SAVING THE CLIMATE: QUIT NUCLEAR MADNESS – ENERGY REVOLUTION NOW!

Summary

Humanity faces the challenge of halving global greenhouse gas emissions before 2050 to stave off potentially irreversible climate change.

Nuclear power is a distraction. Its potential is too limited, it is too costly and it takes too long to deliver. It adds to problems of radioactive waste disposal and undermines international security by fuelling nuclear weapons proliferation.

Forget talk of a “nuclear renaissance”: if there ever was a “nuclear era”, it has been consigned to the rubbish bin of history.

Greenpeace is convinced that the solutions to climate change and ensuring energy security lie in renewable energy and improvements in energy efficiency.

Our detailed “Energy Revolution” blueprint shows how these cost-effective, safe and reliable options can meet the energy needs of businesses and consumers without, literally, costing us the Earth.

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. Currently, 150,000 people die each year from the impacts of climate change.[ii] If global warming is allowed to exceed 2 °Celsius, millions more face increased risks of hunger, malaria, flooding and water shortages. Preventing the worst impacts of climate change requires action now by governments, individuals and businesses around the world.

The energy sector is responsible for two-thirds of man-made greenhouse gas emissions. Expectations are that US $7 trillion will be invested in electricity generation capacity between now and 2030. [iii] Decisions that the electricity sector makes today, and over the next few years, 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[iv] 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.

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Figure 1: Development of global electricity generation under reference scenario

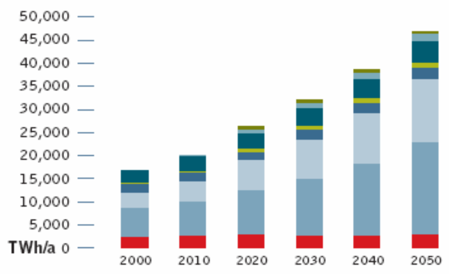
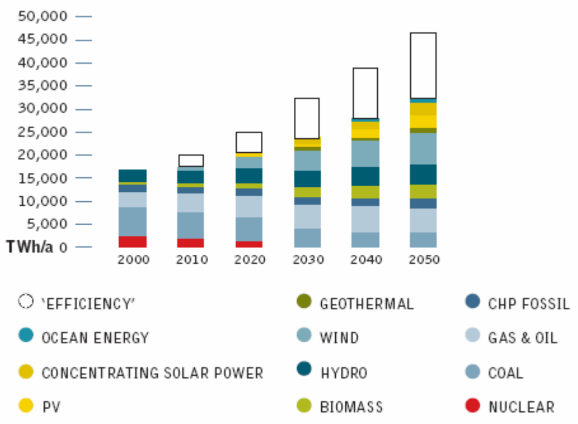


Figure 2: Development of global electricity generation under Energy [R]evolution Scenario



The Energy Revolution scenario shows that by sustaining the current double-digit growth rate of the global renewable energy industry over the next two decades, increasing the use of combined heat and power and introducing high technical efficiency standards for all energy consuming appliances, it is possible to generate sufficient electricity for a globally growing economy. This equates broadly with the demand for energy projected by the International Energy Agency (IEA). There is enough technically accessible renewable energy to deliver current world power demands six times over – and indefinitely.[v]

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.

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[vi] currently supply around 15 per cent of global electricity. This represents only 6.5 per cent of world’s overall energy consumption[vii]. 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 five 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 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 doubled 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 five.) 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, or perhaps more.

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

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

Reactors

The probability of serious reactors accidents leading to widespread radioactive contamination is significantly higher than the chance to win a national lottery, even with the most modern reactors. Accidents will happen: the Windscale fire of 1957, Three Mile Island in 1979, Chernobyl in 1986 and Tokaimura in 1999 are only a few of the hundreds of nuclear accidents that have occurred.

The worst accident, at Chernobyl, in the Ukraine, contaminated an area larger than 120,000 square kilometers and areas as far as 4,000 km away, including Lapland and Scotland. The precise death toll will never be calculated but is in the order of tens of thousands of fatalities and millions of crippled lives. Chernobyl's economic impacts are estimated to be in the order of US $2,000 billion.

Recent reactor designs rule out a repeat of a Chernobyl-style accident. But other scenarios involving different reactor types may have consequences on a similar scale. What is alarming is that the nuclear industry does not have 100 per cent trust in the safety of its reactors. In many countries, the industry has been successful in pushing through legislation that limits its liability for external damage resulting from a serious nuclear accident. The level of compensation which a power company would be obliged to pay to citizens in the event of an accident has been limited to as little as US $200 million in many countries. Insurance companies commonly exclude cover for the impacts of nuclear accidents.

Waste

Nuclear power produces large volumes of nuclear waste. The most hazardous category - high level waste - includes spent nuclear fuel and the contaminated reactor itself. An average nuclear reactor produces 20-30 tonnes of spent fuel each year and roughly 200,000 tonnes of spent fuel have accumulated worldwide. This is a mixture of extremely dangerous radioactive elements that will remain deadly for tens of thousands of years. The International Atomic Energy Agency says that the waste needs to be stored safely for 90,000 years. No reliable way of handling waste has been discovered even after billions of dollars of investment and decades of research in many countries.

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

Iran and North Korea are stark examples of uranium enrichment facilities and civilian nuclear reactors producing materials that can be used for constructing nuclear weapons.

One tonne of spent nuclear fuel typically contains about 10 kilograms of plutonium – enough to build one nuclear bomb. Plutonium will remain in the waste for tens of thousands of years. Experiments by the US government have proven that several nuclear weapons can be built in a matter of weeks using ordinary spent fuel from light water reactors. In France, there is no separation between military and civil nuclear programmes.

The list of non-nuclear countries that have announced plans to gain access to nuclear technology and build nuclear reactors is as long as it is disturbing: Italy, Portugal, Norway, Poland, Belarus, Ireland, Serbia, Estonia, Latvia, Turkey, Iran, Gulf states, Yemen, Israel, Syria, Jordan, Egypt, Tunisia, Libya, Algeria, Morocco, Nigeria, Ghana, Namibia, Azerbaijan, Burma, Georgia, Kazakhstan, Chile, Venezuela, Bangladesh, Indonesia, Philippines, Vietnam, Thailand, Malaysia, Australia and New Zealand.

It is virtually impossible to ensure that all these countries enforce and maintain sufficiently strong safeguards on nuclear materials and technologies. There is serious risk that organised terrorist groups, or governments or state institutions divert them for military purposes.

Civilian reactors are also potential targets for terrorist groups, such as Al-Qaida. 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.

Two Recent Examples of “Nuclear Renaissance”

Two current projects in Europe illustrate the complex problems of the much-vaunted “nuclear renaissance”: the flagship European Pressurised Reactor (EPR) reactor, delivered by Areva to Finland, and the revival of the Mochovce power plant in Slovakia, by Italy’s ENEL.

Olkiluoto 3 / Areva:

French nuclear engineering company Areva developed, and is selling, its new 1,600 MW flagship EPR 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.

Areva’s publicity material in 2005 says: "The EPR is the direct descendant of the well proven N4 and KONVOI reactors, guaranteeing a fully mastered technology. As a result, risks linked to design, licensing, construction and operation of the EPR are minimised, providing a unique certainty to EPR customers."

Since construction of first EPR reactor started in Finland in spring 2005, however, the project has constantly been plagued by failure 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 stagnation in 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.

Mochovce 3&4 /ENEL:

The Mochovce 3 & 4 nuclear power plant is perhaps the most outdated project of its kind anywhere in Europe. It consists of two 440 MWe reactors designed in the Soviet Union back in the 1970s. This is why it lacks crucial safety systems introduced after the Chernobyl disaster of 1986. The most visible deficiency is the entire lack of "containment" – the solid structure above the reactor intended to prevent radioactivity escaping to the environment and to protect the reactor from external accidents such as an aeroplane crash.

The new owner of this unfinished project – the Italian utility ENEL – plans to complete the two reactor blocks and have them operating sometime after 2012. No western European country would now allow a reactor of this type to be constructed and brought on line.

The story is made all the more obscene given the Italian plebiscite, in 1987, which decided in favour of shutting down all of Italy's reactors on the grounds of safety concerns. Twenty years later, a Italian utility, with the Italian government as its largest owner, and controlling over 30 per cent of its shares, plans to build what is perhaps the most risky nuclear project in Europe.

In addition to safety aspects, other serious concerns concerning Mochovce 3 & 4 are the lack of legitimacy of in its approval process and its poor economics. The intention is to complete the project based on a permit issued by Communist decision makers in 1986, in which there was no public participation or a proper environmental impact assessment process. Due to its high financial investment risks, the Slovak state that has been pushing the project forward and is providing ENEL with generous benefits and support which include financial mechanisms that may constitute illegal State Aid under EU legislation.

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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] Kovats,R.S., and Haines, A., *Global Climate Change and health: Recent Findings andFuture Steps.* Canadian Medical Association Journal 15th February 2005; p172

[iii] Reference Scenario according to International Energy Agency World Energy Outlook 2004

[iv] 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

[v] ISES/Dr. Stradman/Dr. Nitsch

[vi] IAEA Power Reactor Information Systam, http://www.iaea.org/programmes/a2/

[vii] International Energy Agency, World Energy Outlook 2006

[viii] trillion (1,000,000,000,000) is a thousand billion

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