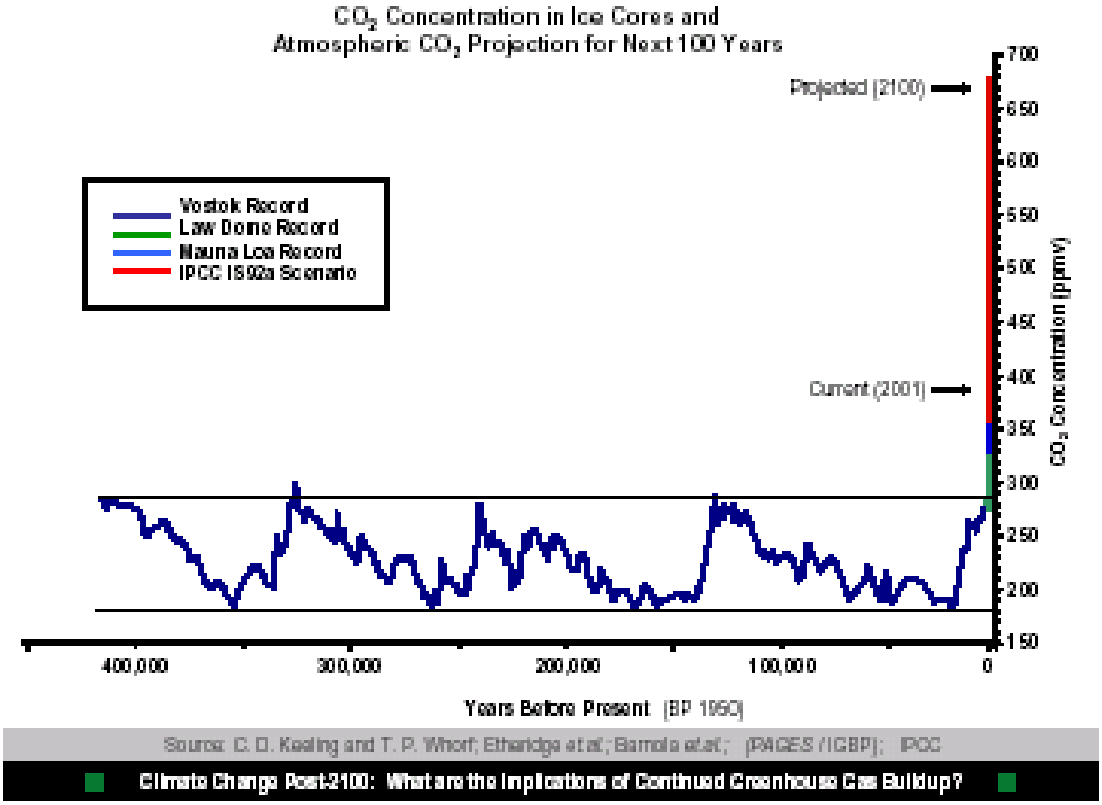
SET 2
Climate Change

Content

Authors:
Ing. Antonia Wenisch, DI Markus Meissner
Austrian Institute for Applied Ecology
Seidengasse 13, 1070 Vienna, Austria
www.ecology.at

Will Nuclear Power meet the challenge of Climate change?

"Atmospheric indicators show that the concentration of carbon dioxide (CO_2) of the lower atmosphere has increased from its pre-industrial concentration of 280 ppm (parts per million) to its 2003 concentration of 375 ppm. This is the highest level in the last 500 000 years. At the same time, the climate in most parts of the world, including Europe, is warming. The global average temperature has increased by about 0.7 °C and the European average temperature by 0.95 °C in the last hundred years. It is estimated that temperatures will further increase by 1.4–5.8 °C globally and 2.0–6.3 °C in Europe by the year 2100. Precipitation patterns show a more varied picture. Recently, central and northern Europe have received more rain than in the past. In contrast, southern and southeastern Europe have become drier. These changes are projected to continue in the future. In addition, extreme weather events, such as droughts, heat waves and floods, have increased while cold extremes (frost days) have decreased." (EEA REPORT 2/2004).



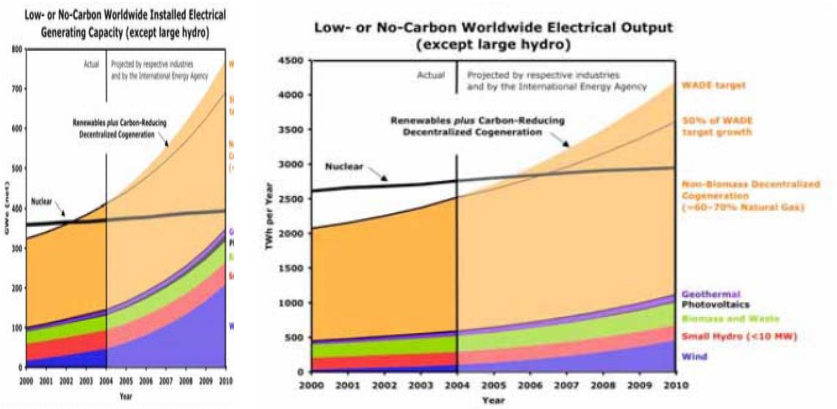
picture 1: CO_2-concentration in various ice cores over the last 400.000 years and the projected concentration for the year 2100 (MOORE 2004)

The limitation of increase of global mean temperature to 2°C above pre-industrial levels is widely seen as a thresholds for prevention of unacceptable consequences to nature and human societies. In order to be in 2050 on the safe side, greenhouse gas concentration must be limited to 400 ppm CO_2 equivalent, with the consequence greenhouse gas emissions have to be decreased by about 50% compared to 1990 level! For the industrialized countries the reduction target is 80 %. (MATTHES 2005)

The decay of CO_2 in the atmosphere is a slow process. The impact of today's CO_2 emission reduction will be visible only after decades. If we want to prevent the worst we have no time to loose. The reduction measures have to be effective and fast to implement. Can nuclear power be part of these measures?

Similar to all other energy suppliers the nuclear industry combats for its market share. Every blackout, oil crisis, or gas supply problem is used as an argument in its public relation campaign. In the last months politicians (Blair, Chirac) promoted the nuclear renaissance as a powerful contribution to minimize CO_2 emissions. European media opened the discussions on this issue (BBC News from Nov. 2005 on, DPA 05.01.06, Profil Feb. 2006)

"Nuclear power is often described as a big, fast and vital energy option—the only practical and proven source big and fast enough to do much to abate climate change. Yet industry and government data tell the opposite story. Nuclear power worldwide has less installed capacity and generates less electricity than its decentralized no- and low-carbon competitors—one-third renewables (excluding big hydroelectric dams), two-thirds fossil-fueled combined-heat-and power. In 2004, these rivals added nearly three times as much output and six times as much capacity as nuclear power added." (LOVINS 2006)



picture 2: Installed capacity and produced electricity (LOVINS 2006)

Worldwide, low- and no-carbon decentralized sources of electricity surpassed nuclear power in capacity in 2002 and in annual output in 2005. In 2004 their increment was three times higher then for the nuclear power. (Large hydro, over 10 MWe, isn't shown in these graphs) The post-2004 forecasts or projections shown are industry's and are imprecise but qualitatively clear.

Moreover LOVINS (2006) points out the enormous importance of improving energy efficiency:

"These comparisons don't count more efficient use of electricity, which isn't being tracked, but efficiency gains plus decentralized sources now add at least ten times as much capacity per year as nuclear power."

At the moment the majority of operating nuclear power plants are outdated, aged plants. New plants (most of these under construction in Asia) are so-called advanced reactors, like the evolutionary Light Water Reactor (LWR), which share a lot of flaws with the actual operating plants with the result that this plants will not be substantially safer. In Europe only one of these is under construction: the Fifth Finnish reactor a 1600 MW EPR (European Power Reactor) which is the European prototype for an advanced PWR – it should be in operation in 2009.

OECD forecast indicate only a slow growth of nuclear power by 2030 – with a net growth rate of only 600 MW annually (MATTHES 2005). In 2030 the nuclear industry hopes to get forward with their Generation IV reactors. Generation IV International Forum (GIF) is a joint research program for new nuclear energy systems with enhanced safety features, breeding of fissile materials, including re-use of fuel and reprocessing. Based on this new nuclear energy system the nuclear industry promises a carbon free power system (SCHULENBERG 2004).

The nuclear industry wants to handle the lack of power supply that is created through the moderate net growth rate and the readiness for use of GIF in 2030 by PLEX. But common energy policy is now on a crossroad where it has to decide whether nuclear fission could be part of a sustainable energy future or not. Since there is not much time to develop new technical solutions for the fuel chain and uranium is a non renewable material we are convinced, that it is much more efficient in terms of abatement of global warming to deploy existing and develop new safe & cheap solutions: improving efficiency and renewable energy resources.

Freedom from carbon emissions is no sufficient argument for nuclear power, because renewables and end-use efficiency provide the same attribute at much lower cost, and co-generation does so partially; a fossil-fueled co-generator that saves, for example, half as much carbon per kWh and costs half as much per kWh as a zero-carbon resource thereby saves carbon at the same cost per ton. Nuclear power can not significantly contribute to abating global warming because its too time consuming in construction and too expensive to provide the needed capacities.

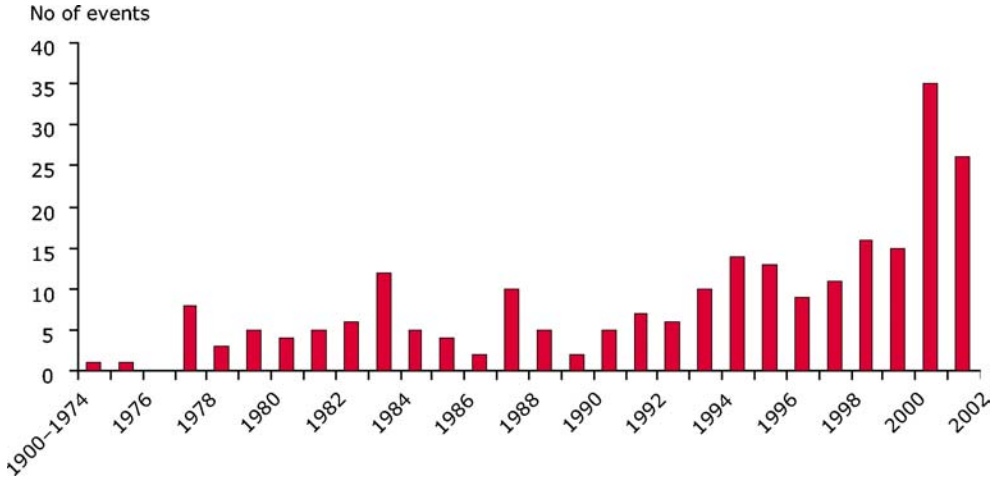
> Buying a costlier option, like nuclear power, instead of a cheaper one, displaces less carbon per dollar spent. This opportunity cost is an unavoidable consequence of not following the least-cost investment sequence: the order of economic priority is also the order of environmental priority. (LOVINS 2006)

Climate change is a safety risk for aging nuclear plants

Adverse weather and climate related events have increased significantly during the past 20 years. The average number of annual disastrous weather and climate related events in Europe doubled over the 1990s compared with the previous decade, while non-climatic events such as earthquakes remained stable. In Europe 64 % of all catastrophic events since 1980 are directly attributable to weather and climate extremes like floods, storms, droughts and heatwaves. Climate change projections show an increasing likelihood of extreme weather events. (EEA REPORT 2/2004)

Licensing of nuclear installations is based on external events. External events are directly or indirectly affected by climate change. Since intensities and frequencies of extreme meteorological events have already changed and will change further over the next decades a re-assessment of the license concerning external events in connection with PLEX is required. (KROMP 2005)

Between 1975 and 2001, 238 flood events were recorded in Europe. Over this period the annual number of flood events clearly increased. Climate change is likely to further increase the frequency of extreme flood events in Europe (WHO-ECEH 2003).



picture 3: Number of European flood events between 1976 and 2002 (WHO-ECEH 2003)

As reported at least during the flooding which destroyed New Orleans NPPs have to be shut down during flood events. Several NPPs in central Europe are located near rivers (e. g. Paks), higher water levels and more flooding events reduce the safety margins of these ageing plants.

Heatwaves are projected to become more frequent and more intense during the twenty-first century. (EEA REPORT 2/2004) Heatwaves and droughts in the last years have caused the shutdown of several nuclear plants in Southern Europe – meaning that NPPs are not able to produce electricity when cooling is required.

Heavy storms or heavy snowfall can not only damage high-voltage lines, but also ventilation stacks and cooling towers, which also cause the immediate shutdown of a NPP. (NNI 2005)

PLEX licensing processes have to consider climate change. If NPPs shall be operated during the next 30 years they must be reconstructed in order to be safe in a changing environment. The French nuclear authority has recognised this problem in its third report to the Convention on Nuclear Safety:

"*What is striking about 2003, is that in a single year nuclear installations were affected by two types of extreme weather conditions: the heat wave and drought in the summer followed by flooding in the autumn. In the first case, safety was not at issue, in that none of the safety-related operating limits in the installations was reached or exceeded, but* ***release temperature limits, which may affect the environment had to be temporarily modified to allow plant operation to continue and avoid power cuts****. In the second case, safety was not at issue either. It is clear that the work done following the late 1999 flooding on the Blayais NPP has borne fruit, since no nuclear installation was actually flooded. However, the exceptional flow rates of the rivers and the materials they were carrying led to clogging of water intakes at two plants, requiring EDF to shut down four units as a precautionary measure. The probable rise in the number of such weather events in the coming years means that even greater emphasis will have to be placed on prevention of their potential consequences. Generally speaking, national and international operating feedback is showing weather-related problems the scale, frequency and nature of which raise questions concerning the initial design of the installations. Thus, certain exceptional phenomena, whether or not related to climate change, are causing EDF and the ASN to be particularly vigilant on this subject. Hazards related to storms, snow, tornadoes, heat sink drying up, frazzle ice, high heat sink water temperature, high air temperature, lightning and forest fires will be reassessed within the framework of the third ten-yearly outages for the 900 MWe series." (CNS F NR 2004)*

Scientific progress must be followed by licensing requirements

In the last couple of years the field of evaluation of seismic hazards was under rapid development new insights and experiences were gained and new methods developed. As seismic events also can potentially lead to severe accidents with large radioactive releases the design of NPPs has to be re-assessed concerning seismicity. The scientific progress has to be taken into account and it is of particular importance that all investigations and analyses correspond to the most recent state-of-the-art.

A licence for PLEX should only be issued if all necessary reconstruction has been done. The actual state-of-the-art concerning seismicity is represented in the latest IAEA publications (of 2002 and 2003), whereas determination of site seismicity in old NPPs is on the level of knowledge of the early 1990s, as compiled in the IAEA Safety Guide of 1991 (e.g. PAKS). (UBA 2005).

Glossary

EEA	European Environmental Agency	NNI	No Nukes Infosource
EPR	European Power Reactor	NPP	Nuclear Power Plant
FZKA	Forschungszentrum Karlsruhe	PLEX	Plant life Extension
GIF	Generation IV International Forum	PWR	Pressurized Water Reactor
IAEA	International Atomic Energy Agency	UBA	Umweltbundesamt
IEA	International Energy Agency	UNFCCC	United Nations Framework Convention on Climate Change
LWR	Light Water Reactor		

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Coming up: PLEX Case Studies