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Environmental and Public Health Impacts of Energy Choices

Comparing Wind with Fossil Fuel and Nuclear Electricity Generation

Our energy choices have a profound and far reaching impact on our health and our environment. Therefore, decisions about electricity generation should be informed ones, in which these impacts are evaluated comparatively. Pollution, natural resource consumption, and operational hazards are important factors that citizens and communities should consider when evaluating proposed electricity generation facilities.

Photo Credit: ACE NY. Wyoming County, NY

Environmental and Public Health Impacts of Fossil Fuel and Nuclear Power Generation

Resource Extraction: Fossil and nuclear fuels extraction (mining and drilling) results in adverse impacts to landscapes, habitat, wildlife, soil, air and water quality, communities, and public health and quality of life. For example, the BP oil disaster of 2010 spewed almost five million gallons of oil into the Gulf of Mexico, and killed 11 workers.[1] In 2008, 5.4 million tons of coal ash flooded communities in Tennessee, sickening people, destroying farmland, and poisoning the water.[2] Hydraulic fracturing for gas in shale is undergoing a national EPA study due to alleged drinking water contamination in communities across the nation.[3] Uranium mining has led to lung cancer, bone cancer and impaired kidney function from exposure to radioactive materials.[4]

Air Pollution: Soot and particulate matter from coal, oil, and gas-fired power plants cause 1,200 premature deaths and 2,500 hearts attacks annually in New York State.[5] While nuclear power reactors emit less air pollution than fossil fuel plants, they routinely release some radioactive liquid and steam as a result of normal operations. [6]

Climate Change Impacts: Electricity generation from fossil fuels is the largest US source of greenhouse gases,[7] the pollutants responsible for climate change. Climate change is expected to result in severe adverse impacts to human health, ecosystems, and the economy in the Northeast U.S., including sea level rise and subsequent flooding, erosion, loss of wetlands, and property damage; decrease in agricultural yield, including dairy,

1. Campbell Robertson and Clifford Krauss, Gulf Oil Spill is Largest of its Kind, Scientists Say. New York Times August 2, 2010 http://www.nytimes.com/2010/08/03/us/03spill.html
2. PBS Newshour, Tenn. Coal Ash Disaster Raises Concerns about Similar Sites Nationwide, Febuary 2, 2009. http://www.pbs.org/newshour/bb/environment/jan-june09/coalash_02-02.html
3. United State Environmental Protection Agency. http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/index.cfm
4. United States Environmental Protection Agency. http://epa.gov/region9/superfund/navajo-nation/index.html
5. Conrad G. Schneider, Dirty Air, Dirty Power: Mortality and Health Damage Due to Air Pollution From Power Plants, June 2004.
6. Liquid Radioactive Release Lessons Learned Task Force Final Report , 2006. http://pbadupws.nrc.gov/docs/ML0626/ML062650312.pdf; and U.S. Nuclear Regulatory Commission, Title 10, Code of Federal Regulations, part 20.1301.
7. EPA http://epa.gov/climatechange/emissions/downloads10/US-GHG-Inventory-2010_ExecutiveSummary.pdf

fruit, and maple syrup; and increased temperatures that will exacerbate air quality problems, leading to increased rates of heart disease, lung disease, and other human health issues.[8]

Mercury Emissions: Mercury is a bioaccumlative neurotoxin that can lead to brain and nervous system damage, and can cause birth defects. Mercury pollution from fossil fuel-burning power plants caused the NYS Department of Health to warn women and children against eating most fish caught in the Adirondacks and Catskills, and all populations are warned against eating certain types of fish in more than 95 water bodies throughout the state.[9] A multi-year study of New York's loon populations found unsafe mercury levels in the blood and feathers of 17% of the state's loons.[10]

Acid Rain: Caused predominantly by emissions of sulfur dioxides (SO_2) and nitrogen oxides (NO_x) from fossil-fueled power plants, acid rain has severely damaged forests and waters in the Catskills and Adirondacks. Approximately 500 lakes and ponds in the Adirondack Park, as well as two-thirds of all streams in the Western Adirondacks, are acidified to levels that are harmful to aquatic life.[11] Acid rain also affects water quality in coastal estuaries such as the Long Island Sound, where nitric acids add to the problem of low dissolved oxygen, known as hypoxia. Acid rain also slows the growth of forests, reduces agricultural productivity, and damages monuments and buildings constructed with marble.

Photo Credit: Kyle Rabin. Indian Point, NY

Nuclear Waste: Nuclear reactors generate highly radioactive and therefore highly dangerous spent-fuel waste, which must be encapsulated and stored for tens of thousands of years.[12] The nation has not developed an adequate method for long-term nuclear waste storage.[13]

Impacts To Fish From Power Plant Cooling: A fleet of 25 aging fossil fuel- and nuclear-powered electric power plants in New York State draw up to 16 billion gallons of water every day from New York's lakes, rivers, and estuaries.[14] This water is used to cool critical plant components, and the heated water is then returned to its source. On an annual basis, up to 17 billion fish eggs, larvae and young hatched fish are entrained, and another 171 million larger fish and other aquatic species are impinged during the cooling process.[15] This diminishes the ecological and economic value of these waterbodies.

8. U.S. Global Research Global Change Research Program, Global Climate Change Impacts in the United States, 2009. http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts
9. NYS Department of Health, 2010-11 Health Advisories for Chemicals in Sportfish and Game, http://www.health.ny.gov/environmental/outdoors/fish/docs/fish.pdf
10. Mercury Connections: The extent and effects of mercury pollution in North America, Biodiversity Research Institute, 2005. http://www.briloon.org/mercury/BRIMercury.pdf
11. USGS, NYSDEC, University of Texas at Arlington, Adirondacks Lakes Survey Corp; *Western Adirondack Stream Survey, 2008*. http://www.nyserda.org/publications/WASS%20Final%20Repor.pdf
12. Ibid.
13. Ibid.
14. New York State Department of Environmental Conservation, "Best Technology Available for Cooling Water Intake Structures," draft policy from March 4, 2010. http://www.dec.ny.gov/docs/fish_marine_pdf/drbtapolicy1.pdf
15. Ibid

Environmental and Public Health Impacts of Wind Power

Wind power emits no harmful emissions at the point of generation, and requires no water for cooling. By offsetting polluting technologies, wind power can actually reduce the amount of pollution produced by electricity generation. Over its 20-year life span, a single 2 MW turbine can produce enough clean electricity to displace approximately 110 million pounds of CO_2, the chief greenhouse gas responsible for climate change, as well as 400,000 pounds of SO_2, and 150,000 pounds of NO_x, the two precursors to acid rain. [16] By avoiding the use of water for cooling, wind power also conserves approximately 20 billion gallons of water annually in the U.S.,[17] and prevents fish and marine species from being killed.

Wind energy does present some environmental and human health concerns; however, the potential negative impacts of wind energy are small compared with those of electricity generation from fossil fuel and nuclear plants.

Wildlife Impacts: Common concerns about wind energy include impacts from habitat fragmentation and collisions with turbines by birds and bats. Early turbine designs and the siting of wind farms in bird migration corridors did cause numerous bird deaths. In an effort to reduce these impacts, wind developers and communities have turned to improved turbine designs, pre-construction bird migration studies, and operational mitigation strategies. A 2007 report by the National Research Council concluded, "There is no evidence that fatalities from existing wind facilities are causing measurable changes in bird populations in the US."[18] The National Academy of Sciences estimated in 2006 that wind energy is responsible for less than .003% of (3 of every 100,000) bird deaths caused by human and cat activities.

Photo Credit: Invenergy, LLC Wyoming County, NY

Wind turbine-related bat fatalities have been less studied than bird fatalities. A preliminary study by the New York State Department of Environmental Conservation indicates that, based on investigations of six New York State wind farms over a seven-month period, there are more bat

16. NYSERDA, Large Wind Frequently Asked Questions, http://www.powernaturally.org/Programs/Wind/largewindfaqs.pdf
17. U.S. Department of Energy, 20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply, 2008. www.20percentwind.org
18. "Environmental Impact of Wind Energy." National Research Council, 2007. http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=11935

fatalities than bird fatalities. Studies are ongoing to determine how widespread this problem is. However, mitigation strategies are already being tested. For example, it appears that a substantial portion of bat fatalities occur during low wind conditions, and most occur during the bat migration period from summer to fall.[19] A study conducted at a Pennsylvania wind farm confirmed that bat fatalities can be significantly reduced by raising turbine cut-in speed (the wind speed at which turbines begin to spin) and by reducing the hours of turbine operation during periods of low wind.[20] As with birds, it may be possible to avoid placing wind turbines in bat migration routes and important habitats.

Photo Credit: CCE, Northport, NY

If wind power is not developed, increasing demand for electricity will result in increased development of other types of electricity generating facilities. These other generation sources all carry their own risks to wildlife. A recent report by NYSERDA attempted to place the wildlife impacts of wind turbines into context by comparing them with the wildlife impacts of other forms of electricity generation. The report assessed the current peer-reviewed scientific literature and concluded that "coal is by far the largest contributor to risks to wildlife found in the New York and New England region," while wind power carries the lowest potential risks to wildlife and habitat.[21]

Human Health Impacts: A 2010 report issued by the Ontario Chief Medical Officer of Health concluded that there is "No direct causal link between wind turbines and adverse health impacts."[22] The report inventoried all the available peer-reviewed scientific studies on wind energy and its effects on nearby residents, including noise effects and shadow flicker effects. This does not rule out the possibility of indirect impacts; for example, some people have claimed that wind turbine noise disturbs their sleep, and sleep disturbance over a sustained period has been shown to have deleterious effects on human health. However, direct human health impacts from wind turbines have not been proved.

By contrast, air emissions from burning fossil fuels have been shown to cause lung damage, asthma, premature death and birth defects. A 2009 report by the National Academy of Sciences estimated that the burning of coal, which accounts for half the electricity produced in the US, costs the US $62 billion a year, primarily in health damages.[23]

Conclusion

No type of electricity generation is completely without negative impacts. However, surveys of the scientific literature have shown that the negative impacts of wind energy are significantly less than those of fossil fuel and nuclear generation. Properly planned and sited, wind energy can reduce the negative impacts of electricity generation, while helping to achieve New York State's clean air and renewable energy goals.[24]

19. Arnett, E. B., K. Brown, W. P. Erickson, J. Fiedler, T. H. Henry, G. D. Johnson, J. Kerns, R. R. Kolford, C. P. Nicholson, T. O"Connell, M. Piorkowski, and R. Tankersley, Jr. 2008. Patterns of fatality of bats at wind energy facilities in North America. Journal of Wildlife Management 72: 61–78.
20. Arnett, E. B., M. M. P. Huso, J. P. Hayes, and M. Schirmacher. 2010. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.
21. Newman, J., E. Zillioux, C. Newman, C. Denny, P. Colverson, K. Hill, W. Warren-Hicks, and S. Marynowski. 2009. Comparison of Reported Effects and Risks to Vertebrate Wildlife from Six Electricity Generation Types in the New York/New England Region. NYSERDA
22. "The Potential Health Impact of Wind Turbines," Chief Medical Officer of Health, Ontario, May 2010. http://www.health.gov.on.ca/en/public/publications/ministry_reports/wind_turbine/wind_turbine.pdf
23. "Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use," National Academy of Science, October 2009.
24. 2009 New York State Energy Plan, http://www.nysenergyplan.com/stateenergyplan.html

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