NUCLEAR POWER

Nuclear power is produced by the splitting (fission) or joining (fusion) of two atoms. All nuclear capacity in place today is produced through nuclear fission. The U.S. currently obtains 20% of its electricity from nuclear power[1] and has more nuclear power plants than any other country, but many of these plants are aging and being retired.[2] There is much debate among environmentalists and public health activists as to whether nuclear power should be promoted as a climate solution.

Nuclear power has many advantages: it provides large amounts of zero-emissions electricity at all times of the year and day/night, avoiding the intermittency problems associated with renewable energy like wind, solar, and even hydropower. With a 93% capacity factor, nuclear power outshines all other sources of power (even fossil fuels) in its reliability and consistency.[3] Its physical footprint (surface power density) is vastly smaller than wind and solar farms.[4] Proponents also claim that nuclear is safer than the burning of fossil fuels for energy, which kills people through air pollution (including radioactive emissions), and even that radioactive waste is an easier problem to deal with than climate change (90% of spent fuel can be recycled, and the rest can be stored safely underground).[5]

Nonetheless, there is much public opposition to nuclear power, partly due to a small but spectacular set of plant failures in Chernobyl, Three Mile Island, and Fukushima. Because of the potential for deadly meltdowns, tritium releases, abandoned uranium mines, mine-tailings pollution, radioactive waste, illicit plutonium trafficking, and thefts of missile material, some experts do not believe that nuclear should be promoted as a climate solution.[6]

Even in the absence of an accident, nuclear power plants can have environmental impacts. Nuclear plants use a large amount of water to cool the heat-generating radioactive cores. This water becomes contaminated with unstable atoms, called radionuclides, which must be filtered out before the waste cooling water is either stored in tanks or discharged into nearby waterbodies. Because nuclear plants require a very large amount of cooling water, they are often located along waterways or coastlines. Prolonged exposure to radionuclides has been found in the lab damage the DNA of aquatic organisms, and for this reason, it is vital that safety

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[1] EIA. "What is U.S. electricity generation by energy source?" https://www.eia.gov/tools/faqs/faq.php?id=427&t=3

[2] Holt, Mark and Brown, Philip (June 10, 2021). *U.S. nuclear plant shutdowns, state interventions, and policy concerns.* Prepared for the Congressional Research Service. https://crsreports.congress.gov/product/pdf/R/R46820/3

[3] DOE. "Nuclear power is the most reliable energy source and it's not even close." https://www.energy.gov/ne/articles/nuclear-power-most-reliable-energy-source-and-its-not-even-close

[4] van Zalk, John and Behrens, Paul. 2018. The spatial extent of renewable and non-renewable power generation: A review and meta-analysis of power densities and their application in the U.S. *Energy Policy* 123: 83-91. https://doi.org/10.1016/j.enpol.2018.08.023.

[5] DOE. "5 fast facts about spent nuclear fuel." https://www.energy.gov/ne/articles/5-fast-facts-about-spent-nuclear-fuel

[6] Project Drawdown. "Nuclear power." https://drawdown.org/solutions/nuclear-power

standards for wastewater be set and rigorously adhered to.[7] Cooling water discharge may also lead to thermal pollution of waterways, which can affect fish and other aquatic organisms.[8]

A final concern that is often voiced about nuclear plants is that they very expensive to build, making it difficult to invest in new nuclear energy without significant federal funding. This can be addressed through carbon pricing and clean energy standards to make nuclear more cost-competitive relative to fossil fuels, and through more investment in advanced reactor designs. However, the time required for construction of a nuclear plant can be as much as ten years, raising questions about the value of nuclear for addressing the climate crisis. Mass-production of small modular reactors, which generate less than 300 MW and can be assembled from components built in factories, may help ramp up construction while reducing costs.[9]

Advanced nuclear technologies, including fusion reactors, are being developed to address safety, technical, economic, and environmental concerns,[10] but opponents say these advantages are overstated.[11] Nonetheless, there is currently more movement at the federal level to support advancements in nuclear power than there has been in decades[12] and a growing chorus of experts assert that it will not be possible to combat climate change without bigger investments in nuclear power.[13]

- Fishery friendliness: Because of its high surface power density, nuclear power has minimal impacts on land use compared to other renewables. However, nuclear power plants use large volumes of cooling water, which can cause thermal pollution when discharged, and can even contain radioactive particles if safety standards are inadequate or not adhered to properly. Because most nuclear plants are located along waterways and coastlines, these potential impacts raise serious concerns for fishery resources and ecosystems. Even slight exposure to radioactive materials can affect the health, breeding and feeding of aquatic species.[14]
- Co-benefits: None.

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[7] Jha, Awadhesh (April 30, 2021). "Nuclear power: How might radioactive waste water affect the environment?" https://theconversation.com/nuclear-power-how-might-radioactive-waste-water-affect-the-environment-159483

[8] USFWS (December 16, 2020). "Energy technologies and impacts: Nuclear power." https://www.fws.gov/ecological-services/energy-development/nuclear.html

[9] Parshley, Lois (May 4, 2021)." The controversial future of nuclear power in the U.S." https://www.nationalgeographic.com/environment/article/nuclear-plants-are-closing-in-the-us-should-we-build-more

[10] Department of Energy. "Advanced reactor designs." https://www.energy.gov/ne/advanced-reactor-technologies

[11] Negin, Elliott (July 23, 2021). "So-called next-generation nuclear power plants are being oversold." *Scientific American*. https://www.scientificamerican.com/article/lsquo-advanced-rsquo-nuclear-reactors-don-rsquo-t-hold-your-breath/

[12] Conca, James (August 17, 2020). "What will a Biden-Harris administration do for nuclear energy?" https://www.forbes.com/sites/jamesconca/2020/08/17/what-will-a-biden-harris-administration-do-for-nuclear-energy/?sh=bac762e1dd9c

[13] Rhodes, Richard. "Why nuclear power must be part of the energy solution." *Yale Environment 360. https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate*

[14] USFWS (December 16, 2020). "Energy technologies and impacts: Nuclear power." https://www.fws.gov/ecological-services/energy-development/nuclear.html

- Environmental externalities: Dangerous impacts to humans and wildlife can occur in the event of a nuclear meltdown or radioactive leakage.
- Policy catalysts: Nuclear power can be promoted through grants, loans, carbon pricing; clean energy standards, and public research investment in advanced reactor design.
- More information:
    - Drawdown: Nuclear power
    - Center for Climate and Energy Solutions: Climate solutions – the role of nuclear power
    - Bokat-Lindell, Spencer (August 26, 2021). "Is there a nuclear option for stopping climate change?" *New York Times.*
    - Conca, James (August 17, 2020). "What will a Biden-Harris administration do for nuclear energy?"
    - Rhodes, Richard (July 19, 2018). "Why nuclear power must be part of the energy solution." *Yale Environment 360.*
    - Department of Energy: Advanced reactor technologies
    - Resources for the Future: Advanced nuclear reactors 101

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