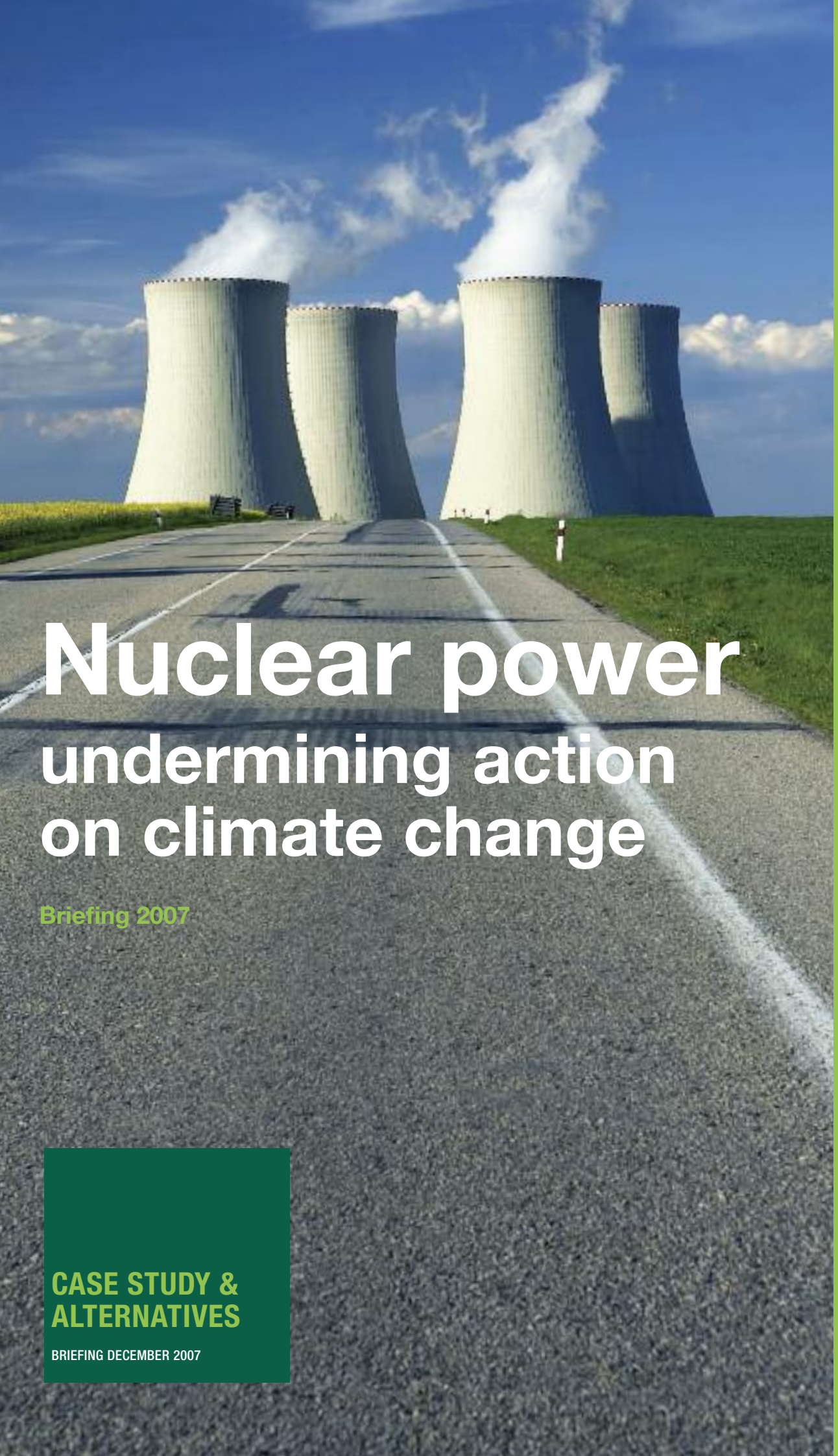

Nuclear power
undermining action on climate change

Briefing 2007

CASE STUDY & ALTERNATIVES

BRIEFING DECEMBER 2007

GREENPEACE

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Nuclear power
undermining action on climate change

Introduction

"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[1]

There is a clear scientific consensus that we must halve global carbon dioxide (CO_2) emissions by 2050 or suffer changes to the global climate with catastrophic consequences. Avoiding the most severe impacts of climate change requires governments, individuals and businesses world-wide to take immediate action.

Some US $7 trillion are projected to be invested in new electricity generation capacity between now and 2030.[2] The energy investment decisions taken today will determine whether or not the world achieves the necessary CO_2 emission cuts in time.

The nuclear industry, which has been in decline in the US and Europe, has seized upon the climate crisis as a revival opportunity, claiming to offer a carbon-free contribution to our future energy mix.

Nuclear power is an expensive and dangerous distraction from the real solutions to climate change. Greenhouse gas reduction targets can only be met through using the proven alternatives of renewable energy technologies and energy efficiency. Every dollar spent on nuclear power is a dollar stolen from the real solutions to climate change.

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image The dark clouds of an advancing tornado, near Fort Dodge, Iowa, USA. As studied and filmed by the Center of Severe Weather Research (CSWR), USA.

Nuclear power
undermining action on climate change

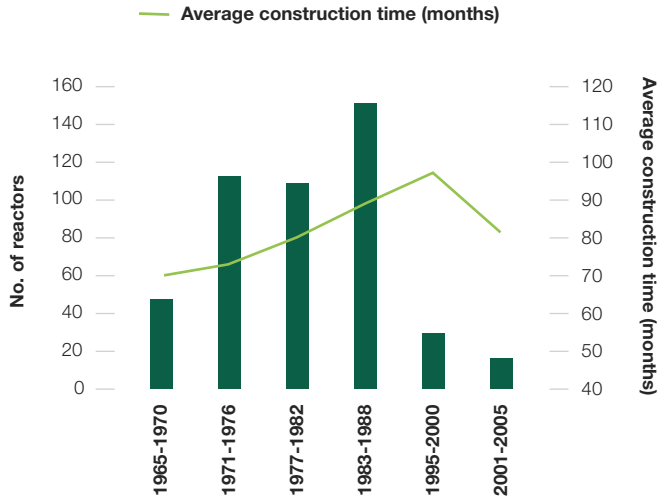
Too little and too late

Nuclear power could at best make only a negligible contribution to CO_2 reduction; even then many years after massive cuts are needed and only by depriving real climate solutions of funding.

Currently 439 commercial nuclear reactors[3] supply around 15 percent of global electricity, providing only 6.5 per cent of overall energy consumption.[4] Even if today's current installed nuclear capacity was doubled it would lead to reductions in global greenhouse gas emissions of less than five percent and would require one new large reactor to come online every two weeks until 2030. An impossible task: even in countries with established nuclear programmes, planning, licensing and connecting a new reactor to the grid typically takes more than a decade. Worldwide, plans for more than 200 new reactors have been announced; even under the most optimistic conditions, only a small fraction of these would be able to generate electricity before 2020.[5]

In stark contrast, proven renewable energy technologies are available now, can be constructed and brought on-line quickly and provide immediate cuts in greenhouse gases. For example, construction time for installing a large wind turbine has fallen to only two weeks, with an associated planning period of between one and two years.

Figure 1 Construction time of nuclear power plants worldwide



Source: Clerici (2006): European Regional Study Group, the Future Role of Nuclear Energy in Europe, World Energy Council, Alexandro Clerici, ABB Italy, 13th June 2006 and for post-2000 figures, calculation based on PRIS database, http://www.iaea.org/programmes/a2/index.html

Nuclear an expensive distraction

Investment in nuclear power stations is highly capital intensive and risky. Current forecast figures and construction schedules being provided by the nuclear industry to investors and governments are not supported by historical or even current experience. In India, for example, completion costs for the last 10 reactors have been on average three times over budget. The Olkiluoto 3 reactor under construction in Finland is already over budget (see Case Study).

Alternatively, The Energy [R]evolution Scenario, commissioned by Greenpeace and the European Renewable Energy Council (EREC) (see page 6 for more information) outlines a sustainable energy pathway, phasing out nuclear power and fossil fuels, that would produce an average annual fuel cost savings 10 times greater than the additional investment cost required for the necessary renewable energy technologies and energy efficiency measures.

There is an investment choice to be made. The investment required to double global nuclear capacity, reducing greenhouse gas emissions by less than 5 percent – would be between two and three trillion US dollars.[6] And as Amory Lovins from the US Rocky Mountain Institute calculates:

"Each dollar invested in electric efficiency displaces nearly seven times as much carbon dioxide as a dollar invested in nuclear power, without any nasty side effects."[7]

200 BILLION USD

CAN BE AVOIDED EVERY YEAR ON FUEL COSTS, BY USING RENEWABLE ENERGY AND ENERGY EFFICIENCY TO GENERATE ELECTRICITY.[8]

1.5 BILLION EUROS

CURRENT COST OVERRUN FOR CONSTRUCTION OF A NEW REACTOR IN FINLAND WHICH IS STILL FOURS YEARS FROM COMPLETION.

Nuclear power
undermining action on climate change - continued

Case Study: Olkiluoto 3 (OL3), the European Pressurised Water Reactor in Finland

The flagship of the so-called "nuclear renaissance", the European Pressurised Water Reactor (EPR), being built in Finland, clearly illustrates the fallacy of using nuclear power to meet the climate challenge.

The International Energy Agency (IEA) warned against the risk of relying on the new reactor for emission cuts, saying in 2004 that any delays would inhibit Finland's ability to meet its greenhouse gas reduction targets under the Kyoto Protocol.[9] That risk has become a reality.

In August 2007, after 27 months of construction, the project was officially declared to be between 24 and 30 months behind schedule and at least EUR 1,500 million (US $2,230 million) over budget. Unlikely to be operational before 2011, OL3 will not be ready in time to contribute to Finland's Kyoto target.

According to former Finnish environment minister, Satu Hassi MEP, once the decision was made to build OL3, the country lost interest in renewable energy sources.[10]

The decision on OL3 was made at a time when new renewables, especially wind, had come of age and significant growth was projected. Projected figures have not been realised, largely because the power market is blocked by OL3, which represents 85% of the country's planned investments in new power generation between 2006 and 2010[10] (See Figure 2). Similarly, we can see in Figure 3 that the commissioning of four nuclear reactors in 1977-1980 led to a standstill in the development of combined heat and power. And the decision for OL3 is already having the same impact.

Contrary to promises that the EPR would be significantly safer, more reliable, cheaper and faster to build than earlier reactors, the project is late, over budget and has failed meet mandatory Finnish quality and safety standards. Problems have been reported with the concrete base slab, the reactor vessel, the pressuriser, and the primary cooling piping as well as with the steel liner of the reactor. All of which could have significant consequences in the case of an accident.[12] As of May 2007, the nuclear safety authority STUK had reported 1,500 quality and safety defects with the EPR project.

The Finnish lesson is clear. Nuclear power can not deliver CO_2 reductions in time, it undermines investment in clean renewable energy and energy efficiency and poses unacceptable health and safety risks.

Figure 2 Impact of OL3 on wind power?[13]

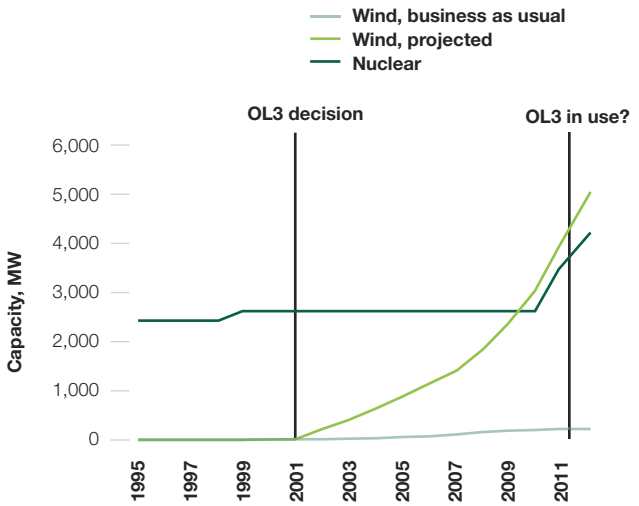
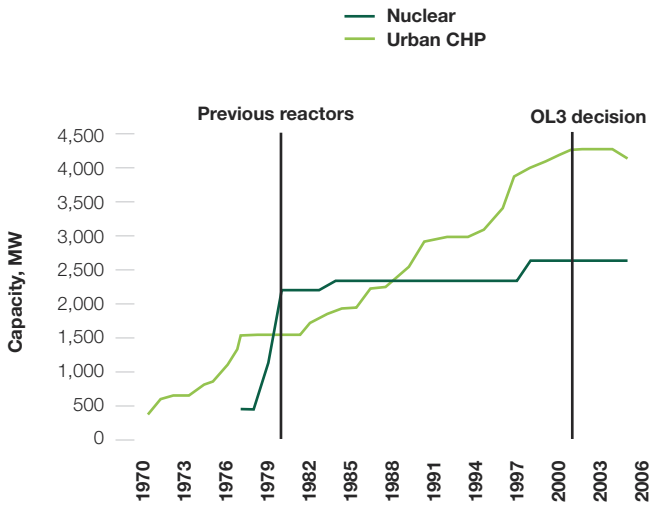


Figure 3 Impact of nuclear construction on Finnish Combined Heat and Power market.



200,000 TONS

APPROXIMATE AMOUNT OF HIGHLY RADIOACTIVE SPENT NUCLEAR FUEL ACCUMULATED WORLDWIDE, FOR WHICH THERE IS NO SAFE SOLUTION.

235,000 PEOPLE

EMPLOYED IN THE GERMAN RENEWABLE ENERGY SECTOR IN 2006, AN INCREASE OF 50% ON THE PREVIOUS TWO YEARS.[14]

image Bashakul, near the Mayak nuclear complex: Kostia Nekharasnov has Down's syndrome, and for eight years his sister Natalia has suffered from a brain tumour. Their mother swam in the radioactively contaminated river Techa when she was a young woman.

A health, safety and security hazard

To propose nuclear expansion in the name of climate change is effectively adding one uncertain, potentially catastrophic health, environmental and security threat to another. Nuclear power poses an unacceptable health, safety and security risk. In fact, as climate change impacts increase, so too do the safety risks associated with nuclear power. For example, because nuclear power requires large amounts of water for cooling, more frequent droughts in a climate changed world will mean less water available to cool the reactor, leading to lower reliability and outages as nuclear plants will be forced into shut-down.

Nuclear power expansion increases the risk of an accident

Accidents happen at nuclear sites all the time. The Chernobyl accident, the worst to date, contaminated an area larger than 120,000 square kilometres and contamination was found as far away as Lapland and Scotland. The precise death toll will never be known, but may be more than one hundred thousand.[19] Chernobyl's economic impacts are estimated to be in the order of hundreds of billions US dollars. An accident in a much larger and more complex reactor, like the EPR, could have even more devastating consequences.[20]

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

There is no safe solution to dealing with the dangerous radioactive waste produced by nuclear power, in spite of billions of dollars of investment and decades of research. An average nuclear reactor produces 20-30 tonnes of highly radioactive spent fuel each year, which remains radioactive for hundreds of thousands of years.

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

One tonne of spent nuclear fuel typically contains about 10 kilograms of plutonium – enough for a crude nuclear bomb. 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. One study showed that a country with a minimal industrial base could quickly and secretly build a small reprocessing facility, called a 'quick and dirty' plant, capable of extracting about a bomb's worth of plutonium per day from spent reactor fuel. The facility would be no longer than 40 metres and could start operation six months from start of construction.[21]

The list of non-nuclear countries that have recently announced plans to gain access to nuclear technology and build nuclear reactors is long and disturbing.[22] Despite extensive efforts, treaties and political mechanisms designed to safeguard nuclear materials and technology, it remains an impossible task. Mohamed El Baradei, head of the International Atomic Energy Agency, responsible for the international 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".[23]

Civilian reactors and nuclear waste transports add another frightening dimension to the nuclear threat as they are attractive targets for terrorist groups.

Box 1 Nuclear power and the developing world[15]

Developing countries were clear in their rejection of nuclear power as part of the Clean Development Mechanism (CDM - a mechanism under the Kyoto protocol that allows industrialised countries to invest in CO_2 emission reduction projects in developing countries as a contribution towards their own domestic CO_2 emission reduction targets).[16]

Nuclear power plants are too large and electricity grids incompatible – Developing countries do not have the high-voltage grids required for large-capacity power stations. Such transmission networks are expensive and of little use in sparsely populated countries. In densely populated countries with emerging economies, long construction lead times mean nuclear power could not keep pace with increasing demand. A diverse and decentralised mix of renewable energy is a much more effective and cleaner means to meet different energy needs quickly.

Nuclear power increases national debt – Nuclear power stations built in developing countries add significant amounts to national debt. In the Philippines, the Bataan plant, which has never been used, was for the last twenty years the country's largest item of overseas debt. The final payment was made this year, almost 32 years after work began.[17] Twenty years since construction began, the Atucha II reactor in Argentina is still not finished despite a one billion US dollar price tag.[18]

One third of the planet's population, some two billion people, have no access to basic energy services. For these people, nuclear power is too big, too expensive and simply incompatible with their electricity grids.

Nuclear power
undermining action on climate change - continued

Renewable energy & energy efficiency - the only option

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 [R]evolution" scenario[24] 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, it is based on credible and proven renewable energy technologies and energy efficiency. It includes both a nuclear and a fossil fuel phase out.

The Energy Revolution scenario shows that by sustaining the current double-digit growth rate of the renewable energy industry, increasing the use of combined heat and power and introducing high efficiency standards for cars, buildings and all energy consuming appliances, it is possible to generate sufficient electricity for a globally growing economy, without throwing the climate into chaos.

Figure 4 Development of global electricity generation under reference scenario

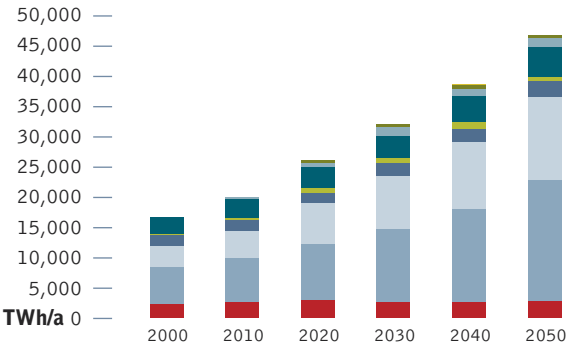
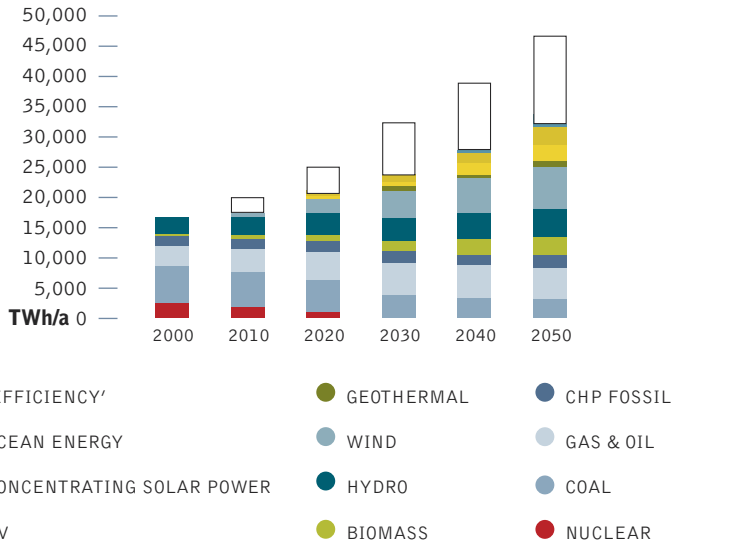


Figure 5 Development of global electricity generation under Energy [R]evolution Scenario



1 Kofi Annan, Secretary-General of the United Nations, "Climate change is not just an environmental issue", The Independent, 9th November 2006, page 39.

2 Reference Scenario according to International Energy Agency World Energy Outlook 2004.

3 IAEA Power Reactor Information System, http://www.iaea.org/programmes/a2/

4 International Energy Agency, World Energy Outlook 2006. However, other analysis by the International Institute for Applied Systems Analysis (IIASA) shows that nuclear power represents only 2.2% of world energy consumption. This is because the IIASA considers the electric output of a nuclear plant a primary energy source. The IEA on the other hand considers heat the primary energy source and then assumes a 33% efficiency. Consequently, the value in primary energy of a kWh of nuclear power produced today according to IIASA's methodology is roughly one third of that of the same kWh according to the IEA methodology.

5 World Nuclear Association country briefings on www.world-nuclear.org

6 Trillion (1,000,000,000,000) is a thousand billion. To double the existing capacities by 2030 would require building at least 500,000 MW of new nuclear capacity, to both replace retiring plants and add new capacity. If we take the most recent experience from Olkiluoto-3 as a reasonable price tag, we get construction cost of 4,300 USD/kW. Moody's analysis gives low estimate at 5,000 and high at 6,000 USD/kW. (New Nuclear Generation in the United States: Keeping Options Open vs Addressing An Inevitable Necessity, Moody's Investor Services, October 10th 2007). Hence: 500,000,000 kW x 4,300 USD (low) = 2.15 trillion, 500,000,000 kW x 6,000 USD (high) = 3 trillion

7 Guardian 12th August 2004, "Nuclear Plants Bloom" by John Vidal, ttp://www.guardian.co.uk/life/feature/story/0,,1280884,00.html

8 Energy [R]evolution-A Sustainable World Energy Outlook, Greenpeace and European Renewable Energy Council, January 2007- http://www.greenpeace.org/international/press/reports/energy-revolution-a-sustainab

9 International Energy Agency, Energy Policies of IEA Countries; Finland 2003 review (http://www.iea.org/textbase/nppdf/free/2000/finland2003.pdf), IEA, 2004.

10 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.

11 Data until 2006 Statistics Finland: Energy Statistics 2006. Nuclear capacity beyond 2006 based on the assumption that OL3 enters into production in mid-2011. Wind power projection before OL3 decision Electrowatt-Ekono 2001: Tuulivoiman mahdollisuudet Suomessa [Prospects of Wind Power in Finland]. Wind business as usual based on Pöyry Energy 2007: Tuulivoimatavoitteiden toteutumisnäkymät Suomessa [Outlook on Meeting Wind Power Targets in Finland].

12 Statistics Finland: Energy statistics 2006.

13 In the case of the concrete base slab, the high water content could, under accident conditions, lead to rapid crack formation. The substandard quality of the reactor's steel liner could mean increased radioactive releases in the case of an accident. Safety Implications of Problems in Olkiluoto, prepared for Greenpeace by Dr Helmut Hirsch, May 2007.

image Photovoltaics facility at 'Wissenschafts und technologiezentrum Adlershof' near Berlin, Germany. Sheep between the 'movers' keeping the grass short.

Greenpeace Recommendations

The world must get on a course to stay as far below a two degree Celsius temperature rise as possible. That course can only be reached by employing sustainable renewable energy and energy efficiency. Nuclear power is not part of the climate solution but an expensive and dangerous distraction.

- Global greenhouse gas emissions must peak and decline by 2015 and be halved by 2050.
- Binding commitments are needed for industrialised countries to cut emissions by 30% in 2020 and 80% in 2050, with domestic measures, and to direct massive funds for decarbonisation in developing countries.

An end to the nuclear age:

- Phase out existing reactors.
- No new construction of commercial nuclear reactors.
- Stop international trade in nuclear technologies and materials.
- Phase out all direct and indirect subsidies for nuclear energy.

A renewable energy future:

- Divert state funding for energy research into nuclear and fossil fuel energy technologies towards clean, renewable energy and energy efficiency.
- Set legally-binding targets for renewable energy.
- Adopt legislation to provide investors in renewable energy with stable, predictable returns.
- Guarantee priority access to the grid for renewable generators.
- Adopt strict efficiency standards for all electricity-consuming appliances.

14 German government press release 17th September 2007: http://www.bmu.de/english/current_press_releases/pm/40029.php

15 With thanks to The Greens and European Free Alliance in the European Parliament for much of the information in this section from their fact sheet " Nuclear power will not save our climate: 40 facts and arguments".

16 The mechanism laid down in Article 12 of the Kyoto Protocol describes the policies whose benefits are shared out among the countries of the northern and southern hemispheres. The aim is to assist southern-hemisphere countries 'in achieving sustainable development and in contributing to the ultimate objective of the Convention' (Article 12.2.). These activities should have 'real, measurable and long-term benefits' (Article 12.5.b). The rejection of nuclear power in the CDM is given concrete expression by the commitment of all the northern hemisphere countries not to resort to CDM for projects based on the use of nuclear energy. In view of the decision-making system that applies, via the CDM Board, this essentially means that nuclear power will be ruled out for the next decade at least.

17 http://www.abs-cbnnews.com/topofthehour.aspx?StoryId=80742

18 "CNEA[the National Atomic Energy Commission of Argentina] reports that the debt is composed as follows: US$100 million to Siemens, US$902 million to German banks, and US$80 million to different investors. The result is a grand total of US$1,08 billion." http://www10.antenna.nl/wise/index.html?http://www10.antenna.nl/wise/618/5651.php

19 Estimations of the death toll vary. The IAEA's estimates 4000 whereas a Greenpeace study found figures of approximately 93,000 fatal cancer cases caused by Chernobyl in Belarus and during the last 15 years, 60,000 additional fatalities in Russia because of the Chernobyl accident. The Chernobyl Catastrophe - Consequences on Human Health, Greenpeace, 2006, http://www.greenpeace.org/international/press/reports/chernobylhealthreport

20 Assessments of the radiological consequences of releases from proposed epr/pwr nuclear power plants in France, John Large, for Greenpeace France, 3rd February 2007.

21 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.

22 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.

23 Spiegel Magazine 8 Dec 2005: Keeping the World Safe from the Bomb.

24 Energy [R]evolution-A Sustainable World Energy Outlook, Greenpeace and European Renewable Energy Council, January 2007- http://www.greenpeace.org/international/press/reports/energy-revolution-a-sustainab

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