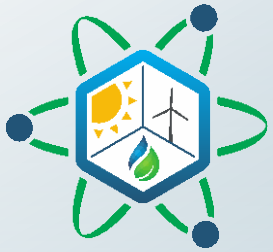

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HERON

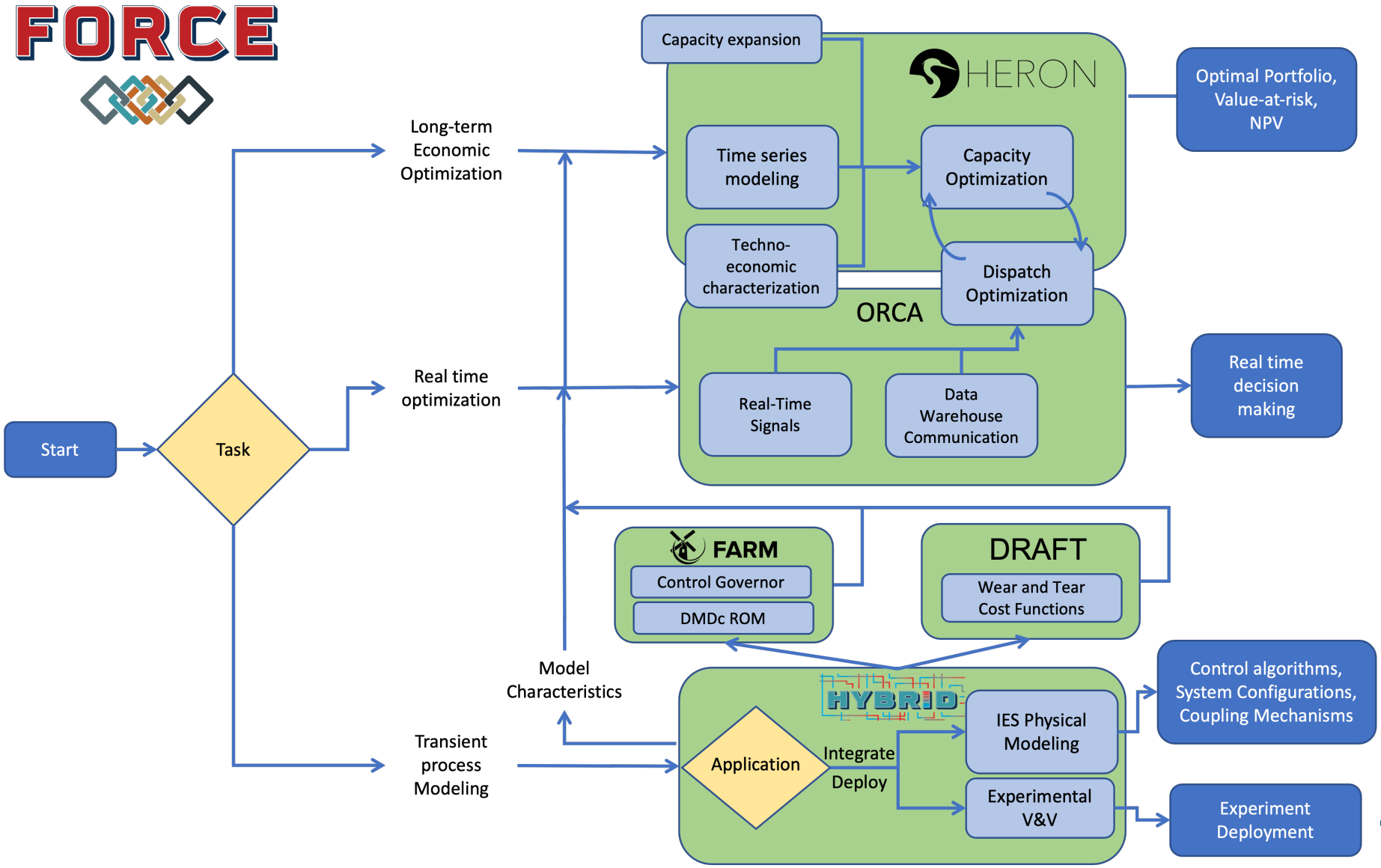
HERON: Overview

FORCE Overview and Training
April 4-6, 2023

Paul Talbot
FORCE Software Architect

Idaho National Laboratory

Sample Body slide



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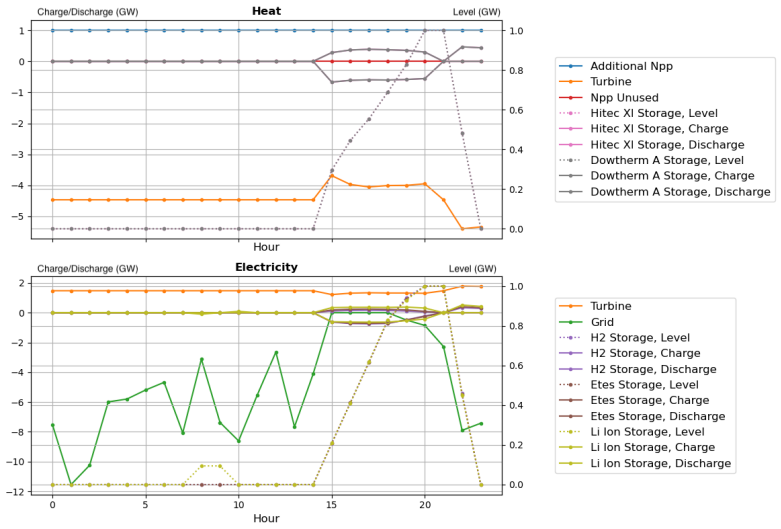
What is HERON?

- Software for stochastic macro technoeconomic analysis of mixed-energy systems
- Command-line software tool
- Optimizes portfolio mixes to maximize statistical benefit
  - Expected NPV
  - Value at Risk
- Free, open source, openly available (https://github.com/idaholab/HERON)

Why HERON?

- Mixed Commodity Systems
  - No preference for electricity
  - Commodity agnostic
- Time-continuous Dispatch
  - Component ramping limitations
  - Storage charge, discharge, level
- Uncertainty Built In
  - Statistical analysis
  - Distributed economic metrics



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HERON: Workflow Writer

RAVEN Outer

Optimize Capacity

Portfolio

E[NPV]

RAVEN Inner

Sample

Postprocess

Ensemble:

SynthHist

Dispatch

TEAL

DispatchManager

Loop Structure

Optimize Dispatch

Technology Characteristics

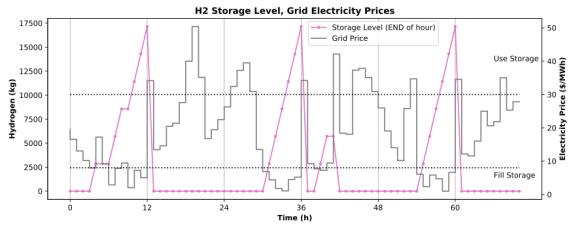
DispatchManager

For each year …

For each cluster …

… optimize dispatch

Optimization Window → Time History



HERON Calculation Flow

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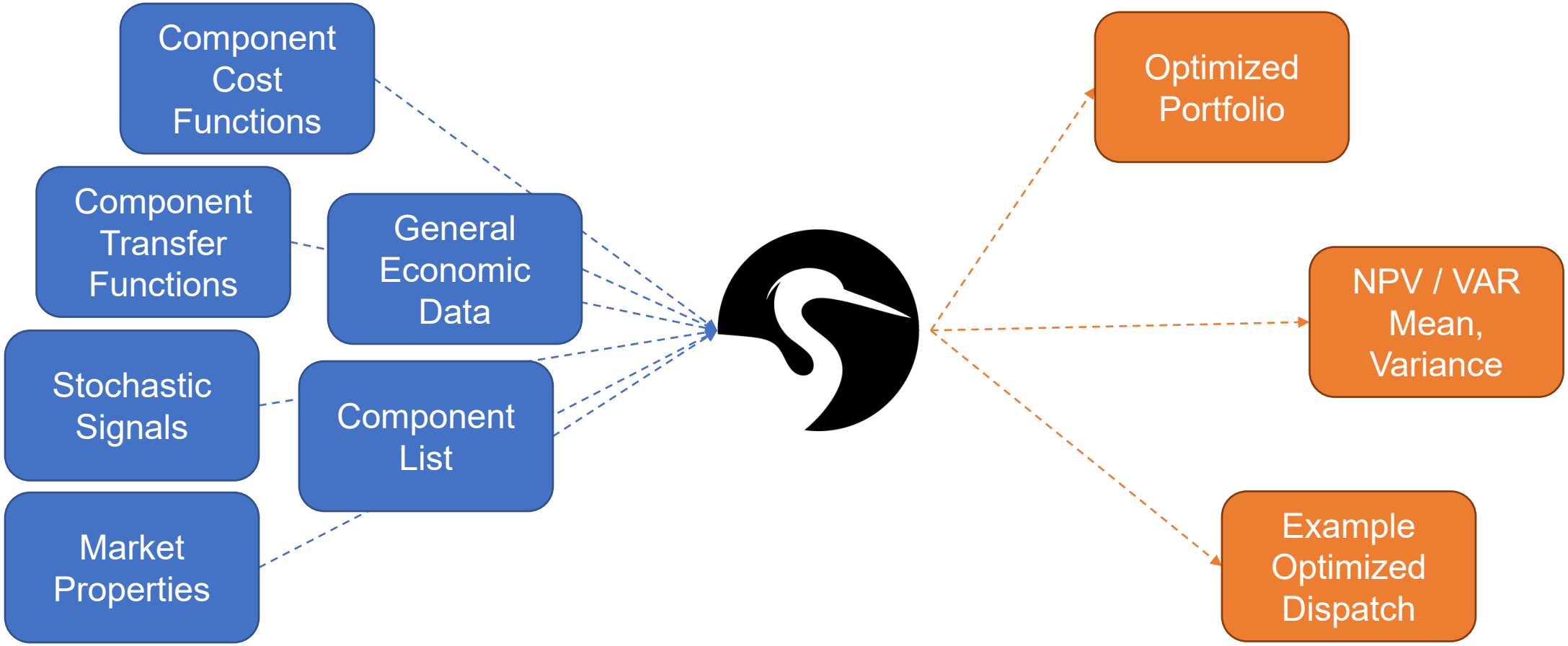
HERON I/O



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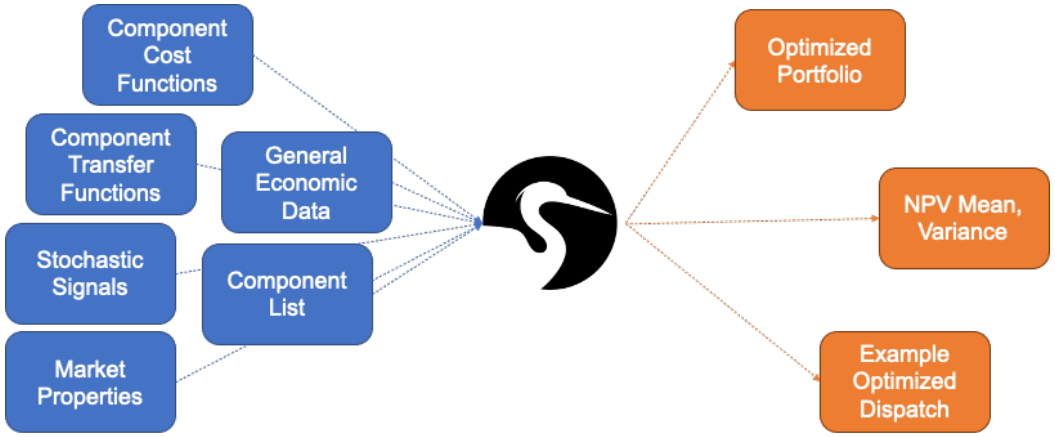
HERON Inputs

- Component List
  - All components you want in your simulation
  - Sources
    - Generators
    - Producers
  - Sinks
    - Demand sources
    - Markets
  - Storage
    - Batteries
    - Commodity Storage



- Where do I find these?
  - Problem Definition
  - Determining what questions you want to answer
  - Previous Examples (HERON, FORCE Github)

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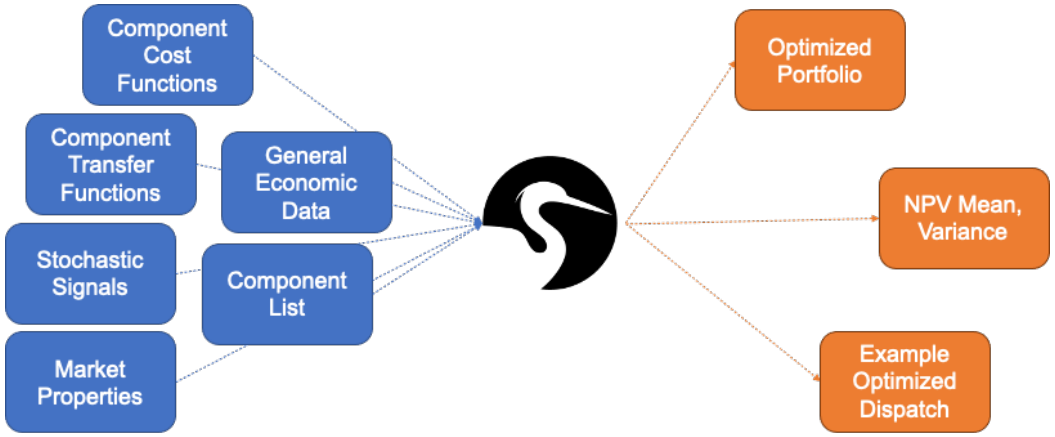
HERON Inputs

- Component Cost Functions
  - Capital construction costs
  - Fixed OM costs
  - Variable OM costs
  - Fuel costs
  - Economy of scale
  - Policy Incentives



- Where do I find these?
  - Literature (EIA, industry reports)
  - Previous studies (OSTI, HERON github)

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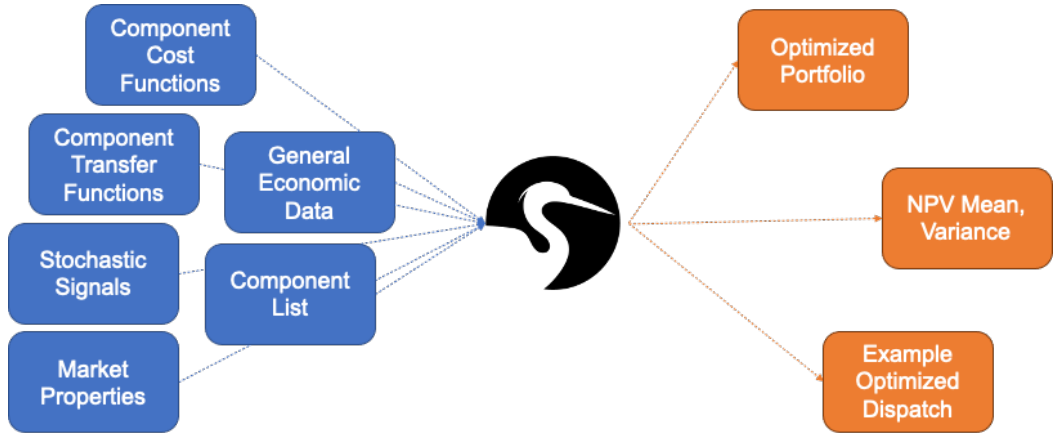
HERON Inputs

- Component Transfer Functions
  - Commodities consumed
  - Commodities produced
  - Reasonable sizing
  - Transfer function
    - Currently linear, but extensible



- Where do I find these?
  - Previous studies (OSTI, HERON github)
  - HYBRID simulations
    - Aspen, Modelica

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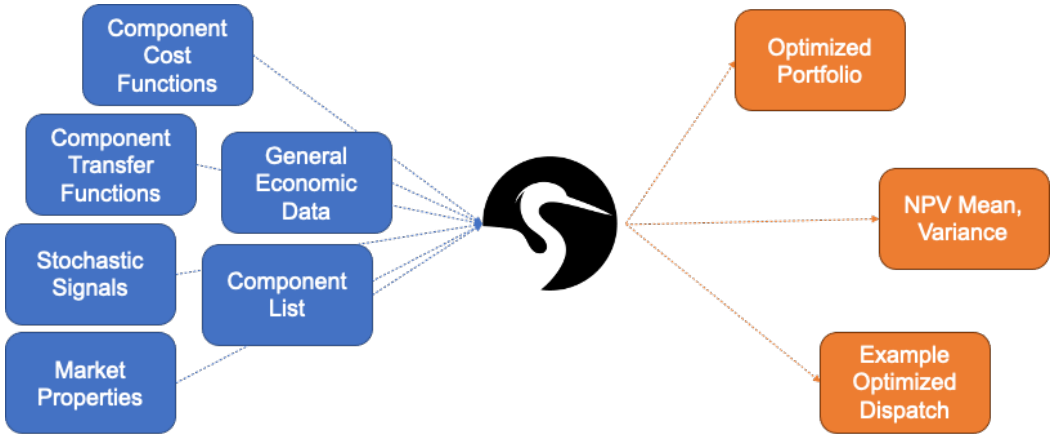
HERON Inputs

- Stochastic Signals
  - Wind
  - Solar
  - Market prices
  - Commodity demand



- Where do I find these?
  - Public databases (NREL solar, wind, ERCOT, PJM, etc)
  - Capacity Expansion Models
  - Stay tuned for session on synthetic history training!

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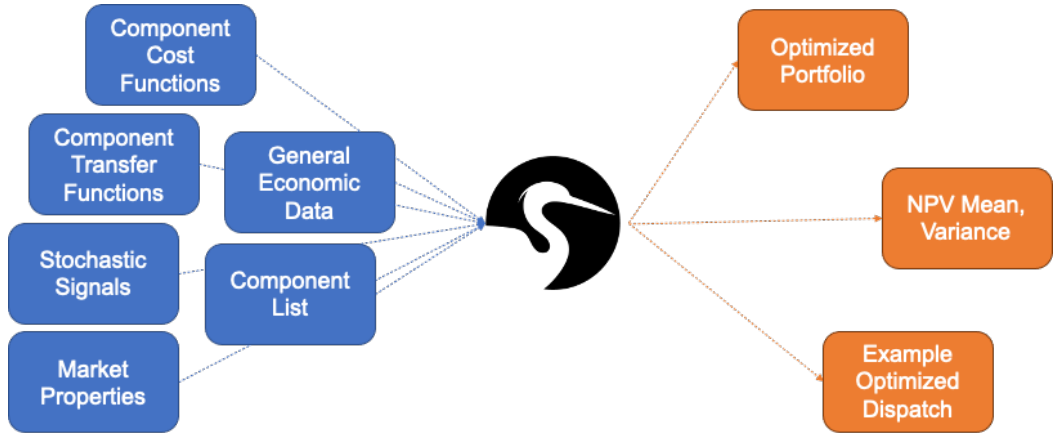
HERON Inputs

- Market Properties, General Economic Data
  - Ancillary market depth, prices, limitations
    - Capacity market
    - Frequency control

- Where do I find these?
  - Specific to each ISO
  - Industry Reports
  - Proposed Policy



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What's Next?

- Documentation
  - User manual
  - Workshop cases
- Other Examples
  - HERON regression tests
  - FORCE repo
    - Previous full studies
- Collaboration
  - Email Aaron.Epiney@INL.gov

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