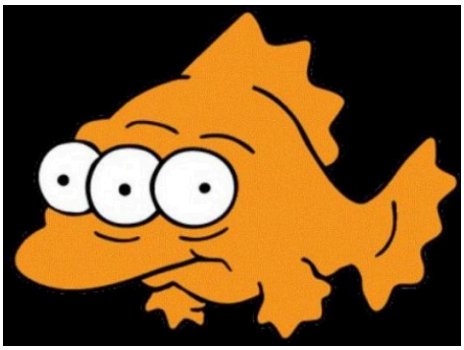

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1nc

We negate: The United States federal government should substantially increase its investment in domestic nuclear energy.

C1: Accidents

Nuke Power unreliable

C.**Dascalu**, 3-19-20**24,** "Myth buster: Nuclear energy is a dangerous distraction", CAN Europe, https://caneurope.org/myth-buster-nuclear-energy/

Myth buster: Nuclear energy is a dangerous distraction

📅 19/03/2024 Contents Introduction More than three-quarters of the EU's greenhouse gas emissions stem from our energy consumption, therefore it is vital to stop burning fossil fuels to avert a climate catastrophe. Fortunately, quick, safe, and proven solutions are available and can be rolled out today: Wind and solar energy have become the cheapest source of energy and just within the past year, they grew so fast that newly installed renewables managed to reduce the EU's greenhouse gas emissions from electricity by 19% while saving consumers an estimated €50bn on their energy bills. Yet, there is a strong lobby that hopes to rival the success of renewables: the nuclear industry, fighting for influence and watering down EU climate legislation when it suits their own interests. This development is creating significant tension with proponents of a fully renewable energy system and marks a regressive step in efforts towards a sustainable and just energy transition. While nuclear champions claim that nuclear energy can work hand-in-hand with renewables, it is becoming increasingly clear that nuclear power acts as a significant hurdle to the roll-out of renewables and fossil fuel phase-out. Myth #1: The recent nuclear push is not a campaign against renewables Fact #1: Nuclear advocates have attempted to lower renewable energy ambition in the context of the Renewable Energy Directive (RED III) revision, France tested the waters in 2023 by calling for a low-carbon 'weighting' in EU renewables target in order to support a higher EU 2030 renewable energy target of 45%, where so-called 'low carbon' energy sources are taken into account when establishing national renewable energy targets. Though this did not see the light, a concession was won on renewable hydrogen and provisions to facilitate nuclear-produced hydrogen – risking further watering down a renewables-based technology pathway. The EU Commission launched its proposal for the Net Zero Industry Act (NZIA) in March 2023 as a response to the Inflation Reduction Act (IRA) of the United States. While nuclear was included as a list of technologies that were seen as making a contribution to decarbonisation, the EU Commission President, Ursula von der Leyen, refused to include it in the list of "strategic technologies", which could receive additional support. The list was limited, as to be better targeted, at technologies such as solar, wind, energy storage, heat pumps and grid technologies. Following intense lobbying and political pressure, the final political agreement has led to the inclusion of "nuclear fission energy technologies" as strategic, while this debate allowed the list to become so extensive it practically loses any strategic element. Pro-nuclear member states have made dirty deals with the fossil lobby During the Electricity Market Design reform, nuclear and fossil fuel promoters in the European Parliament attempted to derail a deal supporting renewables and flexibility. In the Council, due to the focus of the Nuclear Alliance on the Contracts for Difference (supported by some coal dependent countries) the negotiations were delayed by several months and conversations redirected away from renewables, leading to a deal supporting subsidies for existing and new nuclear reactors and a prolongation of subsidies to coal power plants via capacity mechanisms. The nuclear debate is wasting time and diverting attention As the nuclear debate aggressively dominates political negotiations, media, and public discourse, it blatantly diverts critical attention from advancing the existing, affordable, sustainable solutions to the energy transition. This overwhelming focus on nuclear power not only overshadows but also poses a risk of derailing the European energy transition, hindering progress towards aligning with the ambitious yet achievable goal of a 100% renewable energy system by 2040. Fact #2: New nuclear construction is too slow A rapid transition requires the use of existing technologies and solutions which can most quickly be rolled-out such as renewables, primarily solar and wind, energy efficiency, and system flexibility. For years, new nuclear energy projects in Europe have been plagued with delays and, coupled with an untrained workforce, are unable to support the speed of decarbonisation necessary. New nuclear plants typically take 15-20 years for construction, hence failing to address immediate decarbonisation needs to 2030. Indicatively, France's six new reactors are estimated by its network operator to enter into use in 2040-2049, much too late to have any meaningful impact on emissions reduction needed already now, with a view to pathways to 2040, and beyond, for a sustainable future. Myth #2: New nuclear is an effective solution to align Europe to the Paris Agreement and keep global temperature increase to 1.5°C The decision to build the UK's Hinkley Point C nuclear reactor was announced in 2007 with an operational start date of 2017, however it has been delayed several times over, and is now estimated to start in 2031. In France, the Flamanville project is 16 years into construction and hitting new delays, while Finland's Olkiluoto took a full 18 years to come online. Nuclear power is too expensive When compared to renewables, the latest analysis from World Nuclear Industry Status Report, using the data from Lazard, determines that the levelized cost of energy (LCOE) for new nuclear plants makes it the most expensive generator, estimated to be nearly four times more expensive than onshore wind, while unsubsidized solar and wind combined with energy storage (to ensure grid balancing) is always cheaper than new nuclear. Recent European projects in Slovakia, the UK, France, and Finland demonstrate the dramatic rising costs. EDF admitted that the costs for the British nuclear facility Hinkley Point C will skyrocket to 53.8 billion euros for the scheduled 3.2 GW power plant, more than twice as much as scheduled in 2015 when the plant was approved. The French project in Flamanville was originally projected to cost 3.3 billion euros when it began construction in 2007, but has since risen to 13.2 billion euros (16.87 billion euros in today's money). The Finnish Olkiluoto-3 project 1.6GW reactor cost 3 times more than the original forecast price, reaching 11 billion euros. Slovakia's second generation reactors Mochovce 3 and 4 ballooned costs to 6.4 billion euros from an initially estimated 2.8 billion. Slovenia's president announced that a new 1.6GW reactor would cost 11 billion euros, following the Finnish example, demonstrating that these high prices are here to stay. Renewables and energy efficiency are cheaper alternatives When compared against energy savings, analysis by Hungarian NGO Clean Air Action Group highlights that it is more economically efficient to invest in the renovation of households to save energy than in the construction, operation, and decommissioning of a new nuclear reactor. These findings were confirmed by a separate study by Greenpeace France, that showed that by investing 52 billion euros in a mix of onshore wind infrastructure/photovoltaic panels on large roofs, it would be possible to avoid four times more CO2 emissions than by investing the same amount in the construction of six EPR2 nuclear reactors by 2050, while electricity production triples. By investing 85 billion euros of government subsidies in energy savings by 2033, it would be possible to avoid six times more cumulative CO2 emissions by 2050 than with the construction program of six EPR 2 reactors. This would also make it possible to lift almost 12 million people out of energy poverty in a decade. In order to finance new and ongoing projects, the EU has approved State Aid for nuclear, in the case of Hungary, Belgium, and the United Kingdom, while national governments seek support schemes. Despite making references to technology-neutrality, this creates an unlevel playing field slanted against renewable energy. Given the significant investment gap to achieve 2030 climate targets, and the limited fiscal space of many Member States, investments in nuclear risk diverting precious public resources into projects of poor value-for-money compared to alternatives in a renewables-based system, while reducing the availability of public resources for all other components of the energy transition. Such a choice would equally fail to reduce prices for consumers in the context of the current fossil fuel energy crisis. Nuclear power includes many additional hidden costs The costs would be even larger if accounting for "unpaid externalities" borne by taxpayers and the public at large, from nuclear accident risks that are impossible to insure against by private actors. The costs of decommissioning of a nuclear power plant, which can cost 1-1.5 billion euros per 1000 MW, are often borne by the public as these costs are poorly taken into account when planning a new nuclear installation. The cost associated with storing radioactive waste for hundreds of thousands of years is also often undervalued, alongside costs associated with radioactive leaks from plants or storage facilities, as demonstrated by the radioactive leaks in the UK Sellafield site, causing tension with Ireland and Norway. To lower costs, attempted lowering of safety and environmental standards can be expected, posing risks to communities, nature, and society at large, also as a burden to future generations. Myth #3: New innovation will solve the issues of cost and inflexibility Fact #3: Small Modular Reactors are not coming to save us Argued to be more flexible, decentralised, smaller, and cheaper than existing nuclear designs, countries are wasting public resources in favour of non-existent Small Modular Reactor (SMRs), riddled with the same limitations as their predecessors, and presenting poor value-for-money compared to existing alternatives. The focus on SMRs risks delaying the development of renewable energy technologies already available at the moment, and thereby prolonging the usage of fossil fuels. Burdened by the same high capital costs, SMRs would have to run near constantly to reduce losses, thereby further congesting the grid and making them useless **in providing back-up power needed for peak hours ag**ainst renewables and energy storage. Small Modular Reactors are untested Only few SMRs in China and Russia are currently in operation.

Since the technology has not been tested yet at commercial scale**, claims that the industry is making about their supposedly faster** construction and lower costs **are** therefore **purely speculative** at this stage. An SMR project that was planned in the US state of Utah, was terminated in November 2023 as local authorities that were meant to buy the electricity pulled out due to rising costs. The same company that failed with this project intends to build SMRs in Romania, Kazakhstan, Poland and Ukraine. Fact #4: Studies demonstrate that **100% renewable by 2040 is feasible and favourable**. The Paris Agreement Compatible (PAC) scenario, developed by civil society and experts, emphasises renewables-based electrification and energy demand reduction, calling for determined and heightened attention to enable a 100% renewables-based EU energy system by 2040, and foresees no need for nuclear power in Europe. A fully renewables-based energy system even functions in times of low wind and at night, when the sun is not shining. The solution to still provide the required amount of power needed during these times is a combination of flexibility (such as energy storage) and demand-side measures. The myth of the need for nuclear baseload has been debunked for years. The energy system can be reliably and safely managed with 100% renewables and system flexibility. Myth #4: A 100% renewable energy system is unfeasible, and renewables must work together with nuclear. Nuclear power production is not reliable: Nuclear power units across Europe have been proven as unreliable in providing power when needed. Future climatic conditions, such as heatwaves, droughts, flooding and rising sea-levels only increase the likelihood of future nuclear power plant disconnections and pose further security risks. **In 2022, on average French nuclear reactors had 152 days with zero-production.** Over half of the French nuclear reactor fleet was not available during at least one-third of the year, one-third was not available for more than half of the year, and 98% of the year 10 reactors or more did not provide any power for at least part of the day. Nuclear power blocks renewables integration into the electricity grid: The inflexibility of nuclear, caused by technical limitations, safety requirements and economic factors, prevents the feed-in of renewable electricity into the grid, causing grid congestion and curtailment. Nuclear's dominance over grid capacity can block the connection of new renewable energy projects, where even announced and then abandoned plans for a new nuclear unit can delay renewable projects connection, allowing for continued fossil fuel usage. Grid structures designed for large-scale, centralised nuclear power, make it more challenging, time-consuming and costly to introduce small-scale distributed renewable power. An example can be found in Romania where Cernavodă 3 and 4 reactors have reserved grid capacity for years, blocking new renewable energy projects in the Dobrogea region, the most wind-intensive region in the country. Delayed grid investments, due to uncertainty of new nuclear units, have also meant that capacity bottlenecks exist today for renewables online. In the Netherlands, the only current nuclear power station, Borssele is competing for landing space for off-shore electricity. Post-Fukushima, renewables were blocked from connecting to the grid in Japan as the government considered restarting the reactors, despite public opposition to nuclear restarts and support for renewables. Rather than taking the opportunity to invest in grids and integrate renewables twenty years ago, Japan still heavily relies on fossil fuels today. Myth #5: Nuclear energy supports the EU's plans for energy autonomy Fact #5: Nuclear power means continued reliance on Russia and imports Nuclear power units equally fail to pass an "energy security" test, and run counter to the RepowerEU target of enhancing Europe's autonomy, given that more than 40% of the EU's Uranium is imported from Russia and no EU country is currently mining uranium within its own borders. Though Kazakhstan is seen as an alternative, its uranium industry is directly tied to Rosatom, Russia's state atomic energy company. While import bans have been placed on Russian coal and liquified natural gas, and Russian oil and natural gas have been targeted, this has not been the case for uranium. Fact #6: Severe nuclear accidents remain possible, and climate change is adding new risks Nuclear technology inherently carries the risk of severe nuclear accidents with the release of large amounts of radioactivity as shown by catastrophic accidents in Fukushima or Chornobyl. Extreme and more frequent weather events due to climate change create unprecedented risks through storms or flooding that are not captured in planning standards for nuclear plants based on historic frequencies and severeness. Extreme weather events may also indirectly affect nuclear plants, such as breaking dams above nuclear plants or longer disconnection from electricity grids after storms. Cyber attacks, military aggression e.g. Russia's occupation of the Zaporizhzhia Nuclear Power Plant, and terrorist attacks, e.g. via drone attacks, could also lead to severe accidents of nuclear plants. Nuclear waste remains a risk worldwide: Nuclear waste is a risk to the health of all living creatures, including humans, for thousands of years after its use in energy production. Management of any future storage facility would still be at risk of natural disasters and decisions of future generations, whereas currently without any long-term solutions risks are increasingly shifting to interim storage which were not planned for the current supply and length of storage. Myth #6: Nuclear energy is safe Conclusions The climate movement has rightly focused its efforts on achieving a fast, fair and full phase out of fossil fuels with remarkable successes, although major fights are still ahead of us. Renewable energy has seen massive growth rates in many European countries and this development is a win for everyone: People as they benefit from lower energy prices, communities where they are part of benefit sharing schemes and the climate due to much reduced greenhouse gas emissions. We therefore conclude and demand: Nuclear energy is undermining renewables due to the aforementioned issues and must not be portrayed as an alternative or partner for renewables in the energy transition. New nuclear energy in Europe is too slow, and too expensive to meaningfully contribute to the decarbonisation of the energy system by 2040. This pathway is a distraction which only delays fossil fuel phase-out and renewables uptake. Small Modular Reactors are an unproven technology and, like conventional nuclear reactor designs, are unable to contribute meaningfully to decarbonisation. If developed, these units would increase the price for electricity, the levels of radioactive waste and risk the proliferation of nuclear materials. CAN Europe calls for a 100% renewable energy system by 2040, and therefore a managed phase-out and decommissioning of Europe's existing nuclear fleet is required by 2040 at the latest to ensure a safe and sustainable future. Prolongation must not divert public funds away from renewables and energy efficiency solutions and hinder the integration of renewables in the surrounding area. The prolongation of existing nuclear reactors risks safety as old units are pushed well beyond their original foreseen lifespans. Every euro invested in nuclear is a euro not invested in renewables and energy efficiency. For this reason, public finance should remain inaccessible to nuclear, as it should be prioritised on cost-effective, sustainable solutions. This includes the EU's Multiannual Financial Framework and EU funds such as the Just Transition Fund, Modernisation Fund, Innovation Fund, InvestEU, etc, and investments from the European Investment Bank. Renewable energy targets remain an essential tool for the European energy transition, and must be defended against any attempts to water them down through the inclusion of nuclear power. A so-called "low-carbon" directive with "low-carbon" targets would decimate the rate of renewable energy integration, which is already off track, and prevent the EU from aligning with Paris-agreement emissions reduction. Additionally, this opens the backdoor for other false solutions like fossil gas and carbon-capture and storage (CCS). Nuclear power and fossil gas should be excluded from the EU taxonomy for sustainable activities.

Affirming increases the risk of accidents

Greenpeace, xx-xx-xxxx, "Nuclear Energy", Greenpeace, https://www.greenpeace.org/usa/climate/issues/nuclear/

Nuclear power is dirty, dangerous and expensive. Say no to new nukes. Nuclear energy has no place in a safe, clean, sustainable future. Nuclear energy is both expensive and dangerous, and just because nuclear pollution is invisible doesn't mean it's clean. Renewable energy is better for the environment, the economy, and doesn't come with the risk of a nuclear meltdown. The problem People are concerned about many issues surrounding the industry: From the risk of accidents and impacts that radiation has on human health, through contamination of environment and radioactive waste, to violation of human rights and links of nuclear energy to nuclear weapons. Greenpeace got its start protesting nuclear weapons testing back in 1971. We've been fighting against nuclear weapons and nuclear power ever since. Anti-Nukes Protest in Manila. © Basilio Sepe / Greenpeace Play The history High profile disasters in Chernobyl, Ukraine in 1986 and Fukushima, Japan in 2011 have raised public awareness of the dangers of nuclear power. Consequently, zeal for nuclear energy has fizzled. The catastrophic risks of nuclear energy — like the meltdowns of nuclear reactors in Japan or Ukraine — far outweigh the potential benefits. New nuclear plants are more expensive and take longer to build than renewable energy sources like wind or solar. If we are to avoid the most damaging impacts of climate change, we need solutions that are fast and affordable. Nuclear power is neither. We can do better than trading off one disaster for another. The nuclear age is over and the age of renewables has begun. The dangers of nuclear energy Nuclear reactors are inherently unsafe. Meltdowns like the ones in Fukushima or Chernobyl released enormous amounts of radiation into the surrounding communities, forcing hundreds of thousands of people to evacuate. Many of them may never come back. If the industry's current track record is any indication, we can expect a major meltdown about once per decade. As a result, millions of people who live near reactors are at risk. The possibility of a catastrophic accident at a U.S. nuclear plant can not be dismissed. Action at the Nuclear Power Plant at Tihange in Belgium. © Greenpeace / Lieve Blanckaert Ministry of Economics Action in The Hague. © Bas Beentjes / Greenpeace The aftermath of nuclear energy Nuclear power plants typically have a design life of 40-60 years, whereas it might be more than 100 years after plant closure before decommissioning is completed. After a cooling-off period that could be as long as 50 or more years, nuclear reactors and uranium enrichment facilities must be decommissioned. All waste must be reprocessed or stored, structures decontaminated, and the land, air and water around the site remediated. There is still no safe, reliable solution for dealing with the radioactive waste produced by nuclear plants. Beyond the risks associated with nuclear power and radioactive waste, the threat of nuclear weapons looms large. The spread of nuclear technology and nuclear weapons is a threat for national security and the safety of the entire planet. The true cost of nuclear energy Nuclear energy isn't just bad for the environment, it's bad for our economy. Public opposition over safety concerns around nuclear power necessitate high levels of regulation. From a risk perspective, this means that projects may be subject to delays and cost overruns as safety regulations are subject to changing and more stringent regulatory requirements. Nuclear power plants are expensive to build, prompting Wall Street to call new nuclear a "bet the farm" risk. This is even before taking into account the astounding cleanup and health costs caused by radioactive waste pollution and nuclear

meltdowns. Cleaning up Fukushima, if ever possible, will cost at least $100 billion and could be more than double that. Why invest money in a dangerous, unsustainable form of energy when we can have clean, renewable energy for less? Nuclear energy is diverting attention and investment from the sustainable energy solutions we need. It's time to stop building new nuclear facilities, phase out the ones that exist, and focus on clean energy for the future.

An accident puts millions of lives at risk

Green Cross, 3-9-2015, "Fukushima Daiichi Power Plant Disaster: How many people were affected? 2015 Report", ReliefWeb, https://reliefweb.int/report/japan/fukushima-daiichi-power-plant-disaster-how-many-people-were-affected-2015-report

Japan Fukushima Daiichi Power Plant Disaster: How many people were affected? 2015 Report Format Analysis SourceGreen Cross Posted11 Mar 2015 Originally published0 Mar 2015 OriginView original Attachments Preview of 2015_fukushima_report.pdf Download Report (PDF | 1.91 MB) (March 9, 2015) Report says 32 million people in Japan are exposed to radiation from the Fukushima nuclear disaster 11 March, 2015 | Geneva: Approximately 32 million people in Japan are affected by the radioactive fallout from the nuclear disaster in Fukushima, according to the 2015 Fukushima Report now available from Green Cross. This includes people who were exposed to radiation or other stress factors resulting from the accident, and who are consequently at potential risk from both long and short-term consequences. As with the Chernobyl nuclear accident, which impacted 10 million people, Japan is expected to see increased cancer risk and neuropsychological long-term health consequences. The stress-related effects of evacuation and subsequent relocation are also of concern. The evacuation involved a total of over 400,000 individuals, 160,000 of them from within 20km of Fukushima. The number of deaths from the nuclear disaster attributed to stress, fatigue and the hardship of living as evacuees is estimated to be around 1,700 so far. "Our local presence and ongoing activities to help the communities impacted by radioactive contamination in Chernobyl and Fukushima gives us first-hand experience of the human and environmental consequences of nuclear disasters," said Adam Konsuowski, Chief Operating Officer of Green Cross International, who recently shared the stage with former Japanese Prime Minister Naoto Kan for a conference on nuclear power. "This is why we are demanding more transparency and better governance around nuclear power and the risks involved, and a better assessment of its mounting costs. The management of nuclear waste in increasingly burdensome and the cost of decommissioning plants is escalating. In the meantime, renewable energy solutions are getting cheaper. Over the last five years the cost for utility scale solar has declined by 78 per cent, and by for wind by 58 per cent." Based on the International Nuclear and Radiological Event Scale (INES), both the Chernobyl and the Fukushima Daiichi nuclear power plant disasters were categorized as level 7 events - defined as a major release of radioactive material, with widespread effects, requiring planned and extended countermeasures. The radiation released by the Fukushima Daiichi nuclear power plant was largely concentrated in Japan and over the Pacific Ocean. According to estimates, **80 percent of** the released **radiation was deposited in the ocean and** the other **20 percent was** mostly dispersed **within a 50 km radius** to the northwest of the power plant in the Fukushima Prefecture. While the expected cancer risk to humans caused by the radiation released over the Pacific Ocean are small, trace amounts of radiation have already reached the North American continent, in particular parts of the North West Coast of the United States. The overall risk of cancer will increase, especially for those who were still children at the time of the accident. Their health will be at risk over their entire lifetime as a result of the radiation released by the Fukushima Daiichi nuclear power plant. According to calculations by the Tokyo Electric Power Company (TEPCO), the total atmospheric release of radioactive material from the Fukushima nuclear disaster (iodine-131, cesium-134, cesium-137, and noble gases) was estimated to be less than 15 percent of the total radiation emitted by the Chernobyl accident. “However, the number of people affected by radiation in Japan has tripled compared to Chernobyl,” said Nathalie Gysi of Green Cross Switzerland. In addition to the radioactive material initially released in the ocean, water leakage at the Fukushima Daiichi power plant remains a problem four years after the accident. Reports of pipes breaking and water escaping from containment tanks in the months and years since the accident are a source of worry for workers and the public. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) reported that radioactive material had been released as late as May of 2013. There continue to be concerns about additional psychological stress and rising doubts over the safety of seafood, such as radioactivity levels in tuna and other fish. The threshold for cesium in Japan is 100 Becquerel per kilogram. Flounders caught close to the Fukushima Daiichi power plant were found to have high cesium levels, exceeding the allowable limit of 100 Becquerel. The Fukushima Report was prepared under the direction of Prof. Jonathan M. Samet, Director of the Institute for Global Health at the University of Southern California (USC), as a Green Cross initiative. A systematic approach was taken to gather information regarding the number of people affected by the Fukushima nuclear disaster, using the same measurement standards as a similar 2012 study on Chernobyl. The lives of approximately 42 million people have been permanently affected by radioactive contamination caused by the accidents in the Chernobyl and Fukushima Daiichi nuclear power plants. Continued exposure to low-level radiation, entering the human body on a daily basis through food intake, is of particular consequence. Green Cross is committed to conquering the long-term effects of industrial and military disasters, as well as pollution left over from the Cold War, through two key international programmes: Social and Medical Care and Legacy of the Cold War. Top priorities are improving the quality of life of people impacted by chemical, radioactive and other kinds of contamination, and promoting sustainable advancements in the spirit of cooperation instead of confrontation. Green Cross is committed to phasing out nuclear energy worldwide. The organisation is also concerned about the effects military use of nuclear materials can have on the environment and health. Because of the worldwide effects of climate change and nuclear disasters, it is urgently necessary for the global community to work together on developing and using renewable energies, boosting energy efficiency, and pursuing a controlled, global end to the production of nuclear power. ENDS About Green Cross International: GCI is an independent non-profit and nongovernmental organization founded in 1993 by Nobel Peace Laureate Mikhail Gorbachev. It addresses the interconnected global challenges of security, poverty and environmental degradation through global advocacy and local projects. GCI is headquartered in Geneva, Switzerland and has a network of national organizations in 27 countries http://www.gcint.org/ For further information, please contact: Green Cross International (GCI) Etienne Lacombe-Kishibe Communications Coordinator Phone: +41 22 789 08 13 Mob: +41 78 839 79 03 Email: etienne.lacombe@gci.ch Website: http://www.gcint.org

C2: Pollution

Sub A: Sludgey Sludge

Nuclear power creates toxic sludge

David Suzuki, 8-1-2024, "What to do with wastes that are radioactive for over 100,000 years", David Suzuki Foundation, https://davidsuzuki.org/story/burying-radioactive-nuclear-waste-poses-enormous-risks/ August 1, 2024

What to do with wastes that are radioactive for over 100,000 years By David Suzuki with contributions from Senior Editor and Writer Ian Hanington A pilot cave at final depth for the Onkalo spent nuclear fuel repository in Finland. (Photo: Wikimedia Commons) Note: This column has been revised to correct some outdated and erroneous information. As the consequences of burning dirty, climate-altering fossil fuels hit harder by the day, many are seizing on nuclear power as a "clean" energy alternative. But how clean is it? An illustration of a compass Subscribe to Science Matters Email Enter email Submit Although it may not produce the emissions that burning fossil fuels does, nuclear power presents many other problems. Mining, processing and transporting uranium to fuel reactors creates toxic pollution and destroys ecosystems, and reactors increase risks of nuclear weapons proliferation and radioactive contamination. Disposing of the highly radioactive waste is also challenging. It's an all-too-common story: industrial wastes disposed of in communities that need the money such projects promise. The people living in Ignace and South Bruce, Ontario, are learning about the potential dangers and the proposed measures to handle the wastes firsthand. The Nuclear Waste Management Organization, a not-for-profit corporation representing nuclear power companies, has identified those communities as potential sites for disposing of six million bundles of highly radioactive waste in a "deep geological repository." The federal government has agreed to the organization's plans. It's an all-too-common story**: industrial wastes disposed of in communities that need the money such projects promise.** In this case, the NWMO has already paid Indigenous and municipal governments large sums to consider its plans **— ignoring communities that will also be affected along transportation routes** or downstream of **burial sites.** According to Canadian Dimension, industry expects to ship the wastes "in two to three trucks per day for fifty years, in one of three potential containers." Even without an accident, trucking the wastes will emit low levels of radiation, which industry claims will produce "acceptable" exposure. Transferring it from the facility to truck and then to repository also poses risks. The people living in Ignace and South Bruce, Ontario, are learning about the potential dangers and the proposed measures to handle the wastes firsthand. Industry claims storing high-level radioactive waste in deep geological repositories is safe, and it likely is the safest way to dispose of the growing amounts, but so far only one site has been approved, in Finland, despite many years of industry effort. The site in Onkalo, Finland, is expected to be operational this year or next. Canadian Dimension says, "a growing number of First Nations have passed resolutions or issued statements opposing the transportation and/or disposal of nuclear waste in northwestern Ontario, including Lac Seul First Nation, Ojibway Nation of Saugeen, Grassy Narrows First Nation, Fort William First Nation, and Wabaseemoong Independent Nations." Five First Nations — including Grassy Narrows, which is still suffering from industrial mercury contamination after more than 60 years — have formed the First Nations Land Alliance, which wrote to the NWMO, stating, "Our Nations have not been consulted, we have not given our consent, and we stand together in saying 'no' to the proposed nuclear waste storage site near Ignace." Groups such as We the Nuclear Free North are also campaigning against the plan. Nuclear power is enormously expensive and projects always exceed budgets. The spent fuel will remain radioactive for hundreds of thousands of years, and contamination and leaks are possible during storage, containment, transportation and burial. With 3.3 million bundles of spent fuels already waiting in wet or dry storage at power plants in Ontario, New Brunswick, Quebec and Manitoba, and many more to come, industry is desperate to find a place to put it all. Keeping the wastes above ground comes with its own risks, especially over longer time frames, particularly if society at some point loses the technical capacity to manage the wastes. Even with the many risks and no site yet chosen for burial, industry and governments are looking to expand nuclear power, not just with conventional power plants but also with "small modular reactors," meaning they could be spread more widely throughout the country. Nuclear power is enormously expensive and projects always exceed budgets. It also takes a long time to build and put a reactor into operation. Disposing of the radioactive wastes is also expensive and creates numerous risks. Energy from wind, solar and geothermal with energy storage costs far less, with prices dropping every day, and comes with far fewer risks. Industry must find ways to deal with the waste it's already created, and burial in carefully engineered repositories appears to be the safest method, but it's time to move away from nuclear and fossil fuels. As David Suzuki Foundation research confirms, renewable energy from sources such as wind and solar is a far more practical, affordable and cleaner choice. energy alternatives.

Its an unsolvable problem

M. V. **Ramana**, 2-27-20**18**, "Technical and social problems of nuclear waste", Liu Institute for Global Issues, School of Public Policy and Global Affairs, https://wires.onlinelibrary.wiley.com/doi/10.1002/wene.289

ADVANCED REVIEW Technical and social problems of nuclear waste M. V. Ramana Liu Institute for Global Issues, School of Public Policy and Global Affairs, University of British Columbia, Vancouver, Canada Correspondence Drive, Vancouver, BC, Canada V6T 1Z2. Email: m.v.ramana@ubc.ca Despite decades of effort, the nuclear industry does not yet have a working solution for managing spent fuel and high level waste, the most radioactive products generated by nuclear power plants. Although many scientific and technical bodies have endorsed geological disposal as the preferred solution to this problem, there remain significant uncertainties about the long-term performance of repositories and behavior of the nuclear wastes to be stored in these facilities. Apart from a minority of countries, most countries have not chosen any sites for a repository. Further concerns about the long-term safety of repositories arise from the experiences of failures and accidents at pilot facilities. One reason for the absence of operating repositories decades after they were first proposed is widespread public opposition to such facilities. Polls have revealed that substantial majorities of people consider nuclear waste with dread and do not approve plans to dispose of radioactive wastes near them, or, often, far away either. Nuclear power advocates have typically dismissed public concerns as resulting from a lack of understanding of scientific facts but this explanation does not withstand scrutiny. Technical approaches to dealing with nuclear waste, such as reprocessing of spent fuel, mischaracterize the social concerns and therefore do not help gain public acceptance. Concern about radioactive waste has contributed to the failure of the propaganda effort by the nuclear industry to market nuclear power as a solution to climate change. The absence of a solution to waste negatively affects the future expansion of nuclear energy. This article is categorized under: Nuclear Power > Climate and Environment Nuclear Power > Economics and Policy Nuclear Power > Science and Materials KEYWORDS geological repositories, nuclear energy, public opposition, radioactive waste, reprocessing 1 | INTRODUCTION Nuclear waste is controversial. Many consider it highly dangerous, "the least acceptable of hazardous wastes" in the words of a group of researchers who have been at the forefront of research on public attitudes towards risks of all kinds (Flynn et al., 1995, p. 8). Many also see the problem of dealing with it as negating any benefits that nuclear energy might produce. As one activist put it, "Electricity is but the fleeting byproduct from atomic reactors. The actual product is forever deadly radioactive waste" (Kamps, 2016). There is also an extensive literature that highlights various ethical problems associated with nuclear waste (Andren, 2012; Hannis & Rawles, 2013; Shrader-Frechette, 2000; Taebi, 2012). Received: 1 October 2017 Revised: 6 January 2018 Accepted: 8 January 2018 DOI: 10.1002/wene.289 WIREs Energy Environ. 2018;7:e289. wires.wiley.com/energy © 2018 Wiley Periodicals, Inc. 1 of 12 https://doi.org/10.1002/wene.289 Inquiry into the prerequisites for nuclear energy in Australia Submission 95 - Attachment 1 Public resistance has halted multiple proposals to set up sites to bury nuclear waste in several countries. The United States and Germany actually constructed repositories for disposal of weapons-related radioactive waste, and low and intermediate level waste respectively, only to have them shut them down (temporarily in the U.S. case) due to accidents and leakages (Kallenbach-Herbert, 2011; Owen, 2010; U.S. Department of Energy (USDoE), 2015a); their attempts to set up a repository for wastes with higher levels of radioactivity have come to naught.1 And at least three attempts to set up spent fuel repositories in countries without nuclear power plants have failed in the past (Feiveson, Ramana, & von Hippel, 2011). In combination with an ever-increasing stockpile of spent fuel around the world, these failures suggest that nuclear waste is a difficult, if not intractable, problem. At the same time, advocates of nuclear energy consider radioactive waste to be an entirely manageable problem. The American Nuclear Society asserts that "the nuclear industry has found a solution for its waste challenges. Radioactive wastes must be managed and disposed of properly", with the recommendation that the disposal solution for "transuranic and high level wastes" be storage in a deep repository (American Nuclear Society, 2016). The International Atomic Energy Agency highlights "significant progress" on disposal plans in countries such as Finland and Sweden (Henriques & Quevenco, 2015). And, indeed, in November 2015, the ruling center-right party in Finland became the first government to grant a construction license for an underground repository to manage radioactive spent fuel from commercial reactors (Rosendahl, 2015). The state Royal Commission in South Australia went so far as to say that nuclear waste "presents an opportunity that should be pursued"(Scarce, 2016) (our emphasis).2 Given this welter of conflicting narratives on nuclear waste, what is one to make of the challenge of dealing with this material? This paper explores some of the technical and social challenges associated with radioactive waste management and disposal, arguing that there are unique characteristics of nuclear waste that render the problem of managing it in the long term all but intractable. Although this paper does not discuss the institutional challenges, it is worth noting here that managing nuclear waste and siting repositories is a problem that is going to involve, inter alia, the nuclear industry, regulatory and other government agencies, as well as political officials faced with electoral pressure. The complex interplay between these multiple groups makes it very difficult to deal with nuclear waste. This paper will also briefly discuss some of the implications of the connection between nuclear energy and nuclear waste, which goes beyond the obvious technical fact that nuclear reactors produce radioactive waste. In particular, the absence of an acceptable solution to the problem of nuclear waste contributes significantly to public attitudes towards nuclear energy (Whitfield, Rosa, Dan, & Dietz, 2009, p. 426), and has led countries to rethink their policies about this source of electricity. One illustration of this rethink is Taiwan's decision to phase out nuclear power; while that decision was largely related to safety concerns, it was also influenced by concerns about waste management.3 Several surveys have found that public acceptability of a nuclear power expansion would increase significantly if the waste storage problem could be more effectively solved (Ansolabehere, 2007). In the words of a Canadian activist, "To advance [the nuclear industry's] expansion ambitions they want to be able to say that they've solved their biggest problem, which is nuclear waste. The industry's end goal is to have a community say 'yes' and then say 'look, the problem is solved'" (Cornwell, 2012). Conversely, a decision to phase out nuclear power would make it easier to dispose of the waste stockpiles that have already been produced because at least some of the opposition to waste repositories is from activists who see such opposition as a way to force governments and nuclear utilities to stop expanding reactor construction and shut down existing ones, a strategy that has been termed "constructive procrastination" (Darst & Dawson, 2008). 2 | TECHNICAL BACKGROUND Nuclear waste is not a singular category. Different kinds of radioactive products are produced in nuclear reactors as well as in various steps of the nuclear fuel chain. Among the most potent of these is the irradiated fuel, which is also called spent fuel, produced in all operating nuclear reactors. The spent fuel contains all the radioactive fission products that are produced when each nucleus of uranium or plutonium breaks apart to produce energy, as well as those radioactive elements, including plutonium, that are produced when uranium is converted into heavier elements following the absorption of neutrons and subsequent radioactive decays. This paper largely deals with spent fuel and the waste forms produced by processing it. The spent fuel has to be stored underwater for periods ranging from a few years to decades to deal with the high levels of heat and radiation it emits. In some countries, this spent fuel, once it is cool enough, is transferred to dry casks for storage on site or in a centralized facility. Most countries have accumulated large inventories of spent fuel (see Table 1), most of it stored at reactor sites. A few countries practice what is called reprocessing where the fuel is subject to a chemical process that separates out the plutonium produced through transmutation as well as the uranium that is not fissioned (International Panel on Fissile Materials, 2015). The idea, although it is not always implemented, is to use the resulting plutonium and uranium as fuel in 2 of 12 RAMANA Inquiry into the prerequisites for nuclear energy in Australia Submission 95 - Attachment 1 reactors. [Plutonium can also be used to make nuclear weapons (Mark, 1993; USDoE, 1997), and that is a major concern with reprocessing, but this paper does not deal with that problem.)] Reprocessing also results in a variety of waste streams; the one with the highest concentration of radioactivity is called high-level waste. The high-level waste is, typically, vitrified, that is, converted into solid form by mixing with a glass-like substance and cooled. The key technical characteristic that makes dealing with spent fuel and high-level waste so difficult is that the presence of radioactive substances with extremely long half-lives. In the case of spent fuel, for example, it takes several hundreds of thousands of years for the radiotoxicity of the contents of spent fuel (under hypothetical ingestion) to become less than that of the natural uranium (including its associated decay products) from which it was derived (Hedin, 1997). This is graphically illustrated in Figure 1. Since radiation is hazardous to health, even at low levels, exposure to these wastes will be harmful to people and other living organisms as long as the wastes remain radioactive. Thus, they have to be isolated from human contact for periods of time that are longer than anatomically modern Homo sapiens have been around on the planet. Such a need for stewardship is unprecedented in human history • 3 | GEOLOGICAL DISPOSAL There is in fact a technical solution to this problem that is on offer: bury the radioactive wastes underground. The idea of building a geological repository for radioactive wastes is old, and the U.S. National Academy of Sciences proposed the concept as early as 1957 (NRC, 1957). Over the decades, support for the idea has grown and the U.S. Department of Energy cites a "consensus in the scientific community" to advocate for geological repositories, which it characterizes as "the safest Note: In some cases, country totals include spent fuel inventories from different kinds of reactors (e.g., South Korea), with different levels of radioactivity, and so the figures might not be directly comparable. FIGURE 1 Relative ingestion radiotoxicity of uranium ore, of the spent LWR fuel that could be derived from it, the toxicity of the uranium decay products that are separated in the uranium mill, and of the depleted uranium that is stored at the enrichment plant. Source: Hedin (1997) RAMANA 3 of 12 Inquiry into the prerequisites for nuclear energy in Australia Submission 95 - Attachment 1 and most cost-effective method for permanently disposing of spent nuclear fuel and high-level radioactive waste" (DoE, 2015b). In such a repository, the waste would be packed in special containers and placed under the ground in some suitable geological medium. The problem with this method is that the wastes stay radioactive for hundreds of thousands of years and any container or waste package will almost definitely corrode within that long timespan. Therefore, it is only a matter of when, not if, radioactive materials will escape into the biosphere and contaminate ground water sources. How fast this happens is influenced by both the choice of geological media (e.g., granite, volcanic tuff, or clay) and the package in which the materials are emplaced (Ewing, 2011). The hope is that if all of these choices are suitably made, and the repository is well-designed and executed, this could allow the nuclear waste to remain isolated from human contact for long enough for most of the radioactive materials to decay into stable substances. Nevertheless, there could be some remnant radiation releases. Humans could be exposed to radiation from these wastes through "two principal modes", which are, "1) small, concentrated releases produced by human intrusion (from digging a well either near or into a repository) that could result in large doses of radiation to a few individuals; or 2) the gradual release of radioactivity from the repository into ground water (and ultimately into drinking water or food supplies), leading to very small doses (compared to background radiation) to a large portion of the population" (OTA, 1985, p. 74). Because models of how radionuclides behave in repositories over millennia suggest that the radiation doses will be low, some assert that this mode of waste management is safe. The World Nuclear Association, for example, states: "Safe methods for the final disposal of high-level radioactive waste are technically proven" (WNA, 2016). Such assertions raise an obvious philosophical question: given the empirical underpinnings of modern science, how can one "prove" anything about the behavior of a structure that is to last and function as designed for hundreds of thousands of years. Since there are no operational geological repositories that store large quantities of waste from commercial reactors, all that can be offered by way of proof is a theoretical case for why a hypothetical repository will be safe. That, however, does not constitute proof because even in these theoretical safety cases, there remain significant uncertainties. The reliability of these safety cases becomes even more suspect when one considers the major failures that repositories have experienced within just a time span of a few decades of operations. We discuss these two aspects below. 3.1 | Uncertainty Any assessment of the performance and behavior of geological repositories will be beset with uncertainties. What is being attempted is predicting how a complex system, undergoing numerous chemical reactions and a variety of physical changes, will behave in a medium that is going to be subject to multiple transformations over very long periods of time. Some of the complications include climate change, the potential for volcanoes, and changes in the behavior of various parts of the repository, including the intrusion of water, because of chemical changes (Macfarlane & Ewing, 2006, p. 394). The radioactive waste materials placed within the repository constantly generate heat, which also changes the behavior of the repository. A further complication is that "the act of emplacement of the waste affects some of the fundamental properties of the surrounding rock. The construction of tunnels creates a disturbed zone of increased fracture, and pore waters move in response to the thermal pulse generated by the decay of radionuclides" (Ewing, 2015, p. 254). There are also some known unknowns, where the full impact of known threats to the integrity of the radioactive waste package are thus far not well understood; an example is the effect of microbial processes on the behavior of repositories.4 Adding to this technical complexity is uncertainty about how human populations will behave far into the future. How are we to know, for example, that in the 29th century, people might not be mining in the vicinity of the repository to obtain some mineral that has become widely used at that time? Efforts to try and communicate about the dangers of buried radioactive waste through millennia border on science fiction, and believing that the proposed design elements would deter human intrusion thousands if not tens of thousands of years into the future strains one's credulity (Galison & Moss, 2015). Similar uncertainties plague assessments of radiation doses to human beings from repositories because they have to necessarily make unprovable assumptions about characteristics of human populations over tens of thousands of years, for example, about how much groundwater would be used for drinking or in agriculture. Just lavishing money on research will not solve this conundrum. As the U.S. National Academy of Sciences' Committee recognized: "not all… of today's uncertainties in predicting the future behavior of a repository system can be reduced or eliminated by further research and development" (Committee on Disposition of High-Level Radioactive Waste through Geological Isolation, Board on Radioactive Waste Management, National Research Council, 2001, p. 3). Thus, any decision making will have to be made under circumstances of not knowing fully well the future impacts of burying these long-lived wastes, and assertions about safety cannot be treated as definitive by any means. 4 of 12 RAMANA Inquiry into the prerequisites for nuclear energy in Australia Submission 95 - Attachment 1 3.2 | Accidents and failures Given the sheer complexity of the behavior of a repository emplaced with radioactive waste, it should not be surprising that there would be accidents or failures of one kind or the other. Indeed, even the limited experience with existing repositories provides examples. In the case of the Asse repository in Germany, planners chose a poor location within a salt dome, the medium that was chosen because of its presumed ability to be dry, and ignored warnings from local NGOs about flooding (Kallenbach-Herbert, 2011, p. 48). There was, thus, both a failure of design and of the institution managing nuclear waste. An example of an accident comes from the Waste Isolation Pilot Plant (WIPP) in the United States. For long, WIPP had been held up as a model for how radioactive wastes should be dealt with. As environmental lawyers Richard and Jane Stewart, wrote in 2011, "WIPP is functioning without major incident and is well on its way to safely disposing of the bulk of the nation's TRU waste" (Stewart & Stewart, 2011, p. 185). But, in 2014, a drum of transuranic waste exploded and released small quantities of plutonium and americium, which made their way to the Earth's surface (Editorial, 2014). The accident is among the costliest in U.S. history but the explosion resulted from a simple, seemingly minor, decision: to use an organic version of "kitty litter — used to blot up liquids in sealed drums" -- instead of a mineral one (Vartabedian, 2016). The accident in turn is evidence of serious failures. Writing about this accident, three academics from Stanford University pointed out that the "failures were wide-ranging: in safety assessments, control of drum contents, installation and maintenance of equipment, and preparation for an accident" (Tracy, Dustin, & Ewing, 2016, p. 150). Even the official Department of Energy analysis of the WIPP accident concluded that organizations that were involved in managing the facility had allowed safety culture "to deteriorate within pockets of the organization" (DoE, 2015a, p. ES-17). The more important lesson for the purposes of evaluating the safety case for proposed repositories is "how difficult it is to predict potential failures of such a disposal system over millennia" (Tracy et al., 2016, p. 150). One could go further. Because of the possibility of "unknown unknowns", it is simply impossible to predict all potential failures. Further, if such failures have already been observed within such a short period, how can one be confident about safety claims, that no such failures would not occur during the many decades it would take to construct and load hundreds of tons of highly radioactive waste into a geological repository? 3.3 | Failed plans to construct repositories Although geological disposal is widely accepted as the appropriate solution to radioactive waste by nuclear industries and regulators around the world, no country has so far constructed and operated any such repository for storing waste from nuclear power plants. Some countries have made significant progress, but there is still no operating site that holds high-level waste from commercial nuclear reactors. Almost all countries that have tried to site repositories have experienced one or more failures. In most cases, the failure stemmed from the adoption of a process that involved site selection by technical personnel with no involvement from the public at the early stages. As elaborated by academics Gordon Mackerron and Frans Berkhout, the policy in the United Kingdom can be "described as 'decide, announce, defend' (DAD), meaning that Government, the nuclear industry and selected scientists would develop policy in a closed environment, then announce it and finally seek to defend it against the tide of opposition that always ensued. Given the UK Government's unwillingness to force radioactive waste management sites on resistant local populations, this also meant that the word 'abandon' had to be added to DAD – DADA was a fair representation of two decades of policy failure" (Mackerron & Berkhout, 2009, p. 997). Similar DADA sequences occurred in other countries as well. Attempts to site repositories that accept spent fuel or high level waste from other countries have also experienced failures (Feiveson, Ramana, & von Hippel, 2011; Holland, 2002; Silverstein, 1997). Typically, such proposals have involved countries that have no nuclear power plants themselves. Rather, these countries tried to describe themselves as attractive for one reason or the other (remoteness or low population density, for example). The latest such proposal was the one to set up a repository in South Australia (Scarce, 2016), which ended in failure due to widespread public opposition (Australian Broadcasting Corporation, 2016; Green, 2016). In addition to the record of failures, there are normative problems with the idea of exporting nuclear waste, including the environmental injustice inherent in the exports of such hazardous materials, and the ethical argument that those enjoying the benefits of nuclear power should also incur the costs (Dawson & Darst, 2005; Marshall, 2005). Faced with such failures, some countries have started seeking community consultation and verbal commitment to voluntary participation. In practice, however, many of these countries have just focused on finding a relatively powerless community to site the geological repository, portraying the waste management project as a major investment that would bring large amounts of money, jobs, and taxes to local governments, and, if necessary, dealing with any opposition through some combination of undemocratic decision-making at local levels, bribery and force (Burrows-Taylor, 2017; Gosden, 2014; Hannis & Rawles, 2013; jas, 2011; Simpson, 2016). These pay only lip service to democratic and ethical principles. RAMANA 5 of 12 Inquiry into the prerequisites for nuclear energy in Australia Submission 95 - Attachment 1 In Canada, the ethical principles that underlay the plans for setting up a repository in consultation with local communities morphed to, in essence, the offer of an expensive carrot, namely a multi-billion-dollar project, with associated jobs and tax flows, to various impoverished communities (Ramana, 2013). But the focus on small poor localities is likely to emerge as a problem because decisions on final resting places for radioactive waste also necessarily involve larger regions, namely the state in which the repository will be sited, as well as locations along transport routes. Historically these larger areas have opposed waste repository siting for obvious reasons: people living in the larger surrounding areas bear a significant risk, at least in their perception, but they obtain little financial benefit from the presence of the repository. 4 | PUBLIC RESISTANCE Why has there been such a divergence between theoretical confidence in geological repositories as a solution to nuclear waste and real-life impossibility in setting up a repository? The overwhelming reason is public resistance to siting such repositories. Most countries that are looking for specific repository sites are faced with sustained opposition, for example, in France (Oroschakoff & Solletty, 2017), the United Kingdom (RT, 2015), Japan (Ryall, 2017; Suzuki, 2017), and South Korea (Richardson, 2017). Even in countries that have chosen specific sites, namely Sweden and Finland, there is a history of opposition (Sjoberg & Drottz-Sjoberg, 2009; Swahn, 2011; Vira, 2006). Underlying this opposition is the negative attitude that a large fraction of the global public have towards nuclear waste and repositories to store them. This is revealed by numerous polls. An example is a 2008 poll of citizens in the 27 Member States of the European Union that found that 72% of those interviewed were in agreement with the statement: "There is no safe way of getting rid of high level radioactive waste", even though they felt responsible for the waste (as evidenced by 93% agreeing with the statement "A solution for high level radioactive waste should be developed now and not left for future generations") (EC, 2008). Since the preferred "way of getting rid of high level radioactive waste" is by constructing a repository, it follows that a majority of the public would not associate repositories with a "safe way" of waste disposal. Similarly, in China, nuclear waste was identified by a significant fraction of people polled as one of the main risks associated with nuclear energy (Sun, Zhu, & Meng, 2016). A 2015 poll in Churchill County is an illustration of the majority sentiment being against siting a repository at Yucca Mountain in the United States (Churchill County Nuclear Waste Oversight Office & Churchill County High School, 2015). Just association of an area with nuclear waste creates such a negative image that it leads others to shun or avoid the area, which some have termed stigma (Bassett, Jenkins-Smith, & Silva, 1996; Gregory, Flynn, & Slovic, 1995; Slovic, Flynn, & Gregory, 1994). When the United States was considering the Yucca Mountain location in Nevada as a disposal site for highlevel radioactive waste, nationwide surveys showed that a majority of people felt that a repository would reduce the desirability of Nevada as a state to move to, and could deter them from visiting for a vacation or a convention (Flynn & Slovic, 1995) • Thus, regardless of whether or not nuclear waste poses a threat to the health of humans, it does have economic impacts. In addition to such adverse economic effects, it has been argued that "social, psychological, and cultural impacts are often at least as significant and merit greater attention from policymakers and researchers" (Gregory & Satterfield, 2002, p. 347). The public could carry this opposition to the ballot booth. In the United States, a national level poll in 2015 found "63 percent of voters saying they would be less likely to vote for a candidate running for federal office who supported building a nuclear waste storage site in their state, compared to 13 percent who said the opposite" (Burroughs, 2015). **Nuclear waste invokes strong feelings of dread,** and psychometric researchers using opinion polls and other ways of studying attitudes have long realized that it is in a special category in terms of how the public views it. For example, a two country study that surveyed public perceptions of risk in the United States and Japan showed "that **people** in both countries **have the highest level of dread toward nuclear waste disposal, nuclear accidents, and nuclear war, greater even than their dread of crime and AIDS"** (Hinman, Rosa, Kleinhesselink, & Lowinger, 1993). 4.1 | Misdiagnosis There is a tendency to dismiss opposition to waste storage as a "not in my backyard" (NIMBY) phenomenon. However, such a pejorative characterization hides more than it reveals about the underlying source of opposition. Although polls suggest that people typically express less opposition to nuclear facilities located anywhere than to one that would be constructed close to where they live, a substantial fraction, often a majority, of those opposing a facility express opposition even if the proposed waste project is considerably further away, far enough not to be considered one's backyard. For example, the national level 2015 poll in the United States mentioned earlier showed that **77%** of those polled **said they would not live within 10 miles of a nuclear waste storage site, but 63% said they would not live within a 100-mile radius either** (Burroughs, 2015). Their 6 of 12 RAMANA Inquiry into the prerequisites for nuclear energy in Australia Submission 95 - Attachment 1 opposition evidently stems not just from a desire to avoid personal harm, but also from the ethical conviction that no community should be subjected to such risks. In other words, the sentiment might be better characterized as a "**not in anyone's backyard" opposition.** NIMBY, in contrast, suggests that people think of nuclear waste repositories as socially necessary but just that the facility should not be situated in their vicinity—which is far from the truth. Rather, the inconvenient truth for those who think that the nuclear waste can be managed is that opposition to waste is not just from members of the local community. There is a much wider constituency, cutting across local, regional, national, and international lines, that opposes not just the siting of these facilities but the whole idea that one can "solve" the waste problem. 4.2 | Lack of trust Organizations involved in managing nuclear waste are not often trusted by members of the public. In one national survey from as early as 1989**, 68% of Americans disagreed** with the statement: "**The US** Department of Energy **can be trusted to provide** prompt and full **disclosure of any accidents** or serious problems **with their nuclear-waste** management programs" (Slovic, Flynn, & Layman, 1991, p. 1604). The reasons for a lack of trust, not just of the Department of Energy but of the general effort to site a repository in Yucca Mountain, included a site selection process that was perceived as unfair, attempts to coerce the state of Nevada, manipulation of regulatory criteria to make them fit the chosen site, and treating the public as if their concerns were irrational (Tuler & Kasperson, 2010). In Japan, trust in the organizations involved in nuclear power, including waste management, dropped dramatically in the aftermath of the Fukushima accidents, and this has changed people's attitudes towards setting up a repository (Gallardo, Matsuzaki, & Aoki, 2014). Once lost, trust is extremely difficult to regain – a characteristic that has been termed the asymmetry principle (Slovic, 1993). 5 | THE SOCIAL AND THE TECHNICAL Public concern about proposals for nuclear waste disposal is often dismissed by members of the nuclear establishment as not being based on scientific or technical facts [for example, (Peterson, 2017)]. The underlying implication is that "technical" assessment of risk is rational and objective while "social" perception of risk is driven by subjective factors. However, there are sound reasons for doubting the validity of the technical assessments for "social" reasons, both because of the historical experience of how technical assessments err far more often on the side of underestimating rather than overestimating purely "technical" risk factors, and because of the biases inherent in the institutions that generate the technical assessments of risk. The related problem is that the kinds of technical or scientific analyses that are carried out, and how problems are framed in the first place, do not start from public concerns. As a group of social scientists arguing for the intake of "social science input into acceptable solutions" articulated it, "Although scientific and technical analyses are essential, they will not, and arguably should not, carry the day unless they address, both substantively and procedurally, the issues that concern the public" (Rosa et al., 2010, p. 762). Further, what constitutes an adequate level of safety cannot be a technical issue but is necessarily a social and political decision. 5.1 | Reprocessing One example can illustrate the mismatch between the nuclear industry's responses to the problem of radioactive waste and public attitudes. The technical proposal that is most often articulated to be a solution to nuclear waste is to subject the spent fuel to reprocessing (Barbat & Liberge, 2013; Kakodkar, 2012; Kok, 2013; Ling, 2009; Shughart II, 2014). Reprocessing frames the waste problem as one to be tamed through volumetric reduction: instead of disposing of spent fuel as it is, the idea is to concentrate most of the radioactivity contained in the spent fuel into what is called high level waste. Although the latter still requires a repository, its proponents focus primarily on the reduction in volume of the waste. For example, the French nuclear corporation Areva, which operates the largest reprocessing plant in the world, states on its website that "the volume and radiotoxicity of the waste is reduced, compared with the storage of unprocessed spent fuel" (Areva, 2016). What this assertion misses out is that the rate of heat generation, not the volume of the materials being disposed, determines the necessary area for the repository. In turn, how much heat is generated is dependent primarily on the radioactive content. Further, when one includes what is needed to dispose of the plutonium that has been separated and used as fuel in reactors, the repository area increases further. In all, there is at best a marginal benefit from reprocessing on the required repository area (Feiveson, Mian, Ramana, & Von Hippel, 2011, pp. 15, 151). More important, even if there were to be an advantage in terms of the size of the repository needed in the case of reprocessing, that does not solve the problem of nuclear waste. As argued elsewhere, the "public's concern about repositories is RAMANA 7 of 12 Inquiry into the prerequisites for nuclear energy in Australia Submission 95 - Attachment 1 not that they will be too big, but that they simply are being built and will remain hazardous for millennia. Thus, a smaller repository does little to address the underlying concern" (Ramana, 2017). The reprocessing idea also misses a second characteristic of public concern, namely that much of the public is quite concerned about the waste streams that have low concentrations of radioactivity. This is why, for instance, there is widespread concern about the relatively low levels of radioactive contamination from the Fukushima accidents detected off the West Coast of the United States, or about a Canadian utility's proposal (ultimately abandoned) to ship steam generators from decommissioned nuclear reactors to Sweden (Iype, 2011; Sherwood, 2014). At reprocessing plants, because low level waste is produced in extremely large volumes, nuclear establishments find it is too expensive to store them. Therefore, around the world, reprocessing plant authorities simply release these low level waste streams into the environment after some treatment, which can be detected far away from the source (Baburajan et al., 1999; NRPA, 2002). The public's concern also extends to this waste form and the contamination of the environment. Finally, thinking of reprocessing as a way to solve the nuclear waste problem misses out on the fact that reprocessing facilities might well be opposed by members of the public too, in part because there is the risk that an accident at these might release large quantities of radionuclides and these might get dispersed over vast areas (Ramana, Nayyar, & Schoeppner, 2016; Thompson, 2014). The protests in 2016 over the proposed reprocessing plant in Lianyungang in China, because of the health and safety concerns of residents (Hornby, 2016; Hornby & Lin, 2016), leading to the cancellation of the project, offers an illustration of public concern about reprocessing facilities. Thus, in these many ways, offering reprocessing as a solution to nuclear waste mischaracterizes the nature of the public's concern about the problem in the first place. Reprocessing as a cure for the growth of spent fuel inventories is worse than the problem, whether viewed in technical or social terms. 6 | CONCLUSION In 2015, Yukio Amano, the director general of the International Atomic Energy Agency, stated: "Waste disposal is often cited as one of the major problems facing nuclear power. In fact, the nuclear industry has been managing waste disposal for more than half a century. Dozens of facilities for low-level and intermediate-level nuclear waste are in operation throughout the world. As far as the management of high-level radioactive waste and spent fuel is concerned, good progress has been made in recent years, especially in Finland, Sweden and France… The first deep geological repositories for nuclear spent fuel are likely to become operational after 2020. The progress that is being made in this area deserves to be better known" (Amano, 2015). In other words, we know how to deal with high-level nuclear waste and spent fuel and the solution will be apparent to all quite soon. For all the reasons discussed earlier, this picture is misleading and hides more than it reveals. First consider the cases highlighted by Amano as displaying "good progress". France is still battling fierce opposition from protestors (Burrows-Taylor, 2017; Oroschakoff & Solletty, 2017). In Sweden and Finland, the waste disposal concept rests fundamentally on the use of copper canisters and there remain important questions about their reliability (Swahn, 2011). Indeed, in January 2018, Sweden's environmental court ruled that there "is still uncertainty about the ability of the capsule to contain the nuclear waste in the long term", which complicates plans to construct a repository (Karagiannopoulos, 2018). And, of course, there could be failures even with repositories that are constructed—as has happened at WIPP and Asse—that lead then to the project being abandoned. Finally, the process through which the sites for geological repositories in this special group were chosen is not reproducible in all other countries. In sum, isolated and partial successes do not amount to a robust way to manage nuclear waste. The histories of arbitrary imposition of sites and sustained public opposition make it very difficult to obtain voluntary acceptance among communities living near potential repository locations. Therefore, dealing with these hazardous products will continue to be a nearly intractable problem for most countries and programs. What, then, is to be done? One, perhaps obvious, first step is captured by a quote that has been attributed to, among others, American humorist Will Rogers: If you find yourself in a hole, stop digging. In the context of the subject of this paper, the import of that aphorism is straightforward: stop producing more nuclear waste. The problem that some might have with this recommendation to stop producing nuclear waste is that it also automatically implies stopping the generation of more nuclear energy, not to mention the construction of more nuclear plants. In turn, ceasing to produce nuclear power is seen as a problem because its proponents have worked hard at rebranding the technology as an important solution to climate change (Diaz-Maurin & Kovacic, 2015; Doyle, 2011; Stoett, 2003). But it is becoming increasingly clear that phasing out nuclear power does not have to result in an increase in emissions of carbon dioxide because of the drastic reductions in the costs of renewables, and their rapid growth in countries around the world. Nuclear power's substantial limitations have also become more apparent in recent years (Ramana, 2016a, 2016b; Schneider & Froggatt, 2017; von Hippel, 2010), which implies that there need be few regrets about phasing out the technology. 8 of 12 RAMANA Inquiry into the prerequisites for nuclear energy in Australia Submission 95 - Attachment 1 Nuclear power is also not seen as a desirable solution by members of the public, even among those very concerned about the dangerous impacts of climate change. By and large, efforts to change public attitudes towards nuclear power by stressing its potential role in reducing carbon emissions have not been very successful, leading at best to reluctant support (Bird, Haynes, van den Honert, McAneney, & Poortinga, 2014; Pidgeon, Lorenzoni, & Poortinga, 2008). Further, studies of public opinion suggest that "people who did not think that nuclear power can help to prevent climate change were also those who are most concerned about the environment and about climate change" and that "enduring issues over radioactive waste disposal and pollution mean that nuclear energy is unlikely to ever gain the status of an environmentally benign technology" (Spence, Poortinga, Pidgeon, & Lorenzoni, 2010, pp. 399, 401). A particular concern with using nuclear power to mitigate climate change is that it implies having to tolerate the production of long-lived radioactive waste. In a study conducted in the United Kingdom, "survey respondents were more concerned about radioactive waste: 28% were "very concerned" about climate change and 39% were "very concerned" about radioactive waste" and "radioactive waste was far less acceptable to people overall with 63% saying it was very or fairly unacceptable compared with climate change where only 44% said it was very or fairly unacceptable" (Bickerstaff, Lorenzoni, Pidgeon, Poortinga, & Simmons, 2008). For those unwilling to give up nuclear power despite the presence of alternatives and the many problems afflicting that technology, including nuclear waste, the only option is to continue with the present state of affairs, in the hope that someday there will be a path forward. For reasons discussed above, that day will not come anytime soon.

The Impacts are twofold

First, ruining water supplies for millions

Environment America, 1-24-2012, "Nuclear Power Plants Threaten Drinking Water for 49 Million Americans",
https://environmentamerica.org/media-center/nuclear-power-plants-threaten-drinking-water-for-49-million-americans/

Nuclear Power Plants Threaten Drinking Water for 49 Million Americans Media Releases January 24, 2012 Environment America Washington, D.C. – The drinking water for 49 million Americans could be at risk of radioactive contamination from a leak or accident at a local nuclear power plant, according to a new study released today by Environment America Research & Policy Center and the US Public Interest Research Group Education Fund. See map here, key below. **"The danger of nuclear power is too close to home. The drinking water for 49 million Americans is too close to an active nuclear power plant,**" said Courtney Abrams, the Clean Energy Advocate for Environment America. "An accident like the one in Fukushima, Japan or a more routine leak could spew cancer-causing radioactive waste into our drinking water." The nuclear meltdown in Fukushima, Japan last year drew a spotlight on the many risks associated with nuclear power. After the disaster, airborne radiation left areas around the plant uninhabitable, and even contaminated drinking water sources near Tokyo, 130 miles from the plant. According to the new report, "Too Close to Home: Nuclear Power and the Threat to Drinking Water," the drinking water for 49 million Americans is within 50 miles of an active nuclear power plant – the distance the Nuclear Regulatory Commission uses to measure risk to food and water supplies. Major cities, including New York, Boston, Philadelphia, San Diego, Cleveland and Detroit receive their drinking water from sources within 50 miles of a nuclear plant. Radiation from a disaster like the one in Fukushima can contaminate drinking water and food supplies, as well as harm our health. But disaster or no disaster, a common leak at a nuclear power plant can also threaten the drinking water for millions of people, and as our nuclear facilities get older, leaks are more common. In fact, 75 percent of U.S. nuclear plants have leaked tritium, a radioactive form of hydrogen that can cause cancer and genetic defects. In the case of the Fukushima meltdown, large quantities of seawater were pumped into the plant to cool it, and contaminated seawater then leaked and was dumped back into the ocean, carrying radioactivity from the plant with it. Waterways like Lake Michigan, the Missouri River, and the Chesapeake Bay are just a few that provide cooling water for nuclear power plants and could be at risk. "With nuclear power, there's too much at risk and the dangers are too close to home. Americans shouldn't have to worry about getting cancer from drinking a glass of water," said Jennifer Kim, Advocate for the US Public Interest Research Group Education Fund and co-author of the report. In order to reduce the risks nuclear power poses to water supplies immediately, the groups recommend completing a thorough safety review of U.S. nuclear power plants, requiring plant operators to implement recommended changes immediately and requiring nuclear plant operators to implement regular groundwater tests in order to catch tritium leaks, among other actions. "There are far cleaner, cheaper, and less-risky ways to get our energy," concluded Abrams. "The United States should move to a future without nuclear power by retiring existing plants, abandoning plans for new plants, and expanding energy efficiency and the production clean, renewable energy such as wind and solar power.

Aff uniquely threatens more people

Morgan Loew and Cody **Lillich** , 3-20-20**25,** "How rising nuclear power interest threatens Phoenix's strained water supply", Arizona's Family,
https://www.azfamily.com/2025/03/20/renewed-push-nuclear-poses-risk-phoenix-drinking-water/?outputType=amp

How rising nuclear power interest threatens Phoenix’s strained water supply Experts warn of potential radioactive contamination risks to Valley water sources Investigative reporter Morgan Loew looks into the hidden dangers of Arizona's abandoned uranium mines and their impact on water sources and nuclear energy. By Morgan Loew and Cody Lillich Published: Mar. 20, 2025 at 6:29 AM MST|Updated: Mar. 20, 2025 at 10:33 PM MST PHOENIX (AZFamily) — The mountains east of Roosevelt Lake, known as the Sierra Anchas, are home to more than one dozen uranium mines, which operated in the 1950s and 1960s. Today, those mines are dormant. Some have entrances that are wide open. Others are boarded shut. But there are still remnants of their radioactive past. Forest Service signs warn visitors not to camp overnight because of low levels of radiation remaining in the rock, soil, and water. At some point in the not so distant future, miners may return to some of those pits and caves or drill new ones, as nuclear energy experiences a revival in the United States. “We think it’s really critical and exciting,” said Bobby Olsen, who is the associate general manager sustainability executive at SRP. Olsen is referring to plans by state electric utility providers SRP, APS, and Tucson Electric Power to build Arizona’s second nuclear reactor. The Palo Verde Nuclear Generating Station, located west of Buckeye, has been in operation for the past four decades. We’re getting a rare look at the largest nuclear plant in the U.S., the 4,200-acre Palo Verde Generating Station, located 50 miles west of Phoenix. However, the state’s increasing population and increasing appetite for electricity have led the three power companies to combine resources and look at the possibility of building a new nuclear plant. At some point in the not-so-distant future, miners may return to some of those pits and caves or drill new ones as nuclear energy experiences a revival in the United States. “If we start today from a planning perspective, we might be able to have nuclear in the plan by the late 30’s, early 40’s,” said Olsen. Nuclear power plants are fueled by uranium 235. It’s a radioactive element found in only about a dozen US states. Arizona is one of those states. But most uranium used in the US comes from countries like Canada and Russia. VIDEO VAULT: Toxic Mines In Arizona (Oct. 6, 2015) In this report from October 6, 2015, Morgan Loew takes us to abandoned uranium mines leaking toxic heavy metals into the water systems feeding Roosevelt Lake. In 2024, Congress passed a bill that bans most uranium imports from Russia in an effort to jump-start the domestic uranium mining industry. Arizona has one operating uranium mine. It’s near the Grand Canyon and has been the target of criticism from environmentalists and the Native American community. They argue that the mine is located too close to the Colorado River, and they worry about water contamination. Many water sources on the Navajo Nation in northeastern Arizona remain polluted from uranium mining activity in that region. “The track record for this industry is abysmal,” said Taylor McKinnon, who is the southwest director of the environmental group Center for Biological Diversity. He argues that restarting uranium mining, especially near drinking water sources, is a bad idea. The uranium mining industry promotes safe and environmentally friendly modern mining techniques. But not everyone sees it that way. “No, we should not believe them. Because it’s not safe for the environment,” said McKinnon. As co-investors in Arizona’s new nuclear power plant, SRP is in an unusual situation. Because the company is also the custodian of the reservoirs on the Salt River – including Roosevelt Lake. SRP officials sent a statement to Arizona’s Family investigates, saying, “We are not aware of any plans to perform exploratory or production uranium mining on any lands in the Sierra Ancha Mountains. If any such plans develop, SRP would be very interested in ensuring that the activities do not compromise the water quality of the water resources in the area.” However, our investigation found a mining company purchased old mining claims in the Sierra Ancha Mountains in 2011. Uranium Energy Corp (UEC) owns 198 mining claims in the area. In 2022, the company published an initial assessment that recommended moving forward on drilling and testing the claims. In SEC filings, UEC stated any additional activity “will be dependent on and may change as a result of our financial position, the market price of uranium, and other conditions.” An official from UEC told Arizona’s Family investigates, “We do not have any current exploration or development plans for that region. As with all mineral claims, any future exploration activity would be subject to market conditions, regulatory approvals, and environmental considerations.” Whether the increased interest in nuclear power and the law that bans Russian uranium imports result in mining in the Sierra Ancha Mountains remains an open question. But the fact that it is a possibility is not good news to environmentalists. “Uranium in Phoenix’s watershed, I think, would be pretty unpopular for most people in the greater Phoenix metro region,” said McKinnon.

Damaging water supplies impoverishes and kills.

James Kingland, 4-22-2021, "The impact of water poverty in the United States", No Publication, https://www.medicalnewstoday.com/articles/how-water-poverty-impacts-public-health-in-the-us#Digging-deeper

How water poverty impacts public health in the US Access to clean water and sanitation is a human right enshrined in international law. Although there has been progress in recent years, contaminated water and waterborne diseases remain major threats to public health — not only in low income countries, but also in wealthier nations such as the United States. Seth Herald/AFP via Getty Images On August 3, 2010, the General Assembly of the United Nations (UN) recognized access to clean water and sanitation as a human right alongside other fundamental rights, such as life and liberty, freedom of expression, and education. According to the UN, “Lack of access to safe, sufficient, and affordable water, sanitation, and hygiene facilities has a devastating effect on the health, dignity, and prosperity of billions of people and has significant consequences for the realization of other human rights.” Untreated water contains pathogens such as the bacteria that cause diarrhea and the parasitic worms that cause schistosomiasisTrusted Source (snail fever). These pathogens spread far and wide when untreated human waste contaminates groundwater and open water that people use for drinking, irrigation, bathing, and washing utensils. In recent decades, there has been progress toward realizing the universal right to clean water and sanitation. The World Health Organization (WHO)Trusted Source estimates that between 2000 and 2017, the proportion of the global population with access to safely managed drinking water increased from 61% to 71%. During the same period, the proportion of the global population with access to safely managed sanitation services increased from 28% to 45%. Despite this progress, however, dirty drinking water and contaminated soil continue to pose a threat to the health of huge numbers of people worldwide. For example, the Centers for Disease Control and Prevention (CDC)Trusted Source report that among children under 5 years of age, there are 1.7 billion cases of diarrhea and 446,000 deaths from the condition every year globally. The CDC also says that there are around 3 million cases of cholera, a waterborne infection, and 95,000 deaths from it annually. As a result of poor sanitation, parasitic worms in contaminated soil infect hundreds of millions of people worldwide every year. Around 785 million peopleTrusted Source, which equates to around 1 in 10 people worldwide, still lack access to drinking water facilities. Article highlights: Water poverty in rich nations.A surprisingly large number of these people live in rich nations. In fact, one study found that between 2013 and 2017, around 1.1 million people in the U.S. had insecure water access. Almost a half of these people lived in the 50 largest metropolitan areas of the U.S. This included 65,000 people in New York who did not have access to piped water. Researchers at the University of Arizona in Tucson and King’s College London in the United Kingdom conducted this study. It appeared in the journal Proceedings of the National Academy of Sciences in 2020. In the paper, the study authors say: “Without tap water, how do you wash your hands? In a global health pandemic such as COVID-19, the difference between secure and insecure water access — starting with those 65,000 unplumbed New Yorkers — is a matter of life and death.” The study revealed that households without running water were more likely to include people of color, to live in mobile homes or rented accommodation, and to spend a higher proportion of their income on housing costs. “We offer clear evidence that gaps in urban water access are neither random nor accidental but underpinned by precarious housing conditions and systemic social and racialized inequality,” the study authors conclude. They suggest that their numbers almost certainly underestimate the scale of the problem, as the U.S. Census Bureau tends to undercount people in rented accommodation, people without homes, and people of color. They point out, for example, that people without homes often face great difficulty accessing clean water and toilet facilities and that their numbers are currently growing in U.S. cities. Homelessness and poor housing Another study confirmed that, although access to water and sanitation is supposedly universal in towns and cities across the U.S., official figures do not account for people without homes or those in substandard housing. When the researchers took these factors into account, they found that at least 630,000 people did not have access to a flush toilet and that a further 300,000 relied on shared sanitation. Scientists at the Georgia Institute of Technology in Atlanta conducted this study. It appeared in the American Journal of Public Health Trusted Source in 2020. Although the percentage of people without basic sanitation services is low in the U.S., the study authors write, the absolute number is large for “a high income country where resources exist to address the issue.” They note that people living in rented accommodation may have running water and a flush toilet, but when these facilities break, landlords might take weeks or months to organize repairs. Both the above studies conclude that introducing measures to ensure affordable and adequate housing is the most effective way to improve access to water and sanitation in U.S. towns and cities. America’s hidden water crisis In 2019, a major report by two nonprofit organizations — the US Water Alliance and Dig Deep — proposed a plan of action to tackle what it called “America’s hidden water crisis.” The report, Closing the Water Gap in the United States, estimates that more than 2 million people in the U.S. do not have access to safe drinking water and sanitation.However, it reiterates that the U.S. does not collect comprehensive data on water poverty. This has made it particularly difficult to assess the scale of the problem for those who are worst affected: low income communities and communities of color. The report cites evidence that Native American households, for instance, are 19 times more likely than white households to have inadequate plumbing. Also, African American and Latino households appear to be nearly twice as likely to face this challenge as white households. The report’s authors assert that the problem is not isolated dwellings living “off the grid” but entire communities that lack access to clean water and safe sanitation. They provide examples from six communities, from California to Puerto Rico, to highlight how widespread and deep rooted the problems are. In the report, they write: “On the Navajo Nation in the Southwest, families drive for hours to haul barrels of water to meet their basic needs. In West Virginia, they drink from polluted streams. In Alabama, parents warn their children not to play outside because their yards are flooded with sewage. Families living in Texas border towns worry because there is no running water to flight fires.” The report concludes that in rural communities, in contrast with towns and cities, the root cause of water poverty is isolation from municipal water services. In urban areas, utility providers tend to cover the installation and maintenance costs of water and sewer lines. However, for communities that are too far from these municipal systems, individual households may be responsible for installing a private well and septic system, often with minimal technical and financial support. Proposed solutions Among their proposed solutions, the report’s authors argue that community-led initiatives that involve the meaningful participation of residents are more likely to succeed because they foster collaboration among neighbors and a sense of ownership. However, they also call for additional government grants, as well as operational and technical assistance where required. On March 31, 2021, President Joe Biden published a program of infrastructure investment — the “American Jobs Plan” — which includes $111 billion of investments in water infrastructure. Among its ambitions is the modernization of aging drinking water and wastewater systems by scaling up existing successful programs. In addition, the plan includes calls for $56 billion in grants and loans to “states, tribes, territories, and disadvantaged communities.” Medical News Today asked George McGraw, the chief executive officer of Dig Deep, how optimistic he was that the new investments would address the concerns raised in the Dig Deep and US Water Alliance report. “Given the scope of the problem with more than 2,200,000 Americans living without basic access to safe drinking water and sanitation,” he said, “it is impossible that the problem will be solved overnight.” However, he also said that he was encouraged by the investments that Congress and the Biden Administration were making to tackle the problems. He added that the “number one thing” that Congress and the Administration can do to help marginalized communities such as Native Americans is significantly increase the level of annual federal funding targeted at tribes and other impacted communities. However, he emphasized that the funds should be made available as grants rather than loans. Furthermore, local government, utilities, nonprofits, and community groups should be allowed to use the money as they see fit, he said, “for things like decentralized systems or operations and maintenance costs in places that systems cannot financially support themselves.” Digging deeper Looking to the future, many U.S. individuals are going to have to dig deeper — quite literally. A study led by the U.S. Forest ServiceTrusted Source predicts that by the end of the 21st century, climate change and population growth will prevent serious challenges to water supply in some regions of the U.S. Declines in rainfall, say the authors, will rule out any hope of increasing reservoir storage capacity. Among the few remaining options to cope with severe shortages will be to increase groundwater extraction — in other words, dig deeper wells — and pump more water out of rivers, with all the environmental costs that this will entail. Of course, much of the rest of the world will be facing similar challenges from a warming climate and increasing populations. It is hard to escape the conclusion that, in the coming decades, the human right to water and sanitation may seem an increasingly distant dream for som

Second, spreading cancer

Bernard L **Cohen**, 10-xx-20**05**, "Understanding the toxicity of buried radioactive waste and its impacts", PubMed, https://pubmed.ncbi.nlm.nih.gov/16155457/

The oral ingestion toxicities of buried high level radioactive waste from nuclear power plants and of the natural radioactivity in the ground are calculated and expressed as cancer doses, the number of fatal cancers predicted by the linear no-threshold theory if all of the material were fed to people. Unless the size of the U.S. nuclear power industry is greatly expanded, there will probably never be more than 2 trillion cancer doses (CD) in U.S. repositories, as compared with 31 trillion CD in the ground above them. Measurements of the uranium, thorium, and radium in human bodies indicate that the latter cause 500 deaths per year in U.S. The great majority of this material is derived from the top few meters of soil that are penetrated by plant roots. It is concluded that the annual number of U.S. deaths from buried nuclear wastes will be about 1.0 (or less), orders of magnitude less than the number from coal burning electricity generation, the principal competitor of nuclear power.

Cancer is deadly

WHO, 2-3-20**25**, "Cancer", World Health Organization, https://www.who.int/news-room/fact-sheets/detail/cancer

Cancer 3 February 2025 عربي 中文 Français Русский Español Key facts Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths in 2020, or nearly one in six deaths. The most common cancers are breast, lung, colon and rectum and prostate cancers. Around one-third of deaths from cancer are due to tobacco use, high body mass index, alcohol consumption, low fruit and vegetable intake, and lack of physical activity. In addition, air pollution is an important risk factor for lung cancer. Cancer-causing infections, such as human papillomavirus (HPV) and hepatitis, are responsible for approximately 30% of cancer cases in low- and lower-middle-income countries. Many cancers can be cured if detected early and treated effectively. Overview Cancer is a generic term for a large group of diseases that can affect any part of the body. Other terms used are malignant tumours and neoplasms. One defining feature of cancer is the rapid creation of abnormal cells that grow beyond their usual boundaries, and which can then invade adjoining parts of the body and spread to other organs; the latter process is referred to as metastasis. Widespread metastases are the primary cause of death from cancer. The problem Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths in 2020 (1). The most common in 2020 (in terms of new cases of cancer) were: breast (2.26 million cases); lung (2.21 million cases); colon and rectum (1.93 million cases); prostate (1.41 million cases); skin (non-melanoma) (1.20 million cases); and stomach (1.09 million cases). The most common causes of cancer death in 2020 were: lung (1.80 million deaths); colon and rectum (916 000 deaths); liver (830 000 deaths); stomach (769 000 deaths); and breast (685 000 deaths). Each year, approximately 400 000 children develop cancer. The most common cancers vary between countries. Cervical cancer is the most common in 23 countries. Causes Cancer arises from the transformation of normal cells into tumour cells in a multi-stage process that generally progresses from a pre-cancerous lesion to a malignant tumour. These changes are the result of the interaction between a person's genetic factors and three categories of external agents, including: physical carcinogens, such as ultraviolet and ionizing radiation; chemical carcinogens, such as asbestos, components of tobacco smoke, alcohol, aflatoxin (a food contaminant), and arsenic (a drinking water contaminant); and biological carcinogens, such as infections from certain viruses, bacteria, or parasites. WHO, through its cancer research agency, the International Agency for Research on Cancer (IARC), maintains a classification of cancer-causing agents. The incidence of cancer rises dramatically with age, most likely due to a build-up of risks for specific cancers that increase with age. The overall risk accumulation is combined with the tendency for cellular repair mechanisms to be less effective as a person grows older. Risk factors Tobacco use, alcohol consumption, unhealthy diet, physical inactivity and air pollution are risk factors for cancer and other noncommunicable diseases. Some chronic infections are risk factors for cancer; this is a particular issue in low- and middle-income countries. Approximately 13% of cancers diagnosed in 2018 globally were attributed to carcinogenic infections, including Helicobacter pylori, human papillomavirus (HPV), hepatitis B virus, hepatitis C virus, and Epstein-Barr virus (2). Hepatitis B and C viruses and some types of HPV increase the risk for liver and cervical cancer, respectively. Infection with HIV increases the risk of developing cervical cancer six-fold and substantially increases the risk of developing select other cancers such as Kaposi sarcoma. Reducing the burden Between 30 and 50% of cancers can currently be prevented by avoiding risk factors and implementing existing evidence-based prevention strategies. The cancer burden can also be reduced through early detection of cancer and appropriate treatment and care of patients who develop cancer. Many cancers have a high chance of cure if diagnosed early and treated appropriately. Prevention Cancer risk can be reduced by: not using tobacco; maintaining a healthy body weight; eating a healthy diet, including fruit and vegetables; doing physical activity on a regular basis; avoiding or reducing consumption of alcohol; getting vaccinated against HPV and hepatitis B if you belong to a group for which vaccination is recommended; avoiding ultraviolet radiation exposure (which primarily results from exposure to the sun and artificial tanning devices) and/or using sun protection measures; ensuring safe and appropriate use of radiation in health care (for diagnostic and therapeutic purposes); minimizing occupational exposure to ionizing radiation; and reducing exposure to outdoor air pollution and indoor air pollution, including radon (a radioactive gas produced from the natural decay of uranium, which can accumulate in buildings — homes, schools and workplaces). Early detection Cancer mortality is reduced when cases are detected and treated early. There are two components of early detection: early diagnosis and screening. Early diagnosis When identified early, cancer is more likely to respond to treatment and can result in a greater probability of survival with less morbidity, as well as less expensive treatment. Significant improvements can be made in the lives of cancer patients by detecting cancer early and avoiding delays in care. Early diagnosis consists of three components: being aware of the symptoms of different forms of cancer and of the importance of seeking medical advice when abnormal findings are observed; access to clinical evaluation and diagnostic services; and timely referral to treatment services. Early diagnosis of symptomatic cancers is relevant in all settings and the majority of cancers. Cancer programmes should be designed to reduce delays in, and barriers to, diagnosis, treatment and supportive care. Screening Screening aims to identify individuals with findings suggestive of a specific cancer or pre-cancer before they have developed symptoms. When abnormalities are identified during screening, further tests to establish a definitive diagnosis should follow, as should referral for treatment if cancer is proven to be present. Screening programmes are effective for some but not all cancer types and in general are far more complex and resource-intensive than early diagnosis as they require special equipment and dedicated personnel. Even when screening programmes are established, early diagnosis programmes are still necessary to identify those cancer cases occurring in people who do not meet the age or risk factor criteria for screening. Patient selection for screening programmes is based on age and risk factors to avoid excessive false positive studies. Examples of screening methods are: HPV test (including HPV DNA and mRNA test), as preferred modality for cervical cancer screening; and mammography screening for breast cancer for women aged 50–69 residing in settings with strong or relatively strong health systems. Quality assurance is required for both screening and early diagnosis programmes. Treatment A correct cancer diagnosis is essential for appropriate and effective treatment because every cancer type requires a specific treatment regimen. Treatment usually includes surgery, radiotherapy, and/or systemic therapy (chemotherapy, hormonal treatments, targeted biological therapies). Proper selection of a treatment regimen takes into consideration both the cancer and the individual being treated. Completion of the treatment protocol in a defined period of time is important to achieve the predicted therapeutic result. Determining the goals of treatment is an important first step. The primary goal is generally to cure cancer or to considerably prolong life. Improving the patient's quality of life is also an important goal. This can be achieved by support for the patient's physical, psychosocial and spiritual well-being and palliative care in terminal stages of cancer. Some of the most common cancer types, such as breast cancer, cervical cancer, oral cancer, and colorectal cancer, have high cure probabilities when detected early and treated according to best practices. Some cancer types, such as testicular seminoma and different types of leukaemia and lymphoma in children, also have high cure rates if appropriate treatment is provided, even when cancerous cells are present in other areas of the body. There is, however, a significant variation in treatment availability between countries of different income levels; comprehensive treatment is reportedly available in more than 90% of high-income countries but less than 15% of low-income countries (3). Palliative care Palliative care is treatment to relieve, rather than cure, symptoms and suffering caused by cancer and to improve the quality of life of patients and their families. Palliative care can help people live more comfortably. It is particularly needed in places with a high proportion of patients in advanced stages of cancer where there is little chance of cure. Relief from physical, psychosocial, and spiritual problems through palliative care is possible for more than 90% of patients with advanced stages of cancer. Effective public health strategies, comprising community- and home-based care, are essential to provide pain relief and palliative care for patients and their families. Improved access to oral morphine is strongly recommended for the treatment of moderate to severe cancer pain, suffered by over 80% of people with cancer in the terminal phase. WHO response In 2017, the World Health Assembly passed the Resolution Cancer prevention and control in the context of an integrated approach (WHA70.12) that urges governments and WHO to accelerate action to achieve the targets specified in the Global Action Plan for the prevention and control of NCDs 2013-2020 and the 2030 UN Agenda for Sustainable Development to reduce premature mortality from cancer. WHO and IARC collaborate with other UN organizations, inlcuing the International Atomic Energy Agency, and partners to: increase political commitment for cancer prevention and control; coordinate and conduct research on the causes of human cancer and the mechanisms of carcinogenesis; monitor the cancer burden (as part of the work of the Global Initiative on Cancer Registries); identify "best buys" and other cost-effective, priority strategies for cancer prevention and control; develop standards and tools to guide the planning and implementation of interventions for prevention, early diagnosis, screening, treatment and palliative and survivorship care for both adult and child cancers; strengthen health systems at national and local levels to help them improve access to cancer treatments; set the agenda for cancer prevention and control in the 2020 WHO Report on Cancer; provide global leadership as well as technical assistance to support governments and their partners build and sustain high-quality cervical cancer control programmes as part of the Global Strategy to Accelerate the Elimination of Cervical Cancer; improve breast cancer control and reduce avoidable deaths from breast cancer, focusing on health promotion, timely diagnosis and access to care in order to accelerate coordinated implementation through the WHO Global Breast Cancer Initiative; support governments to improve survival for childhood cancer through directed country support, regional networks and global action as part of the WHO Global Initiative for Childhood Cancer using the CureAll approach; increase access to essential cancer medicines, particularly through the Global Platform for Access to Childhood Cancer Medicines; and provide technical assistance for rapid, effective transfer of best practice interventions to countries. 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Sub B: Thermal Pollution

Nuke energy kills biodiversity

Audrey Fox, xx-xx-xxxx, "Is Nuclear Power Bad for the Environment?", Friends of the Earth, https://foe.org/blog/is-nuclear-power-bad-for-the-environment/

Is Nuclear Power Bad for the Environment? Facebook Twitter Is Nuclear Power Bad for the Environment? Donate Now! Your contribution will benefit Friends of the Earth. Is nuclear power bad for the environment? Yes. Is it a threat to public health and environmental justice? Yes. Is it also dangerous and expensive? Yes. Nuclear Energy Definition Electricity from nuclear power plants is generated through the process of nuclear fission. This occurs when a neutron hits the nucleus of certain atoms, splitting the nucleus into smaller nuclei, producing other neutrons, which then hit other atoms, creating more nuclei and more neutrons, resulting in a chain reaction within a nuclear reactor core. This releases massive amounts of energy as heat, radiation, and radioactive waste. The heat generated is used to boil water to create steam, which then turns an electric turbine to create electricity. Nuclear power plants require "enriched uranium" for their fuel to sustain the fission reaction and produce electricity. Naturally occurring uranium must be "enriched" to increase the concentration of the fission-able ("fissile") isotope of uranium (U-235). According to the US Energy Information Administration, as of July 2024, there are 94 active commercial nuclear reactors at 54 nuclear power plants. Nuclear Hazards – Waste The production and use of nuclear power produces waste at every step of the process. Waste produced in nuclear power plants is radioactive and remains so for many thousands of years. There is no safe way to dispose of this radioactive waste, and it has piled up for decades at nuclear facilities. Spent nuclear fuel (i.e., old fuel removed from reactors) can be dangerous for thousands-to-millions of years. According to the Nuclear Information and Resource Service, "For every pound of "enriched" uranium that goes into a nuclear reactor, there are, on average, over 5,000 pounds of radioactive waste…produced in the mining and processing of uranium." And every pound of spent fuel that comes out of the reactor becomes millions of times more radioactive by the time it is taken out. Nuclear Hazards – Extraction Uranium, the metal that commonly fuels nuclear power, is extracted through underground or open-pit mining, or through a chemical process called in situ leaching. Underground uranium mining exposes workers to severe health risks, including lung cancer. Open-pit mining destroys ecosystems, leaving toxic, radioactive remnants and polluted land and water. In situ leaching permanently contaminates groundwater. Nuclear power is bad for the environment. Thousands of abandoned uranium mines dot the Southwest of the United States, disproportionately in Native American territories and communities of color. These markers of environmental injustice continue to harm the health and well-being of impacted communities and their air, lands, and waters. Nuclear Hazards – Safety and Health Nuclear disasters serve as prescient reminders of the unimaginable dangers of nuclear power. They may be caused by human error, mechanical failures, and/or natural disasters. The Chernobyl disaster in Ukraine in 1986 remains the worst nuclear accident in history. It will take at least 1,000 years for the area surrounding the nuclear power plant to be habitable. The second worst nuclear accident occurred in 2011 after an earthquake and tsunami struck the Fukushima Daiichi Nuclear Power Station in Japan, causing all three operating reactors to melt down. The Three Mile Island Generating Station in Pennsylvania experienced a partial meltdown in 1979, leading to increases in cancer and other diseases. The worst radiation disaster in U.S. history is the Church Rock uranium spill, which occurred on the Navajo Nation a few months after Three Mile Island. Nuclear accidents pose extreme threats to life and have forced abandonment of wide swaths of land. Health impacts include increased risk of different types of cancer, immune deficiencies, infant mortality and birth defects, acute radiation syndrome (radiation poisoning), and harms to mental health. Those who mine and mill uranium and who work at nuclear power plants also face higher risk of diseases such as cancer. The U.S. nuclear fleet is old, with an average age of 42 years. Aging infrastructure is more prone to cracks, corrosion, and other compromises in safety. Nuclear power stations are also vulnerable to military strikes and threats of terrorism. Further, the technologies required to make nuclear energy are also the technologies required to make nuclear weapons, raising the risk of nuclear proliferation. Nuclear Hazards – Climate Change Nuclear energy is not a solution to the climate crisis. Nuclear power is bad for the environment. It is magnitudes more expensive than wind and solar energy, and magnitudes slower to deploy. The long timeline needed for nuclear energy is deeply out of step with the urgency of addressing the climate crisis. Resources directed toward nuclear energy are resources that should go to real climate solutions – like solar and wind energy, battery storage, and efficiency. When measured on a full life cycle basis, nuclear energy is far from a zero-emissions technology. From mining, milling, and enriching uranium to plant construction, it is an energy intensive process. Further, the impacts of climate change – from warming waters to more extreme weather events like flooding and hurricanes – pose a serious risk to both operating and decommissioned nuclear power plants and radioactive waste sites. Nuclear Hazards – Water

Producing nuclear energy is water-intensive, with large volumes consumed in various stages of the process. Climate change is driving heat waves and droughts – which in turn can drive up competition for

increasingly scarce water resources, potentially jeopardizing the functioning of nuclear power plants. Nuclear power plants also pollute water and are responsible for killing many billions of fish and other aquatic life every year. Nuclear Power Cons – Cost Nuclear power is bad for the environment, and nuclear energy is extremely expensive. It is uncompetitive with other energy sources without government subsidies. Even with massive federal subsidies, over 100 reactors have been postponed or cancelled. The 17-year construction of two nuclear power reactors at Plant Vogtle in Georgia— the first nuclear energy project in decades — took an extra seven years and cost more than twice its $14 billion estimate. Subsidies for nuclear energy have been buried in hundreds of spending bills, with costs externalized to the environment and future generations and bills literally unpaid, defaulted on, or passed to taxpayers. Conservative estimates suggest that the nuclear industry has received more than $100 billion in subsidies, and federal legislation enacted by President Biden has authorized up to another $140 billion in subsidies, financing, and incentives. The cost to dispose of nuclear waste is high, and the costs to clean up nuclear disasters are estimated to be in the hundreds of billions. Diablo Canyon Nuclear Power Plant – A Special Case for Friends of the Earth Diablo Canyon, California's last operating nuclear power plant, represents one of the greatest nuclear safety dangers in the country. The two reactors at Diablo Canyon are near and on top of several earthquake fault lines, many of which were either unknown when the plant was built or are now known to be far more powerful. Diablo Canyon has also become an expensive obstacle to California's ambitious climate and renewable energy plans, causing the state's already-stressed grid to become overloaded and blocking the expansion of solar generation. In 2016, Friends of the Earth reached a historic settlement for Diablo Canyon's phase-out. The phase-out settlement was approved in 2018 and included fully replacing Diablo Canyon's output with zero-emissions renewable energy and energy efficiency, a just transition for nuclear workers, and tax revenue stabilization for the local communities. Since then, California has added far more renewable energy and battery storage than would be needed to replace Diablo Canyon. But in 2022, with the federal government offering billions of dollars to promote nuclear power, Pacific Gas & Electric Company (PG&E) and CA Governor Gavin Newsom sought to overturn the phase-out and continue operating Diablo until at least 2030, which would cost Californians billions of dollars in higher electric bills. Friends of the Earth is doing everything we can to preserve the phase-out plan. We must ensure the safety of Californians, make utility bills affordable, and accelerate our transition to 100% renewable energy.

Affirming increases thermal pollution

Kori **Williams**, 4-6-20**23**, "Nuclear Power Isn't As Clean As It the Industry Makes It Seem", Green Matters, https://www.greenmatters.com/clean-energy/does-nuclear-energy-cause-pollution

Nuclear Power Isn't As Clean As It the Industry Makes It Seem Kori Williams - Author By Kori Williams Published April 6 2023, 1:43 p.m. ET Nuclear Power Source: Getty Images On the journey to transition the the planet to rely on clean energy, there are a number of sources that we can use to make the energy system more sustainable. But one energy source that causes a lot of confusion is nuclear energy. It doesn't take a lot of it to make a lot of power, and some argue that it doesn't directly do as much harm to the environment as fossil fuels. But when it comes down to it, is this energy source actually renewable? And does nuclear energy cause pollution? Indian Point Source: Getty Images Does nuclear energy cause pollution? Yes, nuclear energy causes pollution. One of the most significant types of pollution nuclear energy plants emit is thermal pollution, which is when an industry changes the temperature of a natural water source, as per Conserve Energy Future. A 2013 study published in the Journal of Hydrology found that thermal pollution from a nuclear power plant had significant effects on lake temperatures. And as the nonprofit Public Citizen noted, thermal pollution from nuclear plants negatively impacts marine ecosystems, as certain cooling systems used at nuclear reactors release billions of gallons of water every day, with that water reaching up to 25 degrees Fahrenheit warmer than the bodies of water it flows into. Additionally, the process of mining and milling uranium into nuclear fuel (which is how a lot of nuclear energy is produced) uses a lot of energy in itself, emitting significant amounts of carbon dioxide, Public Citizen noted. Nuclear Energy Source: Getty Images The nuclear energy industry sees this power source as clean. If you ask those with vested interest in the success of energy, they may tell you that nuclear energy does not cause pollution. The U.S. Dept. of Energy even calls it a "zero-emission clean energy source" and that it "protects air quality." The World Nuclear Association also asserts that nuclear energy is low-carbon, that "nuclear power plants produce no greenhouse gas emissions during operation," and that nuclear energy produces similar or lower amounts of carbon dioxide-equivalent emissions as wind and solar energy. Additionally, the Nuclear Energy Institute (NEI) calls nuclear energy a "responsible, clean energy source," and notes that nuclear energy is very dense, so you only need a small amount of nuclear fuel to get a lot done. However, these resources — which both have vested interests in the country using more nuclear energy — have clearly chosen to highlight the positives of nuclear energy rather than its drawbacks and dangers. Nuclear energy has a number of downsides that can be a huge health hazard to humans and the environment — namely, nuclear energy accidents have caused many governments around the world to question whether the benefits outweigh the risks. There's also the issue of radioactive waste. Ukraine Nuclear Plant Source: Getty Images Nuclear energy produces radioactive waste. Nuclear energy produces waste that can harm people and the environment if not disposed of properly. The U.S. Energy Information Administration states that nuclear energy creates a lot of radioactive waste that can stay radioactive — and dangerous to humans — for thousands of years. Because of this, facilities are required by law in the U.S. to follow specified regulations to dispose of this waste safely. However, when nuclear accidents happen and radioactive waste spills, it can lead to catastrophe — just take a look at the Chernobyl disaster. And overall according to Greenpeace, the benefits of nuclear energy aren't substantial enough to outweigh the drawbacks of using it. Not to mention, nuclear fuels cannot be considered renewable, since they are finite materials that are mined from the ground, as per the National Grid. But the NEI states that there are positive ways to reuse nuclear waste. France for example, recycles nuclear fuel for elements in it that can still produce energy. Those aspects are then used in new fuel. Radioactive pollution can affect on human health. According to the CDC, exposure to high levels of radiation can lead to Acute Radiation Syndrome, symptoms of which include diarrhea, headache, nausea, and vomiting; and in the long term, high radiation exposure can lead to serious diseases including cancer. When we have the option of truly renewable energy sources — such as wind and solar energy — why even turn to energy sources that come with such high risks?

Causes biodiversity collapse

Brandon Clark, 2-28-2019, "'Thermal Water Pollution from Nuclear Power Plants' Submitted as coursework forPH241, Stanford University, Winter 2019", Stanford University, Writtentestimonyonly_opponent_michaelj.keegan_dontwastemichigan_org_5.22.2019.pdf

Thermal Water Pollution from Nuclear Power Plants Brandon Clark February 28, 2019 Submitted as coursework forPH241, Stanford University, Winter 2019 Introduction Water in the Nuclear Heating Process The most common argument for the use of nuclear power over power from conventional fossil fuels is the diminished environmental impact that nuclear power promises. While nuclear fission reactions do not directly produce greenhouse gases like fossil fuel combustion, power plants affect the environment in a myriad of ways. In order to elucidate a clearer environmental impact comparison between all power generation methods, including renewables, less obvious environmental effects must be adequately assessed. For example, both nuclear and fossil fuel plants produce significant thermal pollution to bodies of water. Thermal water pollution is the degradation of water quality due to a change in ambient water temperature. Water is the thread that connects the entire nuclear power process. There are two distinct water streams used, process water and cooling water. Process water travels through a pump to the reaction chamber, containing the nuclear fuel rods, where the water is heated and vaporized to pressurized steam, reaching temperatures of roughly 315°C. The steam then passes through multiple turbines, which turn generators that makes electricity. Finally, the steam is condensed, cooled, and sent back to the reaction chamber. In the second stream, cooling water travels from a natural reservoir to cool process water in the condenser. It then travels to a cooling tower, back into the reservoir, or both. Process water is reused in the generation process, but the cooling water is discharged back into a lake, river, or ocean, as seen in Fig. 1, at a temperature typically around 30-40°C. [1-3] Fortunately, one favorable aspect of this process is that the radioactive water that contacts nuclear fuel rods is not released to the environment, because process water operates on a closed loop. Since steam-based energy production is based on the Rankine Cycle, maximum power generation is determined by the temperature difference between the steam in the generator and the water in the cooling chamber. However, there is still extra thermal energy from the reactor vessel in the liquid-vapor mixture at the exhaust of the low pressure turbines that is not usable. This is because, as the steam loses thermal energy to mechanical work, the rise in moisture content would damage further turbines. Therefore, cooling the process water as much as possible is desirable to the power plant to maintain high energy efficiency, which raises the temperature of cooling water. In response, most state regulations set a hard limit on cooling water maximum temperature, usually around the 30-40°C mentioned above, regardless of season or ambient cooling water inlet temperature. The thermal energy efficiency of a conventional thermal power plant is 30% to 48%, while typical nuclear power plants have thermal efficiencies around 30%, the low end of the spectrum. This is because most nuclear power stations must operate below the temperatures and pressures that fossil fuel plants do in order to provide more conservative safety margins within the systems that remove heat from the nuclear fuel rods. [3] The remainder of the energy is mostly contained in cooling water and released to the environment. While nuclear power's

thermal pollution per usable energy produced is only slightly more than other thermal power generation technologies, nuclear power releases a higher percentage of its wastewater as liquid effluent streams instead of vapor. This is because coal and natural gas plants discharge much higher wastewater temperatures, 128.4°C and 91.1°C, respectively. [3] Therefore, nuclear power plants have a more direct, intense environmental impact on local water sources, while other plants have a less intense, but broader environmental impact. Nuclear Power Plant Water Usage Thermal power plants require enormous amounts of water. The United States Geological Survey (USGS) estimated on a national level that 41% of all freshwater withdrawals in the United States in 2005 were for thermoelectric power operations, primarily for cooling needs. [4] About 60 percent of American nuclear power systems use recirculating cooling, and the remainder use cheaper once-through cooling. The median nuclear recirculating cooling system uses 1,101 gal/MWh, while the median once-through cooling system uses 44,350 gal/MWh. In comparison, the median recirculating and once-through water withdrawal values for natural gas plants are 255 gal/MWh and 11,380 gal/MWh, and the median values for coal plants are 1,005 gal/MWh and 36,350 gal/MWh. [4] Effects on Water Quality and Aquatic Ecosystems Multiple issues occur concurrently when heated water is released to an aquatic ecosystem. The most immediate change is a decrease in dissolved oxygen levels and rise in pH. Warm water cannot hold as much dissolved oxygen as cold water, and organic matter decomposes faster in warmer temperatures. The increase in decomposed aqueous nutrient concentrations causes eutrophication, most commonly realized as algae blooms, which block sunlight for underlying aquatic plants. The abundance of algae is an easy food source for aerobic microbes that soar in population and further deplete the dissolved oxygen. Low oxygen levels create hypoxic dead zones that cannot support most aquatic organisms. [5,6] Additionally, rapidly heated water accelerates the metabolism of cold blooded aquatic animals like fish, causing malnutrition due to insufficient food sources. Since the environment usually becomes more inhospitable to the area's aquatic fauna, many species leave while more vulnerable species may die, changing the biodiversity of both the original and invaded locations. These effects are especially dramatic near coral reefs, the home of over 2 million aquatic species and roughly 25% of all marine life. [7] Vast coral bleaching (coral death) has been observed near coastal power plants that release heated water into the ocean. [1] Extent of Power Plant Thermal Pollution Recent research suggests that the duration and range of thermal pollution is higher than commonly believed. A study of Lake Stechlin in Germany found that industrial thermal pollution in temperate lakes during winter is stored in the deep water column until the next winter, whereas heat added in the summer dissipates relatively rapidly into the atmosphere. [8] Accordingly, this pollution can have lasting effects on deep water biogeochemical cycles, not just surface water or water directly near power plants. Due to discharge from two nuclear power plants, the Danube River in Romania exhibits a thermal plume current that extends up to 6km downstream, where temperature changes up to 1.5°C between plume and non-plume areas can still be measured. [9] Furthermore, a study of 128 power plants lining the Mississippi River Watershed showed that thermal pollution is extensive enough to significantly impair the energy efficiency of downstream plants, since downstream plants indirectly use warmed effluent upstream water for their own cooling processes. [10] The impact of thermal pollution can be felt by both the ecosystem and human populations far beyond the point of release. Such communities would benefit from the knowledge and regulation of pollution that is not directly their fault, and governments should consider these broader chain reactions when making policy decisions. Conclusions The world's environments are much more interconnected than most realize. This review shows that less obvious ramifications of power generation, such as thermal water pollution, can be remarkably influential. The whole story around each option should be given due diligence before making conclusions about the future's energy landscape.

Small ecosystem collapses cascade. The impact is extinction

Torres 19 [Phil Torres. Biodiversity Loss: An Existential Risk Comparable To Climate Change. BAS. 4-11. https://thebulletin.org/2016/04/biodiversity-loss-an-existential-risk-comparable-to-climate-change] //pk (NedJuang) recut //bwAN Recut

Catastrophic consequences for civilization. The consequences of this rapid pruning of the evolutionary tree of life extend beyond the obvious. There could be surprising effects of biodiversity loss that scientists are unable to fully anticipate in advance. For example, prior research has shown that **localized ecosystems can undergo abrupt and irreversible shifts when they reach a tipping point**. According to a 2012 paper published in Nature, there are reasons for thinking that **we may be approaching a tipping point,** of this sort in the global ecosystem, beyond which the consequences could be catastrophic for civilization. As the authors write, a planetary-scale transition could precipitate] "substantial losses of ecosystem services required to sustain the human population." An ecosystem service is any ecological process that benefits humanity, such as food production and crop pollination. If the global ecosystem were to cross a tipping point and substantial ecosystem services were lost, the results could be "widespread social unrest, economic instability, and loss of human life." According to Missouri Botanical Garden ecologist Adam Smith, one of the paper's co-authors, this could occur in a matter of decades—far more quickly than most of the expected consequences of climate change, yet equally destructive.

Biodiversity loss is a "threat multiplier" that, by pushing societies to the brink of collapse, **will exacerbate** existing **conflicts and introduce** entirely **new struggles between state and non-state actors**. Indeed, it could even **fuel the rise of terrorism**. (After all, climate change has been linked to the emergence of ISIS in Syria, and multiple high-ranking US officials, such as former US Defense Secretary Chuck Hagel and CIA director John Brennan, have affirmed that climate change and terrorism are connected.)

The reality is that we are entering the sixth mass extinction in the 3.8-billion-year history of life on Earth, and the impact of this event could be felt by civilization "in as little as three human lifetimes," as the aforementioned 2012 Nature paper notes. Furthermore, the widespread decline of biological populations could plausibly initiate a **dramatic transformation of** the **global ecosystem on an even faster timescale**: perhaps a single human lifetime. The unavoidable conclusion is that **biodiversity loss constitutes an existential threat** in its own right. As such, it ought to be considered alongside climate change and nuclear weapons as one of the most significant contemporary risks to human prosperity and Survival.

Thus, we are proud to negate