NUCLEAR POWER IS NOT THE ANSWER TO CLIMATE CHANGE

The Imperative for an Energy Revolution

"The question is not whether climate change is happening or not but whether, in the face of this emergency, we ourselves can change fast enough."
-- Kofi Annan, former Secretary-General of the United Nations, November 2006[i]

There is a clear scientific consensus that we must halve global carbon dioxide (CO2) emissions by 2050 or suffer potentially irreversible changes to the global climate. Preventing the worst impacts of climate change requires action now by governments, individuals and businesses around the world.

Expectations are that US $7 trillion will be invested in electricity generation capacity between now and 2030. [ii] The investment decisions that the electricity sector makes today, determine how things stand in 2050 and whether the world remains locked in to its current course, or achieves emissions cuts in time.

Greenpeace and the European Renewable Energy Council (EREC) commissioned the DLR Institute (German Aerospace Centre) to develop a global sustainable energy pathway up to 2050. This "Energy Revolution" scenario[iii] is a realistic blueprint for a sustainable and equitable energy future. It would maintain economic growth and achieve fairer distribution and access to energy. Most importantly, this is based on credible and proven renewable energy technologies and energy efficiency. It does not rely on new technology promises like "clean coal" or carbon capture and storage that are many years and millions of dollars out of reach. It does not rely on nuclear power with its unresolved problems and financial, environmental and human health liabilities. Investing time, money and political will in the nuclear distraction exacerbates current problems by diverting resources away from real solutions.

The Energy Revolution scenario shows that by sustaining the double-digit growth rate of the renewable energy industry, increasing the use of combined heat and power and introducing high efficiency standards for all energy consuming appliances, it is possible to generate sufficient electricity for a globally growing economy.

Figure 1: Development of global electricity generation under reference scenario

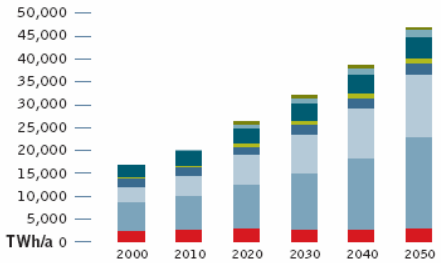
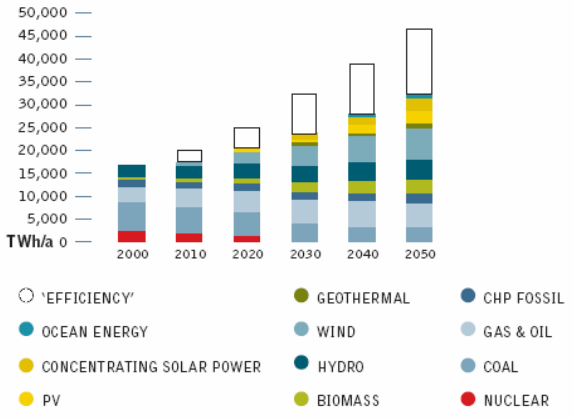


Figure 2: Development of global electricity generation under Energy [R]evolution Scenario



This is not "rocket science". The Energy Revolution blueprint shows that, if we make the right choices, we have the resources and tools needed to safeguard a sound environment, political stability and thriving economies.

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Nuclear Power: a Dangerous and Costly Obstacle

The nuclear industry, and some politicians, claim that nuclear power, as a low carbon source, needs to be part of the energy mix and solution.

Greenpeace contends that it would cost too much to deliver too little and too late, while adding to the risk to global security.

Greenpeace points to nuclear power's high investments, regular cost overruns, long construction periods, huge subsidies, operational risks, radioactive waste production and security issues involving proliferation and terrorism. **In contrast, the Energy Revolution scenario shows how to meet greenhouse gas reductions faster, more effectively and at lower cost using the proven alternatives of renewable energy technologies and energy efficiency.**

Limited potential

The 439 operating commercial nuclear reactors[iv] currently supply around 15 per cent of global electricity. This represents only 6.5 per cent of world's overall energy consumption[v]. Even maintaining this current share would require a massive new build programme, given the increasing number of old plants to be shut down and projected increases in electrical demand. Most of the reactors were built in the 1980s and are on average 20 years old.

Doubling the existing installed nuclear capacity of 372,000 megawatts (MWe) by 2030 would mean building hundreds of new reactors. Yet this would hardly increase the nuclear energy share in world's total energy consumption beyond 10 per cent and would reduce total greenhouse emissions by less than 5 per cent.

Achieving even this small slice of world energy supply would require an unrealistically ambitious plan: A large new nuclear reactor would need to be built and come on line every two weeks from now until 2030.

Immense Costs

Nuclear power is very expensive. Nuclear construction projects consistently run well over budget. Construction costs are often double original estimates. Despite 50 years of development and massive subsidies, nuclear reactors still cannot deliver proven and reliable technology at predictable costs.

The industry promises new reactors at investment costs of around US $2,000 per kilowatt (kW) of installed capacity. The reality, though, indicates that it will be significantly more expensive. Past experience shows that most reactors in the United States experienced cost overruns of more than 200 per cent, as did the most recent nuclear reactors completed in India.

Finland has recent experience of a new, advanced generation of reactors. Construction of Olkiluoto-3 started in 2005 but its budget has already increased from US $4.7 billion to US $6.9 billion. It has been delayed by two years and more than one thousand defects and technical problems have been discovered by the nuclear safety authority. Further delays and cost overruns are anticipated, as highlighted on page four). This project involving a 1,600 MW reactor is evidence that the cost of installing nuclear capacity can easily reach US $4,300 per kW. Recent estimates by Moody's Investors Service give all-in reactor construction costs as US $ 5- 6,000 per kW.

Investment costs needed to double global nuclear capacity, and reduce greenhouse gas emissions by less than 5 per cent – would be between two and three trillion US dollars.[vi]

These are merely the upfront investment costs. Additional costs arise from maintenance and operation, as well as fuel. A shortage of uranium on world markets drives the overall cost still higher. Lastly, there are future costs for decommissioning reactors and disposing of radioactive waste. These costs are difficult to estimate. In past decades, budget estimates have risen rapidly in the UK, the US and a variety of other countries. But the costs would likely amount to hundreds of billions, if not trillions of dollars.

Long Delivery Time

Dozens of governments have announced ambitious nuclear plans. Some of them are serious; some purely speculative. In a number of countries, it would take years to build up an institutional framework and infrastructure to implement a nuclear power project. Even in countries with established nuclear programmes, planning, licensing and connecting a new reactor to the grid typically takes more than a decade.

Under the most favourable conditions, only a small fraction of the approximately 200 new reactors announced so far would be able to generate electricity before 2020. Most of them would make a negligible contribution to addressing climate change long after 2020. **This is many years after the date by which global CO2 emissions need to peak and be reduced.**

Vague promises of fourth generation fission reactors, or even fusion reactors, are decades ahead, if they ever materialise or prove economically feasible. **Such nuclear technologies come long after the decisive decades in which CO2 emissions have to be tackled. They are hopelessly irrelevant to combating climate change.**

Nuclear Hazards

To propose nuclear expansion in the name of climate change is effectively to trading one uncertain, potentially catastrophic health, environmental and security threat for another. These are not risks we can afford to take.

Reactors

Accidents do happen: the Windscale fire of 1957, Three Mile Island in 1979, Chernobyl in 1986 and Tokaimura in 1999 to give a few examples.

The Chernobyl accident, in the Ukraine, contaminated an area larger than 120,000 square kilometers and contamination was even found as far as Lapland and Scotland. The precise death toll will never be known, but may be more than one hundred thousand[vii], with millions of lives crippled. Chernobyl's economic impacts are estimated to be in the order of hundreds of billions US dollars.

Waste

No reliable way of handling waste has been discovered in spite of billions of dollars of investment and decades of research. An average nuclear reactor produces 20 – 30 tonnes of spent fuel alone each year, which remains radioactive for hundreds of thousands of years.

Nuclear expansion plans would significantly increase the volume and unresolved risks of spent nuclear fuel and radioactive waste far into the distant future.

Proliferation and Terrorism

One tonne of spent nuclear fuel typically contains about 10 kilograms of plutonium, enough to build one crude nuclear bomb. Experiments by the US government have proved that several nuclear weapons can be made in a matter of weeks using ordinary spent fuel from light water reactors, using small scale dirty reprocessing that built with accessible technologies[viii].

The list of non-nuclear countries that have announced plans to gain access to nuclear technology and build nuclear reactors is long and disturbing[ix]. In spite of extensive efforts, treaties and political mechanisms to *try* and safeguard nuclear materials and technology, it is an impossible task. Mohamed El Baradei, head of the International Atomic Energy Agency, responsible for the safeguards and security regime said in 2005: "Export controls have failed, allowing a black market for nuclear material to develop, a market that is also available to terrorist groups"[x].Civilian reactors and nuclear waste transports are also potential targets for terrorist groups.

Civilian reactors are also potential targets for terrorist groups. No existing reactor would be able to withstand an impact of large airliner.

Nuclear power expansion would seriously undermine global security by significantly increasing opportunities for nuclear proliferation and terrorism.

Case Study: Olkiluoto 3/Areva

The flagship of the much-vaunted "nuclear renaissance", the European Pressurised Reactor (EPR) in Finland illustrates the complexity of the problems. French nuclear engineering company Areva developed, and is selling, its new 1,600 MW plant as an advanced generation of nuclear reactor. It is claimed to be significantly safer, more reliable, cheaper and faster to build. The company claims it is a mature technology, having learned lessons from previous generations of plants.

The International Energy Agency highlighted the risk of relying on the new reactor for emission cuts, saying it could inhibit Finland's ability to meet its greenhouse gas reduction targets under Kyoto if the plant was delayed in anyway[xi]. That risk has become reality: plagued by technical problems the reactor has fallen behind schedule; and according to former Finnish environment minister, Satu Hassi MEP, once the decision was made for the fifth reactor, the country lost interest in alternative energy sources.[xii]

Since construction of the EPR reactor started in spring 2005, the project has frequently failed to achieve required quality standards. The plant vendor has been forced to remanufacture and repair numerous components. As of May 2007, the nuclear safety authority STUK had reported 1,500 quality and safety defects.

In August 2007, following 27 months of construction, the project was officially declared to be 24 - 30 months behind schedule and at least EUR 1,500 million over budget. Finnish heavy industry, one of the project's main investors, estimates that the delay will cost them EUR 3 billion - the whole overnight cost of the plant - due to the adverse impact on the electricity market.

Areva maintains that problems will not be repeated in future EPR construction projects. But this is doubtful. They already claimed that lessons have been learned prior to the Olkiluoto fiasco. New reactor designs are clearly inherently harder to build and control because of their larger size and fuel burn-up, which places high demands on construction. The stagnation of nuclear construction over recent decades has led to a lack of competent personnel and companies. Together with complicated project structures (Olkiluoto 3 involves over 1000 subcontractors from over 25 countries). This renders quality assurance a next to impossible task. Any nuclear power plant constructed in the near future will be the first of its kind, or a few of a kind, since there are several reactor models but only few orders.

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[i] Kofi Annan, Secretary-General of the United Nations, "Climate change is not just an environmental issue", The Independent, 9th November 2006, page 39.
[ii] Reference Scenario according to International Energy Agency World Energy Outlook 2004
[iii] Energy Revolution-A Sustainable World Energy Outloook, Greenpeace and European Renewable Energy Council, January 2007- http://www.greenpeace.org/international/press/reports/energy-revolution-a-sustainab
[iv] IAEA Power Reactor Information Systam, http://www.iaea.org/programmes/a2/
[v] International Energy Agency, World Energy Outlook 2006.
[vi] trillion (1,000,000,000,000) is a thousand billion
[vii] *The Chernobyl Catastrophe - Consequences on Human Health, Greenpeace, 2006, http://www.greenpeace.org/international/press/reports/chernobylhealthreport*
[viii] Since 1977, US nuclear research labs extensively studied the feasibility of developing a 'quick and dirty' reprocessing plant. . Most of the original documents remain classified, but an excellent overview has been published by V. Gilinsky et al. in 2004 (V. Gilinsky et al., A fresh examination of the proliferation risks of Light Water Reactors was published by the Nonproliferation Policy Education Centre, Oct. 2004). The first major study proved that a country with a minimal industrial base could quickly and secretly build a small reprocessing plant, capable of extracting about a bomb's worth of plutonium per day.
[ix] Italy, Portugal, Norway, Poland, Belarus, Ireland, Estonia, Latvia, Turkey, Iran, Gulf states, Yemen, Israel, Syria, Jordan, Egypt, Tunisia, Libya, Algeria, Morocco, Nigeria, Ghana, Namibia, Azerbaijan, Georgia, Kazakhstan, Chile, Venezuela, Bangladesh, Indonesia, Philippines, Vietnam, Thailand, Malaysia, Australia and New Zealand.
[x] Spiegel Magazine 8 Dec 2005: Keeping the World Safe from the Bomb.
[xi] International Energy Agency, *Energy Policies of IEA Countries; Finland 2003 review* (*http://www.iea.org/textbase/nppdf/free/2000/finland2003.pdf*), IEA, 2004.
[xii] Satu Hassi MEP, Finnish Environment Minister 1999 – 2002, Deciding on Nuclear (*http://www.satuhassi.net/puheet/praseg.pdf*), *UK Parliamentary and Sustainable Energy Group (PRASEG) Briefing,* November 2005. See also Satu Hassi MEP How Kyoto was used as an argument and what happened afterwards (*http://www.satuhassi.net/puheet/kyoto181005.htm*), October 18, 2005.

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