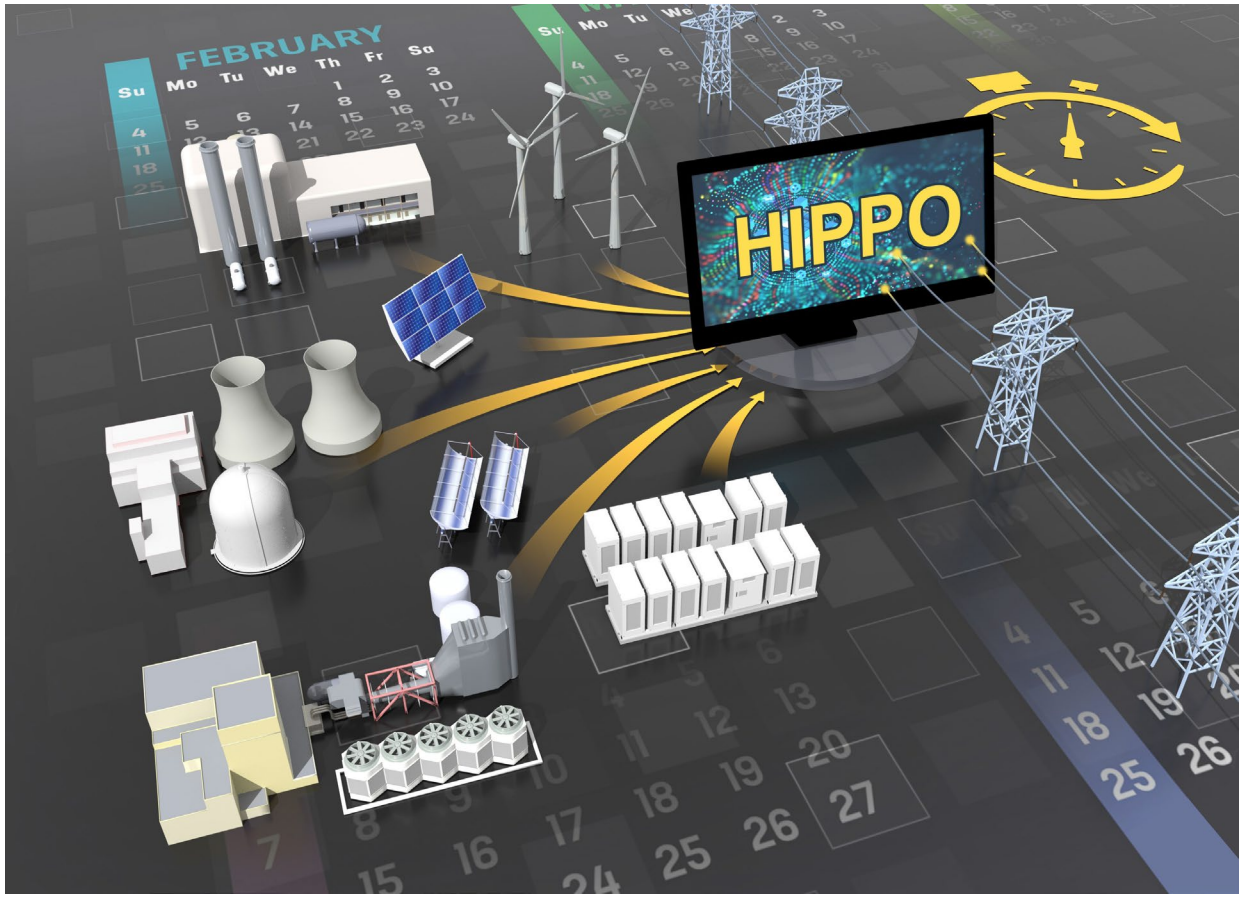
WBS # 1.2.3.604 – HIPPO-HS: A Tool for Planning and Assessing Hybrid Resources at System Level



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July 28, 2022

Project Overview

Project Summary

- This project will support vertically integrated utilities to reach their clean energy goal by investigating the benefits of operating the run-of-river (RoR) and battery storage as a hybrid generation resource. Working with our industrial partner, we are developing accurate representations of hydro generation resources, battery storage and the hybrid operation in real-world system-level day-ahead operation. The project will not only demonstrate the benefits of hybridization in lowering cost and improving system flexibility and utilization of clean energy, will but also provide a decision support tool directly to the industry for its day-ahead operation and resource planning activities.

Intended Outcomes

- High-Performance Power-grid Optimization – Hybrid System (HIPPO-HS) as decision support tool based on enhanced unit commitment (UC) model with industrial operation details for system-level day-ahead operation.
- Unit commitment model with the representation of RoR+battery storage hybrid.
- Battery storage siting and sizing tool for industry resource planning activities.
- Assessment of the benefits of RoR+battery storage hybrid in operating power system

Project Information

Principal Investigator(s)

- Feng Pan, PNNL

Project Partners/Subs

- Idaho Power Company (IPC)
  - Resource planning
  - Day-ahead operation
  - Operation Hydrology

Project Status

Ongoing

Project Duration

- Start: Oct 1, 2021
- End: Dec. 31, 2022

Total Costed (FY19–FY21)

$123,966

Project Objectives: Relevance

Relevance to Program Goals:

- The primary outcome envisioned in this project is for vertically integrated utilities
  - To adapt the developed models and algorithms to their day-ahead operation to achieve their clean energy goal.
  - To create a foundation for prudent investments in hybrid energy resources by utilities and private developers, using the siting and sizing algorithms.
  - With access to a market model for non-commercial use under a no-cost, non-exclusive research license, to enable researchers to explore other novel approaches to hybridization and the implied system value.
- Optimize hydropower operations and planning to best utilize hydropower's capabilities to provide grid services through increasing fleet flexibility and value.

Project Objectives: Approach

Approach:

- Integrate details of industry operation conditions and procedures into a centralized unit commitment optimization model.
- Model validation with industry partner to ensure HIPPO model matches current industry day-ahead operation.
- RoR+battery storage hybrid resource to convert must-take resource to dispatchable resource.
- Large scale mixed integer optimization models and bilevel optimization model.
- Fast algorithms and HPC based solution techniques provide an efficient computation engine.

Project Objectives: Expected Outputs and Intended Outcomes

Expected Outputs:

- Decision support tool for Idaho Power Company's day-ahead operation and resource planning.
- Assessment of the benefits of RoR and battery storage hybrid as a guide for system level resource investment.
- Publication and conference presentation of developed methodologies.

Intended Outcomes:

- IPC will have an advanced day-ahead decision support tool to improve its operation cost and high utilization of clean resources.
- IPC will have a resource planning tool for assessing its battery investment.
- The assessment results can be used as foundation to provide IPC guidance to its battery storage investment.

Project Timeline

FY 2021

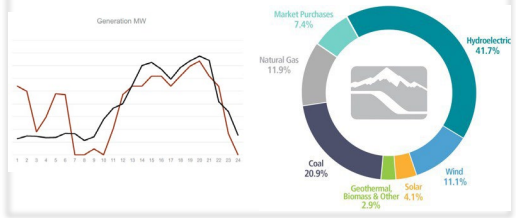
FY 2022

Analysis

Tool

Analysis

Assess the benefits of RoR+battery hybrid resource



05/2022 – 12/2022

Develop unit commitment at the scale of Western Electricity Coordinating Council for large system study.

Establish partnership with IPC.

Industry data acquisition.

Customize day-ahead unit commitment to IPC's day-ahead operation.

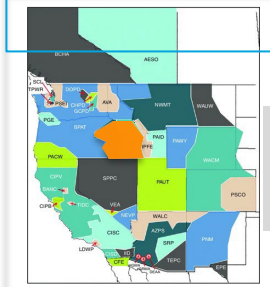
Model validation with IPC to ensure our model matches the current industry practice.

Develop IPC model with RoR+batterystorage hybrid.

Develop battery siting and sizing model

Define scenarios and perform benefit assessment

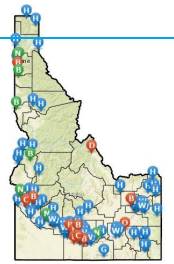
Regional System



Develop general Unit Commitment in WECC system

10/2020 – 05/2021

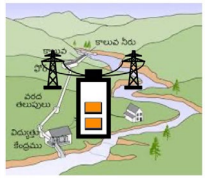
Current System



Develop IPC unit commitment model reflecting its operation details

07/2021 – 05/2022

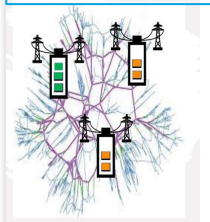
Enhanced System



Develop IPC unit commitment model with hybrid RoR and battery storage

01/2022 – 06/2022

Battery S2



Develop battery siting and sizing model

03/2022 – 07/2022

Project Budget

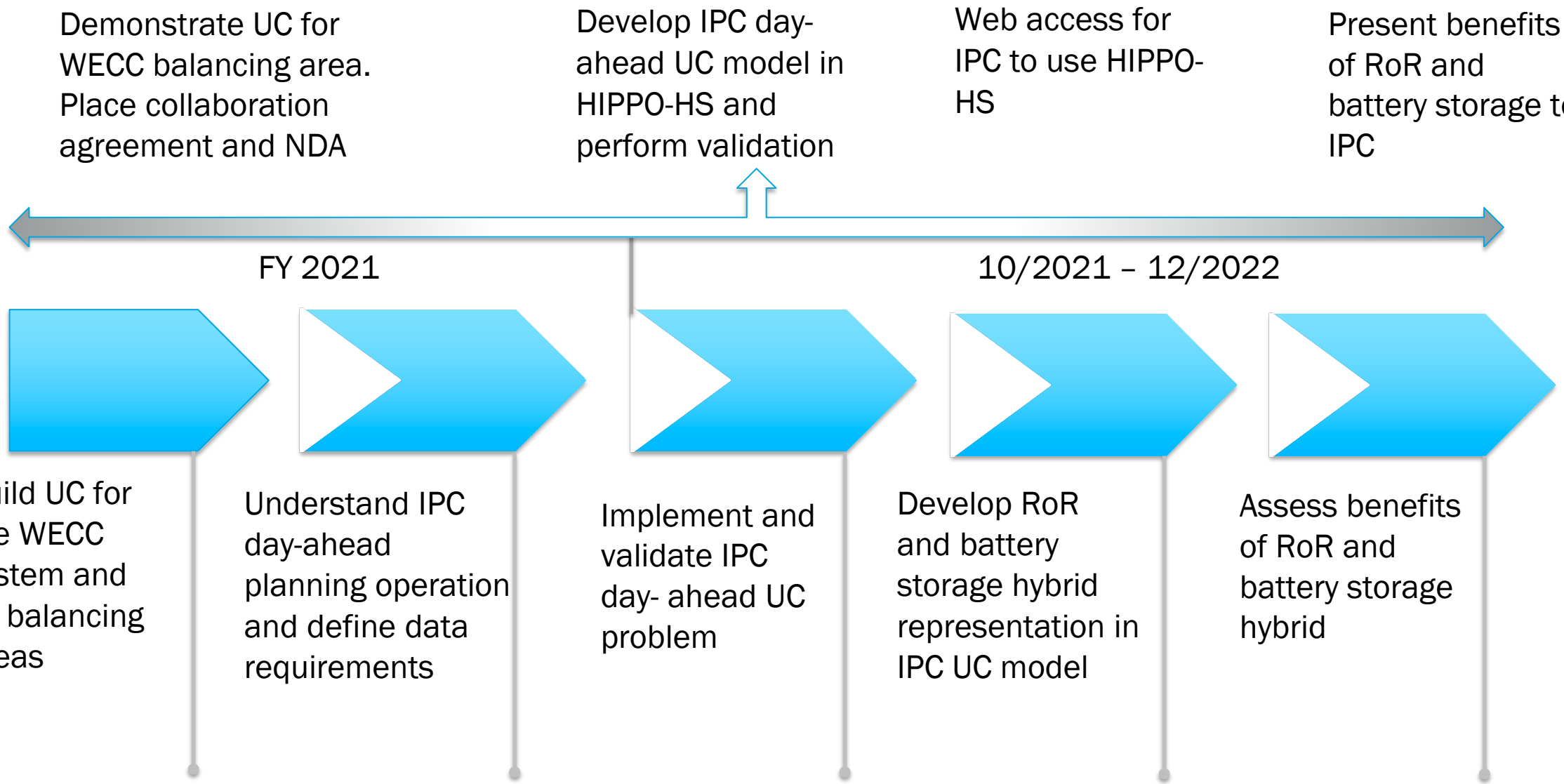
FY21	Total Costs FY19–FY21
Costed	Total Costed
$123,966	$123,966

- The team spent less than the planned budget in FY21. There was a period during which the team was preparing the agreement between PNNL and Idaho Power before the technical work could proceed.

End-User Engagement and Dissemination

- Partnering with Idaho Power Company
  - IPC will be the early adopter of HIPPO-HS.
  - To reach its 100% clean energy goal, the objective is that HIPPO-HS can be used to
    - Investigate the benefits of RoR+battery storage hybrid in terms of cost, flexibility, and clean energy utilization.
    - Improve daily electricity operation with more accurate and faster unit commitment model.
  - With IPC as the project partner, we aim to provide HIPPO-HS as a decision support tool for its day-ahead operation and as a planning tool for its integrated resource planning activities.
  - The team is developing HIPPO-HS with IPCO. Through regular meeting, we model the details of IPC's systems and validate HIPPO-HS with IPC's operation model.
- Technology transfer
  - HIPPO-HS can be licensed from the existing HIPPO license.
  - Multiple phases starting with providing IPC the access to the HIPPO-HS web application

Performance: Accomplishments and Progress



Performance: Accomplishments and Progress

- Develop and implement a UC model for the WECC region
  - Curated WECC data for setting up unit commitment model.
  - Able to solve UC for balancing areas in WECC.
- Established collaboration with Idaho Power
  - Identified the areas for collaboration and signed NDA.
- Develop UC model for IPC
  - Learned Idaho Power's day-ahead planning operation, defined the conditions for modeling UC for IPC, and identified data requirements.
  - Formulating and implementing IPC UC model in HIPPO-HS.

Future Work

- Formulate and implement UC to conform the IPC's day-ahead operation. Add details on hydro storage, river connection and flow conditions to reflect hydro operation and compliance at IPC.
- Validate the HIPPO UC model to confirm the representation of IPC's current operation.
- "Validate UC model to confirm representation of IPC's current operation"
- Formulate and implement RoR+battery storage hybrid model as the enhanced UC for IPC day-ahead planning.
- Formulate and implement battery siting and sizing model and solicit the battery investment options from IPC. Define future RoR+battery storage scenarios for IPC.
- Assess the benefits of RoR+battery storage hybrid and analyze the impacts in IPC's day-ahead operation.

Q&A