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Nuclear Power Is Not “Green Energy”

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Nuclear lobbyists and some scientists are under the mistaken impression that nuclear power is virtually carbon-free, and thus must be pushed to prevent runaway global warming (if you don’t believe in global warming, please forward this to your friends, family and colleagues who do so).

But this is a complete and total myth …

Former Commissioner for the U.S. Nuclear Regulatory Commission Peter Bradford explains that building nuclear plants to fight global warming is like trying to fight global hunger by serving everyone caviar.

Dr. Mark Jacobson – the head of Stanford University’s Atmosphere and Energy Program, who has written numerous books and hundreds of scientific papers on climate and energy, and testified before Congress numerous times on those issues – notes that nuclear puts out much more pollution (including much more CO2) than windpower, and 1.5% of all the nuclear plants built have melted down. Jacobson also points out that it takes at least 11 years to permit and build a nuclear plant, whereas it takes *less than half* that time to fire up a wind or solar farm. Between the application for a nuclear plant and flipping the switch, power is provided by *conventional* energy sources … 55-65% of which is coal.

Keith Barnham – Emeritus Professor at the Faculty of Natural Sciences, Imperial College London – notes that claims that nuclear power is a ‘low carbon’ energy source fall apart under scrutiny.

Mark Diesendorf – Associate Professor and Deputy Director, Institute of Environmental Studies, UNSW – writes:

> Unfortunately, the notion that nuclear energy is a low-emission technology doesn’t really stack up when the whole nuclear fuel life cycle is considered. In reality, the only CO2-free link in the chain is the reactor’s operation. All of the other steps – mining, milling, fuel fabrication, enrichment, reactor construction, decommissioning and waste management – use fossil fuels and hence emit carbon dioxide.

Amory Lovins is perhaps America’s top expert on energy, and a dedicated environmentalist for close to 50 years. His credentials as an energy expert and environmentalist are sterling. Lovins is a former Oxford don, who taught at nine universities, most recently Stanford. He has briefed 19 heads of state, provided expert testimony in eight countries, and published 31 books and several hundred papers. Lovins’ clients have included the Pentagon, OECD, United Nations, Resources for the Future, many national governments, and 13 US states, as

well as many Fortune 500 companies, major real-estate developers, and utilities. Lovins served in 1980-81 on the U.S. Department of Energy's Energy Research Advisory Board, and in 1999-2001 and 2006-2008 on Defense Science Board task forces on military energy efficiency and strategy.

Lovins says nuclear is *not* the answer:

> Nuclear plants are so slow and costly to build that they reduce and retard climate protection.
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> Here's how. Each dollar spent on a new reactor buys about 2-10 times less carbon savings, 20-40 times slower, than spending that dollar on the cheaper, faster, safer solutions that make nuclear power unnecessary and uneconomic: efficient use of electricity, making heat and power together in factories or buildings ("cogeneration"), and renewable energy. The last two made 18% of the world's 2009 electricity, nuclear 13%, reversing their 2000 shares–and made over 90% of the world's additional electricity in 2008.
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> Those smarter choices are sweeping the global energy market. Half the world's new generating capacity in 2008 and 2009 was renewable. In 2010, renewables except big hydro dams won $151 billion of private investment and added over 50 billion watts (70% the total capacity of all 23 Fukushima-style U.S. reactors) while nuclear got zero private investment and kept losing capacity. Supposedly unreliable windpower made 43-52% of four German states' total 2010 electricity. Non-nuclear Denmark, 21% wind-powered, plans to get entirely off fossil fuels. Hawai'i plans 70% renewables by 2025.
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> In contrast, of the 66 nuclear units worldwide officially listed as "under construction" at the end of 2010, 12 had been so listed for over 20 years, 45 had no official startup date, half were late, all 66 were in centrally planned power systems–50 of those in just four (China, India, Russia, South Korea)–and zero were free-market purchases. Since 2007, nuclear growth has added less annual output than just the costliest renewable–solar power –and will probably never catch up. While inherently safe renewable competitors are walloping both nuclear and coal plants in the marketplace and keep getting dramatically cheaper, nuclear costs keep soaring, and with greater safety precautions would go even higher. Tokyo Electric Co., just recovering from $10-20 billion in 2007 earthquake costs at its other big nuclear complex, now faces an even more ruinous Fukushima bill.
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> Since 2005, new U.S. reactors (if any) have been 100+% subsidized–yet they couldn't raise a cent of private capital, because they have no business case. They cost 2-3 times as much as new windpower, and by the time you could build a reactor, it couldn't even beat solar power. Competitive renewables, cogeneration, and efficient use can displace all U.S. coal power more than 23 times over–leaving ample room to replace nuclear power's half-as-big-as-coal contribution too–but we need to do it just once.

(Read Lovins' technical papers on the issue here.)

Nuclear engineer and former nuclear industry executive Arnie Gundersen noted last year:

> Does the nuclear industry's latest claim that it is the world's salvation from increasing levels of CO2 hold up under scrutiny? No! The evidence clearly shows that building new nukes will make global warming worse.

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Nuclear power lobbyists and their marketing firms want us to believe that humankind's current CO2 atmospheric releases would have been much worse were it not for those 438 nukes now operating. How much worse? The World Nuclear Association industry trade group estimates that an additional 1.1 GT of CO2 would have been created in 2015 if natural gas plants supplied the electricity instead of those 438 nukes[17].

Do the math! 1.1 additional GT out of 36 GT emitted is only a 3% difference. This 3% value is not a typographical error. Worldwide, all those nukes made only a 3% dent in yearly CO2 production. Put another way, each of the 438 individual nuclear plants contribute less than seven thousandths of one percent to CO2 reduction[18]. That's hardly enough to justify claims that keeping your old local nuke running is necessary to prevent the sea from rising.

Let's fast forward to 2050. Massachusetts Institute of Technology (MIT) estimates that even if the 2015 Paris CO2 accords (COP 21) are implemented and 1,000 new nukes are constructed, global CO2 emissions will still increase to a minimum of 64 GT[19]. While this increase appears counterintuitive given the Paris agreement, it is on target because pent up energy demands from large populations in India, China, Southeast Asia, and Africa who want to achieve the standard of living in western developed countries.[20]

Can new nukes really help cut CO2 by 2050? Unfortunately, what is past is prologue. To do so, the World Nuclear Association claims 1,000 new nukes will be needed by 2050 to combat CO2 buildup and climate change[21]. The MIT estimate also assumes 1,000 nukes must be in operation by 2050. Using the nuclear trade association's own calculations shows that these new nukes will offset only 3.9 GT of CO2 in 2050. Do the math again! 3.9 GT out of 64 GT is only 6.1% of the total CO2 released to the atmosphere in 2050, hardly enough for the salvation of the polar bears!

If those 1,000 nuclear power plants were cheap and could be built quickly, investing in nukes might still make sense. However, Lazard Financial Advisory and Asset Management[22], with no dog in the fight, has developed a rubric that estimates that the construction cost of those new nukes will be $8,200,000,000,000. Yes, that's $8.2 TRILLION to reduce CO2 by only 6%![23]

Surely that huge amount of money can be better spent on less expensive alternatives to get more bang for the buck! Lazard also estimates that solar or wind would be 80% less expensive[24] for the equivalent amount of peak electric output.

Atmospheric CO2 releases are not going to go on vacation while waiting for those 1,000 nukes to be built. According to the World Nuclear Industry Status Report 2016[25], the mean [average] construction time for 46 nuclear plants that began operation between 2006 and 2016 was 10.4 years, not including engineering, licensing and site selection. Contrast that with a two year design and construction schedule for a typical industrial scale solar power plant.[26],[27] Atmospheric CO2 levels will increase by almost 70 PPM during the 35 years it will take to construct those 1,000 new nukes, an increase that these new nuclear plants will never eliminate – if they ever operate.

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Global climate change is a now problem that requires now solutions[28]. Governments will make the CO2 problem worse by allocating precious resources for alleged atomic power solutions to reduce CO2 when the cost of

> such proposals is unknown and when implementation only begins in 2030. Fortunately, lower cost renewable solutions are readily available and can be implemented on the necessary time scale needed to reverse the rapidly increasing atmospheric CO2.
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> Building new nukes applies a 20th century technology to a 21st century problem. Moreover, building nuclear reactors in a tradeoff for CO2 reduction creates a toxic legacy of atomic waste throughout the world. Proponents of nuclear power would have us believe that humankind is smart enough to store nuclear waste for a quarter of a million years, but at the same time humankind is so dumb that we can't figure out how to store solar electricity overnight. I disagree.
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> Let's not recreate the follies of the 20th century by recycling this atomic technology into the 21st century. The evidence proves that new nukes will make global climate change worse due to huge costs and delayed implementation periods. Lift the CO2 Smoke Screenand implement the alternative solutions that are available now – faster to implement and much less expensive.

Alternet points out:

> Mark Cooper, senior fellow for economic analysis at the Vermont Law School ... found that the states that invested heavily in nuclear power had worse track records on efficiency and developing renewables than those that did not have large nuclear programs. In other words, investing in nuclear technology crowded out developing clean energy.

BBC notes:

> Building the [nuclear] power station produces a lot of CO2 ....

Greenpeace points out:

> When it comes to nuclear power, the industry wants you to think of electricity generation in isolation ..... And yet the production of nuclear fuel is a hugely intensive process. Uranium must be mined, milled, converted, enriched, converted again and then manufactured into fuel. You'll notice the [the nuclear industry] doesn't mention the carbon footprint of all steps in the nuclear chain prior to electricity generation. Fossil fuels have to be used and that means CO2 emissions.

An International Forum on Globalization report – written by environmental luminaries Ernest Callenback, Gar Smith and Jerry Mander – have slammed nuclear power as catastrophic for the environment:

> Nuclear energy is not the "clean" energy its backers proclaim. For more than 50 years, nuclear energy has been quietly polluting our air, land, water and bodies—while also contributing to Global Warming through the CO2 emissions from its construction, mining, and manufacturing operations. Every aspect of the nuclear fuel cycle—mining, milling, shipping, processing, power generation, waste disposal and storage—releases greenhouse gases, radioactive particles

> and toxic materials that poison the air, water and land. Nuclear power plants routinely expel low-level radionuclides into the air in the course of daily operations. While exposure to high levels of radiation can kill within a matter of days or weeks, exposure to low levels on a prolonged basis can damage bones and tissue and result in genetic damage, crippling long-term injuries, disease and death.

See this excellent photographic depiction of the huge amounts of fossil fuel which goes into building and operating a nuclear power plant.

Nature reported in 2008:

> "You're better off pursuing renewables like wind and solar if you want to get more bang for your buck."
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> Evaluating the total carbon output of the nuclear industry involves calculating those emissions and dividing them by the electricity produced over the entire lifetime of the plant. Benjamin K. Sovacool, a research fellow at the National University of Singapore, recently analyzed more than one hundred lifecycle studies of nuclear plants around the world, his results published in August in Energy Policy. From the 19 most reliable assessments, Sovacool found that estimates of total lifecycle carbon emissions ranged from 1.4 grammes of carbon dioxide equivalent per kilowatt-hour (gCO2e/kWh) of electricity produced up to 288 gCO2e/kWh. Sovacool believes the mean of 66 gCO2e/kWh to be a reasonable approximation.
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> The large variation in emissions estimated from the collection of studies arises from the different methodologies used – those on the low end, says Sovacool, tended to leave parts of the lifecycle out of their analyses, while those on the high end often made unrealistic assumptions about the amount of energy used in some parts of the lifecycle. The largest source of carbon emissions, accounting for 38 per cent of the average total, is the "frontend" of the fuel cycle, which includes mining and milling uranium ore, and the relatively energy-intensive conversion and enrichment process, which boosts the level of uranium-235 in the fuel to useable levels. Construction (12 per cent), operation (17 per cent largely because of backup generators using fossil fuels during downtime), fuel processing and waste disposal (14 per cent) and decommissioning (18 per cent) make up the total mean emissions.
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> According to Sovacool's analysis, nuclear power, at 66 gCO2e/kWh emissions is well below scrubbed coal-fired plants, which emit 960 gCO2e/kWh, and natural gas-fired plants, at 443 gCO2e/kWh. However, nuclear emits twice as much carbon as solar photovoltaic, at 32 gCO2e/kWh, and six times as much as onshore wind farms, at 10 gCO2e/kWh. "A number in the 60s puts it well below natural gas, oil, coal and even clean-coal technologies. On the other hand, things like energy efficiency, and some of the cheaper renewables are a factor of six better. So for every dollar you spend on nuclear, you could have saved five or six times as much carbon with efficiency, or wind farms," Sovacool says. Add to that the high costs and long lead times for building a nuclear plant about $3 billion for a 1,000 megawatt plant, with planning, licensing and construction times of about 10 years and nuclear power is even less appealing.
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> Money spent on energy efficiency, however, is equivalent to increasing baseload power, since it reduces the overall power that needs to be generated,

says Sovacool. And innovative energy-storage solutions, such as compressed air storage, could provide ways for renewables to provide baseload power.

Thomas Cochran, a nuclear physicist and senior scientist at the Natural Resources Defense Council (NRDC), an environmental group in Washington DC … argues that the expense and risk of building nuclear plants makes them uneconomic without large government subsidies, and that similar investment in wind and solar photovoltaic power would pay off sooner.

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Another question has to do with the sustainability of the uranium supply itself. According to researchers in Australia at Monash University, Melbourne, and the University of New South Wales, Sydney, good-quality uranium ore is hard to come by. The deposits of rich ores with the highest uranium content are depleting leaving only lower-quality deposits to be exploited. As ore quality degrades, more energy is required to mine and mill it, and greenhouse gas emissions rise. "It is clear that there is a strong sensitivity of … greenhouse gas emissions to ore grade, and that ore grades are likely to continue to decline gradually in the medium- to long-term," conclude the researchers. [And see this.]

Beyond Nuclear notes:

The energy consulting firm Ecofys produced a report detailing how we can meet nearly 100% of global energy needs with renewable sources by 2050. Approximately half of the goal is met through increased energy efficiency to first reduce energy demands, and the other half is achieved by switching to renewable energy sources for electricity production. The Intergovernmental Panel on Climate Change agrees and predicts close to 80% of the world's energy supply could be met by renewables by mid-century.

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Since nuclear power plants are reliant upon the electrical grid for 100% of their safety systems' long-term power, and are shut down during grid failure and perturbations, it is "guaranteed" only as long as the electrical grid is reliable. When the Tsunami and earthquake hit and power was lost in the Fukushima Prefecture, nuclear energy wasn't so "guaranteed." Instead, it became a liability, adding to what was now a triple threat to the region and worsening an already catastrophic situation.

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[The claim that] Nuclear power is "low-carbon electricity" … is the propaganda line commonly used by the nuclear industry which conveniently leaves out every phase of the nuclear fuel chain other than electricity generation. It ignores the significant carbon emissions caused by uranium mining, milling, processing and enrichment; the transport of fuel; the construction of nuclear plants; and the still inadequate permanent management of waste. It also ignores the release - by nuclear power plants and reprocessing facilities - of radioactive carbon dioxide, or carbon-14, to the air, considered to be the most toxic of all radioactive isotopes over the long-term.

In fact, studies show that extending the operating licenses of old nuclear power plants emits orders of magnitude more carbon and greenhouse gases per kilowatt hour from just the uranium fuel chain compared to building and operating new wind farms.

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> Nuclear might begin to address global carbon emissions if a reactor is built somewhere in the world every two weeks. But this is an economically unrealistic, in fact impossible, proposition, with the estimated construction tab beginning at $12 billion apiece and current new reactors under construction already falling years behind schedule.
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> According to a 2003 MIT study, "The Future of Nuclear Power," such an unprecedented industrial ramping up would also mean opening a new Yucca Mountain-size nuclear waste dump somewhere in the world "every three to four years," a task still unaccomplished even once in the 70 years of the industry's existence. Further, such a massive scale expansion of nuclear energy would fuel proliferation risks and multiply anxieties about nuclear weapons development, exemplified by the current concern over Iran. As Al Gore stated while Vice President: "For eight years in the White House, every weapons-proliferation problem we dealt with was connected to a civilian reactor program."

Many experts also say that the "energy return on investment" from nuclear power is lower than many other forms of energy. In other words, non-nuclear energy sources produce more energy for a given input.

David Swanson summarizes one of the key findings of the International Forum on Globalization report:

> The energy put into mining, processing, and shipping uranium, plant construction, operation, and decommissioning is roughly equal to the energy a nuclear plant can produce in its lifetime. In other words, nuclear energy does not add any net energy.
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> Not counted in that calculation is the energy needed to store nuclear waste for hundreds of thousands of years.
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> Also not counted is any mitigation of the relatively routine damage done to the environment, including human health, at each stage of the process.
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> Nuclear energy is not an alternative to energies that increase global warming, because nuclear increases global warming. When high-grade uranium runs out, nuclear will be worse for CO2 emissions than burning fossil fuels. And as global warming advances, nuclear becomes even less efficient as reactors must shut down to avoid overheating.

Also not counted in most discussions is the fact that nuclear reactors discharge *tremendous amounts of heat* directly into the environment. After all – as any nuclear engineer will tell you – a nuclear reactor is really just a fancy way to boil water.

The Bulletin of the Atomic Scientists noted in 1971:

> In terms of thermal efficiency, current nuclear reactors are even worse off than the coal plants. Against the 50 per cent loss of heat in the newest coal plants, as much as 70 per cent of the heat is lost from nuclear plants. This means that thermal pollution can be even more severe ….

1971 was a long time ago, but some nuclear plants are older. For example, Oyster Creek was launched in 1969, and many other reactors were built in the early 1970s. Most American nuclear reactors are old (and they are aging very poorly).

Indeed, the Nuclear Information and Resource Service claims:

> 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.

It doesn't make too much sense to dump massive amounts of *heat* into the environment ... in the name of fighting global *warming*.

The bottom line – as discussed above – is that scientists pushing nuclear to combat global warming are misinformed. (True, nuclear industry lobbyists may be largely responsible for the claim that nuclear fights climate change. Indeed, Dick Cheney – whose Halliburton company builds nuclear power plants, and which sold nuclear secrets to Iran – falsely claimed that nuclear power is carbon-free in a 2004 appearance on C-Span. But there are also sincere environmental scientists who are pushing nuclear because they have only studied a small part of the picture, and don't understand that there are better alternatives.)
