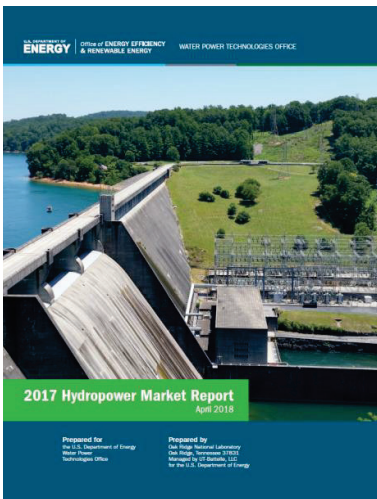


U.S. Hydropower Market Report 2018 Update (April)

Megan Johnson
Rocío Uría-Martínez

Oak Ridge National Laboratory



These slides provide updates to some of the key metrics included in the [2017 Hydropower Market Report](#), which was published in April 2018. The Hydropower Market Report aims to continuously improve publicly available, comprehensive information on the U.S. hydropower fleet and the industry that supports it and develops new projects.

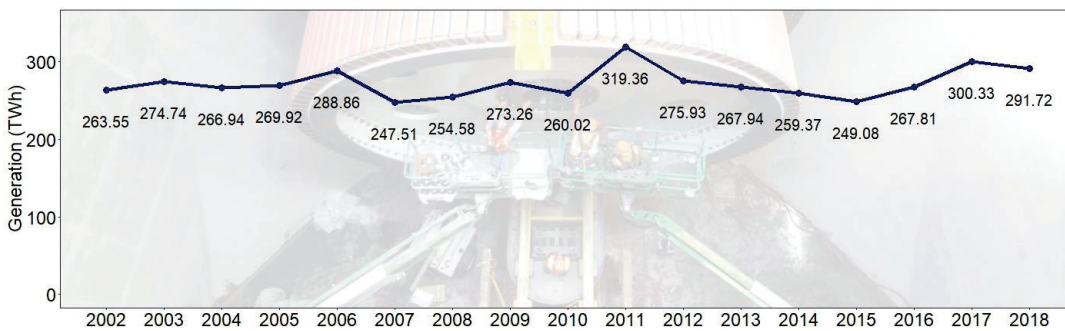
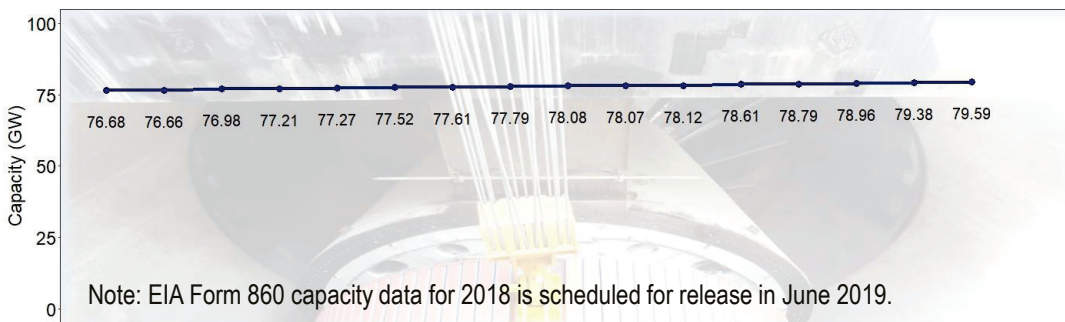
The updated content shown here covers the following topics:

- Installed capacity and generation trends
- Regional generation and drought trends
- Investment on rehabilitations and upgrades to the existing hydropower fleet
- December 31, 2018 snapshots of the hydropower and pumped storage hydropower project development pipeline
- Hydraulic turbine import and export trends
- Any changes to relevant policies and/or markets

The last year of data shown in each of the plots will be 2017 or 2018 depending on the calendar year of data releases followed by the agencies and commercial providers used as sources.

This work has been funded by the **Water Power Technologies Office**, Office of Energy Efficiency and Renewable Energy of the U.S. Department of Energy under Contract No. DE-AC05-00OR22725. Any errors in this document are the sole responsibility of the authors.

U.S. hydropower capacity grew slightly in 2017; hydropower generation decreased in 2018 after two consecutive years of increases



Sources: EIA Form 860 (capacity), EIA Form 923 (2002-2018 generation), Electric Power Monthly (2018 generation)

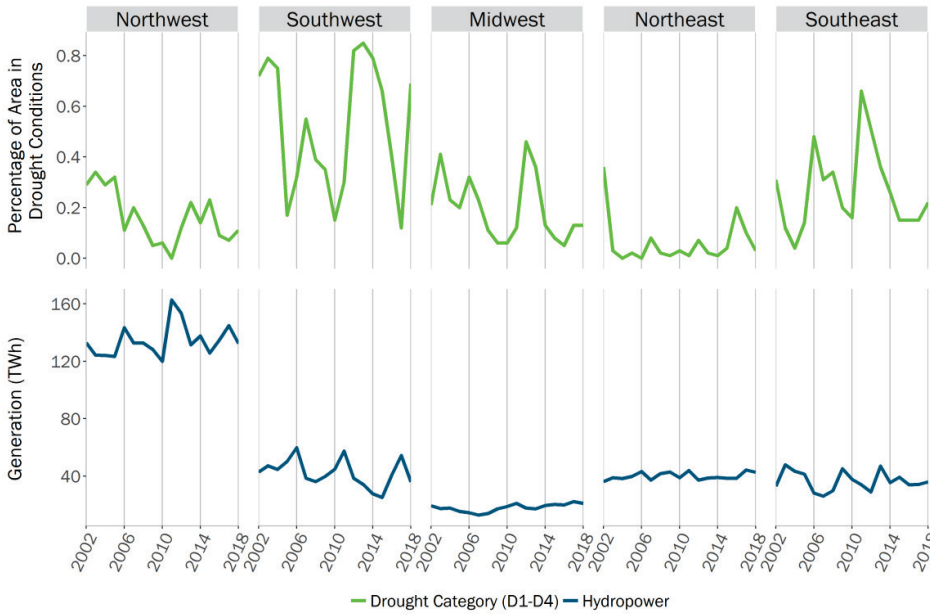
Installed capacity increased by ~200 MW in 2017.

- Almost half of the added capacity corresponds to American Municipal Power's Smithland Project coming online (76 MW).
 - Located on the Kentucky shore of the Ohio River
 - Uses an existing, previously non-powered dam (USACE-owned Smithland Locks and Dam)
 - Its powerhouse contains 3 bulb turbines
 - Operates as a run-of-river hydropower plant

Hydroelectric generation in 2018 was 291.72 TWh (~3% less than the previous year).

- Hydropower generation accounted for 40.9% of renewable electricity generation and 6.8% of total electricity generation.

Hydropower generation decreased significantly in the West in 2018 due to below-average snowpack in parts of the region



Sources: EIA Form 923 (2002-2018 data), United States Drought Monitor

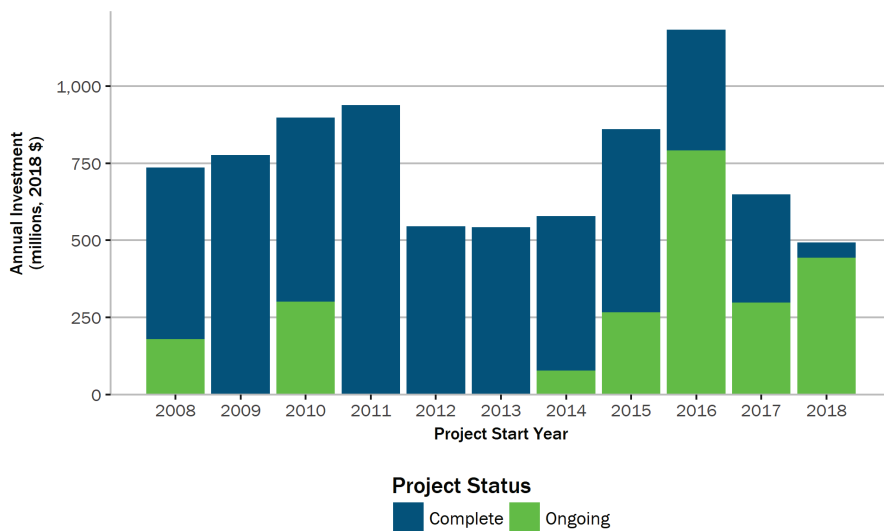
Region	Generation–Drought Area Correlation
Northwest	-0.560*
Southwest	-0.594 *
Midwest	-0.353
Northeast	-0.440
Southeast	-0.520*

* statistically significant at 5% level



- 2018 generation volumes were 16% below the 2002-2017 average in the Southwest, 17% above in the Midwest, and close to average in the rest of the regions.
- Generation decrease in the Southwest is related to the sharp increase in the percentage of area in drought conditions in 2018.
 - In California, snowpack was 159% of the normal average in 2017 but went down to 54% in 2018 ([CAISO Q2 2018 Report on Market Issues and Performance](#))
 - Runoff volumes in the Northwest were also lower than in 2017 and generation decreased by 8.6% relative to the previous year.
- In 2018, on average, all regions except the Southwest had less than 25% of area under drought conditions ([D1-D4](#)).
- Correlation between generation volume and prevalence of drought conditions in 2002-2018 was above 50% in the two western regions and the Southeast.

New investment committed to hydropower rehabilitations and upgrades (R&U) in 2018 was almost \$500 million



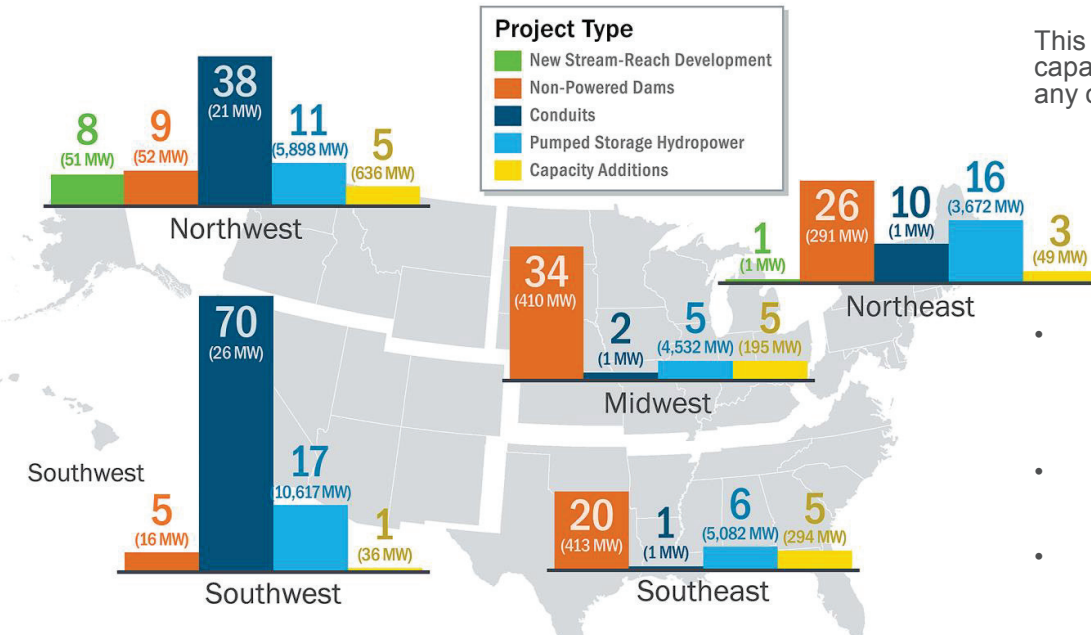
Source: Industrial Info Resources

Note: This plot provides a December 2018 snapshot of completed or ongoing R&U projects started since 2008.

See *Technical Notes* for further details about the data shown in this plot.

- 36 new R&U projects at 32 hydropower plants started in 2018 with a total estimated value of \$493 million
 - 70% of new projects involved refurbishments or upgrades to turbine-generator units.
 - Half of the new investment is directed toward unit uprates at two pumped storage hydropower facilities:
 - Ludington (MI): 2 units being uprated by 50 MW each.
 - Cabin Creek (CO): 36 MW capacity increase
- Distribution of 2018 new investment by owner type:
 - Federal: 75% of new projects (27) accounting for 32.5% of investment
 - Public, non-federal: 11% of new projects (4) accounting for 13.3% of investment
 - Privately-owned: 14% of new projects (5) accounting for 54.2% of investment
- The value of tracked R&U investment since 2008 is just over \$7 billion distributed among 160 hydropower facilities.
 - Value by region: Northwest (38%), Southwest (17%), Midwest (10%), Northeast (12%), Southeast (23%)

243 hydropower projects with a total new capacity of 2.5 GW and 55 new pumped storage projects (~30GW) were in the U.S. development pipeline as of the end of 2018

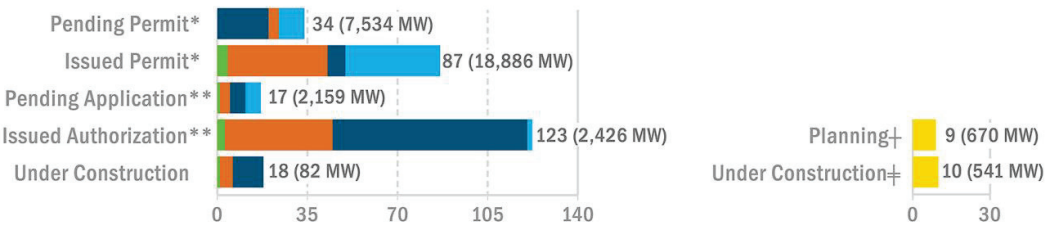


This snapshot includes projects pursuing capacity additions in existing facilities or any of the following federal authorizations:

- FERC original license or exemption (177)
- “Qualifying conduit” determination from FERC (79)
- Lease of power privilege from Reclamation (23)

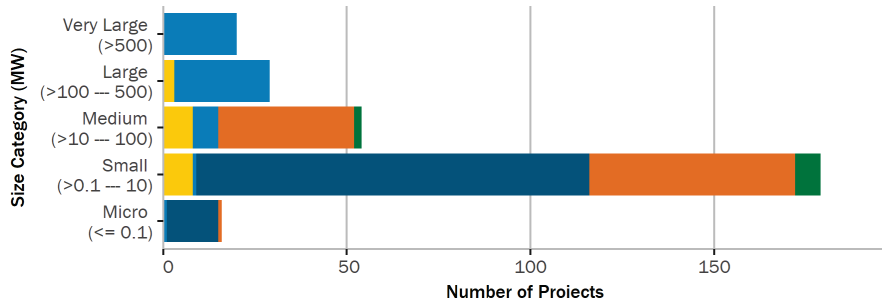
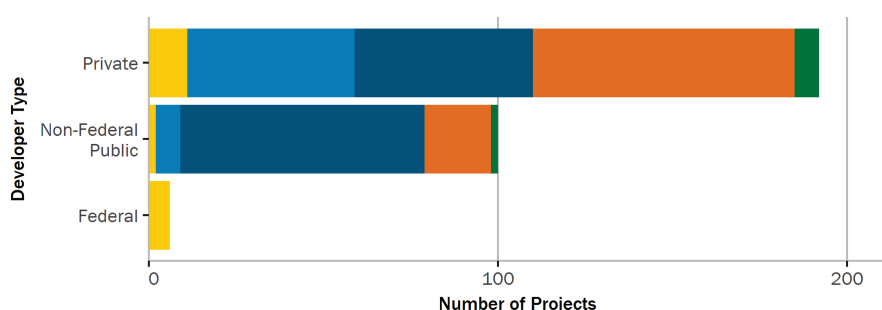
- Conduit projects are primarily located in the West and non-powered dams in the East. Six of the nine proposed new stream-reach developments are in Alaska.
- The number of new preliminary permits issued in 2018 declined by over 50% relative to the previous year
- Half of all projects in the pipeline have already received federal authorization from FERC or Bureau of Reclamation.
- At least 28 projects (623 MW) were under construction at the end of 2018.
- At least 6 projects (12.6 MW) reached commercial operation in 2018.
 - Most of the new capacity (12.4 MW) is located in the West, including two new-stream reach development projects (Hancock Creek and Calligan Creek) in Washington.

Project Type by Development Stage: Number of Projects (MW)



Sources: FERC, Reclamation LOPP database, Industrial Info Resources, and web searches
See *Technical Notes* for details about the authorization stages

All large (>100MW) projects are pumped storage hydropower or capacity additions; private developers are most common except for conduit projects

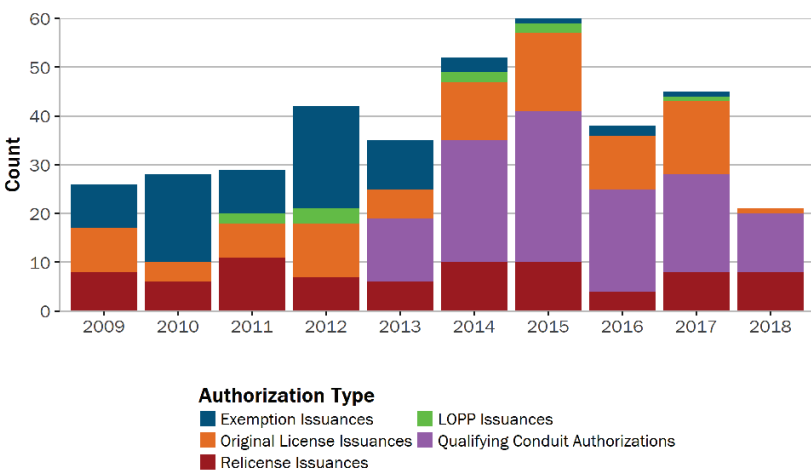


- All federal projects are for capacity additions at existing facilities.
 - However, many new projects propose adding hydropower generation capability to federal infrastructure (dams and conduits).
 - 66% of non-powered dams proposed for addition of hydropower generation capability are owned by federal agencies: US Army Corps of Engineers (53%) and Bureau of Reclamation (13%).
 - 16% of conduit projects target conduits owned by the Bureau of Reclamation.
- All conduit projects in the pipeline have proposed capacities less or equal to 5 MW.
 - Until October 2018, 5 MW was the capacity limit for non-federal conduits to apply for “qualifying conduit” determination (instead of a FERC exemption); the America’s Water Infrastructure Act of 2018 has increased that size limit to 40 MW.

Sources: FERC, Reclamation LOPP database, Industrial Info Resources, and web searches

The number of hydropower projects that received federal authorization for construction in 2018 was the lowest in the last decade

- 21 hydropower projects were issued authorization in the U.S. in 2018:
 - FERC issued 1 original license and 8 relicenses.*
 - 12 projects obtained “qualifying conduit” determination from FERC.
 - Bureau of Reclamation issued no new leases of power privilege (LOPPs).
- The majority of exemptions issued from 2009 to 2013 were for conduit projects; the faster “qualifying conduit” pathway, introduced by the Hydropower Regulatory Efficiency Act of 2013, has since then become the preferred permitting alternative for this type of project.
- Total new capacity authorized from 2009 to 2018 (excluding capacity additions approved through license amendments) was 2.7 GW.
 - 3 pumped storage hydropower (PSH) projects account for ~80% of the total; one of them was cancelled and the other two have not yet started construction.
- Number of authorization applications for new projects has also been very low in 2018
 - 2 10-MW exemptions and no original license applications
 - The number of preliminary permit applications (29) was the lowest since 2000; 19 of them are for PSH projects

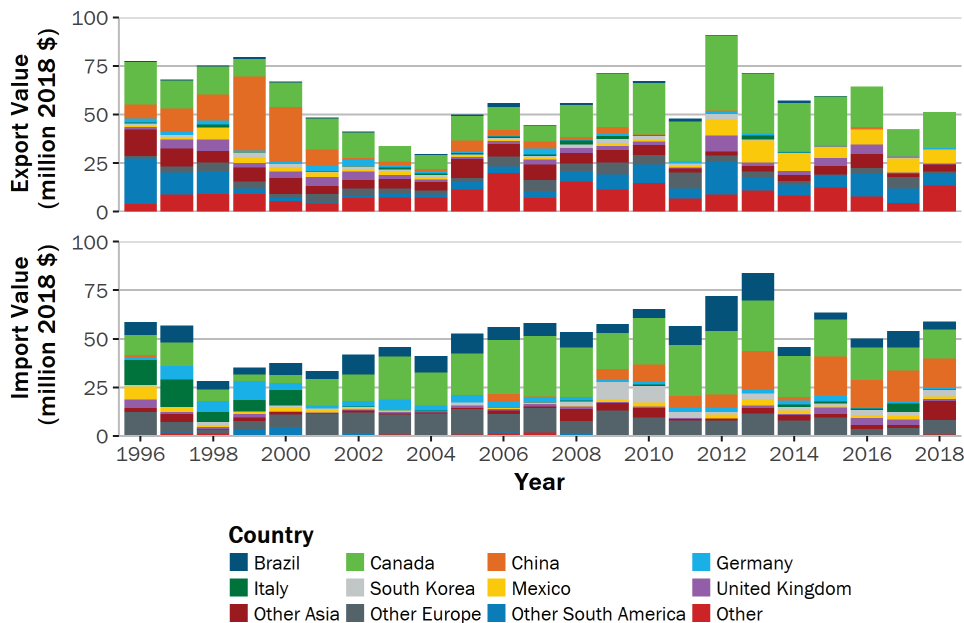


Sources: FERC, Reclamation LOPP database

Note: Licenses and exemptions that have been terminated post-issuance are also included in this plot.

(*) In addition, 1 original license (Upper Collinsville (MA)) that had been issued in 2001 and terminated in 2007 due to failure to start construction was reinstated after Congress approved a request from the licensee to reinstate project development.

U.S. hydraulic turbine import and export values increased in 2018 relative to 2017 but they both remained below the 2008-2017 annual average



Source: USITC Interactive Tariff and Trade Data
See *Technical Notes* for country selection criterion

- Hydraulic turbines and turbine parts are the only hydropower equipment component for which international transactions can be tracked from USITC data.
- Total export value in 2018 was ~\$51 million, a 21% increase from 2017 and 81% of the 2008-2017 average.
- Total import value in 2018 (\$58.7 million) increased by 9% relative to the previous year and was 7% below the 2008-2017 average
- 51% of U.S. exports in 2014-2018 have gone to Canada or Mexico.
- 31% of U.S. imports in 2014-2018 came from Canada; China was the origin of 25% of turbine import value during that same period.

The America's Water Infrastructure Act of 2018, enacted in October 2018, introduces several reforms to the hydropower permitting process:

- It directs FERC to implement an expedited licensing process for eligible non-powered dam and closed-loop pumped storage hydropower projects.
 - In January 2019, FERC released a Notice of Proposed Rulemaking describing the eligibility requirements for the expedited process which would ensure a maximum timeline of 2 years between submission of the license application and FERC's final decision.
- The "qualifying conduit" authorization process is extended to conduits up to 40 MW (previous size limit was 5 MW) and the timeframe for public comment on FERC's initial determination on these applications is shortened from 45 days to 30 days.
 - FERC receives authority to lengthen the duration of preliminary permits (from 3 years to 4 years) and provide an additional 4-year extension if requested by the permit holder.
 - FERC receives authority to extend the deadlines for commencement of construction of licensed projects (from a single 2-year long extension to up to 8 years).
 - The developer of the Eagle Mountain pumped storage hydropower project (CA) invoked this expanded authority in November 2018 to request a second extension of commencement-of-construction deadline (from December 2018 to December 2020).

In September 2018, California passed SB 100 which sets the goal of 100% carbon-free electricity for the state by 2045.

- Small hydropower (≤ 30 MW) and capacity increases at existing hydropower facilities qualify to meet the associated intermediate targets of 50% renewables by 2026 and 60% renewables by 2030.
- Existing large hydropower counts toward the 100% carbon-free electricity target.

In 2018 and early 2019, California, New Mexico, and Puerto Rico have set goals of 100% renewable or carbon-free electricity. Hydropower is one of the eligible technologies to meet those targets.

September 2018: **California** passed SB 100 which sets the goal of 100% carbon-free electricity for the state by 2045.

- Small hydropower (≤ 30 MW) and capacity increases at existing hydropower facilities qualify to meet the associated intermediate targets of 50% renewables by 2026 and 60% renewables by 2030.
- Existing large hydropower counts toward the 100% carbon-free electricity target.

March 2019: **New Mexico** signed SB 489 into law with a target of 100% zero-carbon electricity by 2050.

- Intermediate goals: 50% renewable energy standard by 2030, 80% renewable energy standard by 2040.
- Hydropower facilities brought in service on or after July 1, 2007 (and older facilities for the amount of capacity already included in an energy supply portfolio as of July 1, 2007) count toward the renewable energy standard.

April 2019: **Puerto Rico** signed PS1121 into law with a target of 100% renewable electricity by 2050.

- Intermediate goals: 40% renewable electricity by 2025 and 60% renewable electricity by 2040.
- Hydropower (without size, project type or operational date restrictions) is listed as one the technologies that provides sustainable, renewable energy.

Key takeaways

- Installed U.S. hydropower capacity increased by ~200 MW in 2018 with most of the increase originating in capacity increases at existing facilities.
- U.S. hydropower generation decreased by 3% 2018 largely driven by below-average snowpack in parts of the West.
- U.S. hydropower rehabilitation and upgrade (R&U) projects with an estimated value of \$493 million started in 2018.
- 243 hydropower projects were at some stage of the development process in the United States at the end of 2018.
 - 41% of the projects would be developed as a conduit hydropower facility, mostly in the Western region
 - 32% of projects propose installing hydropower generation equipment at currently non-powered dams of which 84% are located within the Eastern Interconnection
 - Two new stream-reach development (NSD) projects—Calligan Creek (WA) and Hancock Creek (WA)—became operational in 2018. Of the 9 additional NSD projects in the pipeline, 6 are in Alaska.

Key takeaways (continued)

- 55 PSH projects were at some stage of the development process in the United States at the end of 2018.
 - 47 projects have applied for or hold preliminary permits, 6 projects have pending licenses, and 2 projects have issued licenses.
 - The two projects with issued licenses—Eagle Mountain (CA) and Gordon Butte (MT)—requested extensions of time to start construction in 2018.
- 2018 preliminary permit application activity as well as license and exemption issuances were well below the average for the last decade.
- U.S. hydraulic turbine export value increased by 21% in 2018 and import value increased by 9%. Exports to Canada and Mexico and imports from Canada and China continued being the largest trade flows.
- The America's Water Infrastructure Act of 2018, enacted in October 2018, requires FERC to implement an expedited licensing process for eligible non-powered dam and closed-loop PSH projects, extends duration of preliminary permits from 3 years to 4 years, and allows longer extensions of time to start construction for licensed projects.

Slide 5:

- The full value of each project is assigned to the project start year. The green portions of the bars in slide 5 correspond to projects that have not yet been completed as of December 2018.
- Minimum total investment value of projects tracked by Industrial Info Resources (IIR) is \$1 million.
- Updates to project value or completion date can also result in changes in the total estimated value for a given year from one snapshot to the next.
- The value of refurbishment and upgrade projects started before 2007 is not reported due to the finding that IIR PECWeb Dashboard queries produce incomplete results for projects completed earlier than that year.

Slide 6:

Project authorization stages:

- *Pending Permit* includes projects pending a preliminary lease in the LOPP process and projects pending issuance of a preliminary permit.
- *Issued Permit* includes projects that have received a preliminary lease in the LOPP process and projects that have obtained a FERC preliminary permit. Projects in the *Issued Permit* stage have very high attrition rates.
- *Pending Application* includes projects that have applied for an original FERC license, a FERC exemption, or have requested FERC to be considered a “qualifying conduit” hydropower facility.
- *Issued Authorization* includes projects that have been issued an original FERC license or a FERC exemption, projects that have been approved by FERC for “qualifying conduit” hydropower status, or projects that have a final lease contract under the LOPP process.

The number of capacity additions refers to the number of hydropower plants with capacity addition projects. One hydropower plant might be counted in both the “Planning” and “Under Construction” stages if it has projects in the two stages.

Slide 8:

- The 8 individual countries shown in the plot correspond to the 8 countries with the largest total trade flows (imports or exports) over 1996-2018.

*For further inquiries about the content of these slides, please contact the authors:
Rocío Uría-Martínez (uriamartiner@ornl.gov) and Megan M. Johnson (johnsonmm@ornl.gov).*