D. Johnston*

Sustainable energy for future generations

Energy is a key to the future of the planet. Greenhouse gas emissions and global warming, combined with a growing population, are putting us on a fast track to frightening consequences. If we want sustainable development, we must solve our future energy needs without burning up the environment. Indeed, according to Burton Richter, a Nobel Prize-winning physicist, *"It is our responsibility, both on ethical grounds and on grounds of self-interest, to develop technologies that will allow the rest of the world to increase their standard of living without at the same time destroying the environment of the planet."* For the moment, there is no serious discussion on how we are going to do this.

In the 1987 Report of the World Commission on Environment and Development (the Brundtland Report) entitled "Our Common Future", sustainable development was defined as "...development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

This definition is as suitable as any because, taken in its broader sense, it combines environmental, social and economic considerations.

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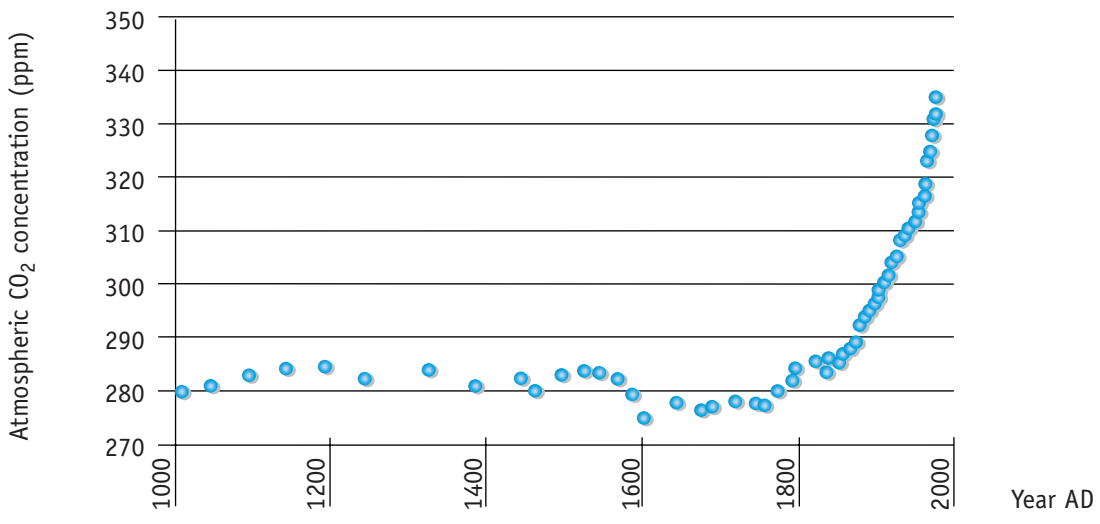
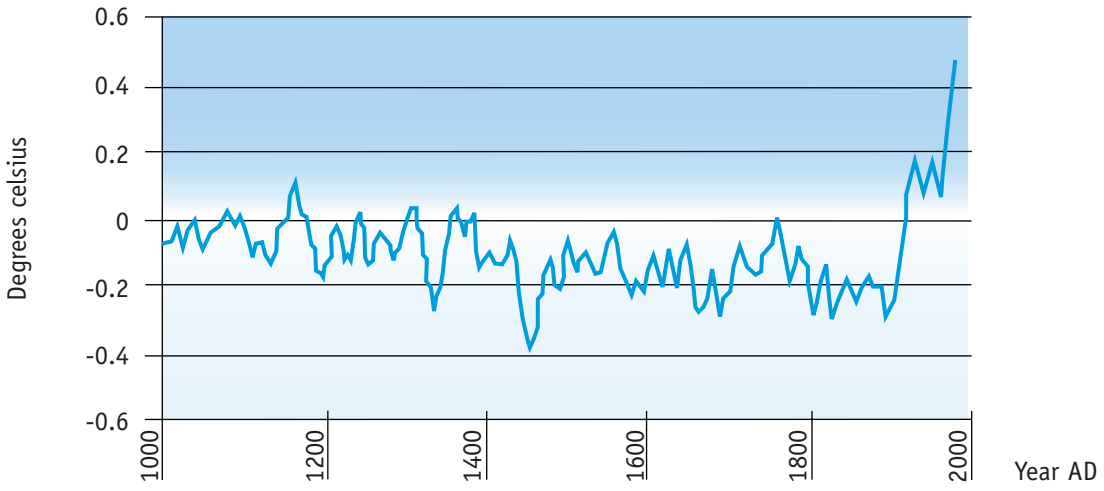
Average atmospheric carbon dioxide concentrations over the last millenium



Annual climate changes in the northern hemisphere



"At a minimum," states the report, "...sustainable development must not endanger the natural systems that support life on earth: the atmosphere, the waters, the soils and the living beings". The erosion of any of these elements, and certainly the absence of any of these elements, make any consideration of the social and economic objectives of sustainable development irrelevant.

Yet the world finds itself on an unsustainable energy path that threatens to lead to catastrophe. One of the most important sets of indicators showing the dangerous direction in which we are headed is that pertaining to the concentration of greenhouse gases in the atmosphere, and the contribution that human activities are making to those concentrations.

The gases that contribute to the greenhouse effect include carbon dioxide (CO_2) and a large number of other, often more complex and less common gases. CO_2 is not the most powerful of the greenhouse gases, but it is the most abundant – accounting for the bulk of the human-induced warming effects. And because of its pathways through nature, it is the gas for which historical concentrations are the easiest to reconstruct.

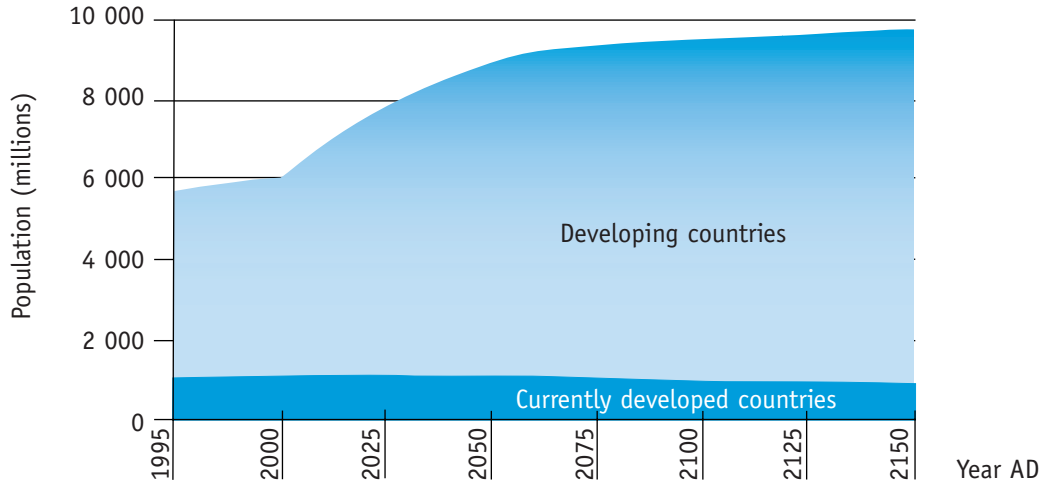
Emissions of carbon dioxide from the burning of fossil fuels increased seven-fold during the 20th century. Since 1900, temperatures have risen steeply, and the rate of increase has accelerated over the past 25 years. Current average temperatures are believed to be close to 0.8° C above normal. In the Antarctic, average temperatures have risen by 2.5° C over the past 25 years. The Intergovernmental Panel on Climate Change believes that global temperatures could rise by as much as 6.1° C over this century.

We are engaged in a perilous experiment with nature that is unprecedented in the history of humankind. Global warming means damage to ecosystems and biodiversity. Rising sea levels will render uninhabitable the world's low-lying seacoasts. Tropical diseases will spread. If current trends continue, this could begin within the lifetime of our children.

Can we do something to turn around the situation? Yes, of course we – that is, the developed, industrialised countries of the world – can. Our populations have stabilised, and we are probably rich enough and smart enough to develop clean, safe energy technologies that can deliver our current level of material welfare while cutting emissions – if we rise to the challenge. But there is a major obstacle to success: poverty and population growth in the rest of the world. According to the United Nations' latest projections, global population will increase by 50 per cent between now and 2150. Virtually all of that growth will occur outside the OECD area.

Globalisation is paving the way for the emergence of a worldwide middle income class of 4 to 5 billion people, with the same aspirations for comfortable homes, a range of choice in foods

UN projections of world population to 2150 (medium scenario)



and consumer products, and opportunities for education and travel that form the accoutrements of our modern civilisation. But these all depend on one vital input: energy.

If the rest of the world were to have the current standard of living of the OECD area, energy production would have to increase by a factor of 30. No one expects such a jump to happen suddenly, but even if increased demand for energy happens gradually, how is it to be met?

Let us look at fossil fuels – the fuels largely responsible for anthropogenic emissions of greenhouse gases. Many experts expect that production of petroleum-based oils will peak some time before mid-century and start to decline thereafter. Coal, which will remain abundant, can easily fill the gap. For geological reasons, natural gas is more abundant than oil and its use can be expected to increase in absolute terms and then stabilise. Under this "business-as-usual" scenario, the International Institute for Applied Systems Analysis (IIASA) predicts that the use of fossil fuels will double over the next century.

Given the strong links between fossil-fuel combustion and growth in atmospheric CO_2 concentrations that we have seen already, can we actually envisage continuing to burn fossil fuels at current or expanding levels over the next century? The consequences for global warming and climate change would be intolerable.

What about clean renewable sources of energy like solar or wind or harnessing the ocean currents? There is certainly room to further develop wind power and solar panels, and perhaps ocean currents and tidal power, but as contributors to basic energy needs they are likely to remain largely insufficient. If we are to hand on to future generations a planet that will meet their needs as we have met ours, it can only be done by incorporating the nuclear energy option. Nuclear power can be abundant, even unlimited; it produces no greenhouse gases of any consequence.

In the mid-1950s, at the time of President Eisenhower's "Atoms for Peace" initiative, nuclear energy was seen as a godsend for both the developed and the developing world. Fossil fuels were understood to have a finite life, which of course they still do, although it has been modestly extended beyond estimates of that day. But fossil fuels were not seen at the time as harbouring the potential for irreversible damage to the biosphere which we now believe to be the case.

Today, the atmosphere is being choked by greenhouse gas emissions, global temperatures are rising dramatically, and the global population has more than doubled since 1955, most living in poverty in the developing world. Yet we seem to be denying ourselves the nuclear option which was seen over four decades ago as the way forward!

What happened to change public, and hence political, attitudes towards nuclear energy? Of course, the accidents at Three Mile Island a little over 21 years ago, and more recently Chernobyl, have had a major negative impact on the evolution of the nuclear industry. The tendency of the nuclear industry to secrecy, probably inherited from national defense orientations of nuclear research, made things worse. No new nuclear facilities are currently planned within the OECD countries except in Japan and Korea. In fact others, following Germany's lead, may opt to phase it out.

There is concern about the health risks associated with nuclear energy, both in terms of functioning nuclear power plants and in relation to radioactive waste. As for the latter, the OECD Nuclear Energy Agency, in a collective opinion developed by its Member countries, confirmed that the disposal of long-lived radioactive waste in deep geologic formations can be designed and implemented in a manner that is sensitive and responsive to fundamental ethical and environmental considerations.

Of course, no energy source is free from risk. Risks are an inherent part of decision making in public policy. When we look at nuclear power, there are obvious ones, but compared to what alternatives? Are we to abandon it on the strength of a few accidents? Between 1918 and 1965, 42 major dam failures caused substantial loss of life. Did we stop building dams as a result? Did we abandon coal because of the high risks associated with coal mining? No. We worked at making technologies more reliable and safety measures stricter.

Those of us who do believe that the future has a constituency must prove it by urgent action. Ideally, a campaign should be led by political and civic leaders who have no vested interests in any particular energy option. This campaign should be based on an honest assessment of the risks and benefits of nuclear, and solutions to solve problems.

The future of energy is not the future of any one part of the globe: it is the future of the fragile planet Earth. To safeguard this future, we must mobilise scientific expertise and material resources in support of accelerated energy research in all areas. Let us together, from every corner of the global village, join forces to ensure that our planet survives in a condition hospitable to human life. That must be our promise to future generations. ■

Total primary energy consumption by region
(IIASA reference projection scenario B)