

1.2.4.403 – Pumped Storage Hydropower FAST Commissioning Prize



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Corey Vezina, WPTO
Tessa Greco, NREL
Vladimir Koritarov, ANL
James “Bo” Saulsbury, PNNL
Scott DeNeale, ORNL

Tessa.greco@nrel.gov

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Project Overview

Project Summary

- The Pumped Storage Hydropower (PSH) Furthering Advancements to Shorten the Time (FAST) to Commissioning Prize aimed to reduce the time, cost, and risk required to commission PSH projects by crowdsourcing ideas via a three-stage prize.
- The FAST Prize aimed to:
 - Reduce the time to commission PSH projects from 10+ years to less than 5 years
 - Develop a baseline analysis for PSH.

Intended Outcomes

- The PSH FAST Commissioning Prize intended to receive innovative solutions to reduce the cost, time, and risk associated with pumped storage hydropower.
- The PSH FAST Commissioning Prize was the first hydropower prize released out of the Water Power Technologies Office (WPTO), and so was viewed as a pilot application of the prize model for the hydropower program.

Project Information

Principal Investigator(s)

- Corey Vezina, WPTO
- Tessa Greco, NREL
- Scott DeNeale, ORNL
- Vladimir Koritarov, ANL
- James (Bo) Saulsbury, PNNL

Project Partners/Subs

- N/A

Project Status

Complete

Project Duration

- 2/1/2019
- 9/30/2021

Total Costed (FY19–FY21)

\$823,516 (NREL), \$664,052 (ORNL), \$270,512 (ANL), \$281,261 (PNNL)

Project Objectives: Relevance and Approach

Relevance to Program Goals:

- **Untapped potential for hydro and pumped storage to support a rapidly evolving grid:** *Develop innovative technologies, including new pumped storage designs, for improved grid service capabilities.*
 - By explicitly seeking concept solutions for cost, time, and risk reduction for pumped storage hydropower facilities, the PSH FAST Commissioning Prize directly addressed stated intermediate and long-term outcomes noted in the “Untapped potential for hydro and pumped storage to support a rapidly evolving grid” challenge. Awards were given to PSH concepts that identified how they might reduce the cost, time, and risk associated with PSH development.

Approach:

- A three-stage prize was initiated to encourage broad participation from a range of stakeholders and contributors not already engaged in hydropower and PSH. Prizes are an excellent way to leverage funding and historical expertise to procure innovative and entrepreneurial solutions to energy issues. The three stages were:
 - **Concept:** A short concept application was submitted describing the PSH innovation
 - **Incubate:** Finalists were paired with the national labs to advance their concepts and prepare for the pitch contest
 - **Pitch:** Finalists presented their pitches to an expert panel of reviewers at the 2019 WPTO Peer Review.

Project Objectives: Expected Outputs and Intended Outcomes

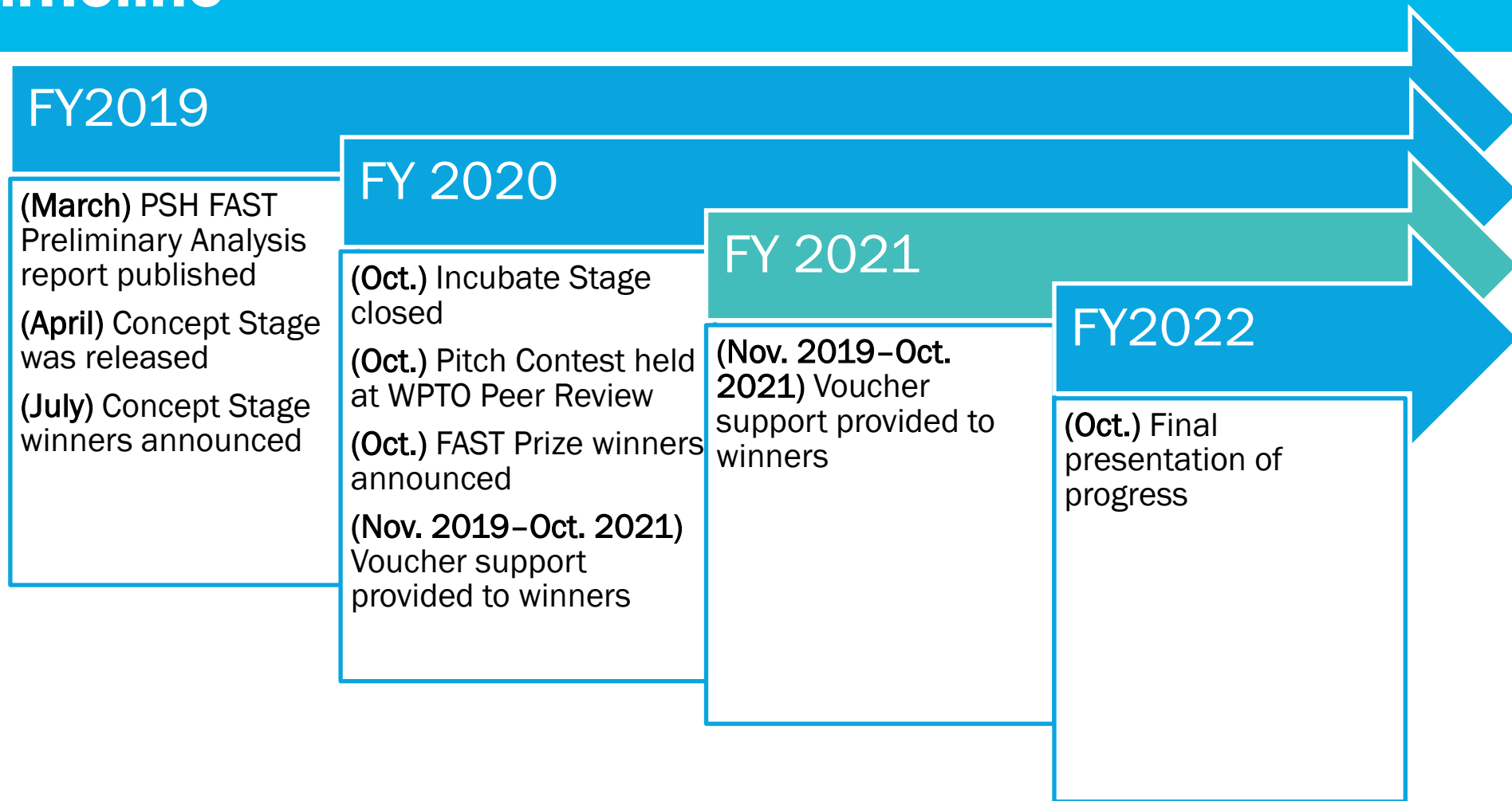
Outputs:

- PSH draft technical report – Year 1
- PSH FAST Commissioning Prize Rules and Requirements Document – Year 1
- PSH final technical report – Year 1
- PSH FAST Commissioning Prize branding and marketing material – Year 1
- PSH FAST Commissioning Prize Website – Year 1
- Execute pitch day and select prize winners – Year 2
- Support winners of pitch contest with voucher support and cash prize – Years 2 and 3
- Draft technical reports from each of the winning prize teams – Year 2
- Final technical reports from each of the winning prize teams – Year 3
- Final conference or webinar presentation – Year 4

Outcomes:

- The PSH FAST Commissioning Prize introduced innovative solutions to significantly drive down costs, timelines, and risks of pumped storage hydropower by engaging a nationwide problem-solving community.
- Pumped storage hydropower is a largely untapped resource that can be used to balance other renewable, variable generation sources. By initiating this important topic via a prize mechanism sought to identify solutions for bolstering a more reliable and resilient grid.

Project Timeline



- The in-kind voucher support for the PSH FAST Commissioning Prize winning teams was extended beyond September 2020 to account for delays associated with executing a multi-lab CRADA for each winner and with COVID-19.

Project Budget

Lab	FY19	FY20	FY21	Total Actual Costs FY20–FY21
	Costed	Costed	Costed	Total Costed
NREL	\$181,883	\$471,059	\$170,574	\$823,516
ORNL	\$471,817	\$103,299	\$88,936	\$664,052
ANL	\$52,043	\$128,758	\$89,711	\$270,512
PNNL	\$106,705	\$90,065	\$21,491	\$218,261

The PSH FAST Commissioning Prize awarded \$150k in cash awards, and \$400k in in-kind support among the participating national labs.

End-User Engagement and Dissemination

The external engagement strategy for the PSH FAST Commissioning Prize was multi-pronged, as follows:

- **Technical Review Committee (TRC):** A five-member TRC was engaged to review and provide feedback on the FAST winners' technology development. The TRC was also encouraged to suggest venues for promoting the PSH FAST Commissioning Prize to their professional networks.
- **Strategic Outreach and Promotion Network:** The project team assembled a list of potential targets to inform a strategic outreach and promotion network consisting of experts in hydropower and pumped storage hydropower from industry, academia, government, and research institutions. This database was solicited to ensure the FAST Commissioning Prize reached the maximum potential applicant pool.
- **Prize Advertisement:** The PSH FAST Commissioning Prize project team engaged with hydropower, PSH, energy storage, and other industry networks to maximize the potential applicant pool reach. Outreach organizations were identified and hired to execute outreach to their membership, including direct solicitation, as well as online marketing and advertising.

End-User Engagement and Dissemination

- Intended beneficiaries of the PSH FAST Commissioning Prize were:
 - WPTO – Awarded concepts were analyzed and considered within their pumped storage hydropower R&D portfolios.
 - Hydropower Industry – Results from the prize were meant to introduce some creativity and new ideas into a well-established industry.
- The PSH FAST Commissioning Prize engagement strategy included the identification of relevant industries and audiences that may better inform PSH development.
- The PSH FAST Commissioning Prize published a full report and an executive summary on a baseline analysis for pumped storage hydropower as well as the identification of opportunity areas to focus the sought-after innovation areas for the PSH FAST Commissioning Prize.

Performance: Accomplishments and Progress

- [PSH FAST Commissioning Challenge Rules Document](#)
- [PSH FAST Commissioning Preliminary Analysis](#)
- 4 winners were selected in October 2019, each receiving a share of the \$150k cash prize pool, and \$400k in-kind voucher support:
 - **Reducing PSH Excavation Duration, Cost, & Risk** – Tracy Livingston and Thomas Conroy, Team Livingston, combined excavation equipment modifications and process optimizations to achieve up to 50% reduction in excavation timelines.
 - **Use of Modern Tunnel Boring Machines for Underground Pumped Storage** – Doug Spaulding, Nelson Energy and Golder Associates, proposed use of tunnel boring machines for underground excavation, which can decrease excavation time by 50% and reduce costs.
 - **Accelerating PSH Construction with Steel Dams** – Gordon Wittmeyer, Southwest Research Institute, presented a modular steel concept for dams that cuts costs by one-third and cuts construction schedules in half.
 - **Modular Closed-Loop Scalable Pump Storage Hydro** – Tom Eldredge and Hector Medina, Liberty University, presented a modular closed-loop, scalable PSH system with a capacity range of 1–10 megawatts, adaptable to sites without natural bodies of water.