

The background of the entire cover is a bright yellow sunburst pattern with rays radiating from the center. The rays are of varying lengths and thicknesses, creating a dynamic, energetic feel. The text is overlaid on this pattern.

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THE RENEWABLE REVOLUTION

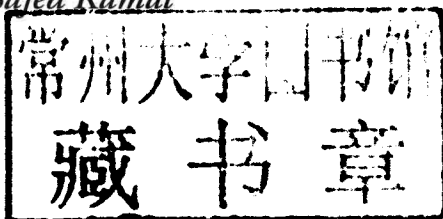
HOW WE CAN FIGHT CLIMATE CHANGE, PREVENT ENERGY WARS,
REVITALIZE THE ECONOMY AND TRANSITION TO A SUSTAINABLE FUTURE

SAJED KAMAL

The Renewable Revolution

How We Can Fight Climate Change,
Prevent Energy Wars, Revitalize the Economy
and Transition to a Sustainable Future

Sajed Kamal



earthscan

publishing for a sustainable future

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Endorsements for *The Renewable Revolution* by Sajed Kamal

‘Sajed Kamal’s book is an immensely important contribution to our understanding of what is happening to our planet and what we can do about it. He combines the careful research of the scientist with the passionate imagination of the poet. I hope *The Renewable Revolution* will be widely read.’

Howard Zinn

Author of *A People’s History of the United States* and
You Can’t Be Neutral on a Moving Train

‘In this book, Sajed Kamal reminds us what we intuitively know – that we must make the transition toward renewable energy as soon as is humanly possible, that continuing to rely on fossil fuel poisons our world with every hour that passes. Even more powerfully, though, he reminds us how possible that transition is. Equally competent with a spreadsheet and a bank of batteries, Kamal is the navigator we need to sail with confidence into this new century.’

Bill McKibben

Founder, 350.org. Author of *The End of Nature*, *The Age of Missing Information* and
Fight Global Warming Now: The Handbook for Taking Action in Your Community

‘Dr Kamal lives and writes a vision. It is a vision of reconciliation between humanity and the planet – a reconciliation that is accomplished through the medium of energy – natural energy, spiritual energy, clean energy. In plumbing the implications of solar technology for our survival, Dr Kamal has identified the transcendent nature of that technology. Solar energy, he reveals, is far more than a simple source of electricity and warmth. It provides an elemental bridge between a history which has been based on depletion and exploitation and a future which, if it is to exist at all, must be based on balance, renewal and a most practical harmony with our species’ home.’

Ross Gelbspan

Pulitzer journalist. Author of *The Heat Is On: The Climate Crisis, The Cover-Up, The Prescription* and *Boiling Point: How Politicians, Big Oil and Coal, Journalists and Activists are Fueling the Climate Crisis – And What We Can Do to Avert Disaster*

‘The great value in this book is the picture it conveys of renewable energy today: the long sought transition is no longer a hope for the future, it is already underway. This is a fine survey of the many applications of solar technologies.’

Howard Ris

President, Union of Concerned Scientists (1981–2003)

‘An important tale that has to be told and Dr Kamal tells it with the passion and precision that’s needed. But *The Renewable Revolution* is more than a message – solutions are offered and it’s our job to follow the solar course so elegantly set for us.’

Jane Weissman

Executive Director, Interstate Renewable Energy Council. Former Chairperson, Policy Committee and Board Member, American Solar Energy Society

'*The Renewable Revolution* is an excellent treatise on the practical use of renewable energy. Sajed Kamal has not only pleaded for the worldwide use of renewable energy, but also proven its practical utility in supplying energy to promote sustainable development of communities. He has proven with illustrations, many from his own experiences, that harnessing renewable energy is not only environmentally sound, but also economically viable and socially acceptable.'

Kazi F. Jalal, PhD (Harvard)

Faculty, Harvard University Extension School Environmental Studies Program.

Former Chief, United Nations-Economic and Social Commission for Asia and Pacific (UN-ESCAP). Former Chief, Office of Environment and Social Development of the Asian Development Bank (ADB). Co-author of *Introduction to Sustainable Development*

'In the face of the growing reality of climate change and its devastating worldwide consequences we need solutions. An urgent transition to the renewable energy path is fundamental in that solutions mix. *The Renewable Revolution*, an exceptional combination of scholarship, personal experience and inspiring examples, charts the path. This comprehensive and highly readable book is both an indispensable educational resource and a tool for action.'

Saleemul Huq, PhD

Director, Climate Change Programme, International Institute of Environment and Development (IIED), London. Lead author of International Panel on Climate Change Report, recipient of the Nobel Prize for Peace, 2007. Recipient of the Burtoni Award for contributions to Research on Climate Change Adaptation, 2007

'Dr Sajed Kamal proves once again that he is a most thoughtful and knowledgeable advocate of sustainable solar energy and its critical potential contribution for our future. *The Renewable Revolution* needs to be read by decision-makers at the World Bank, the UNDP, as well as the smallest community-based organizations if the costly mistakes of current policies are not to continue to pollute and impoverish us, threatening our sustainability.'

Prof. Laurence R. Simon

Professor and Director, Program in Sustainable International Development, Brandeis University, Massachusetts, US. Former advisor, the World Bank and the UNDP

'At this time of darkness when most people have given in to despair, apathy and powerlessness, Sajed Kamal's book is a true beacon of light. It is hopeful, inspiring and practical. It shows the way to the resolution of the global energy crisis as well as the deeper moral crisis in which the so-called environmental crisis is embedded. A powerful and compassionate work.'

Asoka Bandarage, PhD

Visiting Professor, Elliot School of International Affairs, Georgetown University.
Author of *Women, Population, and Global Crisis: A Political Economic Analysis*

‘Clear, insightful and compelling. *The Renewable Revolution* provides us with inspiring examples and information to understand how renewable energy is succeeding, together with the moral vision to realize that we must.’

Bruce Allen

Professor, Department of English Language and Literature, Seisen University,
Tokyo, Japan. Environmental writer and translator of *Lake of Heaven*
by Ishimure Michiko

‘All life is one – interconnected and interdependent with the rest of Nature. We can survive only if this right understanding is acquired and cultivated. Sajed Kamal conveys this message where knowledge, wisdom, intuition, experience and vision are all combined with a clear agenda for the novice as well as the expert. This one book contains everything that one may seek in one hundred books.’

Dr A. T. Ariyaratne

President, Sarvodaya Shramadana Sangamaya, Sri Lanka. Recipient of the Magsasay Award, The Philippines; The King Baudouin Award for International Development, Belgium; Niwano Peace Prize, Japan; Hubert H. Humphrey Award, US; Gandhi Peace Prize, India

‘*The Renewable Revolution* is not just another book on alternative energies: the author is a scientist and a poet as well. He not only started ‘solar revolution’ projects in different parts of the world, he also lives what he preaches. He brings ‘Head and heart and hands together,’ as the Swiss pioneer in education, Heinrich Pestalozzi, suggested. All this shines through in this very well written and richly illustrated book and makes it an outstanding tool in this crucial time of change.’

Martin Vosseler, M.D.

Founder of PSR/IPPNW Switzerland (Swiss chapter of the International Physicians for the Prevention of Nuclear War, Nobel Peace Prize, 1985).

Co-founder of the Swiss Physicians for the Environment and of ‘sun21’. Crew member of Transatlantic21 on the first Atlantic crossing with the solar catamaran ‘sun21’ (*Guinness Book of World Records*, 2007). SunWalk 2008 from Los Angeles to Boston. Recipient, European Solar Prize 2007

Synopsis

Our world faces an unprecedented energy crisis. Fuel shortages, skyrocketing energy prices, climate change, nuclear contamination, catastrophic oil spills and energy wars define the global scenario. The nonrenewable energy path of oil, natural gas, coal and nuclear is headed for a dead-end at an accelerated speed. In our race for survival we are awakened to the simple truth that the essential condition of sustainability lies in our ability to live within the limits and renewability of natural resources. It invokes within us an urgent need for transition – from an obsolete, destructive and unsustainable energy path to a sustainable path of innovation, renewable energy and peace. The good news is that the technology required to make this transition is already available.

From an author with over 30 years of experience campaigning for and setting up renewable energy projects around the world, this book is unique for its interdisciplinary approach – interweaving technology, economics, environmental science, philosophy, history, spirituality and politics, asserting that to understand the crisis and find a sustainable solution requires a holistic perspective. Readers will understand the vast renewable resources we have at our disposal in the form of sunlight, wind, heat, water movement and photosynthesis, and the technologies used to harness this power. There are also the emerging prospects of solar hydrogen fuel cells, biofuels and geothermal systems. The true economic advantages of a shift to a renewables-based economy (and how we can get there) are laid out clearly. There's much to learn from examples around the world while we devise local and appropriate solutions.

Written for a crossover readership of students, educators, professionals, academics, activists and policymakers, both nationally and internationally, this is a comprehensive but readable and practical book that will inspire people to wake up to renewable solutions.

About the Author

Sajed Kamal, EdD, who teaches ‘Renewable Energy and Sustainable Development’ in the Sustainable International Development programme at Brandeis University, has been involved in the field for more than 30 years. He has been a lecturer and consultant on renewable energy internationally, setting up projects in the United States, Bangladesh, Sri Lanka, Armenia and El Salvador. His work has also provided the basis for projects in Latin America, Europe and Africa. He is also an award-winning poet, artist, educational consultant, psychotherapist, translator and published author of a dozen books and many articles in a wide range of areas. In 2007, he was awarded the Boston Mayor’s First Annual Green Award for Community Leadership in Energy and Climate Protection and, in 2008, a Lifetime Achievement Award by the U.S. Environmental Protection Agency, New England Region. The ‘Greener Issue’ of *The Boston Sunday Globe Magazine* on 28 September 2008, featured him as one of the ‘Six local heroes whose work is having rippling effects – at home and far away – in making the world a better place’.

Acknowledgements

Growing out of more than 30 years of experience in the renewable energy field, this book is a product for which I am deeply indebted to many persons and organizations around the world that have inspired, challenged and supported me in my writing it. The list would be too long, so I will only be able to mention a few. Even in doing that there may be some inadvertent omissions. I will include them in any future editions.

A vision, an idea or a hope for a solution is not much more than something in one's mind – unless it can be implemented and put to the test. That involves others – their interest, opinion, participation, collaboration and partnership. I thank all my colleagues – in the US, Bangladesh, Sri Lanka, Armenia and El Salvador – for being there for me. Nothing has taught me more – practically, intellectually, socially, politically, morally – than working first hand on actual projects involving the issues and technologies I write about.

I thank all my colleagues and students at the universities where I have taught – Boston University, Northeastern University, Antioch New England Graduate School and Brandeis University. While teaching, I have also learned – that's the essence of dialogue. The same is true with my lectures before highly diverse audiences.

I thank the journals, magazines and newspapers that have published my articles on the subject, paving a path for this book. Among these are *The Fenway News*, *New England Condominium*, the on-line journal of the Interstate Renewable Energy Council (IREC USA), the *Journal of Bangladesh Studies* (a peer-reviewed journal published by the Bangladesh Development Initiative, www.bdiousa.org), *The Daily Star* (Bangladesh) and *New Age* (Bangladesh). In Bangladesh, under the leadership of Farhad Mazhar and Farida Akhter, UBINIG: Policy Research for Development Alternative published my booklet *Photovoltaics: A Global Revolution & Its Scope for Bangladesh* (1989). It proved to be highly instrumental in my simultaneous launching – and subsequent promotion – of 'A Photovoltaic Pilot Programme for Bangladesh,' with the implementation of 10 stand-alone PV systems across the country, pioneering the utilization of the technology in the country. I thank the Overbrook Foundation for a grant for the programme. Some of the Boston projects which I have initiated, and which I describe in this book, were funded by the Mission

Hill Fenway Neighborhood Trust, Massachusetts Technology Collaborative, Solar Boston, Fenway Community Development Corporation, Massachusetts Energy Consumers Alliance, City of Boston and Boston Public Schools. I thank them too.

As the manuscript evolved, I invited comments. Many people offered their comments and I am grateful to them all. They include the endorsers. Not only did they enthusiastically take the time to read and comment on it, some of them offered valuable critiques toward finalizing the draft, as well. They are: Howard Zinn, Bill McKibben, Ross Gelbspan, Howard Ris, Jane Weissman, Kazi F. Jalal, Saleemul Huq, Laurence R. Simon, Asoka Bandarage, Bruce Allen, A.T. Ariyaratne and Martin Vosseler. Here I would like to say a few words about Howard Zinn, whom I first met as a doctoral student at Boston University in the early 1970s, and later over the years at numerous anti-nuclear and anti-war rallies. His sudden death on 27 January 2010 is a loss to the world never to be recovered. Rosie, my wife, and I saw him coincidentally on the street last year and I was happy to tell him that the manuscript was under consideration by Earthscan. He was delighted and had only encouraging words to say. It saddens me deeply that I won't be able to present this book to him. But – while feeling deeply honoured to have his endorsement – I hope this book will also serve to carry his voice of conscience, justice and peace to its readers.

I thank the photographers. I have credited each photo individually, either by the photographers' names or by mentioning the organizations through which I got the permission to use the photographs. If I have inadvertently left out anyone, I apologize and will make corrections for any future editions.

The awards I have received have certainly added credibility to my writing. For honouring me with such awards I would like to thank Boston's Mayor Thomas Menino, Chief of the City's Office of Environmental and Energy Services Jim Hunt, Director of Energy Policy Brad Swing, Special Assistant Mayor's Office Sarah Zaphiris and City Councillor Mike Ross; the U.S. Environmental Protection Agency, New England Region; Fenway Community Development Corporation; AltWheels: Creating a Sustainable Transportation and Energy Vision for the 21st Century; and the New England Bangladeshi American Foundation. Also, there are numerous magazines, both in the US and abroad, who profiled me and television and radio stations who interviewed me. I thank them all.

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It is my absolute good fortune to be published by Earthscan – to be joining in our shared mission and vision for a healthier, just, peaceable and sustainable future. It has been both a pleasure and privilege to work with Michael Fell, my editor. The book simply wouldn’t be what it is without his commitment, knowledge, astute observation and guidance. Working with him has been a mutually respectful dialogue that has both supported and challenged me, leading to clarity, assertions and changes, when appropriate. Not only have I felt that the integrity of my voice and writing was fully valued and retained, it was also enhanced. The rest of the Earthscan team that I have been in contact with – Nicki Dennis, Anna Rice, Martha Haworth-Booth, Claire Lamont, Lee Rourke and Martha Hawley-Bertsch – have demonstrated to me exceptional professionalism and helpfulness. Rob Watts has designed an attractive cover and Howard Watson has done skillful copy-editing. I am grateful to them all.

My deeply cherished friendship with Alex Roth – spanning over 47 years since our Loomis prep school days – is a testament to the saying: ‘A friend in need is a friend indeed.’ It’s not the first time that Alex has been helpful to me in preparing my manuscripts. And I am sure, this won’t be the last. Use of the computer is something I try to keep up with; Alex masters it. Especially for the inclusion of a whole chapter of photographs – and preparing them according to the publishing criteria and transferring them overseas, this manuscript presented a special technical challenge for me. Another challenge was to find someone with the skill, meticulousness and an understanding of the subject to prepare the index. Unfailingly – and ever cheerfully – Alex was always there to help. Even more than that, his comments rooted in our shared concerns, his intellectual depth and knowledge, and his eye for detail enriched this book immensely. Thank you, Alex!

Last but not least, my loving thanks to my family members both in the US – Rosie and our son, Ashok – and in Bangladesh – my brother, Shahed Kamal, brother-in-law, Supriyo Chakravarty, sisters, Amena Quahhar, Sultana Kamal and

Saeeda Kamal, and their families. As always, their support and partnership were essential elements in my efforts to bring this project to its fruition. My parents, Kamaluddin Ahmad Khan and Sufia Kamal, passed away some years ago. But the values they inspired in me through their own examples, and the encouragement they provided, have been sustaining elements in my commitment to renewable energy. The book embodies those values and is nourished by their encouragement. To them I offer my loving thanks.

Preface

Racing for Survival: Transitioning to a Renewable Energy Path

We are like tenant farmers chopping down the fence around our house for fuel when we should be using nature's inexhaustible sources of energy – sun, wind and tide. I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that.

Thomas Alva Edison (1847–1931), 'The father of the electrical age'¹

We will harness the sun and the wind and the soil to fuel our cars and run our factories ... All this we can do. All this we will do.

President Barack Obama, Inaugural Address, 20 January 2009²

Energy is our basic means of survival. As people everywhere aspire for a better lifestyle, nothing is more convincing than the promise of the better lifestyle that energy can bring. A more comfortable home, good health, eating well, nice clothes, travel, more entertainment, more opportunities to learn – the list goes on. And human ingenuity struck more than gold in detecting, extracting, storing, distributing, using at will and profiting from the energy contained in fossil and nuclear sources. As compact sources of energy, fossil and nuclear sources were amazingly attractive and powerful – like the Genie in Aladdin's lamp, ready to be released and serve its master – without ever getting exhausted.

The Industrial Revolution in the late 18th century was fuelled largely by coal.³ Since then global industrialization has been accelerated by an increasing reliance on coal and other fossil fuel sources as well, such as oil and natural gas, and uranium for nuclear power, as these were detected over the years. Together and in varying percentages these continue to provide the main fuel sources for the global industrial economy.

The benefits of the fossil fuel/nuclear path need not be discounted. But the story of human triumph with energy, and the benefits it has provided, now has other chapters – some that are newly written, some that were not included, some that were

lost and some that were even suppressed. There are problems rooted in this path and, with rapid industrialization, some of these problems have reached a critical level – so much so that, ironically, the very lifestyle that this energy path promised to improve is now threatened by the path itself.

Oil, natural gas, coal and uranium are being quickly depleted. Current scientific estimates suggest that the remaining reserves of oil, natural gas and uranium will be exhausted within the next 50 years, and coal within 250 years.⁴ These resources took millions of years to accumulate. We are depleting fossil fuels at a rate 100,000 times faster than they are being replenished, thereby making them nonrenewable.⁵

More urgent is the concern that the crisis is hitting gasoline stations and national defence policies long before the world runs out of oil. We can go on arguing over the exact number of years before the world runs out of oil, and it may not run out of oil completely. But for individual consumers or for economies as a whole, the news is just as bad if they cannot afford it any longer. US oil production already peaked in 1970 and has been declining since. Global oil production is estimated to peak by 2010, triggering an energy crisis causing more price hikes and political tension than we have ever experienced.⁶ As the supply of a needed product decreases, the demand increases – unless there is a commensurate decrease in demand or an alternative to the needed product. It's that simple. The skyrocketing oil prices and their worldwide effects, from collapsing economies to wars over control of oil, are symptoms of this crisis. The era of 'cheap oil' has ended. Period. A drop in gasoline prices during an economic downturn or recession makes very little difference. When income drops – due to a lack of pay increases, pay cuts, unemployment – on a massive scale, even the lower gasoline price is no longer cheap for most customers. The long-term trends continue unaffected: downward oil production and upward fuel costs. Stop-gap measures such as the discovery of additional reserves, efficiency and innovation in extraction, and substitution of one nonrenewable fuel for another, at best amount to choosing one disaster over another and keeping the wolf away from the door for a bit longer. We can only go so far while running on empty.

War is not an answer. It's naive to explain any war by a single motive or cause. But it's even more naive to avoid the root cause. History abounds with wars over control of natural resources – land, minerals, water, oil. Nothing better explains the Middle East quagmire than our dependency on, and ever-growing hunger for, oil.⁷ The region with two of the largest oil reserves in the world – Saudi Arabia and Iraq – has turned into a bloody battlefield that continues to escalate. About 5,000 US soldiers and an estimated 1 million Iraqis – including innocent civilians – who were killed in the Iraq War are still only a partial toll of the long-term death and destruction caused by the war. When it comes to civilian killing – common to most wars and the warring mentality – any sense of equity and moral threshold seems to have been among the war's first casualties. However it may be justified or politicized, that path of occupation, exploitation, retaliation and destruction will lead us to nowhere but a dead end with more human, environmental and economic costs on all sides.

But let us assume there was an unlimited supply of the conventional fuel resources and nobody needed to go to war over oil. There would still be questions to answer. The entire chain of exploration, extraction, production, utilization and waste disposal is infested with critical, costly and out-of-control health and environmental hazards.

These cause the pollution of air, water, rain and soil – in short, of our ecosystem. We get so accustomed to these consequences that they no longer make news, even if the conditions continue to worsen. Air becomes so polluted that we need to wear a mask; water becomes so contaminated that we cannot go for a swim or fish in a pond or a lake; rain turns so acidic that it destroys vegetation; and soil becomes so contaminated that food grown in it threatens health. Occasional reports or a media blitz sounding a sudden alarm tend to quickly succumb to the desensitizing category of ‘old news’. In December 2008 the US news media reported that toxic coal sludge – later estimated to be around a billion gallons – had just spilled over hundreds of acres of land and waterways surrounding the Kingston Fossil Plant of the Tennessee Valley Authority. Further investigation revealed that ‘millions of tons of toxic coal ash is piling up in power plant ponds in 32 states, a situation the government has long recognized as a risk to humans and the environment but has done nothing about’.⁸ In January 2009, the *New York Times* reported that river pollution from contaminated water from the Alberta oil sand projects in Canada – poised to become the ‘new Saudi Arabia’ – was causing serious environmental hazards. Susan Casey-Lefkowitz, a senior attorney with the Natural Resources Defense Council in Washington, DC, called it ‘one of the most destructive projects on earth’.⁹ As we keep entrenching ourselves in the nonrenewable path through conventional and novel means, these and other toxic consequences continue to worsen around the world and their occasional exposures are mere symptoms of a dam of worldwide catastrophes waiting to be broken.

The most talked about consequence of relying on nonrenewables is global warming and its effects on climate change, resulting from carbon dioxide (CO₂), nitrogen oxide and other gaseous emissions from the use of fossil fuels. Global warming to a degree is a natural process which, in fact, is necessary to create and maintain a thermal blanket or an atmospheric shield that keeps the planet’s temperature suitable for life. The process is also referred to as the ‘Greenhouse Effect’ for its similarity to the way a greenhouse nurtures plants by trapping heat inside its boundaries. However, incontrovertible scientific evidence has established that accelerated emissions due to human activities since the Industrial Revolution are causing global warming,¹⁰ acid rain¹¹ and various kinds of pollution to become environmental threats with critical impacts on the planet’s climate and its species. The findings by the world’s leading scientists, such as the 130 members of the United Nations (UN) Intergovernmental Panel on Climate Change (IPCC), are no longer refutable by debate. Rajendra K. Pachauri, chairman of the IPCC, warned world leaders at the climate summit meeting at the UN on 22 September 2009: ‘Science leaves us no space for inaction now.’ What is urgently needed is widespread public education of the findings, challenging political manipulation and denial by vested interests in the conventional energy paths. How much more evidence do we need beyond the growing number of intensifying heatwaves, droughts, melting ice caps and glaciers, rising sea levels, downpours, floods, cold snaps and storms? Even before the catastrophic oil spill in the US Gulf Coast started in April 2010 – spilling millions of gallons to date, Hurricanes Katrina, Gustav, Hanna and Ike caused massive human, environmental and economic devastations in the region; there are more frequent and intense cyclones, typhoons and tornadoes around the world; and drought conditions from California to Australia are destroying food production and

fuelling uncontrollable fires. All these things are telling us something about what we have got into by following the nonrenewable energy path. Even worse, they tell us the direction in which we are headed. The catastrophic scenario depicted by the 2004 blockbuster movie *The Day After Tomorrow*, however dramatized and fast-forwarded, could be more than mere fiction. Al Gore's *An Inconvenient Truth* speaks loudly while a California-sized area of ice melts in Antarctica and in the Himalayas the glaciers melt at an accelerated rate. A truth can be inconvenient, but courageously confronting it could be the only turning point away from its consequences.

Nuclear power is often promoted as a solution to climate change. But the promoters carefully avoid mentioning the devastating economic, environmental and political consequences associated with it. To name a few: exclusive and highly secure land requirement, the intensive use of fossil fuels for nuclear power generation (contributing to climate change), radioactive contamination during uranium mining, tilling, processing and power production, massive water usage and contamination, risk of accidents, nuclear waste storage, transportation risks, underground disposal, leakage, potentially devastating impacts of earthquakes and other seismic movements on underground repositories, decommissioning, terrorist attacks on nuclear power plants, nuclear weapons proliferation and out-of-control costs.¹²

The catastrophic consequences of climate change are telling us what we have gotten ourselves into by abusing the atmosphere above ground. With deep geological repositories for nuclear waste we are driving ourselves into an unpredictable and dangerous future by abusing what lies underground.

Since the construction of the first civilian nuclear power plant (Obninsk, with an electrical capacity of 5 megawatts [MW]) near Moscow, Russia, in 1954, there are now 400 nuclear power plants around the world, generating approximately 17 per cent of the world's electricity. While the number of nuclear power plants has increased by 400 per cent, the solution to permanent and safe storage of nuclear waste – which has grown exponentially – has progressed 0 per cent, compounded by all the other associated problems. The waste remains radioactive for millions of years. However it is packaged or bottled, temporary storage of nuclear waste for a few decades or even for a hundred years – in pools, by dumping it in the ocean or by sticking it underground – or passing it on to economically and politically vulnerable communities or nations, are not solutions. When questioned, the nuclear proponents are quick to reply – as they have been doing for years – that scientists are working on a solution. It is like making a toast with a poisoned drink and trying to reassure everyone that chemists are in the lab trying to invent an antidote, although there is no surety that they will ever find one.

Digging for more oil or gas, or excavating another coal or uranium or thorium mine, or building a nuclear 'breeder' reactor, all at an ever greater cost and ever greater risk, are not solutions. Even after the short-term life of a nuclear power plant is over, its radioactive legacy lasts for millions of years and costs billions of dollars. Even if the Gulf Coast oil spill can be stopped, its destructive consequences will continue indefinitely, costing billions of dollars, never truly recovering what has been lost.

The solution requires us to be awakened to the simple truth – and the holistic, perennial wisdom – that the essential condition of sustainability lies in our ability to

live harmoniously within the limits and renewability of our natural resources. The age of unlimited, exploitative and imbalanced industrial growth at any cost is over. And the truth should invoke within us an urgent need for a transition – from an obsolete, destructive and unsustainable nonrenewable energy path to a sustainable path of innovation, renewable energy and peace.

Is such a transition possible? The answer is yes, but only under certain conditions. Such a transition is possible only through a worldwide moratorium on further entrenchment into the fossil-nuclear path while, through conservation and efficiency, utilizing these resources only as transitional fuels toward a sustainable renewable energy path. Undoubtedly, the transition will face short-term challenges and risks, but these pale in comparison to a suicidal entrenchment into the dead-end nonrenewable energy path – and that path is inevitable if the risk is not taken. We must set a clear goal and an uncompromising and sustained action-oriented policy for transition. We cannot go on fuelling the nonrenewable path – especially funding it at an astronomically higher rate than funding for the renewable path – and hope that we will somehow be able to reverse the trend. Einstein's saying that we cannot prepare for war and peace at the same time has never been more applicable.

We need practical solutions. However, substituting renewable energy sources for our current nonrenewable fossil fuel and nuclear sources is not as simple as unplugging a toaster from a socket and plugging it into a sunbeam. The transition will not take place without a profound reorganization of social and economic values: it requires transforming our current simplistic conceptions of energy – 'endless', 'cheap', 'bountiful', 'harmless' – into a more sophisticated understanding of the costs, resources, consequences and legacies of our energy choices.

We need a transforming vision of energy in our world and tools to turn that vision into action. We need widespread dissemination of information to understand the worldwide energy dilemma, and to empower people with the tools to tap alternative sources for their energy needs. We need to inspire and motivate people to advocate judicious structuring of energy management in their communities. We need the best expertise in both the nonrenewable and renewable energy paths to unite in a shared vision of sustainability and to lead the transition. What is at stake is our common future – and the common legacy we leave behind for our future generations. We need dynamic plans and programmes of transition to a renewable energy path which are simultaneously tested, strengthened and broadened in their scope through practice.

We need a global perspective. In our increasingly interdependent world, a global perspective is necessary both to comprehend the crisis and find a sustainable solution. Solutions must have global implications so that we do not devise a solution for one place which causes a problem for another. The potential of biofuels does not have to end-up in a 'fuel vs. food' dilemma. The need for transportation or industrial fuel for a few people in one part of the world does not have to be met through massive destruction of the rainforest elsewhere – destroying the biodiversity, ecological balance and the livelihood of those who depend on it. The voracious appetite and unbridled energy consumption by the industrially developed countries – the main cause of climate change – have pushed developing countries and islands around the world to the verge of obliteration under rising sea levels. Sustainability, progress and advancement must be redefined by equity and justice, from a global perspective.