Upper Valley Subcommittee

of the Connecticut River Joint Commissions
October 21, 2019 Meeting Minutes
Latham Library, Thetford, VT

NH Members:	Present	Absent
Alice Creagh, Hanover, NH	X	
Jim Kennedy, Chair, Hanover, NH	X	
Eric Agterberg, Lebanon, NH	X	
Ruth Bleyler, Lebanon, NH		X
Bruce Garland, Lebanon, NH (alt)	X	
Bill Malcolm, Lyme, NH	X	
Vacancy, Lyme, NH		
Christine Bunten, Orford, NH	X	
Carl Schmidt, Orford, NH	X	
Karyn Brown, Piermont, NH		X
Helga Mueller, Piermont, NH		X

VT Members:	Present	Absent
Vacancy, Bradford, VT		
Vacancy, Bradford, VT		
Nancy Jones, Bradford, VT (alt)		X
Ben Dana, Fairlee, VT	X	
Vacancy, Fairlee, VT		
Danielle Allen, Fairlee, VT (alt)		X
David Barrell, Hartford, VT		X
Lynn Bohi, Hartford, VT		X
Jason Houle, Hartford, VT (alt)		X
Tara Bamford, Thetford, VT	X	
Bill Bridge, Thetford, VT		X
Linda Matteson, Thetford, VT (alt)	X	
Melissa Horwitz, Norwich, VT		X
Vacancy, Norwich, VT		

Others present: Jennifer Griffin, Great River Hydro; Olivia Uyizeye, Staff from UVLSRPC

1. Chairman Kennedy opened the meeting at 7:03 pm. Introductions are made.

2. Speaker – Jennifer Griffin from Great River Hydro and CRJC Commissioner

Kennedy introduces Griffin to talk about the dams managed by Great River Hydro along the Connecticut River. Griffin shares her background as a fisheries biologist and current activities, including compliance of the GRH dam operations with FERC license and commissioner on CRJC as an industry representative. Griffin starts her presentation, including a slide presentation.

Griffin explains that hydropower starts with the water cycle, influencing how much drains into the rivers. There is a strong history of hydropower used by various industries in the New England region up to present day. In 2018, hydropower was a significant portion of the renewable energy portfolio of New Hampshire, and across the United States, referencing the EIA.

Griffin describes some of the basic structural components of a hydropower dam, including the penstock that allows the water to increase speed and drive a turbine, which is connected to a generator shaft that uses magnetism to generate electricity that is fed into the regional grid. All the GRH dams have a spillway that moves water when there is more than the hydropower system can handle. The Bellows Falls Dam must be kept at a specific level due to restriction on the spillway functioning.

Griffin gives a history of dams along the Connecticut River. The Bellows Falls Canal, first in the US, was build in 1802. Chase and Harriman build dams along the Connecticut and Deerfield Rivers. Current GRH

assets have a capacity of 584 MW, mostly from the Connecticut River. The first and second Connecticut Lakes act as storage. Lake Francis is owned by the State of NH. The 15 Miles Falls is a 3-dam system that functions more as a unit due to their close proximity. Griffin describes the Gilman Dam as "run of the river" as the dam only crosses one side of the river, allowing the remaining section to run freely. ISO New England is a regional transmission organization that works to manage the electric grid. GRH is able to be called on for capacity during a black out that can give some base supply that allows other systems to be brought on line. The dams hold reserve energy, are resilient during storms, do not emit CO_2, and contribute to local property taxes.

Griffin explains that the FERC licenses range from 35 to 50 years in length, with newer systems given 50 years and older given less. These licenses include an operation plan, fish passage, recreation, cultural and historical aspects of importance, emergency action, and public safety. The operators for GRH dams are all located at the Wilder Dam with staff available on site for each dam in case of an issue. The operators also look at the flow coming in from the tributaries.

The FERC relicensing process, currently active for GRH, has required 33 studies. Griffin and representatives engage in a discussion about bank erosion, the topic of 3 studies. GRH concludes that there are some locations where the dam operations are affecting erosion, but mostly this is due to spring flows. Kennedy notes that CRJC has made significant comments in response to these studies. The remaining FERC process is likely to take a minimum of 3 more years and the license will likely last for 40 years. There are situations and where the license may be modified after issued.

3. July Meeting Minutes

Kennedy opens the July meeting minutes up for comment. Kennedy asks to add a note of thanks to Alice and John Creagh for facilitating the boat ride after the meeting. Matteson makes a motion to accept the minutes with edits. Creagh seconds the motion. The motion passes unanimous.

4. Permit Review – Fisher Riverbank Project, Orford

Peter Fisher, owner, has submitted plans to extend a riverbank stabilization project in Orford. Based on lessons learned from the first project, logs will be placed slightly differently to deter coming loose. The plans will include the use of a biodegradable, snake friendly map. Kennedy describes that suggestions were made to expand the riparian buffer beyond 50 ft and to add drainage structures to the project map. This permit has been approved.

5. LRS Election

Uyizeye describes the role of the chair of cochairs (see attached). Bamford explains that the CRJC bylaws require an election to be done once a year. Uyizeye opens up the room for nominations. Bamford nominates Kennedy as chair. Kennedy nominates Bohi as vice chair. Bohi is not present, Kennedy has confirmed that she has been made aware of this nomination. Bamford makes a motion to accept the Kennedy as Chair and Bohi as Vice Chair. Bridge seconds the motions. The motion passes unanimous.

6. Future Topics – Corridor Plan Review

Bamford has looked back at the corridor plan and feels there is a lot of work that needs to be done. Bamford notes that CRJC should be actively advising the VT Agency of Natural Resources (ANR) staff in their update of the basin plans. Kennedy asks what defines the corridor. Bamford explains that the corridor has been defined as the towns abutting the Connecticut River. Bamford indicates that she is willing to take the lead on an update to the Upper Valley portion of the CRJC Corridor Plan. Kennedy notes work done that could be incorporated, including the Hanover Open Space plan, Orford Natural Resources Inventory, etc. Bamford suggests first inviting speakers on issues of concern. Kennedy notes that the update might include a condensing of studies done on the Connecticut River, such as those for the FERC process. Bamford notes that the group will have to decide how much data to include, as it has not been a data heavy document in the past. Uyizeye agrees to reach out the VT ANR about a presentation.

7. Other Updates and Business
   a. Wetlands Permit Process

Kennedy reminds the committee that the wetlands permit process will change in mid-December, at which point, the CRJC as a whole and each LRS will need to review certain points of process. This includes a pre-applications process and might include encouraging representative to make connections with local planning boards ahead of time.

b. Jacobs Brook Restoration, Orford

The CRC has benched out the banks and planning to have a planting on October 31, asking for volunteers. The project is going along well.

c. Girl Brook Restoration

Kennedy explains that last winter, the Hanover were line was exposed at a point on Girl Brook, which was responded to by covering up with rip rap. Now soil and plantings have been added to the system to restore it back to a meandering channel.

d. Living Shoreline Initiative

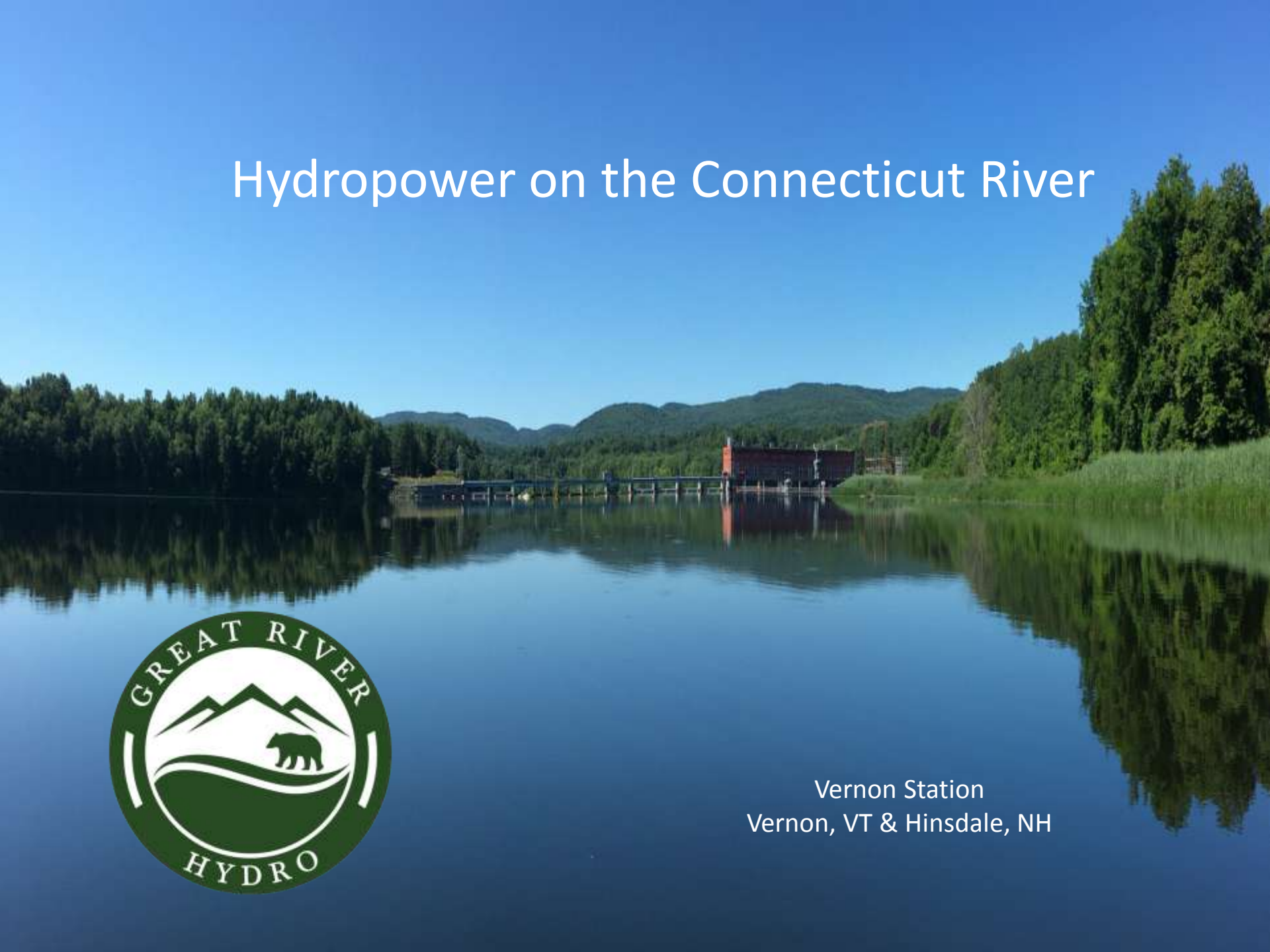
Kennedy indicates that he would like to see this incorporated into a corridor plan update.

8. Adjourn

A motion is made to adjourn (Creagh/Garland). The motion passes unanimous. The meeting adjourned at 9:05 pm.

Respectfully Submitted by Olivia Uyizeye.

Hydropower on the Connecticut River



Vernon Station
Vernon, VT & Hinsdale, NH

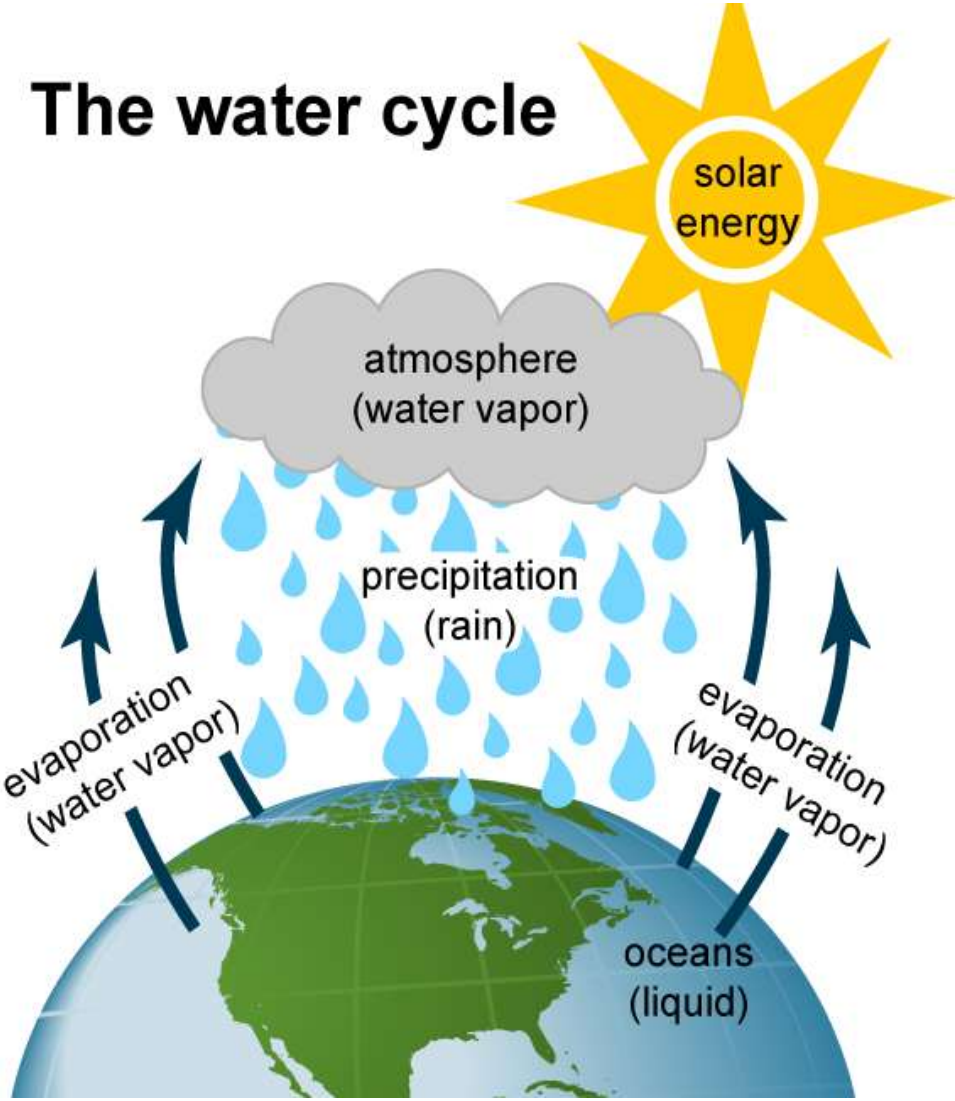
Agenda

- What is hydropower
- Hydroelectricity generation in US and NE
- Components of a Hydroelectric Station
- Brief history of hydropower on the Connecticut River
- Quick look at each station
- Hydro operations
- Relicensing (optional)

Hydropower starts with the water cycle

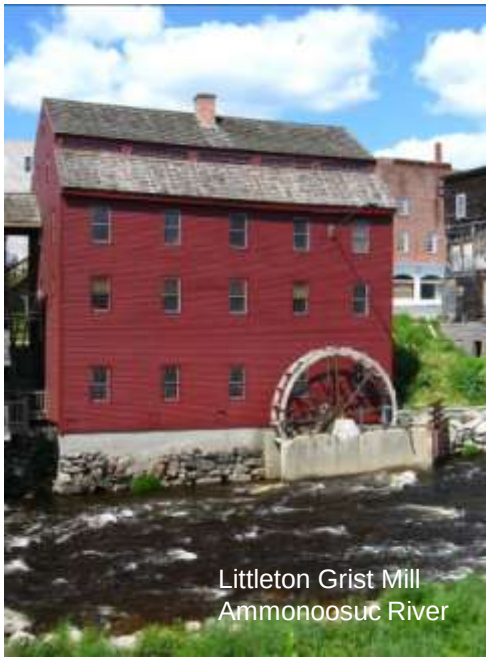
- Solar energy heats water on the surface of rivers, lakes, and oceans, and causes the water to evaporate.
- Water vapor condenses into clouds and falls as precipitation—rain and snow.
- Precipitation collects in streams and rivers, which empty into oceans and lakes, where it evaporates and begins the cycle again.

The amount of precipitation that drains into rivers and streams in a geographic area determines the amount of water available for producing hydropower. Seasonal variations in precipitation and long-term changes in precipitation patterns, such as droughts, have a big impact on hydropower production.



Harnessing the power of water

- Early water wheels spun by rivers were used to process grain, cloth, and paper, and power hand tools.
- 1849 British-American civil engineer James Francis developed the first modern water turbine. The Francis turbine is the most widely used water turbine today.
- 1882, world's first hydroelectric power plant began operating along the Fox River in Appleton, Wisconsin.
- By 1940, hydropower accounted for 40% of the country's electricity generation.

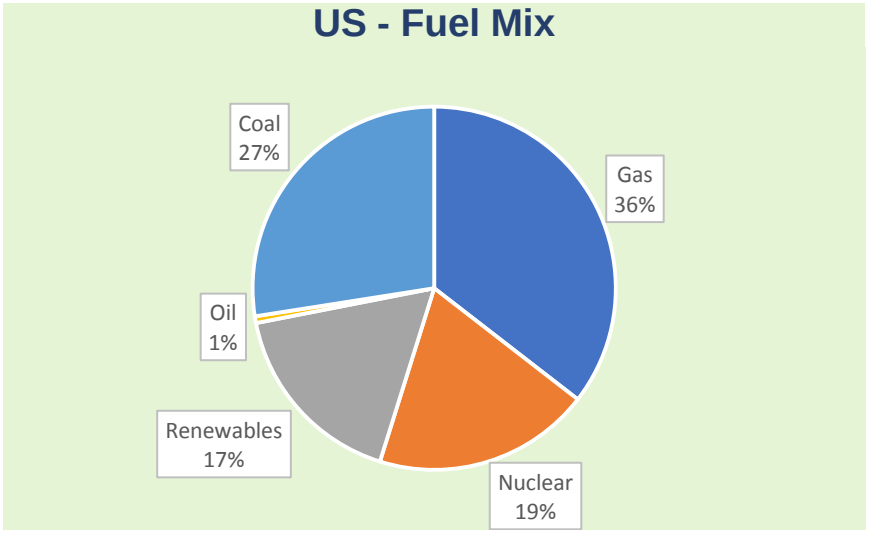


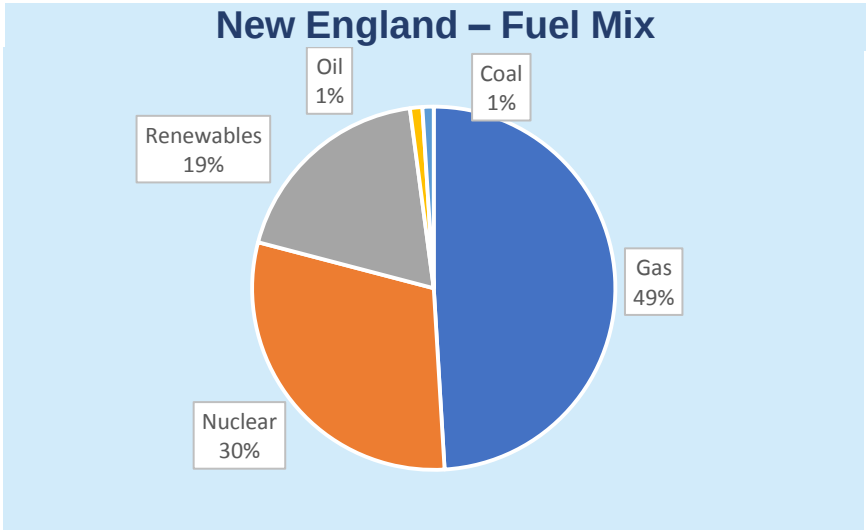
Littleton Grist Mill
Ammonoosuc River

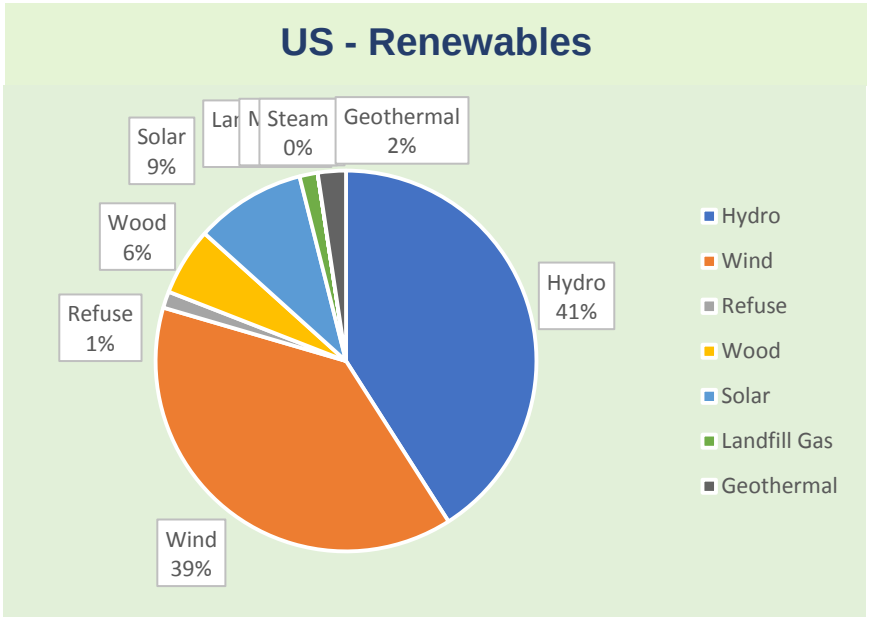
Francis Runner
Grand Coulee Dam

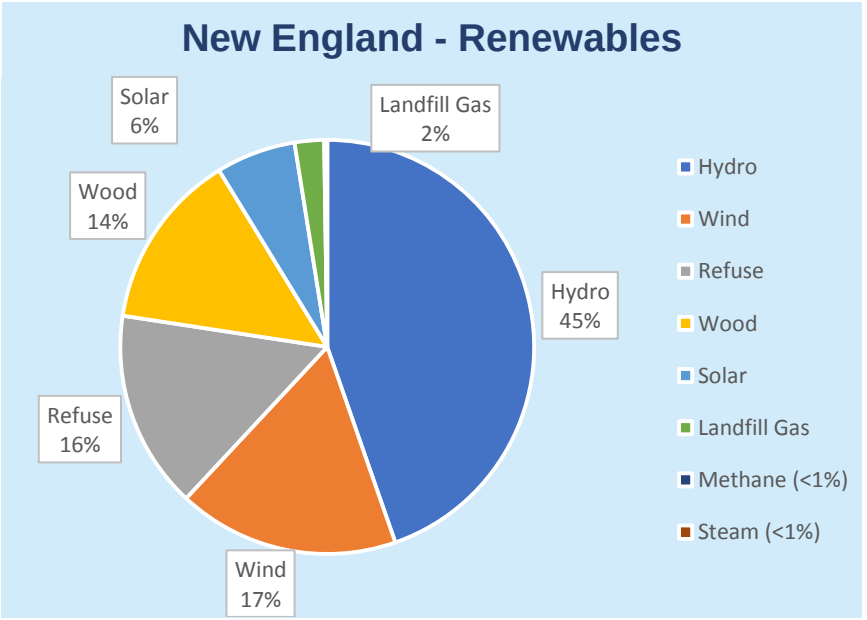
Source: US Bureau of Reclamation photo archive

Hydropower in the US and New England Fuel Mix
(Source: Energy Information Administration and ISO-New England)

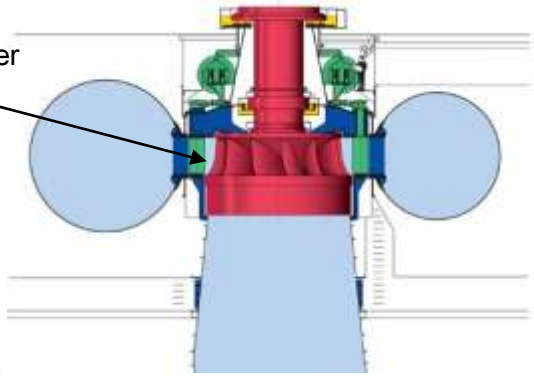


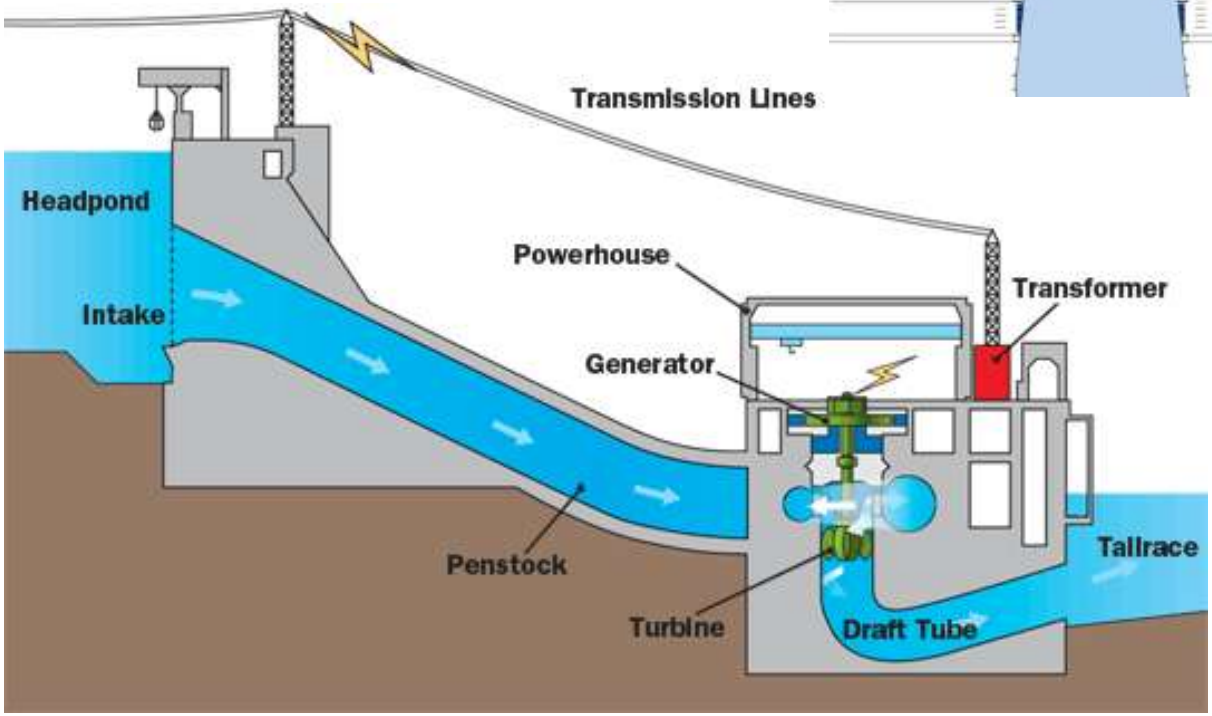


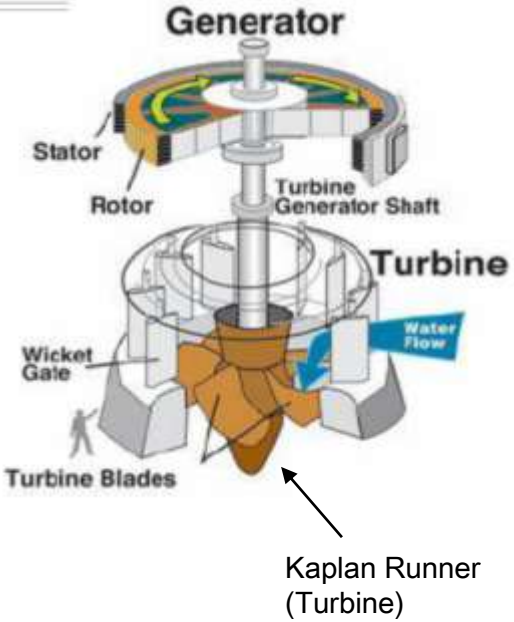




Hydropower → Hydroelectricity

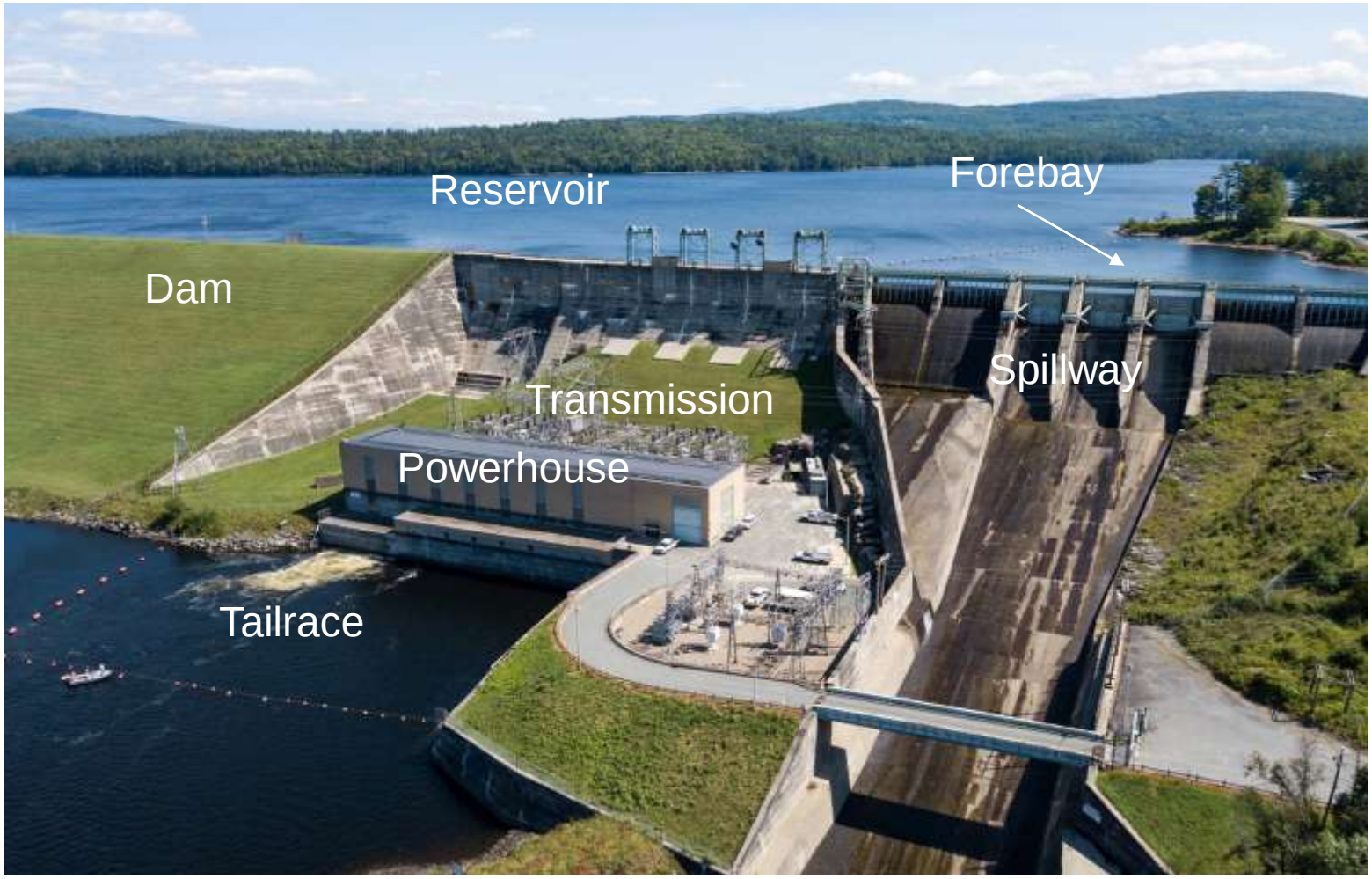






Vernon Station

Components of a Hydroelectric Station



Brief History

- **1802 – completion of the Bellows Falls Canal, first canal in the US.**
  - Nine locks and a dam to bypass the 52-foot high Great Falls gorge.
  - 1849 – railroads constructed and by 1858 canal primarily used for waterpower to run paper mills.

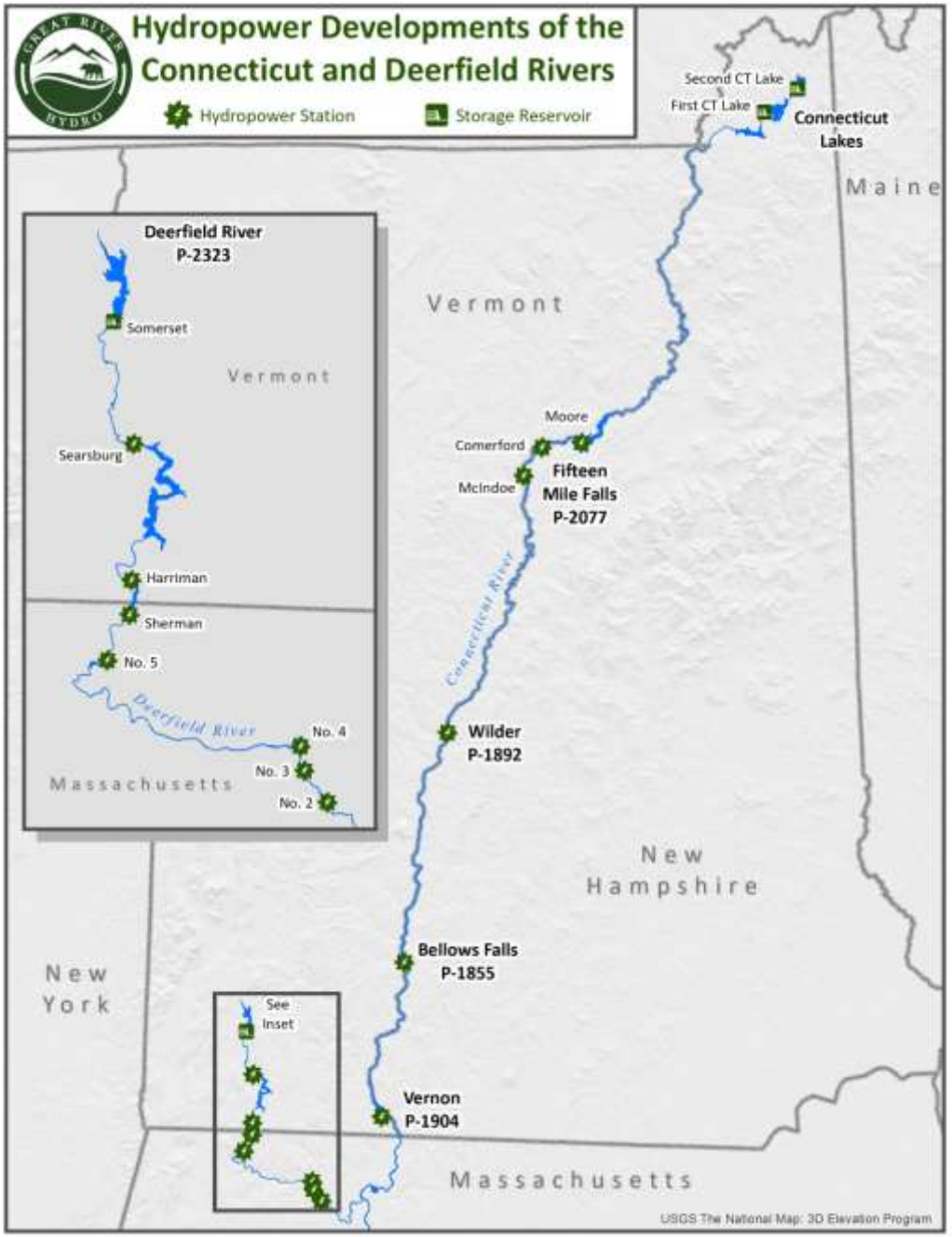
- **1903 - Malcolm Greene Chace (1875–1955) and Henry Ingraham Harriman (1872–1950) establish Chace & Harriman.**
  - Over its many incarnations grows into one of the largest electric utility companies in New England, building a series of hydroelectric facilities on the Connecticut and Deerfield rivers in Vermont, New Hampshire, and western Massachusetts.
  - Purpose was to provide a reliable and less expensive alternative to coal-produced steam power, primarily to serve industrial centers in Massachusetts and Rhode Island. Also provided power to residential customers and municipalities in New England.
  - Chace & Harriman becomes:
    - New England Power Association (NEPA) in 1926,
    - New England Electric System (NEES) in 1947,
    - U.S. Generating and then PS&E Generating in the 1990s,
    - TransCanada acquires the hydroelectric projects between 2004-2005,
    - Great River Hydro purchases the projects in 2017.

Overview of Assets

	Hydroelectric Station/Reservoir	MW	In Service	Location
Connecticut River	Second Connecticut Lake Dam	Reservoir	1914	Pittsburg, NH
	First Connecticut Lake Dam	Reservoir	1915	Pittsburg, NH
	Moore	192	1957	Littleton, NH and Waterford, VT
	Comerford	168	1930	Monroe, NH and Barnet, VT
	McIndoe	11	1931	Monroe, NH and Barnet, VT
	Wilder	41	1950	Lebanon, NH and Hartford, VT
	Bellows Falls	49	1928	Walpole, NH and Rockingham, VT
	Vernon	37	1909	Hinsdale, NH and Vernon, VT
Deerfield River	Somerset Dam	Reservoir	1911	Somerset, VT
	Searsburg	5	1922	Searsburg, VT
	Harriman	41	1925	Readsboro and Whitingham, VT
	Sherman	6	1927	Rowe and Monroe, MA
	Deerfield #5	14	1974	Rowe and Florida, MA
	Deerfield #4	6	1913	Buckland and Shelburne, MA
	Deerfield #3	7	1912	Buckland and Shelburne, MA
	Deerfield #2	7	1913	Conway and Shelburne, MA
	Total	**584 MW**		

Great River Hydro, LLC

- Owns and operates five FERC licensed hydroelectric projects, comprising thirteen generating stations and three storage reservoirs in New England, totaling 584 MWs.
- GRH's Moore and Comerford stations are the two largest conventional hydro stations in New England at 192 and 168 MWs.
- GRH supplies approximately 23% of the generation and 40% of the qualified capacity realized from conventional hydro generators within ISO New England*.
- ISO New England – not-for-profit Regional Transmission Organization, oversees operation of New England's bulk electric power system and transmission lines. Responsible for operating NE's 32,000 MW (43,000,000 hp) bulk electric power generation and transmission system.

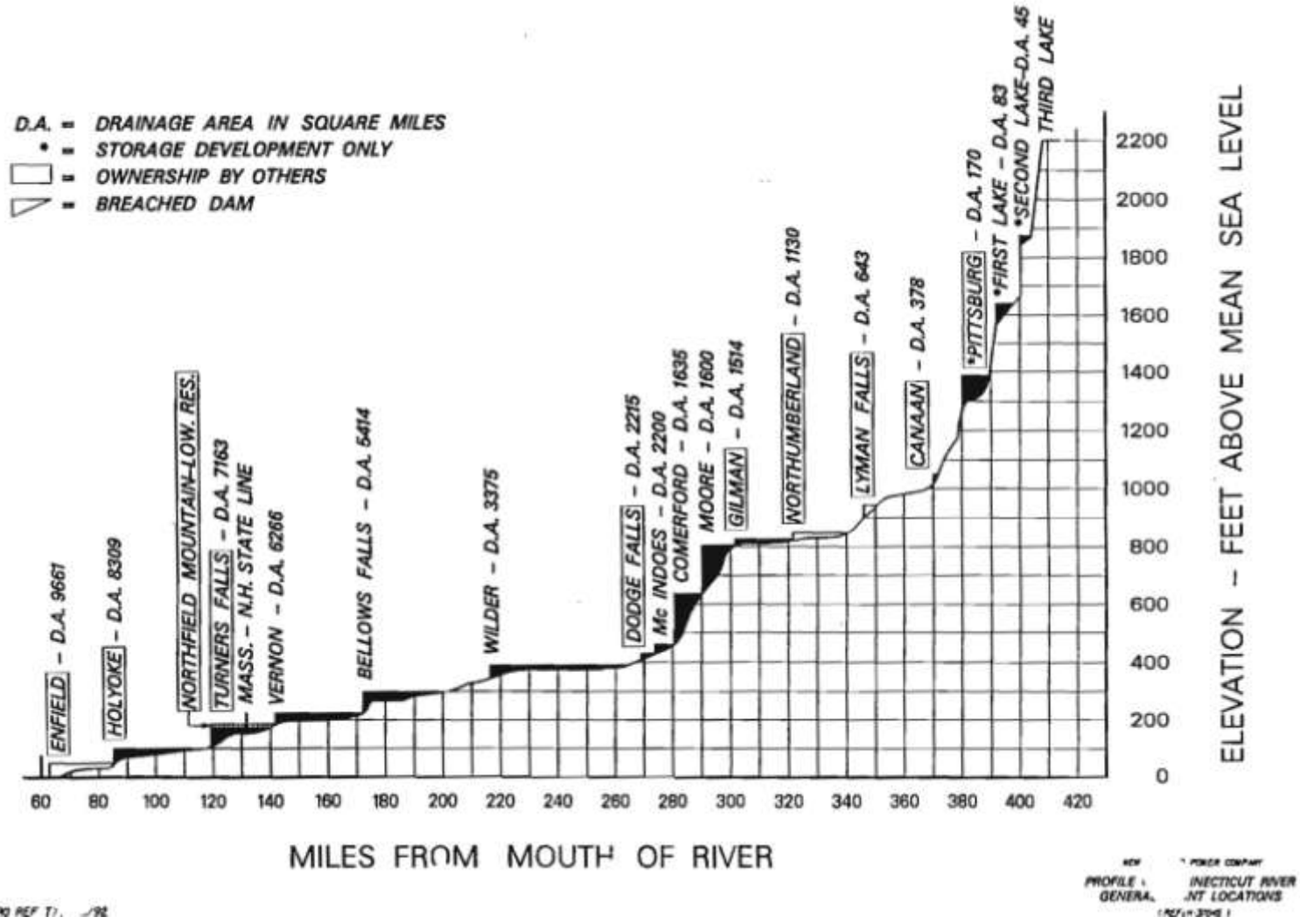


*** Source: 2018 ISO-NE CELT Report**

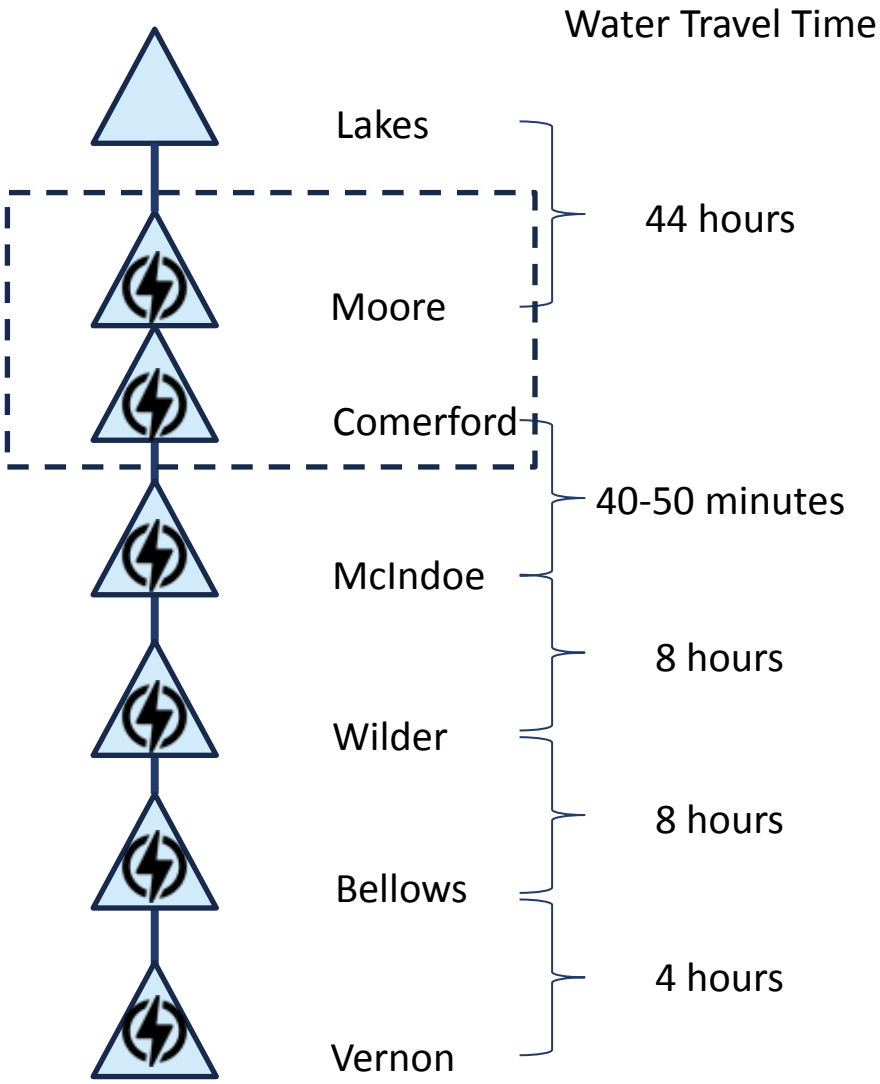
FERC License

- **Issued by the Federal Energy Regulatory Commission, license ranges from 35-50 years.**
- **FERC's licensing's process has evolved over the years**
  - Provides for input from state and federal resource agencies, tribal interests, and interested parties that may include NGO's, other local organizations, individuals, abutting landowners, etc.
- **On the Connecticut and Deerfield Rivers our licenses generally include provisions for:**
  - Operating plan (reservoir management, minimum flow, management of high flows)
  - Fish passage
  - Recreation
  - Land management and protection (forestry, wildlife, conservation easements)
  - Cultural and historical resource management
  - Public Safety Plan
- **Dam Safety – all FERC licensed project**
  - Annual inspections
  - Emergency Action Plans and EAP training, exercises

River Profile



Hydro - water travel time



Hydro Operations

Normal flows

Each day operators calculate next days inflow, only run that much for the day, draw and fill, usually uses less than top 30%

High flows

During high flows inflow surpasses generator discharge capacity, excess water is passed through spill gates.

At Wilder in 2018 inflow greater than generator capacity ~15% of the time

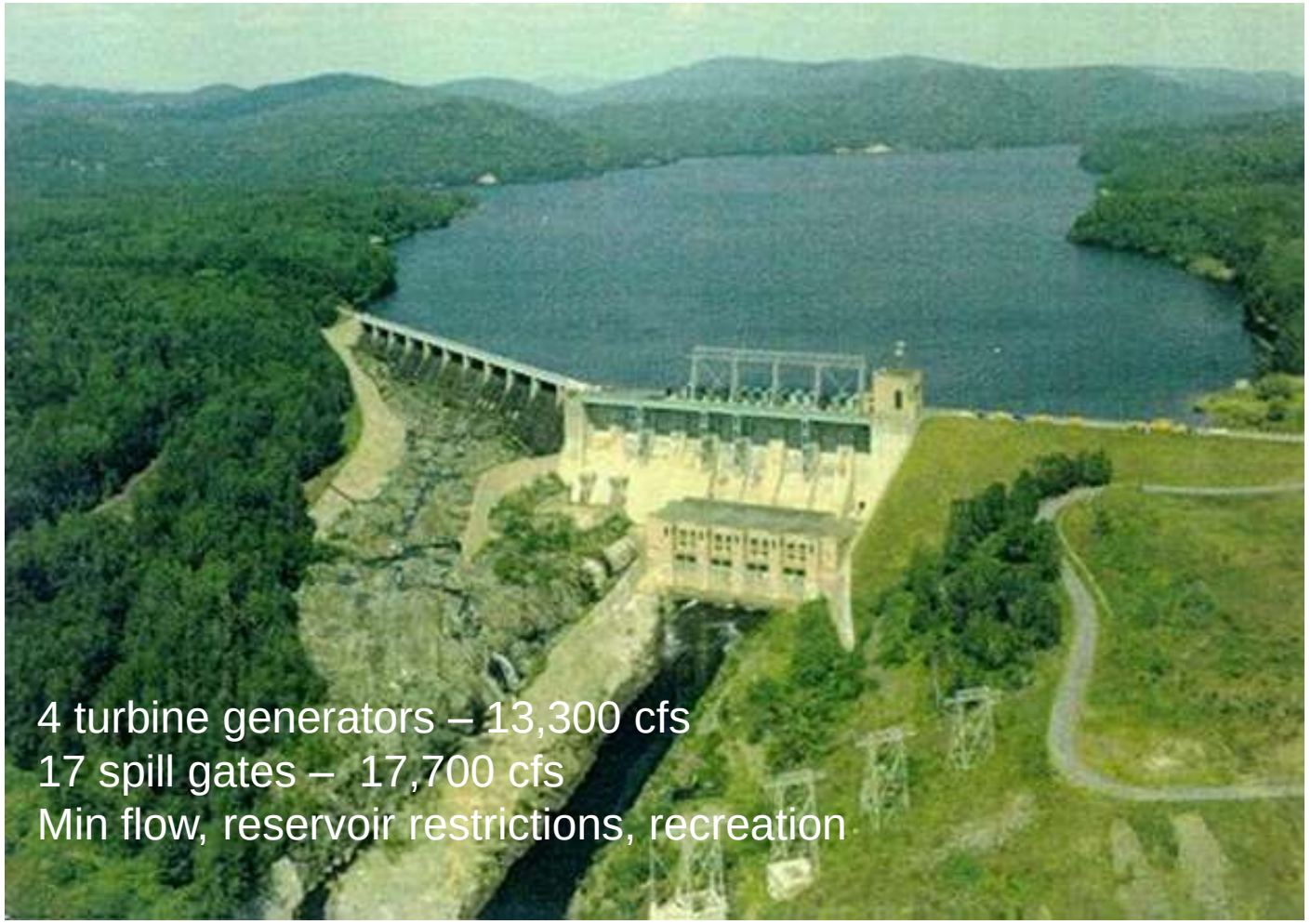
Frist and Second Connecticut Lakes

Second CT Lake - 6 miles from border, no generation, seasonal min flows, reservoir managed for lake trout spawning.

First CT Lake – no generation, seasonal min flows.

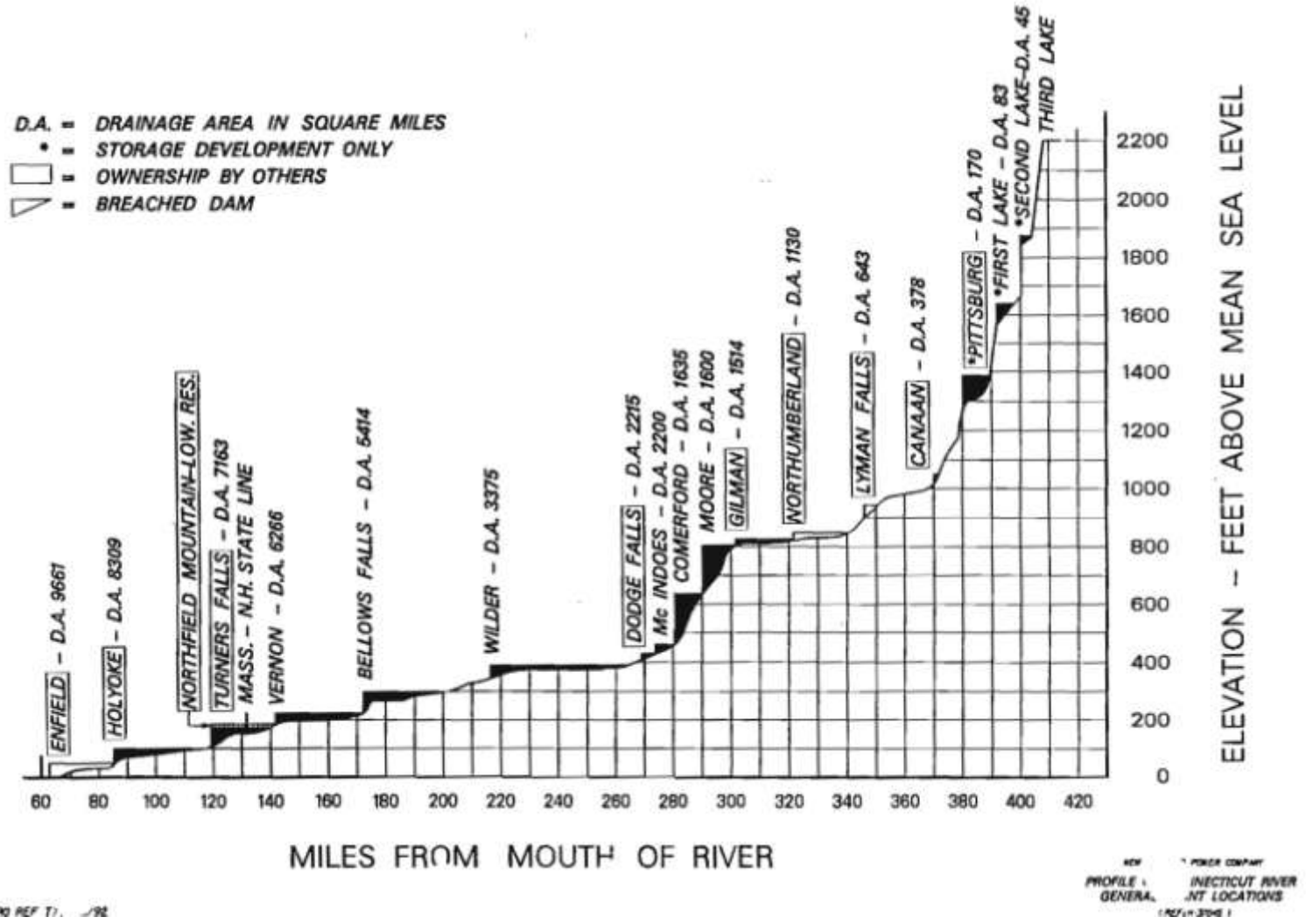
Moore Station

Comerford Station

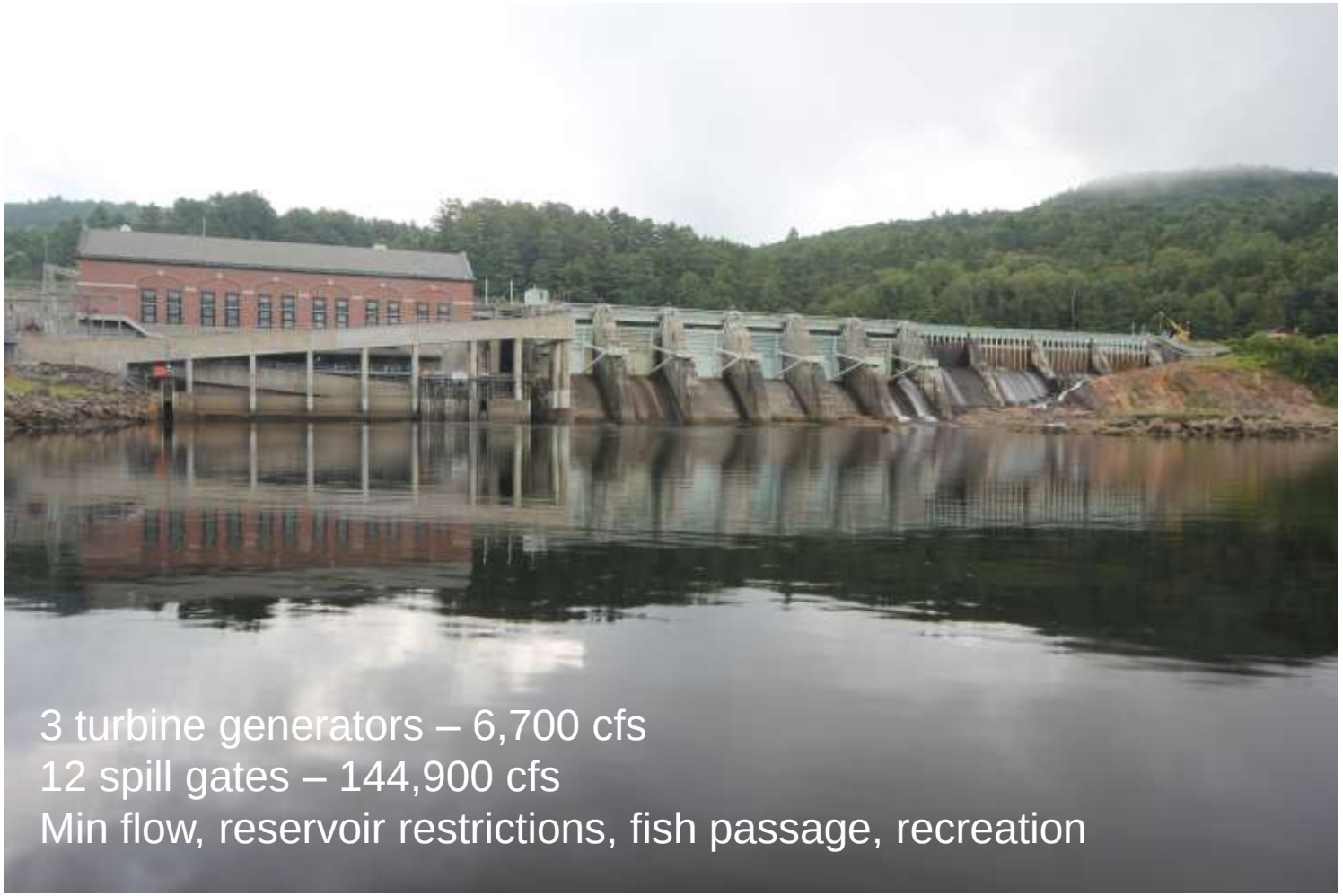


McIndoe Station

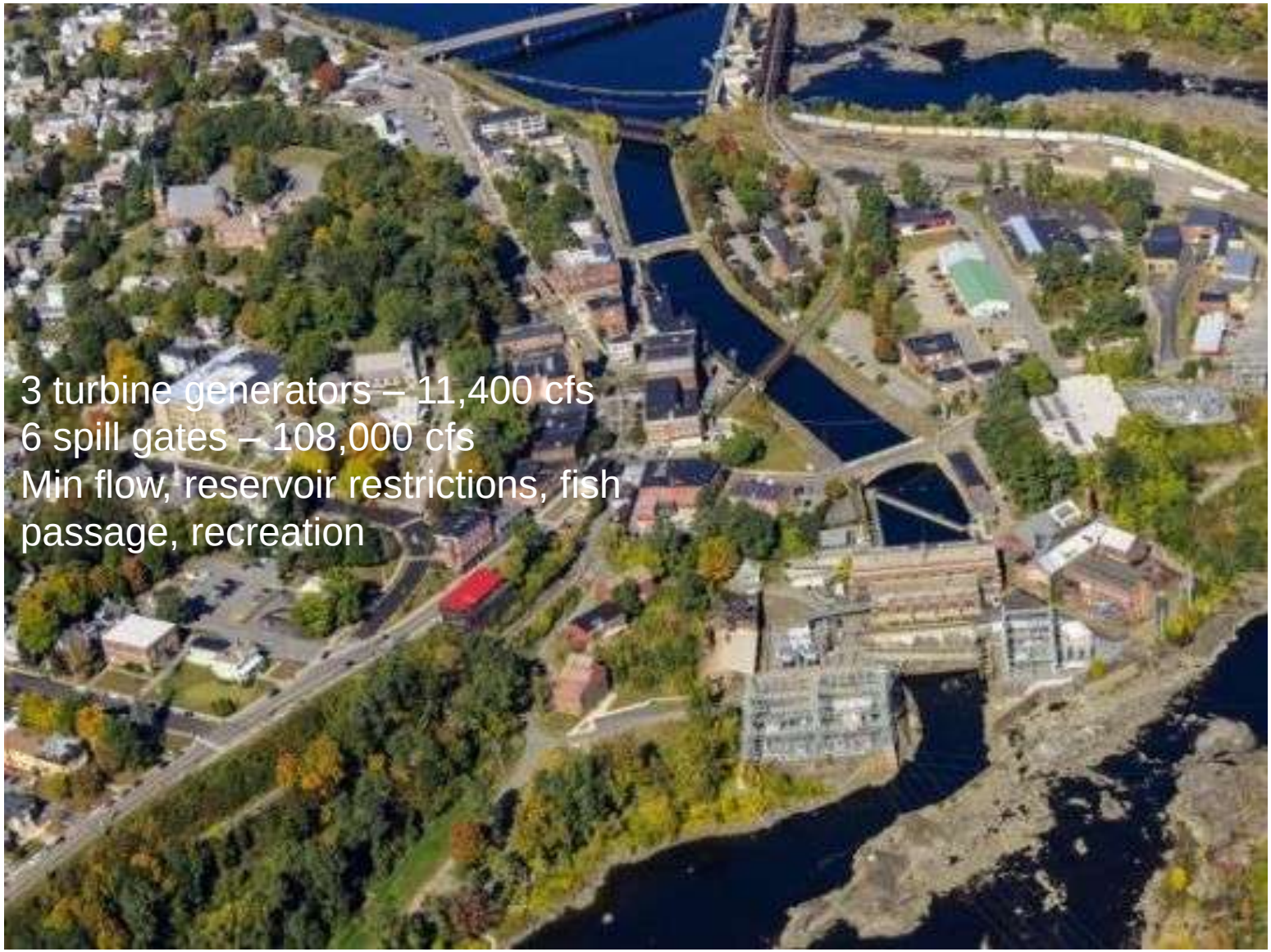
River Profile



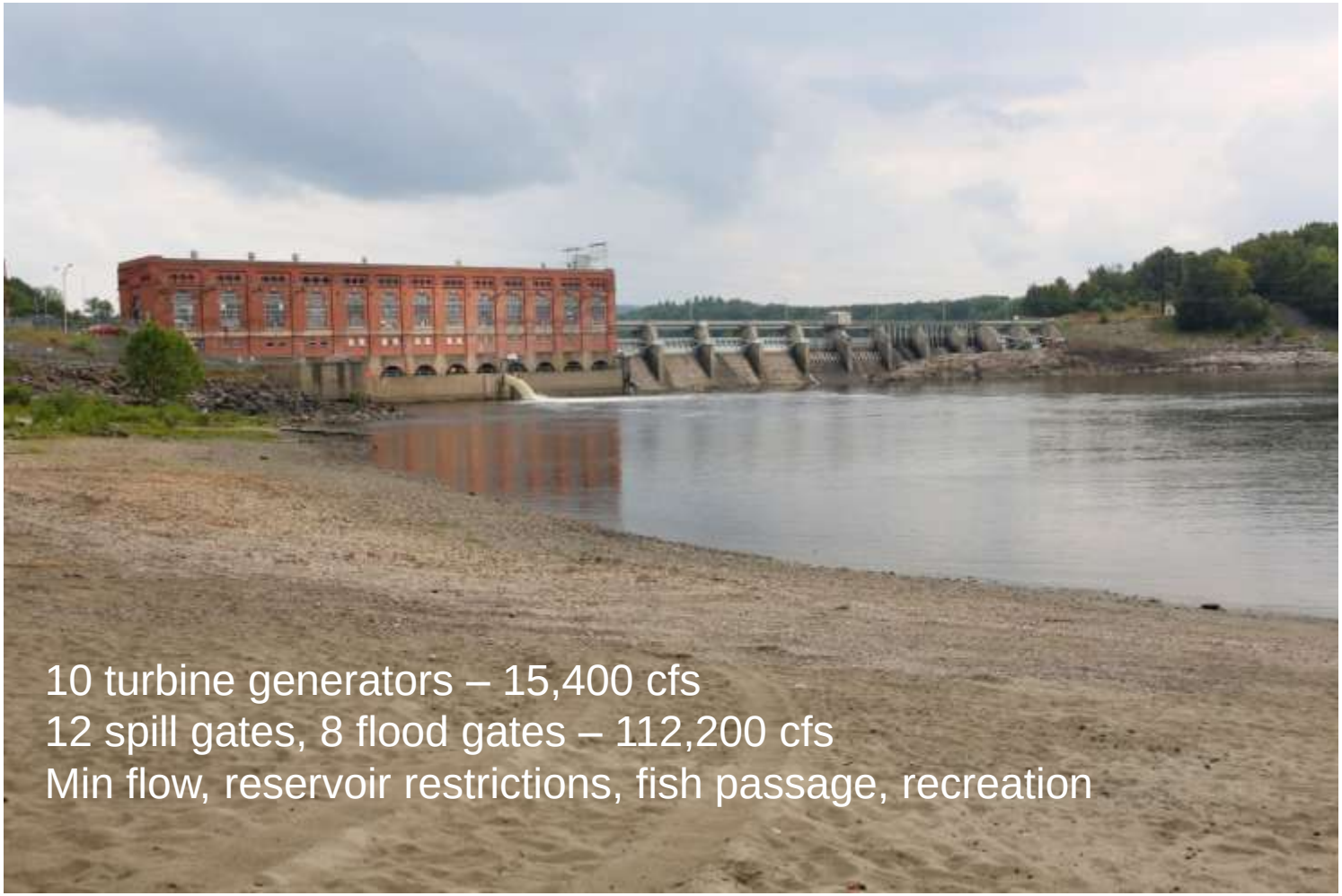
Wilder Station



Bellows Falls Station



Vernon Station



Great River Hydro's Role

Critical	Resilient	Renewable

• 50% of the qualified capacity from weekly storage.
• 23% of energy from conventional hydro.
• 10 Min Spinning and Non-Spinning Reserves.
• Black start.
• VAR Support
• AGC & Ramping
	• Track record of performance during major system and weather events
	  • 1965 system blackout
	  • Tropical Storm Irene
	  • Hurricane Sandy
	  • 2014 polar vortex
	  • 2017-18 bomb cyclone
		• Renewable generation displacing ~680,000 tons of CO_2 per year
		• Responsive reserve energy and system transmission support services that enable the penetration of variable renewables such as wind and solar into the regional energy mix.

Additional Benefits

- Flood Control. Storage reservoirs and operations play an important role in flood control.
- Skilled Local Jobs. 41 jobs in Vermont, 39 in New Hampshire, and 40 in Massachusetts.
- Significant Source of Local Property Taxes. ~ $23.5 million to 51 municipalities in three states—a major taxpayer in each of the towns where the stations are located. Numerous long-term agreements with communities.
- Land Conservation and Public Recreation. 30,000 acres of land in New England mostly protected and open to the public in perpetuity under conservation easements, dozens of picnic areas, 20 boat launches, miles of trails
- Historic. Facilities historically significant for their roles in the development of the regional electric system and industries it supported. Most eligible for listing under National Register of Historic Places.

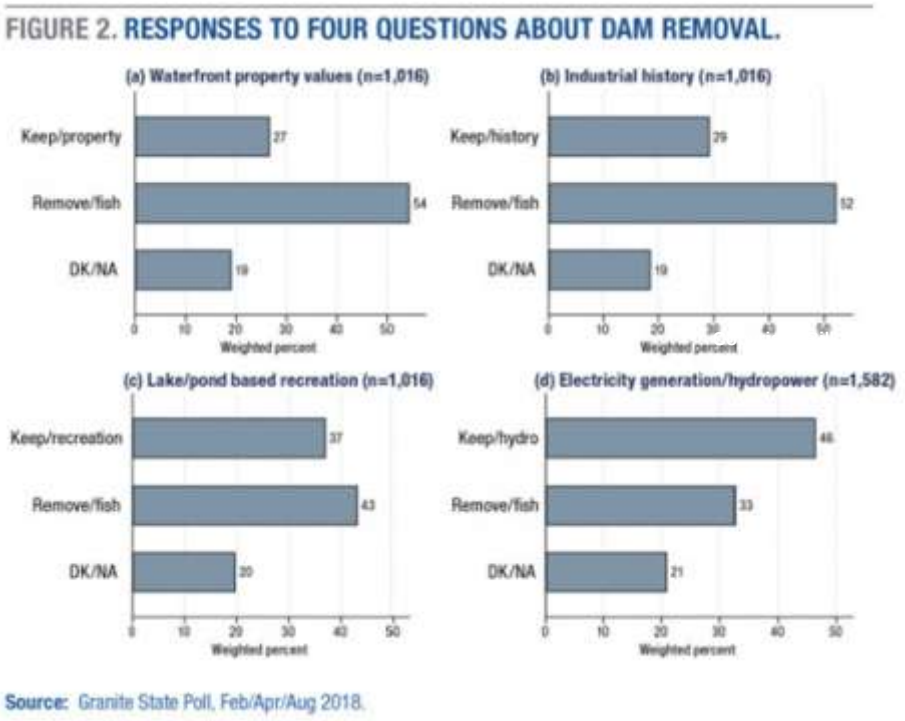
Hydro's and New Hampshire

What to do with Dams; An Assessment of Public Opinion to Inform the Debate in New Hampshire

Natallia Leuchanka, Catherine Ashcraft, Kevin Gardner, Lawrence Hamilton

In your opinion, is it more important to use dams on NH rivers and stream to generate electricity or is it more important to remove dams and allow free-flowing river that benefit fish and wildlife.

- Waterfront property values
- Lake/pond-based recreation
- Industrial history

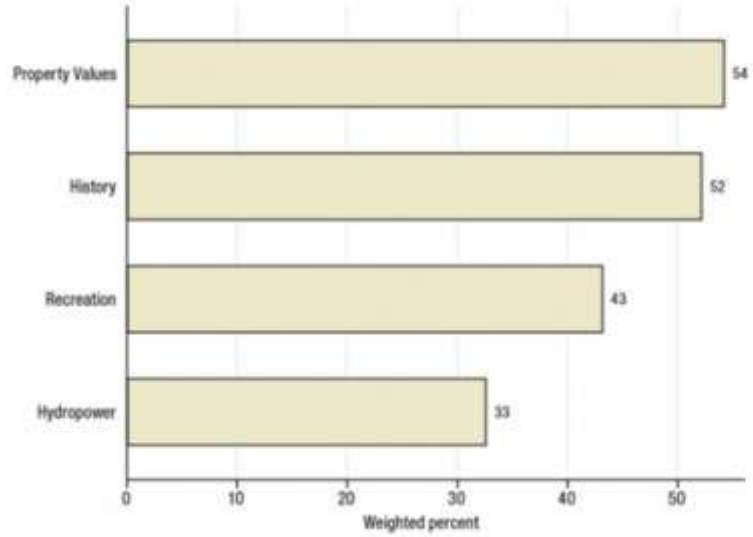


https://carsey.unh.edu/publication/NH-Dams

University of New Hampshire
Carsey School of Public Policy

Hydro's and New Hampshire

FIGURE 3. PERCENTAGES FAVORING DAM REMOVAL WHEN THE ALTERNATIVE IS TO KEEP DAMS FOR MAINTENANCE OF WATERFRONT PROPERTY VALUES, PRESERVATION OF INDUSTRIAL HISTORY, MAINTENANCE OF LAKE- AND POND-BASED RECREATION, AND HYDROPOWER GENERATION.



Source: Granite State Poll, Feb/Apr/Aug 2018. Property Values n=1,016; History n=1,016; Recreation n=1,016; Hydropower n=1,582.

Relicensing

FERC Relicensing Currently in Process

Three GRH projects engaged in relicensing on Connecticut River in NH and VT:

- Wilder Project – FERC Project No. 1892
- Bellows Falls Project – FERC Project No. 1855
- Vernon Project – FERC Project No. 1904

Relicensing Vision:

- Minimize project effects on resources;
- Provide regional public recreation, natural resource, socioeconomic benefits;
- Continue to provide over 570,000 MWh of clean renewable energy, powering approximately 53,000 households in NH.
- Maintain operational flexibility necessary to support New England's dynamic and evolving energy matrix, supporting regional renewable and reliability objectives.

Wilder Station (Lebanon, NH and Hartford, VT)

For more information: http://www.greatriverhydro-relicensing.com/

FERC Relicensing Process

- **Integrated Licensing Process (ILP) initiated with the filing of a Pre-application Document (PAD) for each Project on October 31, 2012**

- **Study Phase - December 2012 – August 2019**
  - Study requests from stakeholders (federal & state agencies, NGO's, tribes and tribal interests, public).
  - 33 studies to assess existing conditions and project effects.
  - Studies conducted, reviewed, updated and deemed complete by FERC.

- **Initial License Application filed for each Project on April 30, 2017**

- **Final Revised License Applications in April 2020**
  - Projects Currently operating on continued "annual licenses" for each Project

- **NH and VT Water Quality Certifications will be sought.**
  - Certifications or waivers needed before FERC issues any license, 1-year review process.

- **2-yr FERC Review after Application accepted for Env. Review (NEPA)**
  - Two opportunities for public review - GRH application and FERC NEPA review.

Hydropower

- Largest source of renewable power in the United States.
- ~7% of all electricity generated and 56% of the nation's renewable generation.
- Avoids as much carbon pollution as removing 38 million passenger cars each year.
- Reliable source of energy that can meet rapidly changing demands for electricity.

Questions?