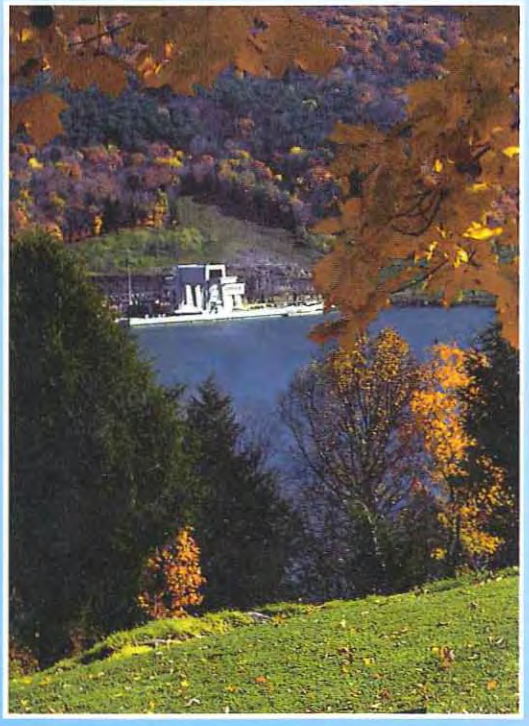
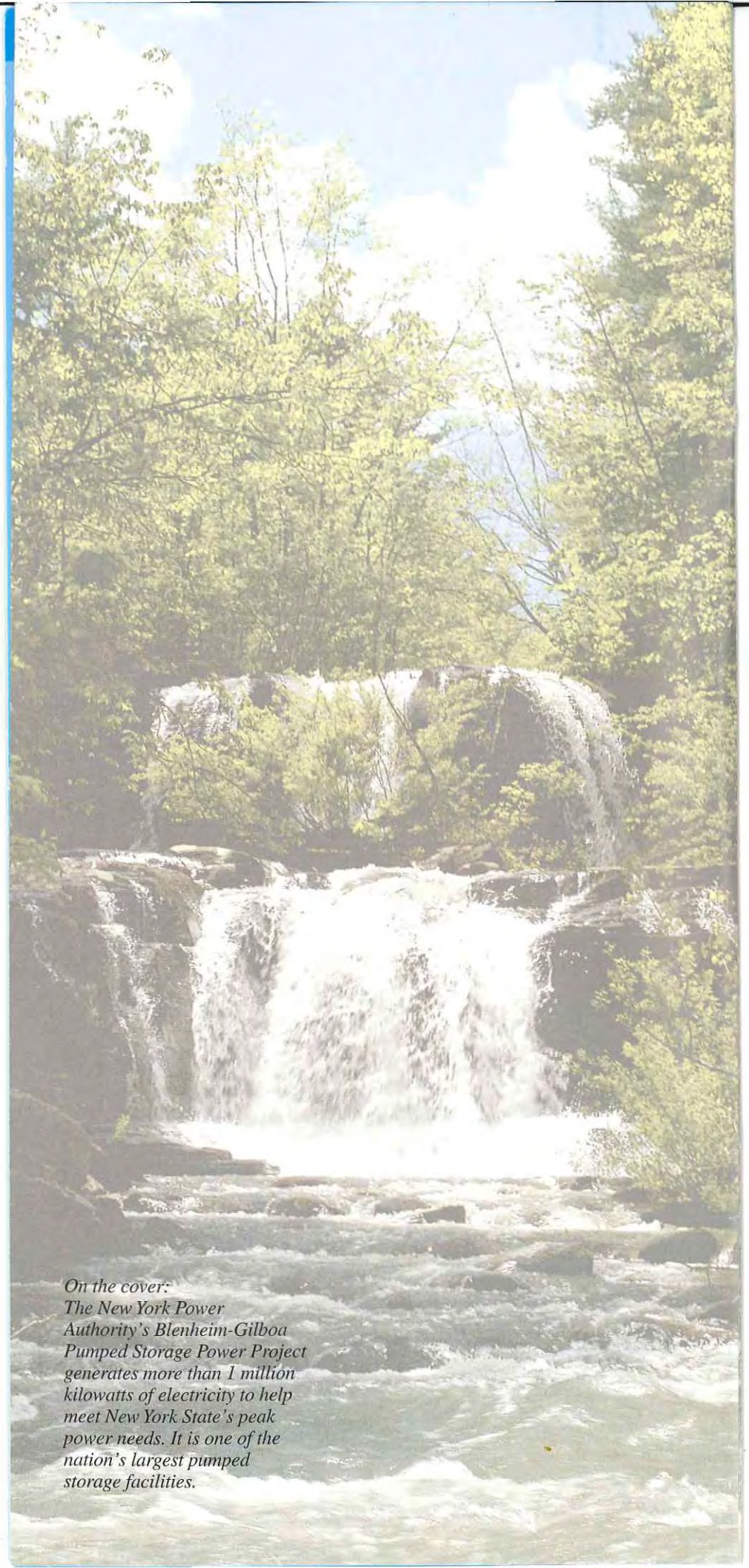
The

Blenheim-Gilboa

Pumped Storage Power Project



New York Power Authority



On the cover:
The New York Power Authority's Blenheim-Gilboa Pumped Storage Power Project generates more than 1 million kilowatts of electricity to help meet New York State's peak power needs. It is one of the nation's largest pumped storage facilities.

Since 1973, the New York Power Authority's Blenheim-Gilboa Pumped Storage Power Project has generated clean, quiet and reliable electricity.

Blenheim-Gilboa is New York State's largest energy storage system. It helps meet the state's daily peak power needs by recycling water between two reservoirs—one atop a mountain, the other at its base—taking advantage of daily highs and lows in statewide electricity demand.

Blenheim-Gilboa generates up to 1,040,000 kilowatts (kw) of electricity, making it one of the nation's largest pumped-storage projects. Its quick-starting units can also compensate for the temporary loss of another generating plant or transmission line and play a key role in restoring service in the event of a systemwide power blackout.

Ground was broken for the project on July 12, 1969. Four years later, on July 5, 1973—after 10 million person-hours of work—Blenheim-Gilboa produced its first power.

Named for the Schoharie County towns it straddles, Blenheim-Gilboa is about 40 miles southwest of Albany in the northern Catskills, one of New York's most scenic areas.

The project blends into its natural setting, with much of the powerhouse hidden from view. When the lower reservoir is full, only the top few feet of the plant are visible above the water's surface.

Blenheim-Gilboa's powerhouse assumes a low profile along the banks of the project's lower reservoir. More than three-quarters of the facility is underground.

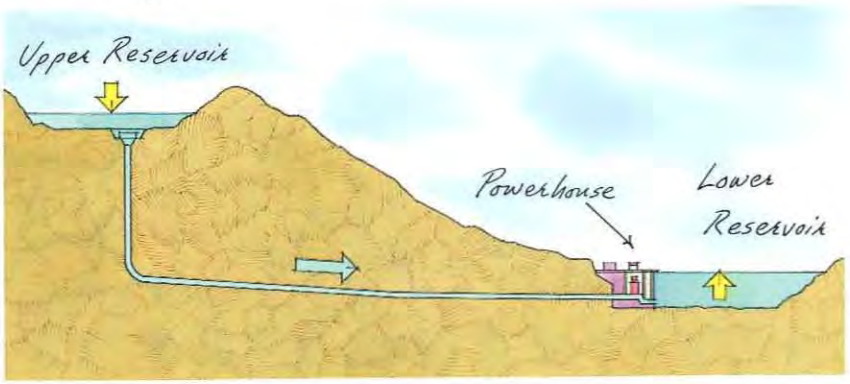
Pumped Storage: The Concept

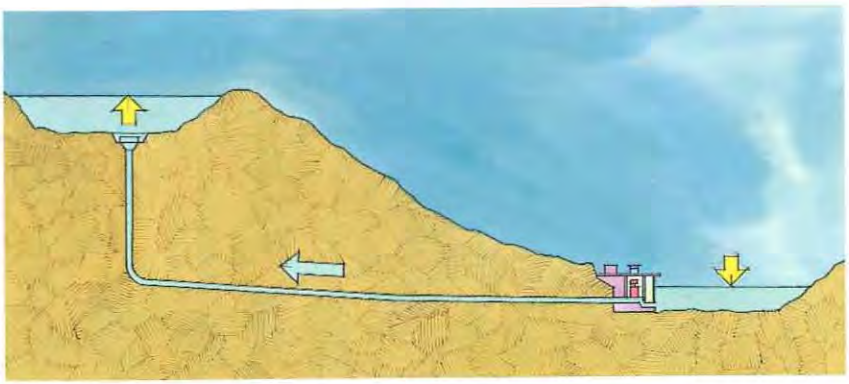
The Blenheim-Gilboa project works like a giant storage battery. Electricity cannot be stored in large amounts. Instead, the project stores energy in the form of water at times of slack power demand so that it can be used to produce electricity during peak periods, when alternate sources are more expensive.

At such times, water released from the upper reservoir on Brown Mountain falls through conduits to spin the project's four turbine-generators, which together can produce 1,040,000 kilowatts of electricity. First, the water drops down a 1,042-foot shaft, five times higher than Niagara Falls. From there, it flows to four penstock tunnels, each feeding a reversible, hydraulic pump-turbine. The force of the falling water rotates the turbines, which, in turn, drive the electricity-producing generators set above them. The power output is controlled by gates that regulate the flow of water to each of the four units. Up to 3,720 cubic feet of water a second flow through each turbine and then are discharged into the lower reservoir.

Cutaway of Brown Mountain illustrates the pumped storage concept. Water falls from the upper to the lower reservoir to generate electricity during peak-demand periods. At night and on weekends, when demand is low, water is pumped back to the upper reservoir.

Peak Energy Demand





Low Energy Demand

At night or on weekends, when electricity demand is low, the turbine-generators are reversed to become motorized pumps, and the water is returned back up the shaft to the mountaintop. Each pump operates at 403,000 horsepower (the equivalent of 4,000 automobile engines).

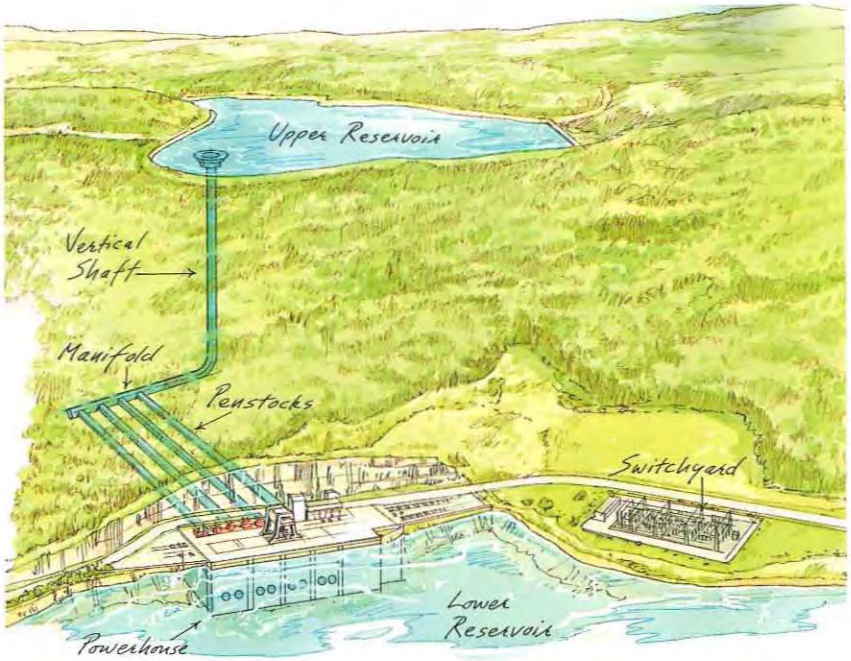
Pumped storage is a closed cycle. The same water is used again except for that lost through natural evaporation.

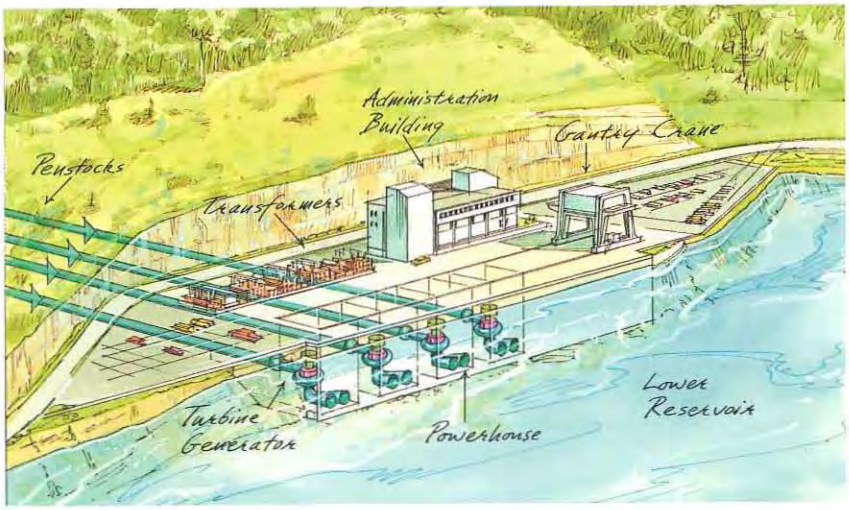
Construction photograph captures the immense size of Blenheim-Gilboa's water-conduit system. From here, water flows to four turbine-generating units to produce electricity.

Blenheim-Gilboa's electricity is available almost immediately for peak-demand or emergency use.

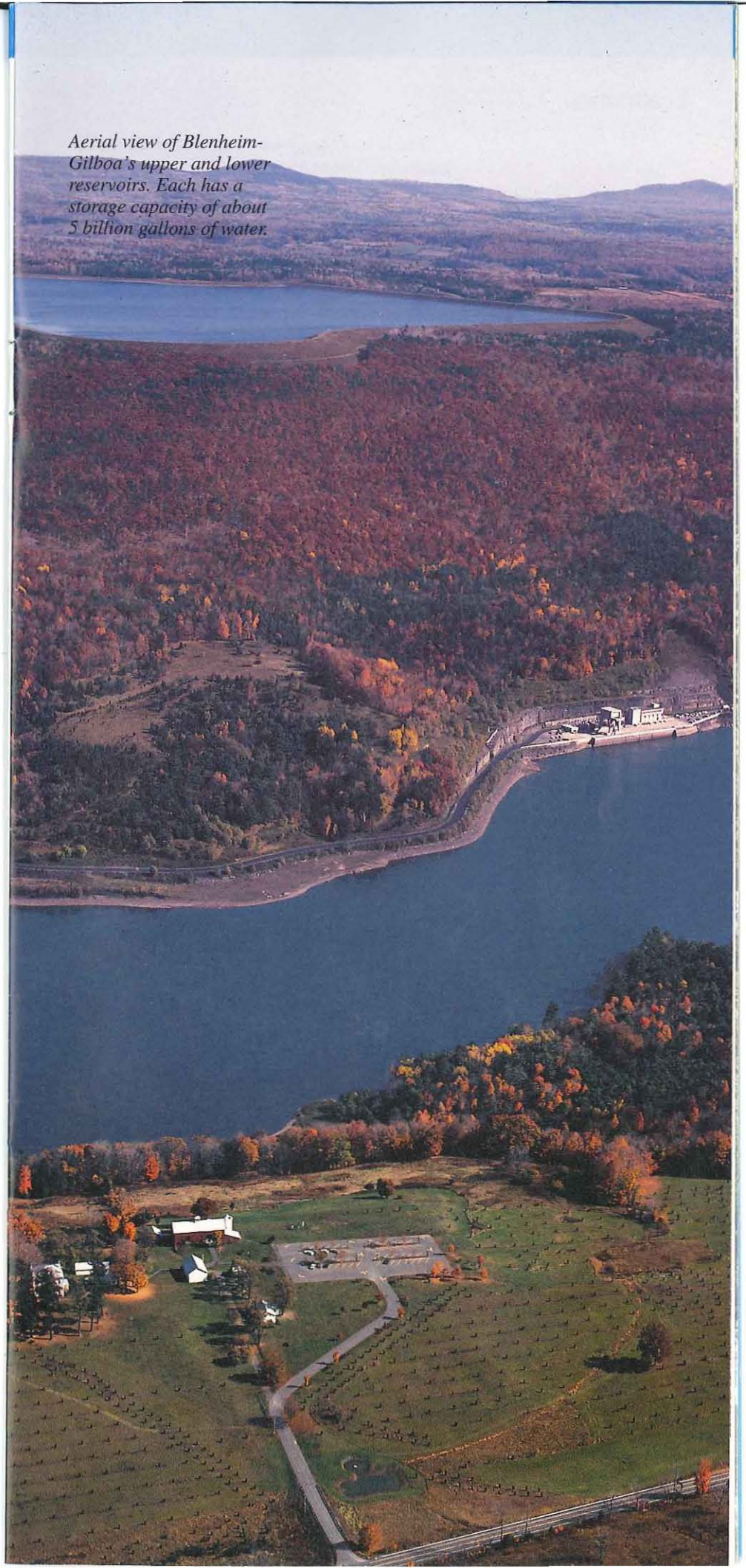
Within two minutes, the project can generate up to 1,040,000 kw. No other plant can even approach its rapid-response capability. This is particularly important when another plant or transmission line temporarily shuts down, often unexpectedly. Blenheim-Gilboa makes up the difference quickly and efficiently.

In the event of a systemwide power failure, Blenheim-Gilboa can provide "cranking power" to restart other Power Authority facilities and, eventually, the statewide energy grid.





Artist's rendering shows water's journey through Brown Mountain. Each of the project's four turbine-generators can produce up to 260,000 kilowatts of electricity.



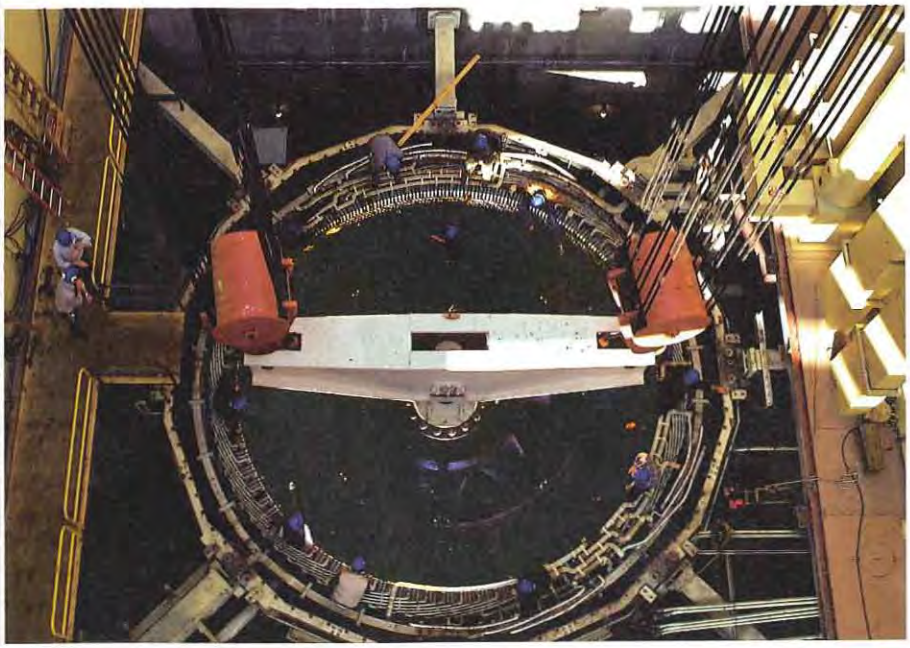
Aerial view of Blenheim-Gilboa's upper and lower reservoirs. Each has a storage capacity of about 5 billion gallons of water.

Economics

Blenheim-Gilboa uses more electricity than it generates. It takes more power to pump water back to the upper reservoir than is generated when water flows through the project's turbines. But Blenheim-Gilboa still saves money for New York's electricity consumers by increasing the supply of economical power when it is most needed.

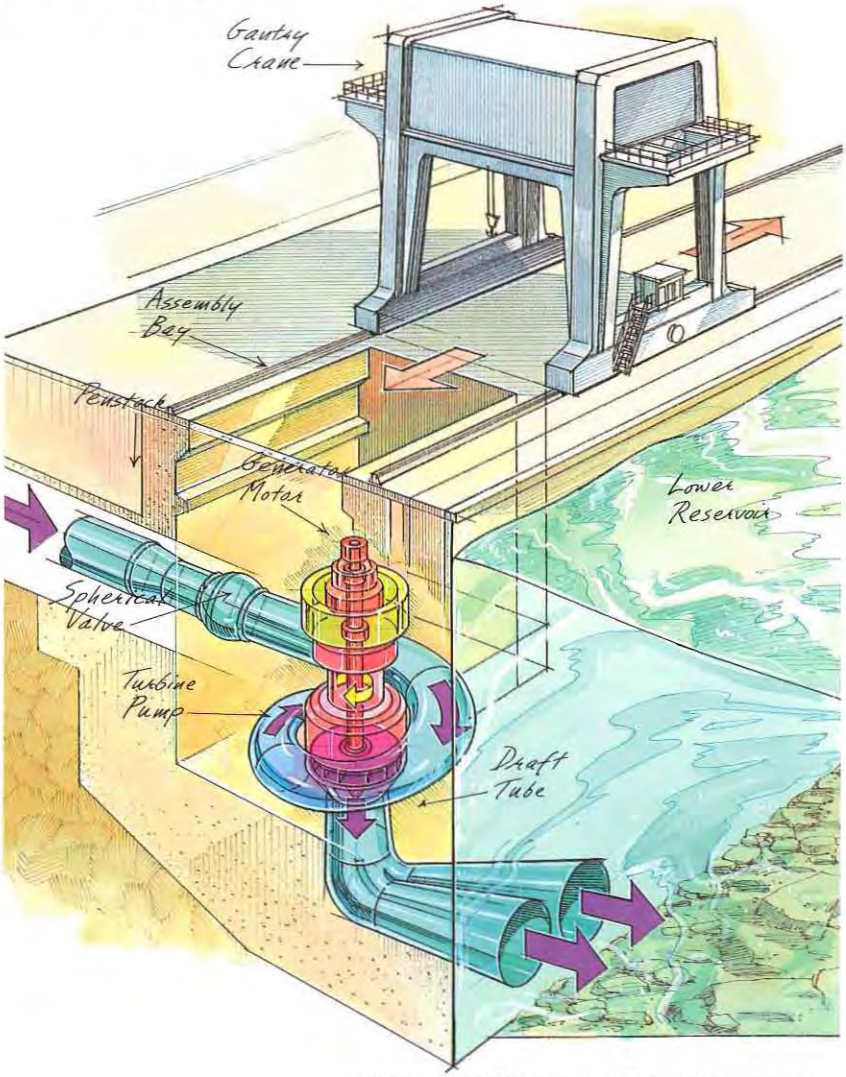
When electricity demand approaches a peak, New York State's most-efficient power plants, with the lowest operating costs, are often already running. But consumers may need even more electricity at such times, and Blenheim-Gilboa makes it possible to minimize the use of older, more-costly plants to make up the difference.

While the project uses large amounts of electricity to return water to its upper reservoir, pumping is accomplished with the least-expensive power available from other sources during low-demand periods.



Workers service one of Blenheim-Gilboa's four pump-turbine generating units, which have a dual purpose. Each unit harnesses the force of falling water to produce electricity. By reversing leads on motors, the same units later pump water back to the project's upper reservoir.

When the spherical valve on a unit is opened, water from the penstock rushes in under tremendous pressure and strikes the blades of a turbine, which, in turn, spins a generator to produce electricity.



The sources of pumping energy are power plants that produce electricity more efficiently and economically by operating around the clock. They could be hydroelectric facilities, which rely on nonstop river flows, or natural gas- or oil-fueled or nuclear plants, where uninterrupted operation is more economical.

When overall demand is low, the excess electricity from such sources is used for pumping at Blenheim-Gilboa. This electricity costs less than the power Blenheim-Gilboa replaces during peak-demand periods, more than compensating for energy losses in the pumping-generating cycle.

Blenheim-Gilboa Power Project

Powerhouse

■ Where electricity is generated

■ Built largely under the base of Brown Mountain on Schoharie Creek, beside the project's lower reservoir

■ With the lower reservoir filled, only the top five feet of the plant are visible.

■ Height: 132 feet
Width: 172 feet
Length: 542 feet

■ Built with 121,000 cubic yards of reinforced concrete

■ Total excavation: 1,559,000 cubic yards of earth and rock

Generating/Pumping Equipment

■ The powerhouse contains four modified Francis-type reversible hydraulic pump-turbines with steel spiral cases and full-length steel draft-tube liners.

■ Each pump-turbine is connected to a generator-motor set below the plant's top deck.

■ Each generator can produce 260,000 kilowatts of electricity. Each turbine is spun by up to 3,720 cubic feet of water per second.

■ When reversed, the generators become motors and the turbines become pumps to return the water to the upper reservoir. Each pump operates at 403,000 horsepower at a head of 1,085 feet, with a capacity of 3,000 cubic feet of water per second.

Switchyard/Transmission

■ Power transformers on the powerhouse deck increase voltage of electricity produced from 17,000 to 345,000 volts.

■ Power cables and control wiring run 1,650 feet through a tunnel to the switchyard, where electricity is dispatched by three transmission lines to customers throughout New York State.

■ The switchyard is built on 600,000 cubic yards of earth and rock.

Powerhouse Crane

■ A 510-ton gantry crane can easily lift any plant component for maintenance or replacement. It moves directly above the generating-pumping units, normally enclosed by weather-tight hatches.

Lower Reservoir

■ Formed by impounding the waters of Schoharie Creek behind the lower reservoir dam, 1.1 miles downstream from the powerhouse

■ Approximately three miles long

■ Total storage capacity is 16,350 acre-feet, or 5.33 billion gallons.

■ At full pond, the water surface elevation is 900 feet above sea level.

Powerhouse and administration building

Switchyard

Powerhouse crane (left), power transformers (right)

Generator-motor

Lower Reservoir Dam

- Built with approximately 1,159,000 cubic yards of earth and rock
- Maximum height: 165 feet above streambed
  Maximum width: 400 feet
  Length: 1,800 feet
- At its western abutment, the dam has a 560-foot-long, concrete-lined, side-chute spillway, lined with 42,800 cubic yards of concrete.
- Controlled by three 38-foot-wide, 45-foot-high electrically operated tainter gates
- Spillway designed to accommodate water flows of up to 150,000 cubic feet per second

Upper Reservoir

- Located atop Brown Mountain
- Total storage capacity: 18,400 acre-feet
  Water surface area: 360 acres
- Usable storage capacity is 15,000 acre-feet, or 4.9 billion gallons, enough water to produce 12 million kilowatt-hours of electricity.
- At full pool, the water surface elevation is 2,003 feet above sea level. The minimum surface elevation is 1,995 feet.

Intake Structure

- At the northwest corner of the upper reservoir
- Permits water to begin its downward flow through Brown Mountain to the lower reservoir
- Uses an ungated, submerged circular weir, 50 feet in diameter. Equipped with trash racks and a flow-directing hexagonal cover slab supported on concrete piers
- Inside, the opening tapers from 38 feet in diameter to the 28-foot-diameter opening of the vertical shaft through Brown Mountain.

Upper Reservoir Embankment

- Formed by 5,875,000 cubic yards of earth and rock
- Maximum height is 162 feet above the bedrock foundation (110 feet above the original ground surface).
- Maximum width: 650 feet
- Length: 11,900 feet (more than two miles)

Water Conduit System

- Directs water between the upper and lower reservoirs
- From the upper reservoir, a 28-foot-wide, concrete-lined vertical shaft drops 1,042 feet inside Brown Mountain, where it is joined at right angles by a horizontal power tunnel 906 feet long.
- A 460-foot-long manifold links the vertical shaft with four penstock tunnels, one for each pump-turbine unit.
- Each penstock tunnel is 12 feet wide and approximately 1,915 feet long, of which 1,760 feet are lined with 40-foot-long sections of steel.
- Areas between the steel liner and tunnel excavations are sealed with concrete.
- Total excavation: 127,000 cubic yards of earth and rock
- Total concrete poured: 42,000 cubic yards

Lower reservoir dam

Intake structure

Upper and lower reservoirs

Water conduit system

Water Monitoring

Blenheim-Gilboa recycles tremendous amounts of water between two 5-billion-gallon reservoirs. But the production of electricity has no effect on downstream water levels and neither causes nor prevents flooding. In fact, the Schoharie Creek flows as if the power project did not even exist.

The total amount of water in the two reservoirs must remain constant at 7.25 billion gallons. To maintain that volume, water is released from the lower reservoir's spillway at a rate equal to the amount of water entering the reservoir from the nearby Gilboa Dam and Schoharie Creek tributaries.

Project staff members routinely monitor Schoharie Creek water flows to ensure this equilibrium, and they alert officials downstream when high-water conditions threaten.

This map (of the Schoharie Valley watershed) looks north. Schoharie Creek, which enters Blenheim-Gilboa's lower reservoir, flows in a northerly direction.

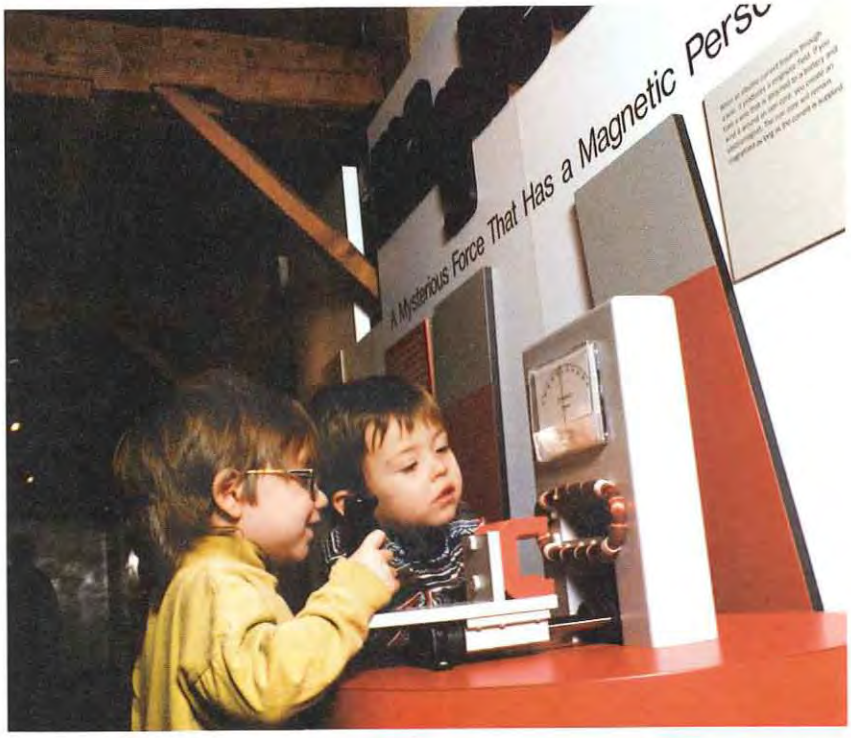
An aerial view of the Schoharie Valley, looking south. The project's upper reservoir (top, left) is atop Brown Mountain; beneath it are the powerhouse and lower reservoir, fed by Schoharie Creek (top, right).

Recreation and Education

The U.S. Department of the Interior honored the Power Authority with its highest outdoor recreation award for the varied conservation, recreational and cultural facilities developed by the Authority as part of the Blenheim-Gilboa project.

The 650-acre Mine Kill State Park, built by the Power Authority adjacent to the project's lower reservoir, is operated by the Saratoga-Capital District Region of the State Office of Parks, Recreation and Historic Preservation. The park offers a three-pool swimming complex, picnic areas, hiking trails and a boat-launching ramp.

Lansing Manor Museum, an early 19th-century country estate that was restored by the Power Authority and opened to the public, overlooks the lower reservoir. The museum, which is listed in the National Register of Historic Places, is operated by the Power Authority in cooperation with the Schoharie County Historical Society.



Hands-on displays help Blenheim-Gilboa visitors learn the basics of electricity.

The Blenheim-Gilboa visitors center, housed in a renovated 19th-century dairy barn, abuts Lansing Manor. The center's state-of-the-art exhibits use video and computer technology to explain the basics of electricity, how it is produced at the Blenheim-Gilboa project and other power projects, and its many uses in everyday life.

Historic Lansing Manor (right), restored by the Power Authority to its early 19th-century grandeur.

Blenheim-Gilboa's visitors center (below) overlooks the project's powerhouse and lower reservoir.

Blenheim-Gilboa Milestones

May 21, 1968	Governor Nelson A. Rockefeller signs bill authorizing Power Authority to build pumped-storage and nuclear generating plants.
August 15, 1968	Power Authority applies for Federal Power Commission (FPC) license to build Blenheim-Gilboa Pumped Storage Power Project.
June 16, 1969	Power Authority formally accepts FPC license.
July 12, 1969	Official groundbreaking ceremonies
April 10, 1970	Routing of transmission lines is approved by FPC.
May 20, 1970	First concrete is poured for powerhouse.
January 18, 1972	First turbine runner and shaft are installed.
July 27, 1972	Gilboa-Fraser and Gilboa-New Scotland transmission lines are placed in service.
July 5, 1973	Blenheim-Gilboa generates first power.
July 31, 1973	Project dedication
December 17, 1973	Full-power production

1971: Workers pour concrete for one of Blenheim-Gilboa's four generating units.

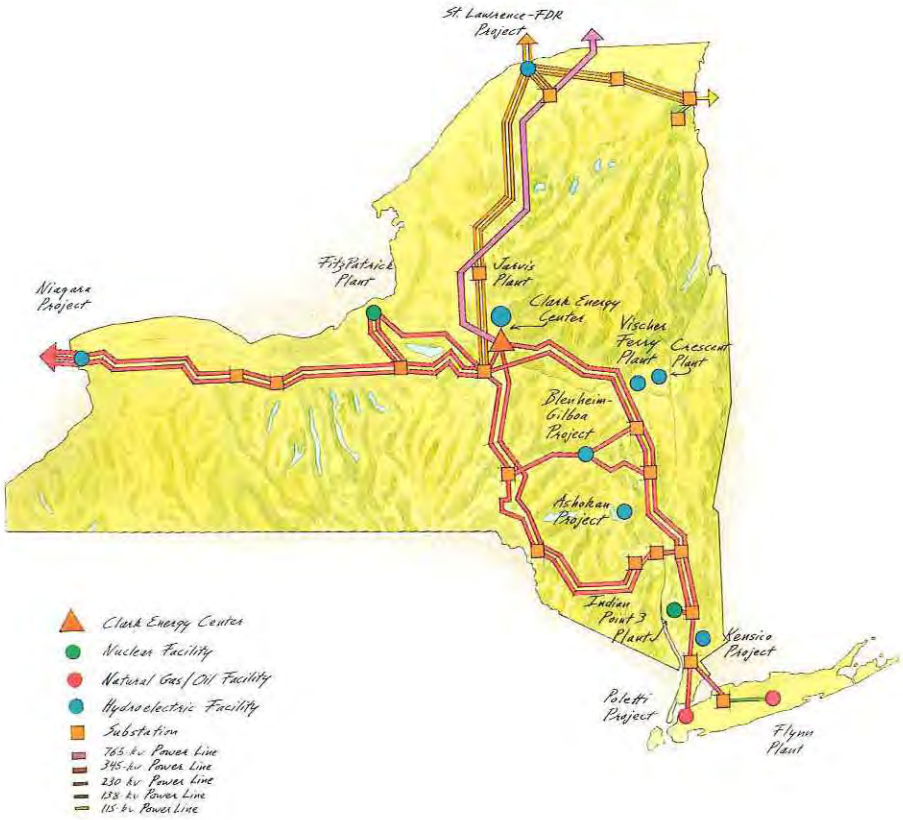
July 30, 1974	Dedication of visitors center
May 26, 1977	Lansing Manor Museum is opened to public.
January 25, 1978	Gilboa-Leeds transmission line is placed in service.
October 22, 1982	Ashokan Project generates first power. The 3,000-kilowatt small hydro facility in Ulster County is operated and maintained from Blenheim-Gilboa.
February 1, 1986	Power Authority assumes ownership of Crescent and Vischer Ferry small hydro plants north of Albany. Blenheim-Gilboa staff members oversee operations.
May 21, 1988	Marcy-South transmission line is energized. Blenheim-Gilboa staff members maintain 75 percent of 207-mile route.
January 23, 1997	Major multiyear overhaul is completed on project's four turbine-generators.
July 5, 1998	Blenheim-Gilboa is in operation for 25 years.

September 7, 1972: view of powerhouse and switchyard as construction nears completion.

About NYPA

The New York Power Authority is the nation's largest state-owned power organization. Providing more than one-quarter of New York's electricity, the Power Authority operates 12 generating plants and more than 1,400 circuit-miles of transmission lines. It sells electricity to government agencies; to community-owned electric systems; to job-producing companies; to private utilities for resale—without profit—to their customers; and to neighboring states, under federal requirements.

A non-profit, public-benefit energy corporation, the Power Authority does not use tax monies or state credit. It finances construction of its projects through bond sales to private investors and repays the bondholders with proceeds from operations.



For more information, contact:

Community Relations
Blenheim-Gilboa Pumped Storage
Power Project
New York Power Authority
P.O. Box 898
North Blenheim, NY 12131

1-800-724-0309

NYPA online:http://www.nypa.gov

Printed on recycled paper 1/99