



**BUILDING A BUSINESS CASE FOR  
HYDROPOWER REHAB AND CAPACITY  
UPDATES AT USACE POWERED DAMS**

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PNREC 2026



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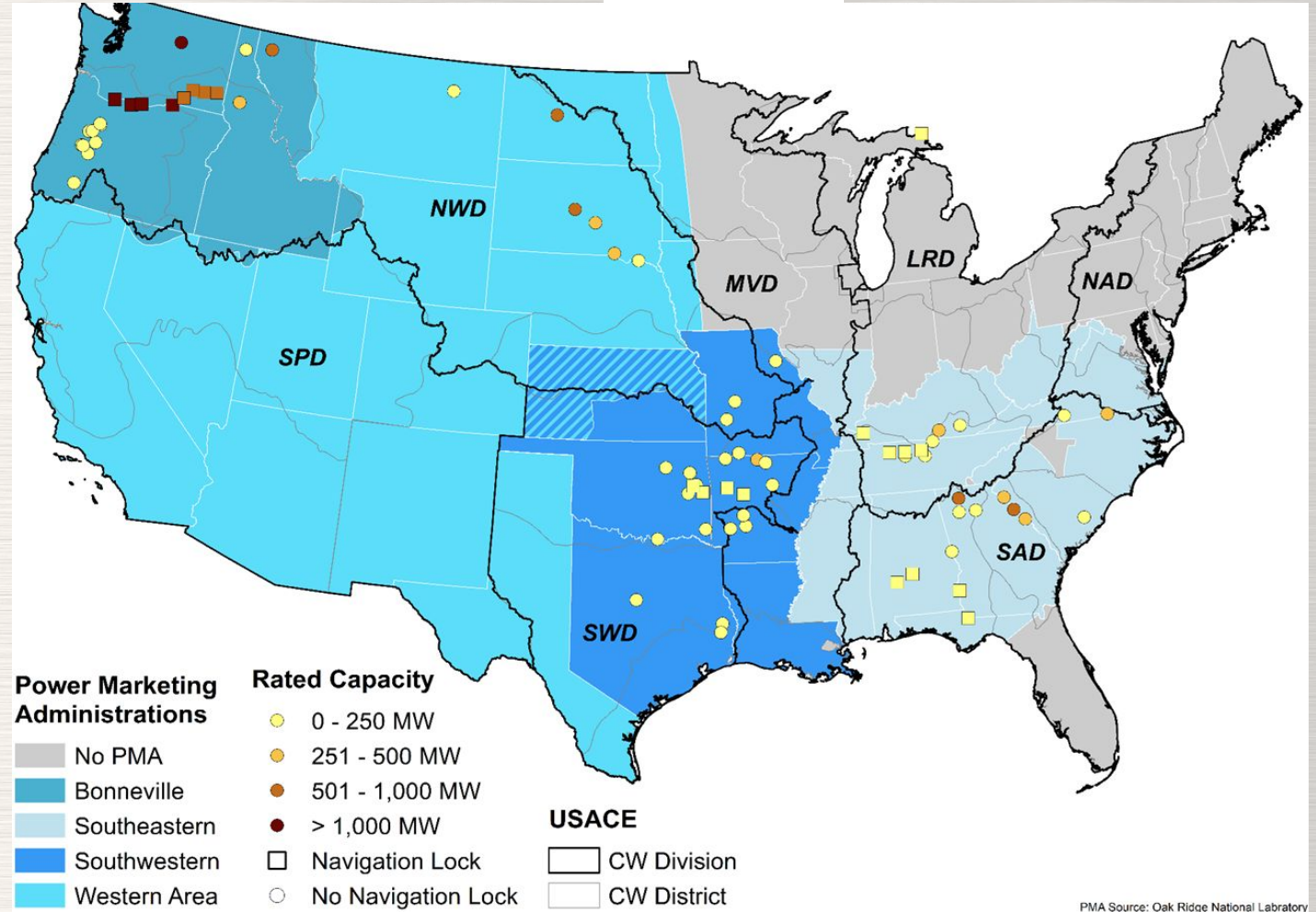
Hydroelectric  
Design Center



# USACE Hydropower



- Part of the **Corps Civil Works Portfolio**
- **75 Hydropower Projects** with a Total of 356 Grid Connected Hydroelectric Generators
- Approximately 24000 MW of capacity and 70000 GWh of generation
- Largest Hydropower Producer in the United States; **Provides approximately 25%** of the Hydropower Produced in the U.S.
- Hydropower Assets Cover **5 Divisions** and **16 Districts** Across USACE
- Capacity and Generation is Marketed by the Department of Energy's **4 Power Marketing Administrations** to Non-Profit Municipalities and Cooperatives Known as **Federal Preference Customers to Repay Costs**



PMA Source: Oak Ridge National Laboratory



# Hydropower Analysis Centers (HAC) roles and Responsibilities:



- Developing national-level guidance on National Economic Development valuation of USACE hydropower.
- Developing business cases for USACE hydropower asset replacement and maintenance.
- Determining the impacts on hydropower from changes in water availability and access, including water supply reallocations and environmental impact statements.
- Benchmarking plant-level efficiencies and utilizations.
- Storing and ensuring accessibility of key USACE hydropower economic indicators.
- Researching and developing new tools to model hydropower's dynamic role on the grid



The Hydropower Analysis Center (HAC) is a Planning Center of Expertise (PCX) and MCX within the Hydroelectric Design Center (HDC )



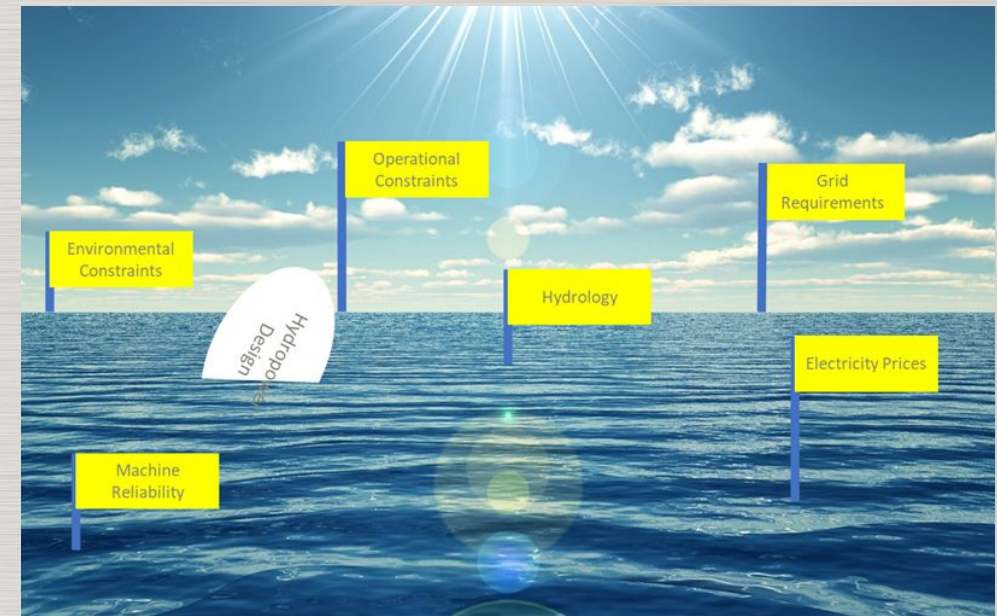
# The State of Design / Asset Management For The USACE Hydropower Fleet



## Trends:

- Federal Hydropower remains in the rehab stage
- Most Project Funding comes through the customer funding (SWPA, WAPA, and SEPA) or direct funding BPA mechanisms
- Water supply use is changing the availability of water for hydropower use
- Use of hydropower is changing to include more ancillary services
- Environmental demands can impact water availability for hydropower use and also increase cost (joint-use) for mitigation structures
- Hydrologic variability, electricity price uncertainty, and environmental constraints shape the design of the powerhouse
- Current Administration is seeking to expand non-federal hydropower on federal dams (Section 408)

## Ocean of Uncertainty

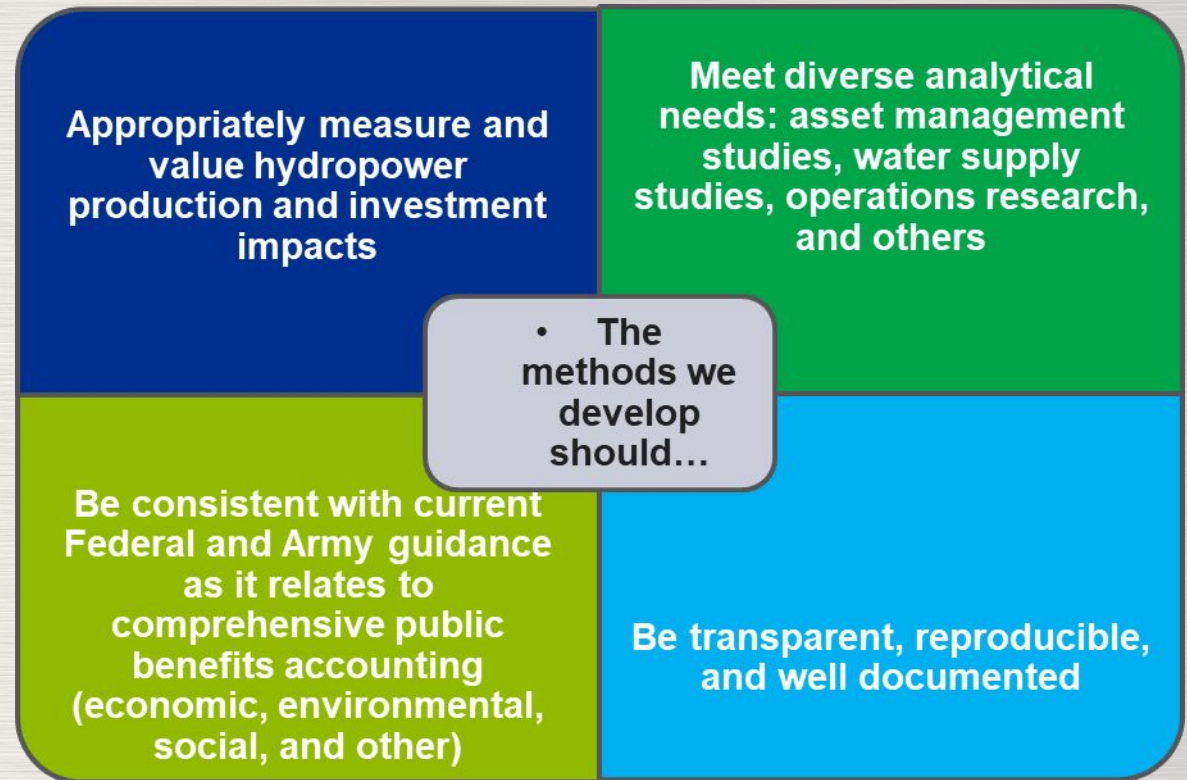




# Updating our guidance on calculating benefits

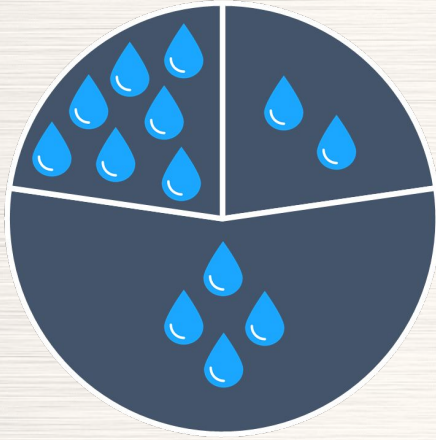


- Engineer Manual 1110-2-1701 Engineering and Design – Hydropower is used as our guidance to quantify the value of hydropower.
- Three main benefits-Dependable capacity, generation , and ancillary services
- Its was published and last updated in 1985.
- The current methodologies are deemed inadequate and outdated for assessing impacts in today’s regulatory, policy, and technological setting.
- HAC has been holding inter-agency meetings with PMAS to help develop methodologies to value hydropower for current and future uses.

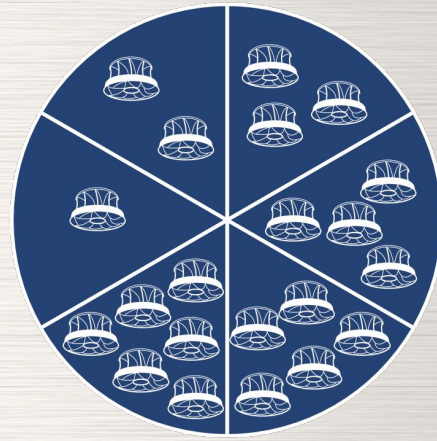


# Making a business case for investment

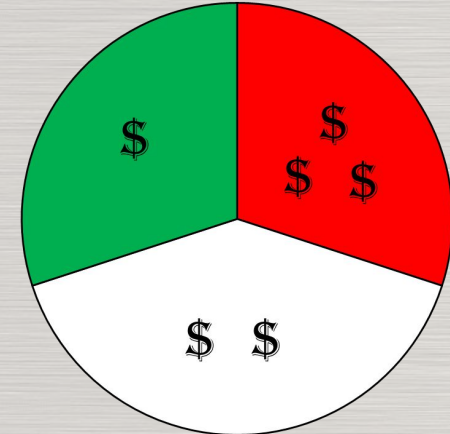
## Stochastic vs Deterministic Analysis



Hydrology



Unit Availability

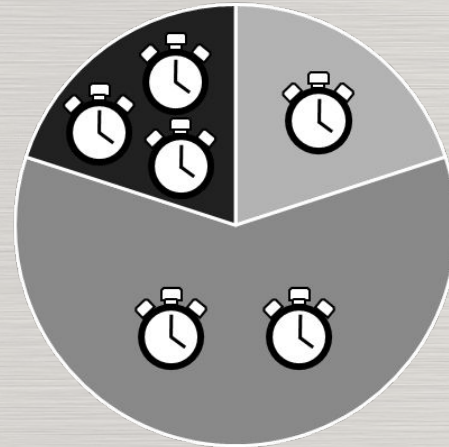
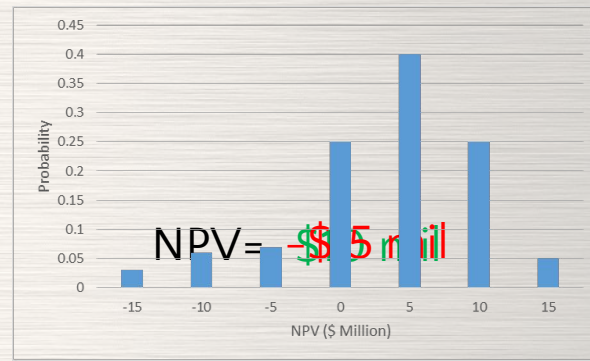


Project Cost



Energy Prices

85% Probability that NPV > 0



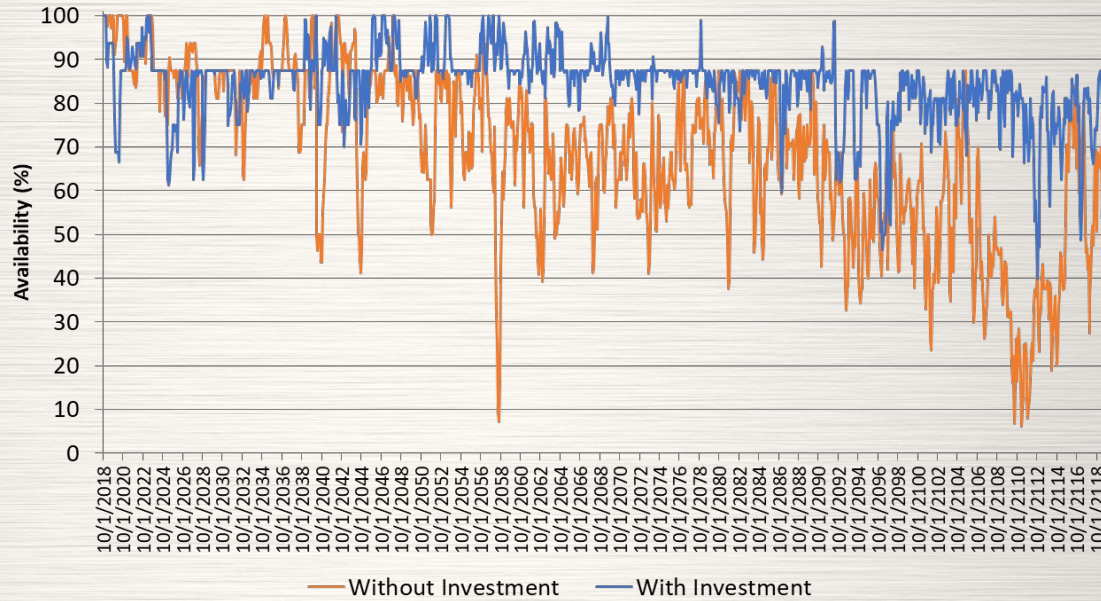
Outage/Project Duration



# Availability workbench (AWB) simulated Availability



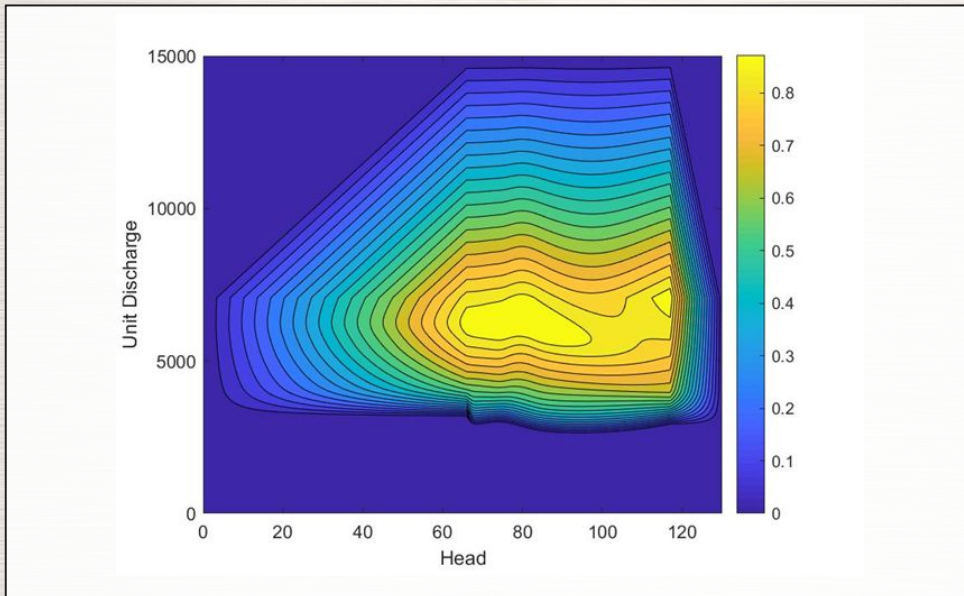
The Availability Workbench (AWB) simulation engine employs Monte Carlo simulation methods to estimate system and sub-system parameters such as unavailability, number of expected failures, production capacity and costs



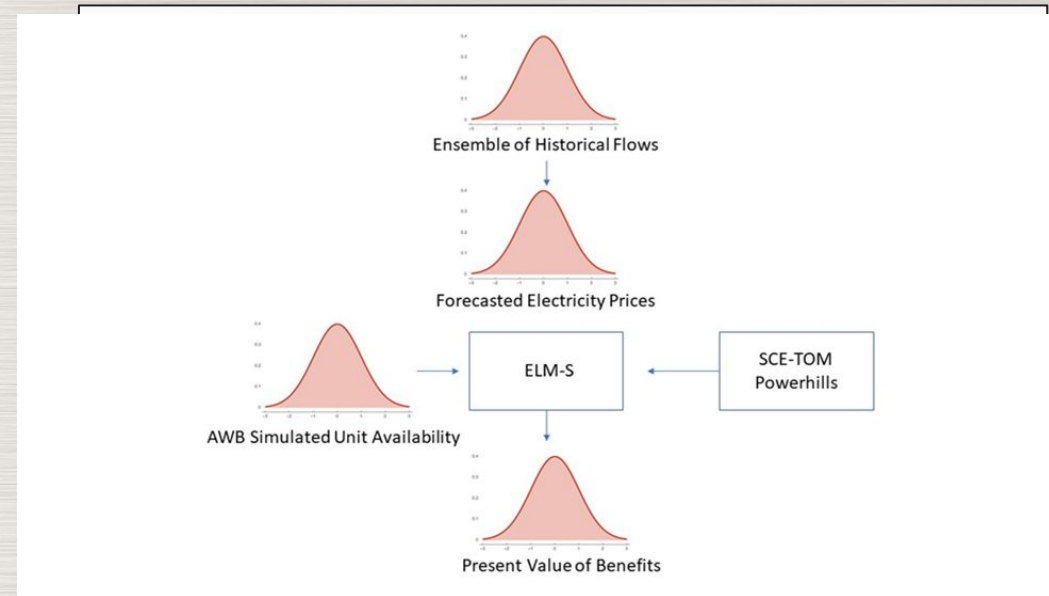
| Equipment Type                    |
|-----------------------------------|
| Turbine Runner                    |
| Turbine Components - Wicket Gates |
| Generator - Stator Winding        |
| Generator - Stator Frame          |
| Generator - Stator Core           |
| Generator - Rotor Electrical      |
| Generator - Rotor Structure       |
| Excitation System                 |
| Governor - Control System         |
| Governor - Hydraulic System       |
| Circuit Breaker                   |
| Transformer                       |

Baseline (Alt 0): No action alternative. No scheduled replacements. Assets will fail and then repaired to Hydroamp score.

## SCE-TOM ( Optimal Unit Dispatch Model)



## ELM-Energy Linking Model

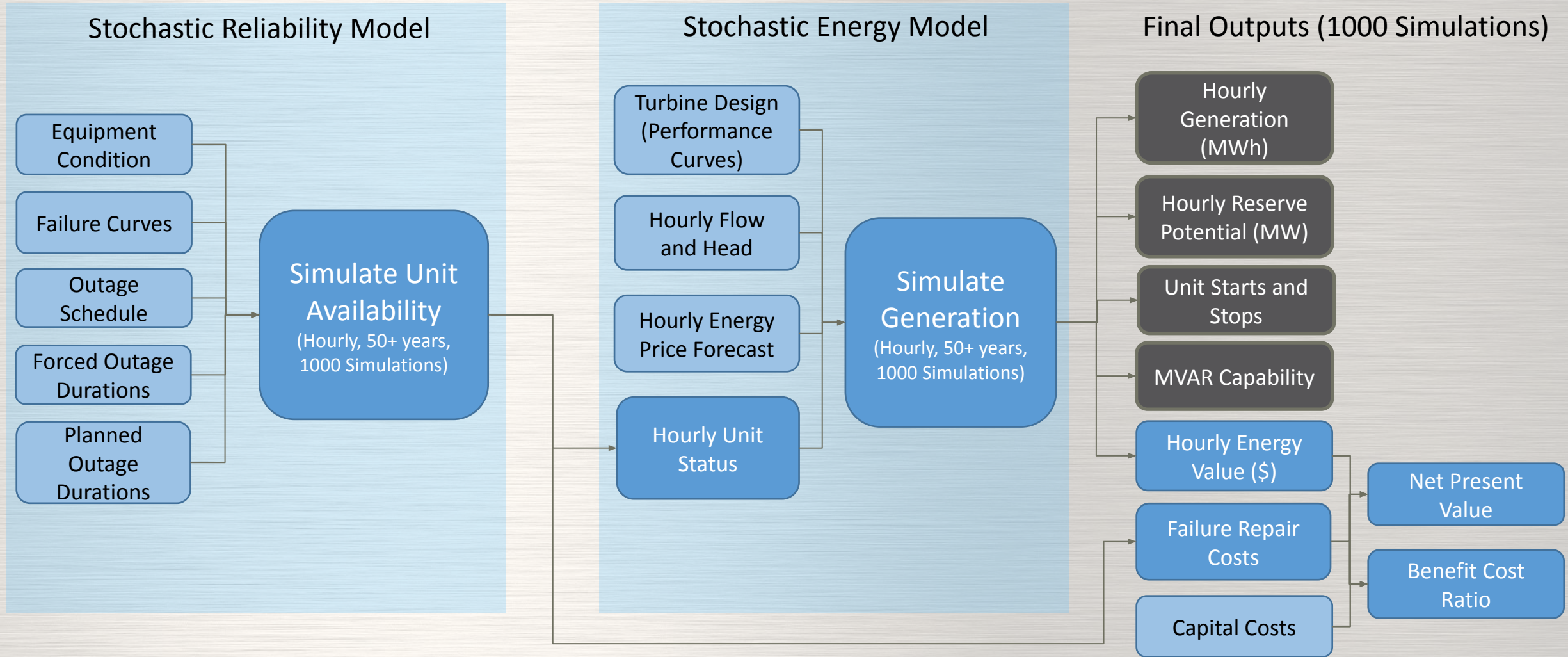
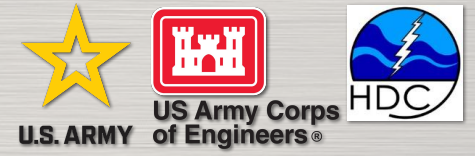


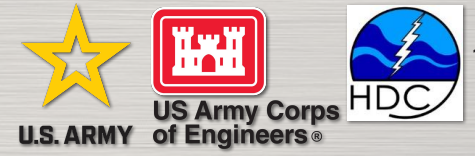
Optimal unit dispatch model developed to quantify benefits of turbine replacement across different families, and fully capture efficiency gains/losses

Monte Carlo simulation developed to simulate the response of the hydropower plant to uncertainties including electricity prices, hourly operations, hydrology and reliability.



# Alternatives Modeling





# Questions we've analyzed with this framework

Optimal timing and alternative for investment

Optimal number of units to modernize

Optimal design (Flexible vs Peak, sizing)

Optimal # of spares

Tradeoffs of fixed vs adjustable turbines

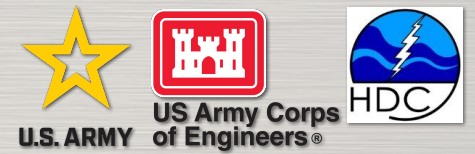
Value of new units

Transmission line impacts

Reserve capability and voltage support



# Benefits of Powerhouse Rehab



## Increased turbine efficiency

New turbines have higher efficiency (+5%)

Sizing designed for current hydrology and operations

Replace degradation and derating

## Increased reliability

Resetting survivor curves

Planned vs forced outages

- Reducing time for design and lead times

## Lower Maintenance Cost

Reduction in direct cost associated with outage

Better design for current operations (less stops and starts, rough zone operations)

## Increase in operational flexibility

Turbines have broader operating ranges

Increased capacity to increase reserves and peaking capability



# Making the case for new capacity on existing plants



## Upgrading Units

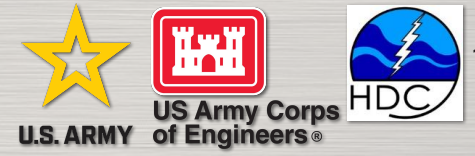
- All plants have this capability-to a point
- Economic justification usually falls into these categories:
  - Unplanned water availability
  - Changes in hourly operations (baseload to peaking/ ancillary services)
  - Redundancy-(will upgrading one unit reduce need to rehab all units)

## Adding new units

- Not all plants have open skeleton bays
- Much higher cost-requires all components not just a turbine
- Unplanned water availability
- Redundancy



# Dworshak Dam



## Current configuration:

- Location: Ahsahka, Idaho
- Power Marketing Agency: BPA
- Capacity: 400 MW
- Number of units: 3
- Average annual generation: 1.6 million MWh
- Number of skeleton bays: 3

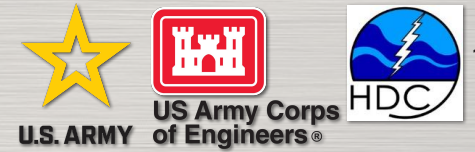
## Additional Unit Alternatives Considered:

- Adding a 4<sup>th</sup> unit (300 MW)
- Adding a 5<sup>th</sup> Unit (150 MW)

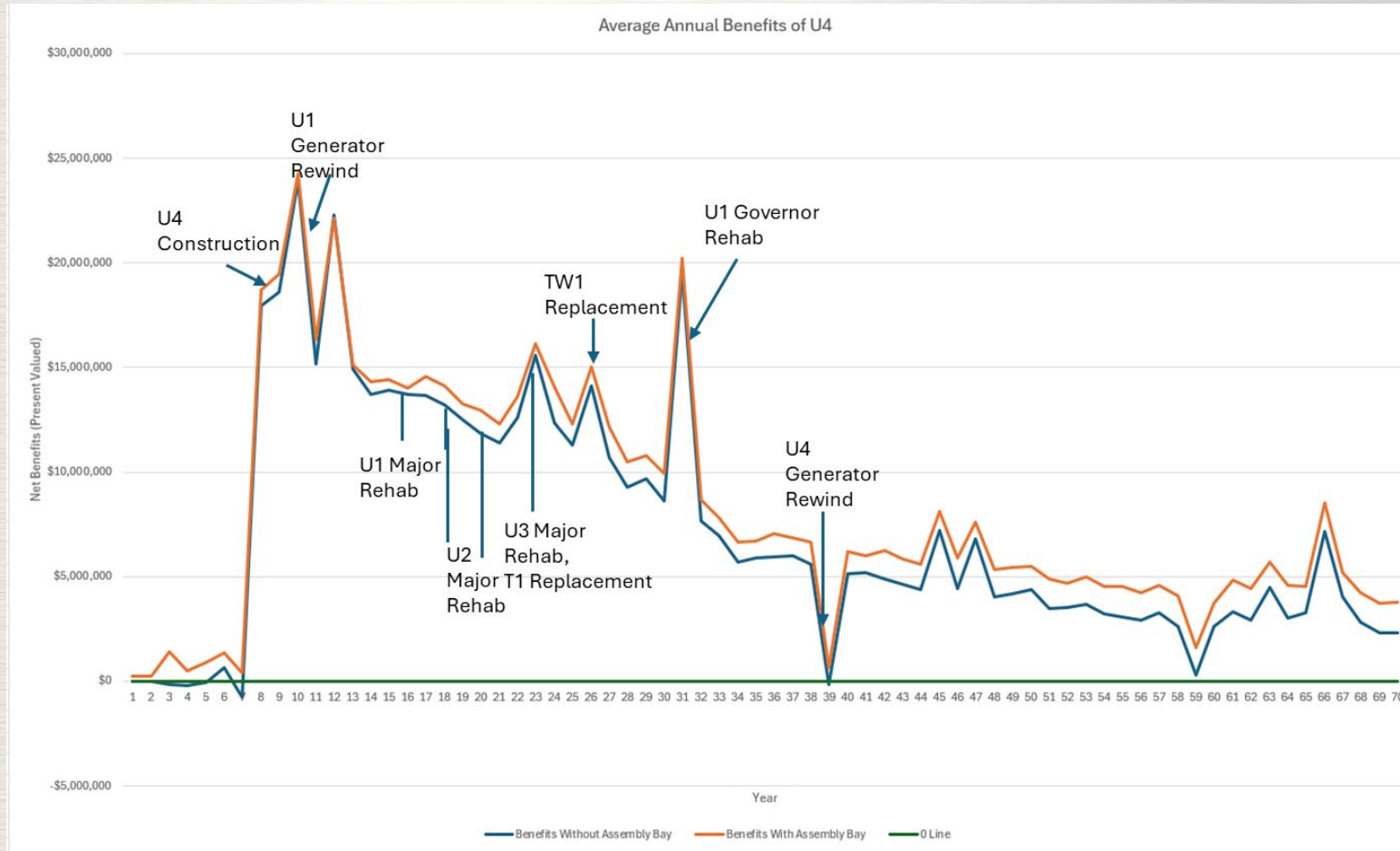




# Building new capacity –Dworshak dam



## Average Modeled Benefits of 4th Unit



- 5<sup>th</sup> Unit was not economically justified
- 4<sup>th</sup> unit was justified largely due to upcoming long rehab.
-



# Libby Dam

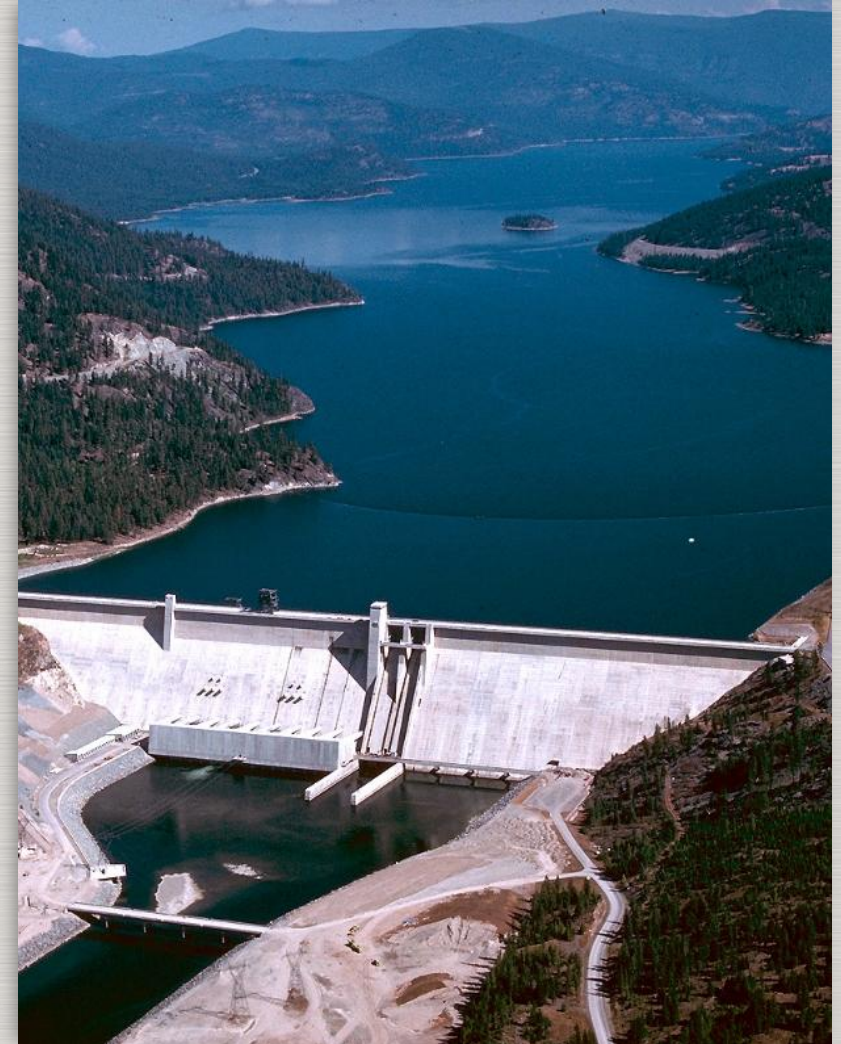


## Current configuration:

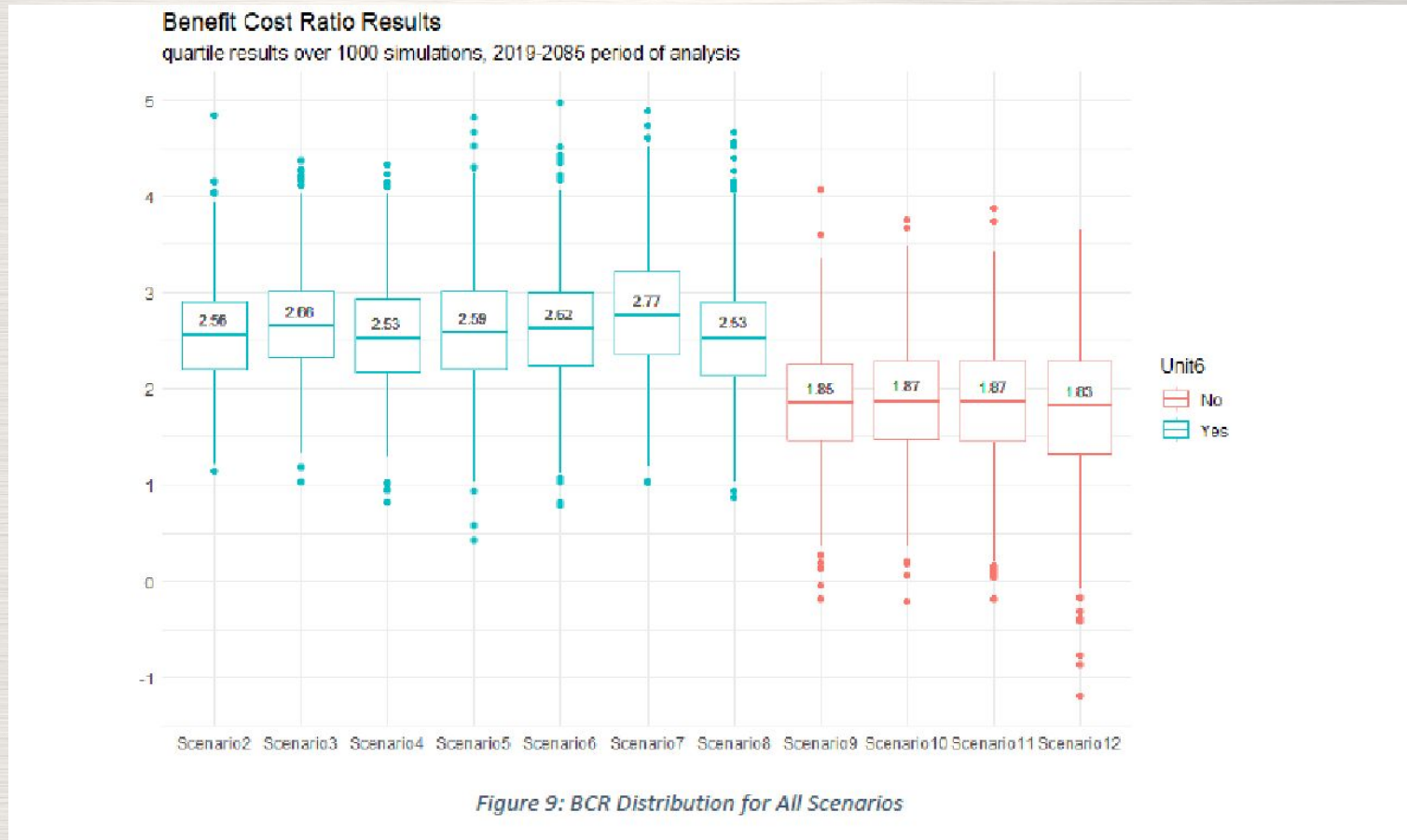
- Location: Lincoln County , Montana
- Power Marketing Agency: BPA
- Capacity: 600 MW
- Number of units: 5
- Average annual generation: 1500 GWh
- Number of skeleton bays: 3

## Additional Unit Alternatives Considered:

- Adding a 6<sup>th</sup> unit (150 MW)



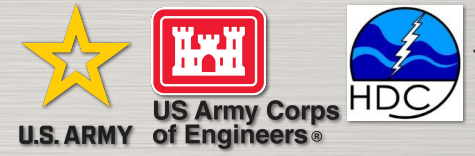
# Building new capacity-Libby Dam



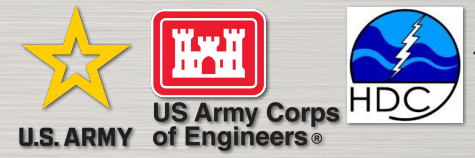
- Libby was originally designed to have 8 units. After the 5<sup>th</sup> unit, the remaining three units stopped construction after turbine components were installed. Additional parts were put into long term storage.
- Because of the partially completed infrastructure, adding a 6<sup>th</sup> unit has minimal expense (approx. \$17M in FY19).
- Units 1-5 will also require rehab in the near term. A 6<sup>th</sup> Unit helps mitigate some of the generation losses from this rehab.



# Challenges ahead



- EM Update:
  - Understanding how the hydropower will be used in the future
  - Understanding how to properly forecast the values
- Costs and Acquisition Lead times
  - Last five years have shown dramatic change in both cost and outage durations
  - Historic analysis isn't really accurate
- Manufacturing and Installation
  - USACE has stricter contracting guidelines
- Changing Hydrology
  - Water Supply needs
  - Environmental constraints (spill)



Questions?