to be stored underground out of harm's way, but that it can be turned into a *good*, for the benefit of both the biosphere and humanity. Life is carbon-based, and instead of trying to sequester it by technical means, can we do so by biological means? Instead of geosequestration, major biosequestration initiatives are needed. This means improving the condition of soils, forests and aquatic vegetation to absorb carbon dioxide. Some of



these measures will have the additional benefit of protecting watersheds, enhancing biodiversity and countering soil erosion and desertification.

Conservation of forests needs to be put on a new footing by supporting rural communities to protect forests rather than to allow them to deteriorate. In addition, large-scale reforestation initiatives are urgently required. An impressive start has been made by the Billion Tree Programme initiated by UNEP and Kenya's Green Belt movement, but much more needs to be done. Adequate funding also needs to be provided to assure substantial efforts to restore carbon-depleted soils. To this purpose, biochar – charcoal made from waste organic matter – can be incorporated in soils for long-term carbon storage for the benefit of local communities as well as the stability of the world's climate.

In this context, modern food production needs to be closely scrutinized. Our food supplies are extraordinarily dependent on huge inputs of fossil fuels, artificial fertilizers and pesticides. At least 10 times more fossil-fuel energy goes into modern food production than is contained in the calorific content of the food we buy in the shops. As an additional problem, the transfer of ever-larger amounts of food from rural areas to cities has led to the depletion of carbon from the world's farmland. This trend urgently needs to be reversed.

The carbon-storage potential of healthy soils is very significant indeed. Large-scale soil sequestration of carbon is very cost-effective and could take effect very quickly. We discuss how rural populations across the world could benefit by becoming carbon stewards. Support for sustainable farming practices that enhance the potential for soils to sequester from the atmosphere in large quantities must now be given very serious consideration.

Chapter 3 – Renewable Energy

As we were writing this book, we could hardly keep up with announcements about new policy initiatives on renewable energy and on new technical breakthroughs in renewable energy technologies and energy storage. As the development of renewable energy and supporting technologies is accelerated, it seems entirely feasible for us to wean ourselves off our systemic dependence on fossil fuels.

In Europe, wherever forward-looking policies such as Feed-In Tariffs (FITs) have been introduced, the scale of the creation of new jobs and businesses has been astounding. Renewables have had a transformative effect on the economies of countries such as Germany, Spain and Portugal. There, very rapid renewable energy development – encouraged by appropriate government policies – has become a spur to technological innovation that, in turn, increases the plausibility of renewables becoming the basis for future human endeavour.

Germany: having a FIT

- **280,000 jobs created, €30 bn turnover for renewable energy companies, €8.7bn investment per year**
- **€4.3 billion of fuel imports saved**
- **117 million tonnes of CO₂ saved**
- **Eco-benefit: €5.40 less environmental damage per household/month**
- **Total cost: €3.10 per household/month**
- **15% share of electricity consumption**
- **At current growth rates, renewables will provide 40% of electricity by 2020 and 100% by 2050**

Supplying the bulk of humanity's energy needs entirely from renewable energy is becoming a plausible prospect: living in a world where we can switch on a low-voltage light or drive an electric car without being complicit in warming the planet; where we are no longer tempted to start international conflicts to secure oil and gas supplies; where future generations no longer have to depend on electricity supplies from nuclear and coal power plants.

We introduce the concept of energy subsidiarity, aiming to supply as much renewable energy from local and regional sources as possible. Whilst the technical feasibility of electricity 'supergrids' – linking countries and even continents together – has been proved, the question whether such a scheme is also socially and economically desirable needs to be discussed.

It is becoming increasingly clear that the switch to renewables is ultimately dependent on political decision-making, and pressure from the general public can make all the difference. Citizen and community participation in energy production must in turn be facilitated by government policy and new business models.

"One of, I think, the most important infrastructure projects that we need is a whole new electricity grid. Because if we're going to be serious about renewable energy, I want to be able to get wind power from North Dakota to population centers like Chicago. And we're going to have to have a smart grid if we want to use plug-in hybrids, then we want to be able to have ordinary consumers sell back the electricity that's generated from those car batteries, back into the grid. That can create 5 million new jobs, just in new energy."

– President Barack Obama

Chapter 4 – Towards Energy Equality

Ever since the Earth Summit in Rio de Janeiro in 1992, sustainable development has been a key concept for creating a viable future for humanity on a finite planet. But in reality not very much has happened. The simple reason for this is that industrial and urban development as we know is fossil-fuel dependent. So far only minimal efforts have been made to power such development by renewable energy systems instead.

Energy equality means a new balance between the energy consumption patterns of countries across the world, prioritizing supplies from renewable energy technologies. Ways must be found for developing countries to reach parity in the 'reasonable use' of energy, and even to leapfrog renewable energy development in the rich countries.

The Clean Development Mechanism (CDM) under the Kyoto Protocol was intended to offer developing countries the tools to overcome energy inequality. The CDM aims to promote RE through the exchange of technology, finance and knowledge for emissions reduction units. But so far, the reality has not matched the expectations. Good examples from different parts of the world are now urgently needed, showing how development can be powered by renewable energy. Simpler and more cost-effective solar technologies are being developed, and this could make a huge impact in developing countries.

Grameen Shakti in Bangladesh now supports deployment of many RE technologies, including PV, wind, biogas and cooking stoves. It enables rural people to improve their quality of life while also allowing them to take part in income-generating activities. These approaches are now being spread to other developing countries.

President Mohamed Nasheed of the Maldives announced in March 2009 that they aim to



become the first nation in the world to become fully carbon neutral. As a low-lying island nation, the Maldives could be among the first to drown if sea levels rise as predicted. This threat has concentrated the President's mind, and he argues that the cost of powering his country with renewable energy would roughly equal the amount they spend on importing fossil fuels over ten years.

The road to energy equality between rich and poor countries may continue to be a long, arduous and contested one, but the establishment of the International Renewable Energy Agency headquarters in Abu Dhabi could signal a major acceleration in the journey.

Chapter 5 – Energy Sufficiency

Maximum energy efficiency is crucial in a world demanding ever-greater energy supplies. Efficient technologies and processes will deliver the same amount of services with a lower input of energy resources. Besides behavioural changes, increases in energy productivity can achieve such savings.

Increasing energy efficiency in buildings, in the transport sector and in production requires that efficiency standards, financial incentives and regulations are introduced for replacing inefficient practices. Government agencies should take the lead in this by adapting appropriate public procurement policies.

Assuring people's wellbeing across the world, whilst defining limits to the use of non-renewable energy, is one of the great challenges ahead of us. Whilst energy efficiency measures are necessary first steps, there also has to be an actual upper limit of global per capita fossil-fuel use. We argue that the concept of energy sufficiency needs to be applied across the world if we wish to prevent runaway climate change. A clear understanding of energy sufficiency is crucial for the long-term

ecological viability of the global economy.

Limiting total energy use per person will be a critical goal in any future energy scenario. In Switzerland the idea of the 2000-Watt Society has been mooted. 2,000 watts corresponds to the average consumption of Swiss citizens in 1960 and is approximately the current world average. It compares to around 6,000 watts in Western Europe, 12,000 watts in the United States, 1,500 watts in China, 1,000 watts in India and only 300 watts in Bangladesh.

Energy Descent is a term that is used in this context – we will have to start reducing the number of 'energy slaves' working for us, which will require significant changes in our habits. But gains in quality of life may emerge from this energy descent – life will become less hectic, there can be more personal contacts, more walking, less driving, better air quality and less noise.

Chapter 6 – The Green-Collar Economy

'Green-collar jobs' are becoming a major plank of economic policy in many countries. These new jobs allow society to focus equally on protecting the environment and future-proofing the economy. The transition to a low-carbon, 'circular' economy will deliver many employment opportunities, bringing environmental protection into the daily lives of many more people than at present. The greening of existing jobs and the creation of many new green jobs is already a multi-billion dollar global reality.

The green jobs agenda is one of the most important in the environmental and social justice movements. It unites people with responsibility and opportunity. Green-collar jobs can cover many sectors, from low to high skill levels. They are not necessarily brand new types of jobs, but can be 'greener' versions of

existing job types, such as in research and development, or in manufacturing and agriculture, with associated support staff and service sector positions. These jobs are all directly associated with addressing the vast panoply of environmental issues around the world, including food, water, ecosystems, energy, manufacturing, transport, buildings and waste.

Over the past three decades, several European countries have been quietly moving ahead with a transition in their economies, mainly in renewables and energy efficiency. Studies come mostly from Germany, which has forged ahead in these areas, but countries such as Denmark and Sweden have excelled in introducing renewable energy generation, insulation, heating and more efficient building design, as well as reducing urban transport and increasing recycling rates.

Green-collar jobs have recently become a major issue in US politics, as the nation attempts to address its environmental, economic and financial crises. While they had been held back for many years, the focus on green jobs is increasing due to efforts by state and municipal governments, non-profit initiatives, trade unions and social partnerships. The fact that the US administration has identified the 'green-collar economy' as a key for restarting stalled industrial production, re-visioning failing industries, securing energy supplies and protecting the environment, is an important signal that is now being heard globally.

Chapter 7 – Renewing the City

In many towns and cities around the world a renewable energy revolution is underway. For many, the aim is a 100 percent renewable energy supply from within the city region.

The last 300 years have seen the growth of ever-larger cities – there are now 20 cities of

over ten million people and hundreds over two million. Large modern cities are perhaps the primary products of fossil-fuel technologies. Such vast urban structures depend on a continuous supply of energy – for powering high-rise city centres and low-density sprawling suburbs, as centres of production, consumption, services, transportation and communication.

On just three to four percent of the world's land surface, and with half its population, cities consume around 80 percent of global energy supply and emit the bulk of greenhouse gases. What will it take for our existing modern cities to exist sustainably and to be powered by renewable energy systems instead?

City administrations across the 'developed world' are becoming increasingly aware that the cities in their charge are primary contributors to – and potentially primary victims of – global climate change, because many are located in coastal regions vulnerable to rising sea levels, or in river valleys prone to flooding, or are vulnerable to loss of water supply. Therefore in an urbanizing world, sustainable development must, above all else, mean sustainable urban development. Most cities are here to stay, but they must fundamentally change their energy supply systems. The 'Solar City,' powered 100 percent by renewable energy, must be top of the agenda in an age increasingly defined by climate change.

Understanding cities as dynamic and ever-evolving eco-technical systems can help us formulate strategies for a sustainable urban future. For their long-term viability we would be well advised to model our cities on the functioning of nature's own highly complex ecosystems, such as forests or coral reefs, in which every output discharged by an organism becomes an input that renews and sustains the continuity of the whole.



Developing environmentally sustainable cities is one of humanity's greatest challenges for the new millennium. Across the world, a revolution in 'future-proofing' our urban systems has started, assuring high levels of energy efficiency and rapidly switching to renewable energy technology.

Sustainable City Principles

- Compact urban development
- Renewables as primary energy supply
- Small ecological footprint
- 'Circular urban metabolism'
- Biodiversity in landscape design
- A city embedded in farmland

Chapter 8 – From Global to Local?

Industrialization and globalization have created many things, and increasing dependency on forces beyond our control is one of them. The view that local economic resilience is a desirable goal has been strengthened by the recent international financial upheavals. A profound sense of insecurity has come to affect many people. This new kind of 'insecuritization' has triggered a search for alternatives, including increased localization.

People involved in this burgeoning movement start by pointing out the social benefits. They speak of a better sense of community spirit, of empowerment, of meaningful relationships, of neighbourhood living. A great priority is the urge to reduce the daily, routine dependence on fossil fuels, but can this be achieved without having to 'give things up'? Options for 'energy descent', local resilience and richer community living are all on offer here, but not by creating hermetically

sealed neighbourhoods cut off from the rest of the world.

The introduction of many regional currencies offers a pragmatic way of establishing an alternative form of globalization. As the world experiences financial and economic upheavals, peak oil and the dangers of climate change at the same time, smaller-scale solutions look increasingly plausible. The development of regions as economic units may present one of the most successful ways of moving toward another form of globalization, and the introduction of its own currencies can strengthen this development.

In the UK the rapidly growing 'Transition Movement' sees the move towards more localized approaches as being an inevitable change. It is not so much 'Small is Beautiful' but 'Small is Inevitable,' a transition from a time when economic success and personal prowess depended entirely on our degree of oil consumption, to one where our degree of dependency is also our degree of vulnerability. But it is a transition that will not be successful without an extraordinary level of co-ordination, community spirit, creativity and determination.

Chapter 9 – Problem Technologies

Any arguments for or against the nuclear question will be immediately and absolutely countered by the other side. Nuclear energy is now, above all else, being sold as a low-carbon technology. Decisions around replacement and/or expansion of existing nuclear facilities are likely to follow the traditional pattern of dominant interests seeking all avenues to advance their agenda, while an infinitely poorer, decentralized opposition will seek to stop it in its tracks.

In the UK and the US the links between government and the nuclear industry are very close. This "friends in high places" strategy by

the nuclear industry is one of the most troubling aspects of the issue; it could be considered undemocratic and does nothing to develop trust in the industry. It also serves to underline that it is not necessarily a matter of what makes sense in terms of energy investment and planning for the future, but of who has the power to decisively influence government policy in their favour.

The future for nuclear energy has rarely looked rosy, but fast-changing circumstances and the financial and economic crisis could see it stranded by a lack of taxpayer's money to guarantee its development. The pro-renewables side would surely see this as the time to finally get serious about truly 'clean' energy.

Nuclear energy is not the only controversial technology. Biofuels were hailed as a vital

option for the future until it became apparent that there is direct competition for land that is needed to produce food for a rapidly growing world population. Second generation biofuels, which depend on crop and forestry wastes, look more plausible, but the jury is still out on what role they will ultimately play. Algae biofuels, now the subject of enormous investment by the oil giant Exxon, appear to offer a more sustainable option yet.

Chapter 10 – Thinking Deeper, Going Further

Prevailing economic theory views the earth as an infinite resource which can be exploited and polluted at zero cost. But this view has become untenable. The global economy is unprecedented in scale, but the damage to the atmosphere or the loss of ecosystem services



Credit: Herbert Girardet. Children and future generations must be accounted for in national and international policy making.

may ultimately cost us more than its entire output.

Having grown up in a fossil-fuel dependent world, most of us understandably find it hard to imagine complex societies organized in very different ways. There is no doubt now that we need a revolution in the way we live and the way we invest. The global financial crisis offers a unique opportunity to transition to a low-carbon, resource-efficient and socially sustainable economy, incorporating sustainability and social responsibility measures into short-term economic recovery measures, and longer-term reform of the credit and investment markets.

Some commentators say that it is too late to 'turn the ship around', that we are inevitably headed for the rocks. It is true that we are currently living off the earth's natural capital and that we are, therefore, living on borrowed time. But the growing realization of this has also become a spur for action, imagination and the realization that we *can* create a renewable world, but that it is up to *all* of us to make this a reality.

To extend the way of life currently practised in the developed countries to the rest of the world would require three planets. Let us be clear: it is quite difficult to make new inhabitable planets, and transferring humans to them in large numbers is a misguided illusion. Even if a few daredevil astronauts might try a trip to Mars at some point, it will be no more than a fleeting visit.

There is now a great deal of evidence that a combination of feed-in tariffs, green taxes, local trade and exchange, green consumerism and conscious investing can redirect very large amounts of money towards creating a sustainable world. It will be a major contribution to the historic challenge of (re)directing adequate money flows towards:

- **the regeneration of the world's ecosystems in the face of climate change, and**
- **the vigorous development of an efficient and sustainable energy system for the world.**

International cooperation and connectedness is going to be vital, more than ever, in meeting these challenges. A local-only strategy has no hope of reforming the global energy, food, trade and financial systems. All sectors of society, all governments and all businesses will need to find ways of working together towards some clear common goals. There is simply too much at stake to leave it to purely market forces, or purely person action, or government regulation alone.

This book is seeking to show that we can renew our world, despite many of the grim developments of the last few centuries, and particularly of recent years. It is an essential part of the World Future Council's Climate and Energy Campaign, but it is equally relevant for all policymakers, organizations and individuals who want to influence real action on climate and energy, and biosphere restoration. If it achieves this aim it will make a useful contribution to the cause of sustainable development across the world.

*Herbert Girardet and Miguel Mendonca,
July 2009*



Credit: Herbert Girardet. Kayapo mother and baby. It is our duty to guard the future of this new child, and that of all children. This means assuring the continuous renewal of the biosphere, and our lifestyles within it, rather than the continuing devastation of the world's ecosystems.



Acronyms and abbreviations

1G	first generation
2G	second generation
3G	third generation
ANU	Australian National University
ASES	American Solar Energy Society
AusAID	Australian Agency for International Development
BRT	bus rapid transit
CCS	carbon capture and storage
CDM	clean development mechanism
CERT	carbon emission reduction target
CtL	coal-to-liquids
DFID	Department for International Development
DMF	2,5-dimethylfuran
DSO	Distribution System Operator
EDF	Électricité de France
EE	energy efficiency
EEG	Erneuerbare-Energien-Gesetz (Renewable Energy Sources Act)
ESCO	energy services company
EU	European Union
FIT	feed-in tariff
GDP	gross domestic product
GEF	Global Environment Facility
GM	General Motors
GNP	gross national product
GHG	greenhouse gas
Gt	gigatonnes
GTC	Grameen Technology Centre
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH
GW	gigawatt
HVDC	high voltage direct current
ICS	improved cook stove
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producers
JRC	The Joint Research Centre of the European Commission
km	kilometres
kWh	kilowatt hour
LPG	liquefied petroleum gas
MDG	millennium development goal
MIT	Massachusetts Institute of Technology

Mt	megatonnes
NASA	National Aeronautics and Space Administration
NGO	non-governmental organization
ODA	official development assistance
PPA	power purchase agreements
PV	photovoltaic
R&D	research and development
RE	renewable energy
REEEP	Renewable Energy and Energy Efficiency Partnership
REP	renewable energy payment
RESCO	rural energy service company
RMI	Rocky Mountain Institute
REDD	Reducing Emissions from Deforestation and Forest Degradation
SCAD	Social Change and Development
SEFI	Sustainable Energy Finance Initiative
SHS	solar home system
SOC	soil organic carbon
TCW	The Converging World
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UK	United Kingdom
US	United States
USA	United States of America
USSR	Union of Soviet Socialist Republics
WBCSD	World Business Council for Sustainable Development
WFC	World Future Council
WHO	World Health Organization
WIREC	Washington International Renewable Energy Conference



