Energy-Water Nexus

Past GAO findings on the need for more data and increased coordination

The National Academies' Roundtable on Science and Technology for Sustainability

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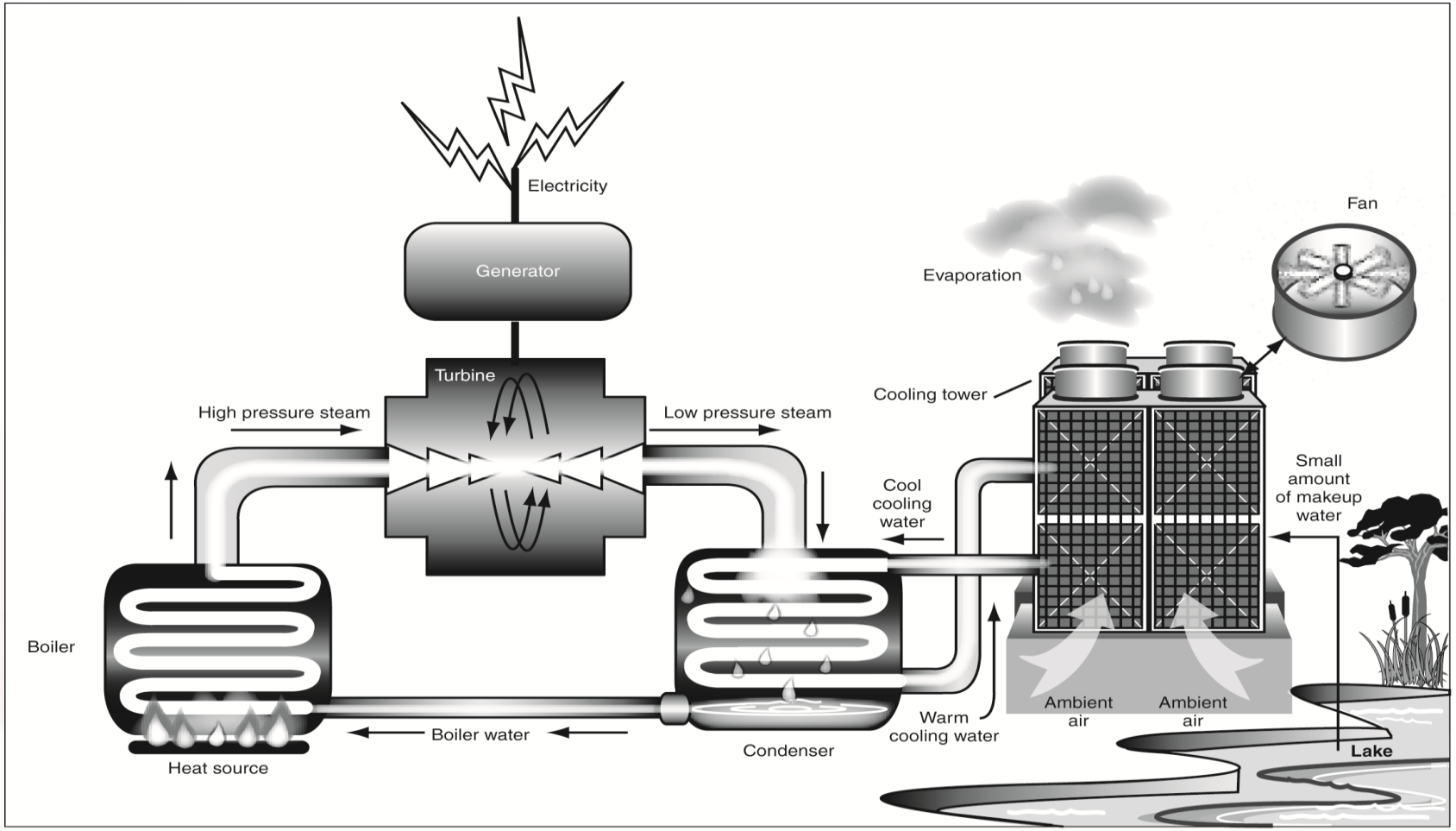
Key GAO reports related to the energy-water nexus

- **Thermoelectric power plants** – Energy-Water Nexus: Improvements to Federal Water Use Data Would Increase Understanding of Trends in Power Plant Water Use, GAO-10-23
- **Biofuels** – Energy-Water Nexus: Many Uncertainties Remain about National and Regional Effects of Increased Biofuel Production on Water Resources, GAO-10-116
- **Oil shale** – Energy-Water Nexus: A Better and Coordinated Understanding of Water Resources Could Help Mitigate the Impacts of Potential Oil Shale Development, GAO-11-35
- **Energy for water** – Energy-Water Nexus: Amount of Energy Needed to Supply, Use, and Treat Water Is Location-Specific and Can Be Reduced by Certain Technologies and Approaches, GAO-11-225
- **Produced water** – Energy-Water Nexus: Information on the Quantity, Quality, and Management of Water Produced during Oil and Gas Production, GAO-12-156
- **Nexus capping report** – Energy-Water Nexus: Coordinated Federal Approach Needed to Better Manage Energy and Water Tradeoffs, GAO-12-880.
- **Oil and Gas**: Information on Shale Resources, Development, and Environmental and Public Health Risks, GAO-12-732
- **Unconventional Oil and Gas Development**: Key Environmental and Public Health Requirements, GAO-12-874
- **Freshwater Supply**: States' Views of How Federal Agencies Could Help Them Meet the Challenges of Expected Shortages, GAO-03-514

Background on thermoelectric power plants

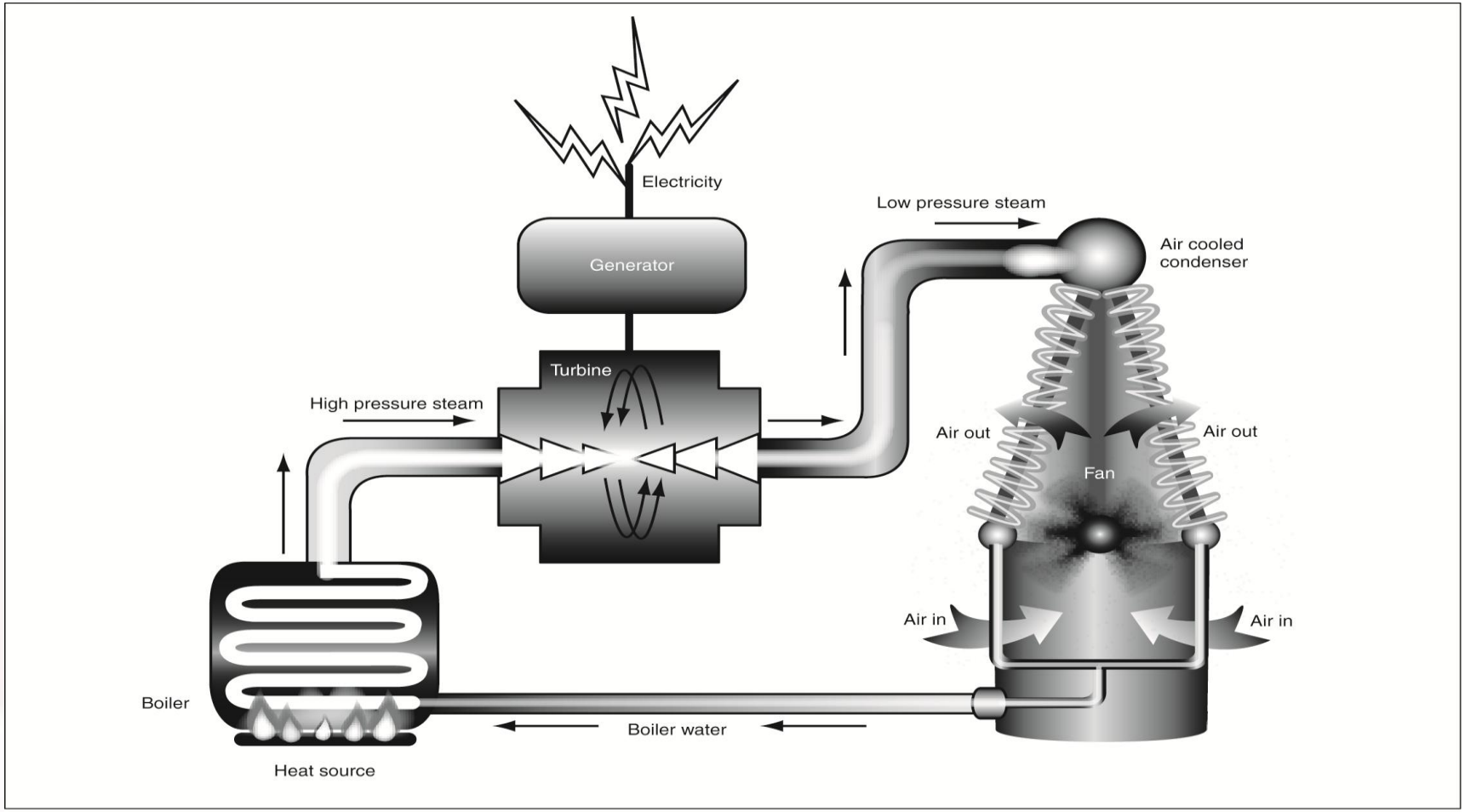
- Two types of cooling systems
  - Wet recirculating
  - Dry cooling

Wet recirculating system with cooling tower



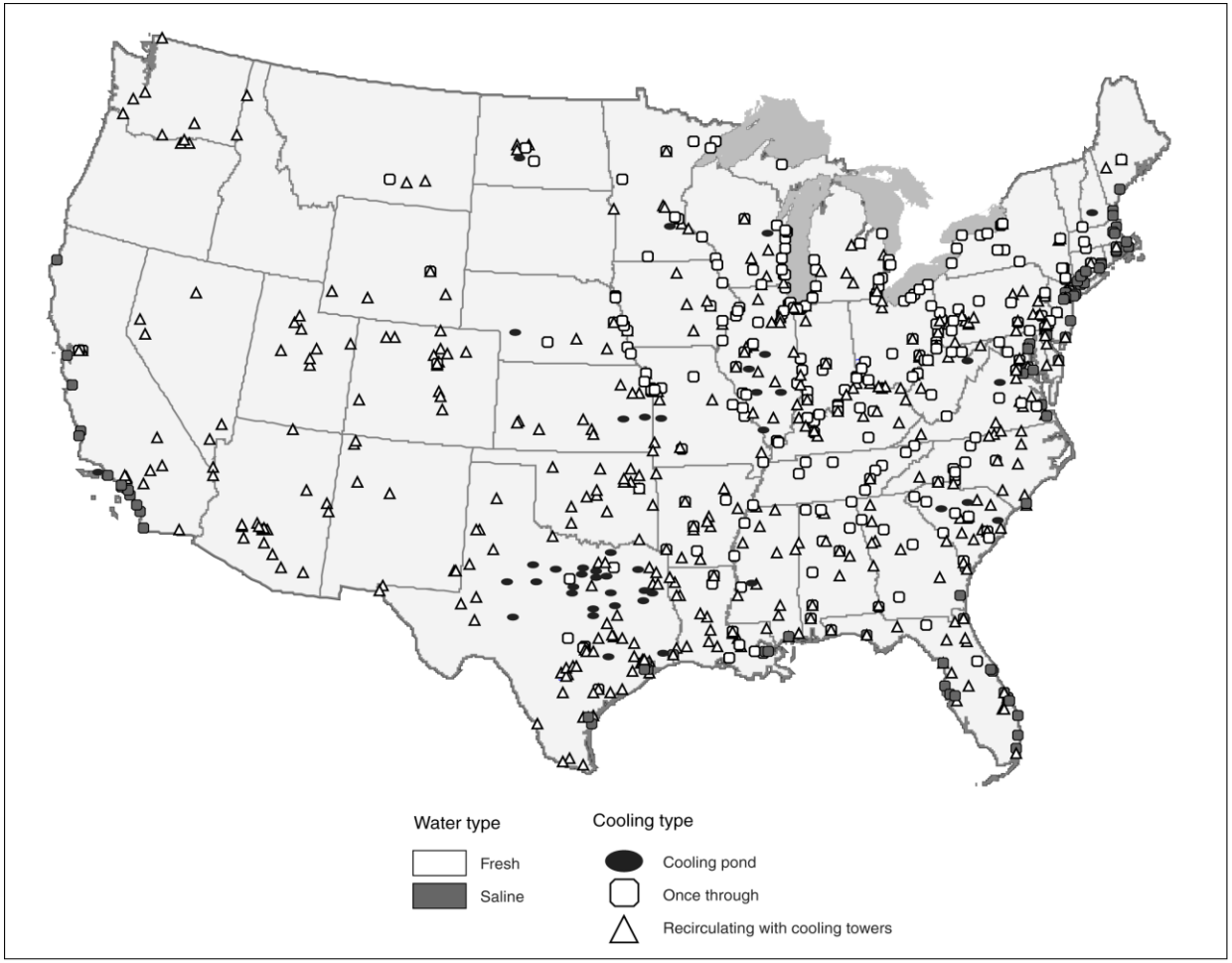
Source: GAO analysis of various national laboratory and industry sources.

Dry cooling system



Source: GAO analysis of various national laboratory and industry sources.

Water-based cooling systems by technology and water source



Source: National Energy Technology Laboratory, based on EIA-collected data; Map (Mapinfo).

Data needs

- Our thermoelectric power plants report identified data needs in the following areas:
  - Advanced cooling technologies,
  - Alternative water sources,
  - Nuclear and combined cycle plants, and
  - Consumption at thermoelectric power plants.

Data needs: Advanced cooling technologies

- Our review found that EIA did not systematically collect info on use of advanced cooling technologies. Data in EIA's database were incomplete and inconsistent.
- Without these national data, it is not possible without significant additional work to comprehensively identify how many plants use the technologies, where they're located, and to what extent the technologies have decreased freshwater use.

Data needs: Alternative water sources

- Our review found that federal data sources could not be used to comprehensively identify plants using alternative water sources, such as reclaimed water.
- EIA routinely reported data on individual plant water sources, but the data did not always identify whether the water source was an alternative source.
- USGS data identified plants using ground, surface, fresh, and saline water, but they did not identify those using alternative water sources.

Data needs: Nuclear and combined cycle plants

- Our review found that EIA did not collect data on the water use and cooling systems of two significant components of the sector.
  - In 2002, EIA discontinued its reporting of water use and cooling technology information for nuclear plants, making it more difficult to monitor trends in the industry.
  - EIA did not collect water use and cooling system data from operators of some combined cycle thermoelectric power plants.

Data needs: Consumption at thermoelectric power plants

- Our review found that USGS had discontinued distribution of data on water consumption for power plants and other users due to limited funding.
- Officials told us they would like to restart distribution if funding becomes available because the data can help determine water for reuse by power plants and other users.
- Users of the data told us that not having data on consumption limits their understanding of how power plant water consumption is changing over time. Increased use of wet recirculating technologies, which consume more but withdraw less water than once-through cooling, has changed plant water use patterns.

GAO recommendations on data from the thermoelectric power plants report

- Recommendations to EIA:
  - add cooling technology reporting codes for alternative cooling technologies, such as dry and hybrid cooling, or take equivalent steps to ensure these cooling technologies can be identified in EIA's database;
  - collect and report data on the use of alternative water sources, such as treated effluent and groundwater that is not suitable for drinking or irrigation, by individual power plants;
  - expand reporting of water use and cooling technology data to include all significant types of thermoelectric power plants, particularly by reinstating data collection for nuclear plants and initiating collection of data for all combined cycle natural gas plants.

GAO recommendations on data from the thermoelectric power plants report

- Recommendations to USGS:
  - expand efforts to disseminate available data on the use of alternative water sources, such as treated effluent and groundwater that is not suitable for drinking or irrigation, by thermoelectric power plants, to the extent that this information becomes available from EIA;
  - reinstate collection and distribution of water consumption data at thermoelectric power plants.

Future uncertainties complicate planning

- Uncertainties that affect energy and water must be considered in setting federal policies related to these resources.
  - The magnitude of the impacts on water resources stemming from the nation's future energy use will vary depending on what energy sources are pursued.
  - While the actual effects of climate change remain uncertain, the effects are expected to vary by location and, in some locations, to increase demand for both energy and water resources while simultaneously decreasing water supplies.

Freshwater resource data needs

- National water availability and use was last comprehensively assessed in 1978.
- Concerns have been expressed over decreased funding for USGS's monitoring efforts, such as reduction in the number of streamgages.
- Research and data on hydrological processes are needed. Areas in need of additional research and data include the interactions between groundwater and surface water, aquifer recharge rates, and groundwater movement.

Coordination needs

- Our energy-water nexus work found the following coordination needs:
  - Overcoming stove-piping, and
  - Implementing EPAct 2005 provision.

Coordination need: Overcoming stove-piping

- Energy and water planning are generally “stove-piped” and frequently split across federal, state, and local levels, resulting in decision making that does not adequately account for the interactions between energy and water.
- Improved planning will require federal agencies to coordinate with one another as well as with other stakeholders, such as state and local agencies, academia, industry, and environmental groups.

Coordination need: Implementing EPAct 2005 provision

- The Energy Policy Act of 2005 directed the Secretary of Energy to carry out a program of research, development, demonstration, and commercial application to address the energy-water nexus and assess the effectiveness of existing federal programs to address the nexus.
- The provision also directs the Secretary to consult with the Administrator of EPA, the Secretary of the Interior, the Chief Engineer of the Army Corps of Engineers, the Secretary of Commerce, the Secretary of Defense, and other federal agencies, as appropriate.

GAO recommendations on coordination

- Thermoelectric power plants report (GAO-10-23)
  - EIA and USGS: establish a process for regularly coordinating with each other, water and electricity industry experts, environmental groups, academics, and other federal agencies, to identify and implement steps to improve data collection and dissemination.
  - EIA: include USGS and other key users of power plant water use and cooling system data as part of EIA's triennial review process.

GAO recommendations on coordination

- Nexus capping report (GAO-12-880)
  - DOE: take the actions necessary to establish a program to address the energy-water nexus, with involvement from other federal agencies as described in the Energy Policy Act of 2005.

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