Confronting a False Myth of Nuclear Power:
Nuclear Power Expansion is Not a Remedy for Climate Change
Commission on Sustainable Development, United Nations

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May 3, 2006 New York— Nuclear power is being widely promoted as a "solution" to global climate change. Unfortunately nuclear power is not a solution and it is further counterproductive to any real remedy for human impacts on climate.[3] Those selling the expansion of nuclear power are on a par with any salesman of counterfeit medicine; one must closely examine the motives of anyone associated with nuclear schemes of any kind.[4]

In the service of this disinformation campaign U.S. Vice President Cheney has publicly stated[5] a falsehood: he asserted that nuclear power is carbon-free. Nuclear power is not free from carbon emissions. A number of recent studies have found that when mining, processing, and extensive transportation of uranium in order to make nuclear fuel is considered, the release of carbon dioxide (CO2) as the result of making electricity from uranium is comparable to burning natural gas to make electric power.[6] Additional energy required for decommissioning and disposition of the wastes generated increases this CO2 output substantially.[7]

Nuclear power is not only dependent upon fossil fuels for the production of uranium fuel, decommissioning, and the disposition of wastes generated: it is also dependent upon a grid that is powered by other sources of energy, typically coal. This is due to the simple fact that nuclear reactors cannot "black start"[8] – in other words, they depend on electric power from the external power grid to be able to come on-line. Transition away from the combustion of fossil fuels cannot be accomplished solely by the expansion of nuclear power since it depends on the grid being powered up before reactors can come on-line.[9]

A second false facet of the promotion of nuclear power as a "solution" hinges on the claim that nuclear energy is clean.[10] The implication: if you cannot see it, there is no pollution. In truth nuclear power can only operate because it enjoys some of the most lenient public "protection" standards in the world.[11] The destructive activity of radioactivity is to disrupt the structures of living cells, especially DNA.[12] The international regulatory regime for exposure to radiation results in an unfortunate level of human sacrifice. Considering only the exposure of "standard" adult males in the US civilian population to "permissible" levels of radiation, one official estimate of risk finds that of every 57 men exposed, one will suffer fatal cancer.[13] Obviously this same level of radiation exposure will produce more cancers in children and others who are more vulnerable[14]. US worker standards have recently been revealed to produce cancer in 1 in 4 workers.[15] Recent revelations of massive tritium releases from US reactors, contaminating groundwater in residential neighborhoods, exposes the lie that nuclear power is "clean."[16]

The vast majority of radioactivity in nuclear waste worldwide is from the production of electricity. Even in the United States, where for decades a robust nuclear weapons program operated, more than 95% of the total radioactivity is in waste from commercial nuclear power.[17] Reactor waste contains materials with half-lives measured in tens of thousands, and some in millions of years. More than 12,000 human generations -- are required to reduce the hazard of these materials to acceptable levels. The most concentrated waste is irradiated fuel from electric

power reactors, and the residual wastes from attempts to "recycle" or reprocess the fuel.[18] Other wastes include the entire massive reactor structure itself when the facility is shut down.[19]

In addition to radiological pollution, nuclear power also contributes massive thermal pollution to both our air and water.[20] It has been estimated that every nuclear reactor daily releases thermal energy –heat-- that is in excess of the heat released by the detonation of a 15 kiloton nuclear bomb blast.[21] In addition to horrendous direct impact of this heat on aquatic ecosystems, nuclear power contributes significantly to the thermal energy inside Earth's atmosphere, making it contraindicated at this time of rapid global warming.

A fundamental element in finding that nuclear power is a false solution to climate change is that the economics of nuclear power are not sound – in open markets nuclear cannot compete.[22] Since splitting atoms is not a cost-effective source of electric power, it is even less cost-effective in preventing greenhouse gas emissions. Life cycle costs for nuclear power generation (in the USA) have been estimated at 12 cents a kilowatt hour, whereas life cycle costs for wind power in the same analysis is estimated at 4 cents a kilowatt hour.[23] Others find that expanding nuclear generating capacity is about twice as expensive as expanding generating capacity through investment in wind power.[24] Since the same money will buy 2 -- 3 times more electric power when used to purchase wind generated electric power, it is clear that prevention of greenhouse emissions will also be 2 – 3 times greater when buying wind generated electricity.

Wind energy is the fastest growing form of electric power generation in the world.[25] This technology leads the portfolio of renewable energy options, and solar power is also making enormous strides with significant annual drops in cost of photovoltaic hardware.[26]

In the USA, the ongoing waste of electric power makes investment in energy efficiency[27] protocols and hardware an even more cost-effective way to reduce carbon emissions. Amory Lovins[28] finds that a combination of assertive efficiency programs combined with decentralized industrial cogeneration of electric power from waste heat results in 7 times more reduction of CO2 emissions than a comparable investment in expanding nuclear power. A comprehensive strategy for the USA – a real remedy for reducing greenhouse gases – is contained in the "Sustainable Energy Blueprint: A Plausible Strategy for Achieving a No-Nuclear, Low-Carbon, Highly Efficient and Sustainable Energy Future."[29]

The finding that nuclear energy is not profitable, that it is not compatible with public health, and that it releases massive heat directly contradicting climate goals, calls into question the basis upon which individuals, governments and corporations are seeking to invest public funds in nuclear expansion. Inquiring minds will ask if there is an additional agenda underlying this gambit to "revive" nuclear power. Before offering some conjecture about such motives, there remain several points about why nuclear power is not qualified to remedy our climate fever.

An extensive 2003 study by the Massachusetts Institute of Technology[30] investigated the future of nuclear power, including its potential to combat climate change. MIT's nuclear boosters project that expanding nuclear generating capacity worldwide to 1000 billion watts would be required to address the climate problem to any meaningful degree. This would roughly mean adding *one new reactor every two weeks* until 2050. In the USA, some of the last reactors to be built (Vogtle 1 & 2) cost more than $4 billion each! The industry has recently asserted that it will be possible to build reactors for $ 2 billion[31] -- ½ the previous actual figure; this however, is

speculative. Even taking the $2 billion industry "guestimate," it would require trillions of dollars to implement this supposed "fix." It is plain that a similar investment in efficiency in the USA and other energy-hog nations, and investment in wind energy worldwide would be a far more cost-effective use of capital. One can only imagine the results if a fraction of the residual funds were invested in technology development in solar, appropriate hydro, appropriate biomass and other sustainable power innovations!

The economic factors outlined above do not consider the considerable risk associated with operating facilities that are effectively pre-deployed nuclear weapons.[32] In the USA the prospective costs associated with such risks are effectively relegated to future victims.[33]

The financial analyses, as unfavorable as they are already, assume that splitting uranium is a bona-fide source of energy. There is the assumption that one does, in fact, achieve the production of new energy over and above the investment of energy required to create, fuel, and run the reactor. An in-depth analysis by Jan Willem Storm van Leeuwen and Philip Smith[34] challenges this assumption. These authors find that operating a nuclear power reactor does not always result in new power production. When all of the energy used to produce uranium fuel, build the reactor and decommission it (not including long term waste disposition) are considered, some of the scenarios show that no new energy is achieved – in some cases no matter how long the reactor is run! Outcome of the calculations is directly tied to the quality of the uranium ore used. Clearly it does not make sense to spend trillions of dollars on a technology that does not reliably produce the desired product – energy. Given the steep curve on technology costs associated with implementing hydrogen as a transportation fuel, using uranium as the base for producing hydrogen production may simply amplify this black-hole effect.

Storm and Smith show that uranium, similar to oil, is subject to a "peak" in the availability of high-grade uranium ores, and that these premium ores are already being exhausted. "Peak uranium" is a driver in the push to "close the fuel cycle" and move to plutonium as the fuel in atomic reactors. Plutonium may be used either in combination with uranium – as MOX (mixed oxide) fuel,[35] or alone in high-temperature breeder reactors, both of which are vulnerable to diversion of plutonium for nuclear weapons proliferation.[36]

2005 marked a deeply disturbing turn in US nuclear policy toward a plutonium economy.[37] The Energy Policy Act of 2005[38] awarded billions of dollars in direct tax subsidy, tax credits, guaranteed loans[39] and other inducements to spawn a new generation of (partially) publicly funded commercially owned nuclear power reactors in the US. Nonetheless a major Wall Street credit analyst, Standard and Poors[40] responded to the legislation stating that nuclear power is still "a risky business practice" and suggested that it would require "progress" in traditional problem areas, such as long-term nuclear waste disposition for Wall Street to jump into new reactor investments. High-level nuclear waste is currently stored on corporate reactor sites.

For the past two decades the nuclear waste program in the US has been based on the goal of deep geologic burial. Reprocessing was tried (and abandoned) 40 years ago – to disastrous environmental and economic consequences in West Valley, New York.[41] The industry found reprocessing to be unprofitable, and US Presidents Ford and Carter banned it thanks to the demonstration by India that this technology results in the separation of nuclear weapons-usable plutonium-239 from the waste.[42]

In November 2005 Congress reversed US policy on reprocessing -- in part driven by the technical failure of the Yucca Mountain repository program,[43] and perhaps in part by a desire on the part of the French nuclear interests (AREVA, Cogema, Framatome) to access the US tax base. The French have been leaders in nuclear fuel reprocessing and yet their plutonium MOX fuel business has run dry – lacking international customers.[44] In any case, this reversal of decades of US commitment to a "once through" fuel program is deeply disturbing. Aside from global security issues, plutonium generates even more heat for our planet to absorb,[45] has even worse emissions, and in the event of "a Chernobyl" would be twice as deadly.[46]

Finally, as a crowning point – nuclear power is not qualified to operate in extreme weather. As cited above, nuclear reactors – all of them – depend on energy from the grid to operate. Since the core of a reactor continues to generate heat for years, even "off-line," it is vital that emergency cooling equipment be operable around the clock. As is sensible, every reactor site is equipped with back-up power, most often in the form of diesel generators. Unfortunately these generators, in part because of intermittent use, are not terribly reliable.[47] When both the grid and the back-up power fail, the site is said to be in "station blackout." According to the US Nuclear Regulatory Commission, station blackout contributes a full one-half of the total risk of a major reactor accident at US nuclear power stations.[48]

Recent years have seen an escalation in all kinds of extreme weather: intense heat, drought, blizzards, tornados, and perhaps most compelling – hurricanes and cyclones. All of these conditions may contribute to electric grid failures. The loss of grid power will not necessarily trigger a nuclear crisis, but there is an elevated risk. Overall blackout risk increases as the number of outages increases. Nuclear energy is an enormous liability in these turbulent times.

Nuclear power is also incapable of operating in hot water, as evidenced by the heat waves of 2004. A number of nuclear reactors in France were not operable.[49] The reactors were at low power not because of nuclear safety issues – but rather because of the basic design of a nuclear reactor. Essentially an expensive, dangerous "tea pot," a nuclear power reactor harvests the heat from splitting atoms to make steam, to turn a turbine. The closed loop system relies on the heat differential between the temperature of the steam, and the temperature of a condenser, to turn the steam back into liquid to repeat the process. When the water used to cool the condenser gets too warm this differential is lost. The steam no longer condenses back to liquid. When river and lake water gets too hot, electric power cannot be generated.[50] As temperatures rise, nuclear power will be less and less qualified as a means to even try to generate electric power.

Now some conjecture about why *anyone* would campaign for the "revival" of an unprofitable, unreliable, dangerous, even fraudulent technology like nuclear "power." In a nutshell: to retain centralized control of the supply of energy, as well as control over the timing of the availability of any "alternative."

Fossil fuels – and uranium – are traditionally centralized energy production models. Efficiency is the ultimate in "decentralization" since the factors that will optimize efficiency are unique to each operation. Wind, solar and other renewable resources can be centralized, however the inherent value of distributed generation has become clear in helping to increase overall efficiency of power usage and minimization of power loss throughout the distribution system. Distributed generation is also recognized as means to increase grid stability.[51]

Given the urgency of the climate challenge we face, it is vital to note that energy efficiency, wind, appropriate hydro, biomass and solar are all viable, and available at industrial scale NOW.[52] However for those holding the reins on fossil fuels – particularly oil – there is a distinct (and highly profitable) advantage to forestalling the implementation of any alternative until the full impact of the oil "peak" and resulting energy shortages are experienced.[53] While oil is primarily tied to transport, it is important to note that the Bush administration projects the use of nuclear power reactors to make hydrogen for use in vehicles.[54] Since wind makes more electricity per dollar invested, it is also cost-effective at generating hydrogen than nuclear. Electric cars charged on the grid would vastly increase the demand for electric power – far exceeding traditional electric energy guzzlers like hot water heaters.

Those who promote nuclear expansion are simultaneously promoting a deeper agenda to dominate civil society with a model of central control. Given the security issues associated with nuclear power, (even more so with the use of plutonium fuel) this control may exceed compatibility with democracy. Yet one more reason to oppose this false solution.[55]

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[3] Amory Lovins, More Profit With Less Carbon, Scientific American: September 2005.

[4] See for instance, Dr. Helen Caldicott, Nuclear Madness, (updated edition) W.W. Norton 1994.

[5] Cheney was speaking on C-Span in 2004 when he made the statement that there is already an alternative fuel developed that "is carbon-free" – incorrectly referring to nuclear power.

[6] Felix Christian Matthes, Nuclear Energy and Climate Change, 2005. Issue Paper # 6, Heinrich Boll Foundation & World Information Service on Energy, at: http://www.nirs.org/ch20/publications/nrandclimate.htm

[7] Andrew Sims, Mirage and Oasis—Energy Choices in an Age of Global Warming, 2005. Posted at: http://www.neweconomics.org/gen/uploads/sewyo355prhbgunpscr51d2w29062005080838.pdf

[8] See Wikipedia on line at: http://en.wikipedia.org/wiki/Black_start

[9] See also Lovin's footnote #44 in Amory Lovins: Nuclear Power Economics and Climate Protection Potential 2005, Rocky Mountain Institute, E-05-08, posted at: http://www.rmi.org/images/other/Energy/E05-08_NukePwrEcon.pdf .

[10] Nuclear Energy Institute advertising campaign.

[11] Mary Olson, the Myth of the Millirem, 2004. See http://www.nirs.org/factsheets/mythmiliremfctsht.htm

[12] Cindy Folkers, Radiation Basics, 1999. See http://www.nirs.org/radiation/radiationbasics.pdf

[13] US Nuclear Regulatory Commission, published in the Federal Register: Below Regulatory Concern Policy Statement 1990 establishes that the US radiation standard of 100 millirems a year would result (at government assessed levels of risk) in 1 in 286 people exposed suffering fatal cancer. US regulations promulgated in the Code of Federal Regulations, Chapter 10, Part 20 allow the public to be exposed to up to 500 millirems a year from combined sources of air, water and sewage, raising the cumulative level of risk, as assessed by that agency (which assumes a linear dose-response relationship) to 1 in 57.

[14] Cindy Folkers and Mary Olson, Radiation and Children: The Ignored Victims, 2004. See http://www.nirs.org/radiation/radiationandchildren.pdf

[15] National Academy of Sciences, Biological Effects of Ionizing Radiation VII, 2005. Also, Cindy Folkers, US Panel Recognizes No Safe Dose of Radiation, 2005. See: http://www.nirs.org/radiation/radtech/nosafedose072005.pdf

[16] See: http://www.nirs.org/radiation/tritium/tritiumhome.htm .

[17] US Department of Energy, Integrated Spent Fuel Database, 1994.

[18] See High-Level Nuclear Waste Fact Sheet, 1997, http://www.nirs.org/factsheets/hlwfcst.htm

[19] See Low-Level Radioactive Waste Fact Sheet, 1992, http://www.nirs.org/factsheets/llwfct.htm

[20] Paul Gunter and Linda Gunter, et al, License to Kill, 2000. See: www.nirs.org/reactorwatch/licensedtokill/LiscencedtoKill.pdf

[21] See news report posted at: http://www.closeindianpoint.org/articles/tjn_071103.htm

[22] Amory Lovins, Mighty Mice, Nuclear Engineering International, December, 2005. http://www.rmi.org/images/other/Energy/E05-15_MightyMice.pdf There are many other citations given by Lovins in his recent review article on economics of nuclear power, see note #51.

[23] Nuclear Economics, Safe Energy Communication Council, 1992. This figure does not reflect full costs of long term waste disposition, or any health impacts.
[24] Lovins, More Profit with Less Carbon, see note #3.
[25] Jim Moltivalli, Catching the Wind, E Magazine, January 2005. http://www.emagazine.com/view/?2176
[26] See http://www.eande.tv/transcripts/?date=092805
[27] Efficiency and conservation are not the same. Conservation is the suspension of use – efficiency is wise use. The opportunity to develop using energy efficient hardware, protocols and strategies is the opportunity to avoid emissions through wise use and relative reduction in overall demand.
[28] See note #3
[29] Sustainable Energy Blueprint: A Plausible Strategy for Achieving a No-Nuclear, Low-Carbon, Highly Efficient and Sustainable Energy Future. See: http://healthandenergy.com/sustainable_energy_blueprint.htm
[30] J. Deutsch and E. Moniz (co-chairs), The Future of Nuclear Power, MIT, 2003.
[31] Seattle Times, April 28, 2006, Nuclear Power's New Generation.
http://seattletimes.nwsource.com/html/nationworld/2002958091_nuclear28.html
[32] On September 18, 2001 Mohamed El Beredei was quoted in the world press admitting that if a jumbo jet hit a nuclear reactor it would result in a Chernobyl level release of radioactivity and that in fact, no reactor in the world could withstand such a hit. Unfortunately it does not take an airplane to cause a major reactor accident as has been portrayed in a number of dramatic presentations including *China Syndrome; Meltdown; 24 (2005) and West Wing.* See also Frank von Hippel, Revisiting Nuclear Power Plant Safety, Science 291:201, 2003.
[33] The USA relies upon a publicly administered insurance program for nuclear power (the Price-Anderson Act) that provides a system whereby all reactor operators pay in the event of any one unit having a major accident – and a liability cap, beyond which the industry does not have to pay. It is of interest that while an act of terror would be covered by the program, acts of war are not. The Bush War on Terror has neutralized all liability for the industry.
[34]Jan Willem Storm van Leeuwen and Philip Smith, Nuclear Power: the Energy Balance, 2002 (revised and posted in 2005 with updates at: http://www.stormsmith.nl/)
[35] See Basic Info on MOX Fuel: http://www.nirs.org/factsheets/basicmoxinfo.htm
[36] Frank von Hippel, No Hurry to Recycle, May 2006 Mechanical Engineering.
[37] Margaret Meade and Rene Dubos, The Plutonium Economy: A Statement of Concern, 1974 for the US Council of Churches, resulted in a 1976 resolution calling for a moratorium on plutonium fuel use.
[38] Energy Policy Act of 2005 – Conference Report -- http://energy.senate.gov/public/_files/ConferenceReport0.pdf
[39] Mary Olson, Nuclear Power: The Next Degeneration, 2005.
[40] See: http://www.mineweb.net/sections/energy/783025.htm
[41] Kevin Kamps, Radioactive Wreck, The Nuclear Monitor, 2006. See: http://www.nirs.org/mononline/nm643.pdf
[42] Plutonium does not occur on Earth except in trace residues, where it is produced in tonnage quantities inside all nuclear reactors that use uranium fuel. In the USA irradiated reactor fuel contains about 1% plutonium.
[43] See note 41.
[44] Cogema is a partner in the US MOX fuel program, ostensibly for the "disposition" of weapons grade plutonium in partnership with Russia. AREVA is a full partner in the new Bush/Cheney Global Nuclear Energy Partnership.
[45] See: MOX at a Nuclear Power Reactor Near You, http://www.nirs.org/factsheets/moxandreactor.htm
[46] Dr. Edwin Lyman – Public Health Consequences of Substituting Mixed-Oxide Fuel For Uranium Fuel in Light Water Reactors, 1999. Nuclear Control Institute -- http://www.nci.org/k-m/moxsum.htm
[47] Summary of findings given in: http://www.nirs.org/reactorwatch/mox/nirsmcguirecatawbacontentions.htm
[48] U.S. Nuclear Regulatory Commission, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," NUREG-1150, 1990.
[49] French reactors off line 2004
[50] David Lochbaum, Union of Concerned Scientists
[51] See article by Amory Lovins cited in note # 9
[52] Renewables are Ready – a guide to teaching about renewable energy, published by Union of Concerned Scientists.
[53] It should be noted that not all subscribe to the necessity or value of experiencing peak oil – see Amory B. Lovins: Winning the Oil Endgame, 2004. Cosponsored by the US Pentagon.
[54] Cindy Folkers: Hydrogen Production By Nuclear Power, 2003. See www.nirs.org/
[55] See also, NIRS / WISE, Nuclear Power: No Solution to Climate Change, published in the Nuclear Monitor, February, 2005 posted at: http://www.nirs.org/mononline/nukesclimatechangereport.pdf