ALTERNATIVE ENERGY

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Reservoir construction, operations and decommissioning impact fish movement and habitat.

Resource extraction and power generation have the greatest number of effects and pose the greatest risk to wildlife.

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PROJECT NUMBER 9675

0903

New York Energy $mart℠
EMEP
Environmental Monitoring, Evaluation, & Protection

NYSERDA
New York State Energy Research and Development Authority

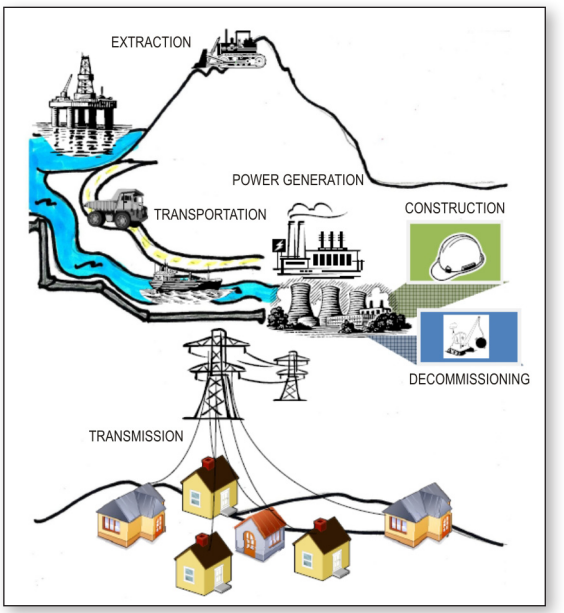
Synthesis of Electricity Generation Impacts to Wildlife

PROJECT FOCUS

Electricity generation causes adverse effects to both people and the environment, including wildlife and habitats. The types of effects and relative risk vary among the different electricity generation sources. This project compared the literature-reported effects to vertebrate wildlife from electricity generation by coal, oil, natural gas, nuclear, hydro, and onshore wind, with the goal to provide an objective life-cycle analysis of the relative risk posed by each of these major electrical generation sources in New York State.

CONTEXT

Demand for electricity continues to grow, and with it the need to construct new generation facilities. As the environmental effects of electricity generation have become better understood, each proposed new generation facility has prompted concerns about potential impacts to wildlife. Typically, environmental impact studies assess proposed facilities on a project-vs-no-project basis, focusing on the local impacts of the proposed technology at a single life-cycle stage. To make informed energy choices going forward, planners should be able to compare the broad scale, life-cycle ecological impacts associated with various electrical generation technologies available to meet the growing demand. This study provides a methodology for such comparisons.



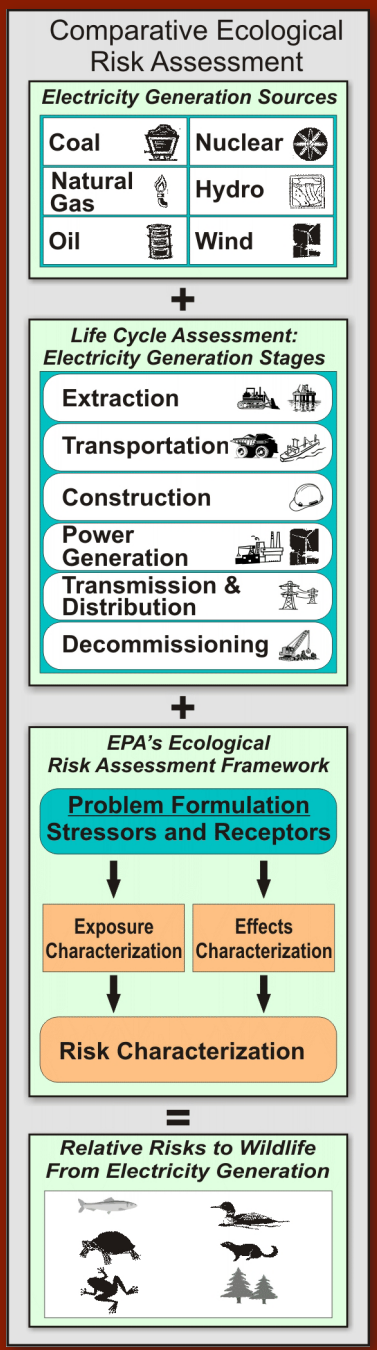
Every form of electricity generation includes many life-cycle stages. Each stage presents unique potential risks to wildlife.

Major studies on the ecological impacts of conventional electricity generation show varied and widespread impacts. However, the existing data have proved difficult to use effectively in comparing potential impacts of competing technologies from "cradle to grave." This is because most previous studies failed to address renewable energy technologies, few took a life-cycle approach, and none offered a method for apples-to-apples comparison of all major generation technologies.

This project begins to address these needs by providing a baseline comparison of the life-cycle environmental impacts of all major generation technologies available in the New York/New England region.

PROJECT IMPLICATIONS

Potential risks to wildlife from electricity generation are increasingly of concern when planning and siting generation facilities. Prior to this study, decision makers lacked the comprehensive data and methods to make meaningful comparisons between competing electricity generation technologies. Consequently, attempts to assess potential wildlife risks from proposed projects have generally been based on local impacts of the proposed technology. This study provides a scientifically rigorous assessment of the relative risks to wildlife in the New York/New England region from the available electricity generation technologies, taking into account the entire life-cycle of each technology and the specific risks to wildlife in the region, given the current and anticipated mix of generation technologies in use.



The CERA combines a life-cycle assessment and the EPA's Ecological Risk Assessment Framework for each electricity generation source to determine the relative risks to wildlife.

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NYSERDA

Since 1975, the New York State Energy Research and Development Authority (NYSERDA) has developed and implemented innovative products and processes to enhance the State's energy efficiency, economic growth, and environmental protection. One of NYSERDA's key efforts, the Environmental Monitoring, Evaluation Protection (EMEP) Program, supports energy-related environmental research. The EMEP Program is funded by a System Benefits Charge (SBC) collected by the State's investor-owned utilities. NYSERDA administers the SBC program under an agreement with the Public Service Commission.

METHODOLOGY

The centerpiece of this project is a Comparative Ecological Risk Assessment (CERA), which is based on the U.S. Environmental Protection Agency's (EPA) Ecological Risk Assessment (ERA) model. The project team compiled the known wildlife impacts of each generation technology at each life-cycle stage, including resource extraction, fuel transportation, facilities construction, power generation, transmission and delivery, and facilities decommissioning. To rank relative risk potential, five risk categories were defined: Lowest Potential, Lower Potential, Moderate Potential, Higher Potential, and Highest Potential Risk. The Lowest Potential risk level is associated with limited or no mortality of wildlife individuals; the Highest Potential risk level is associated with large-scale population-level mortality.

In interpreting the results, it is important to note the project's limitations. The study included only vertebrate wildlife and associated natural habitats. Impacts to invertebrates, human health, and previously disturbed habitats were not considered, nor was the potential for wildlife and habitat recovery. In addition, certain catastrophic events (such as the breaching of a hydroelectric dam) were not evaluated due to low probability. The impacts of transportation and storage of radioactive wastes also were not considered because the long-term disposal of nuclear waste remains unresolved. Because the report is based on published literature, it is a retrospective of impacts; the effects of future policy changes and technological advances (for example, the use of double-hulled oil tankers or the development of carbon dioxide capture and storage) were not considered. No attempt was made to compare relative risks by considering electricity generation sources of the same size, such as risk per megawatt (MW).[1]

[1] Life-cycle risks can vary considerably depending on the size of facilities. For example, the collision risk to birds associated with a 500 MW nuclear plant is likely to be considerably smaller than that associated with a 500 MW wind project, which would require hundreds of turbines. Such a comparison is not likely to be realistic.

FINDINGS

The report finds that all electricity generation types pose risks to wildlife. However, these risks vary widely. The table at right ranks these risks by generation type and life-cycle stage. The report draws a number of conclusions based on this ranking, including the following:

Source	Relative Wildlife Risk Level for Potential Harm					
	Resource Extraction	Fuel Transportation	Construction of Facility	Power Generation	Transmission and Delivery	Decommissioning of Facility
Coal	Highest Potential	Lower Potential	Lower Potential	Highest Potential	Moderate Potential	Lower Potential
Oil	Higher Potential	Highest Potential	Lower Potential	Higher Potential	Moderate Potential	Lower Potential
Natural Gas	Higher Potential	Moderate Potential	Lowest Potential	Moderate Potential	Moderate Potential	Lowest Potential
Nuclear	Moderate Potential	Lowest Potential	Lowest Potential	Moderate Potential	Moderate Potential	Lowest Potential
Hydro	None	None	Highest Potential	Higher Potential	Moderate Potential	Higher Potential
Wind	None	None	Lowest Potential	Moderate Potential	Moderate Potential	Lowest Potential

This table summarizes the relative wildlife risk levels for each electricity generation source during each life-cycle stage.

- Coal is by far the largest contributor to wildlife risks associated with acid deposition, climate change, and mercury bioaccumulation. This is due to the comparative amounts of sulfur dioxide, nitrogen oxides, carbon dioxide, and mercury emissions generated from coal use.
- Overall, non-renewable electricity generation sources, such as coal and oil, pose higher risks to wildlife than renewable electricity generation sources, such as hydroelectric and wind.
  a. Coal has unique risks during resource extraction (e.g., effects of strip and mountain top mining) and contributes to acidification and mercury bioaccumulation during power generation.
  b. Oil has unique risks during resource extraction and fuel transportation, and contributes to acidification risks during power generation.
  c. Natural gas power generation risks are similar to those of oil, but they are of lower magnitude due to the lower magnitude of emissions.
  d. Nuclear presents some risks found with other non-renewable electricity generation sources, such as bird collisions with stacks and cooling towers associated with coal and oil.
  e. Hydro has unique risks during construction, power generation, and decommissioning, such as habitat loss and blocked fish migration.
  f. Wind has unique risks during operation (i.e., bird and bat collisions with wind turbines). No population-level risks to birds have been noted. Population level risks to bats are uncertain.
- Since there are more conditions, by-products, and actions in the resource extraction and power generation stages that act as stressors to wildlife, higher risks to wildlife are associated with these life-cycle stages. Construction, transmission and delivery, and decommissioning stages generally have fewer stressors affecting wildlife; however, the construction, operation, and decommissioning of dams pose relatively Higher Potential risks.