Hybrid Resources

ESIG
ENERGY SYSTEMS INTEGRATION GROUP

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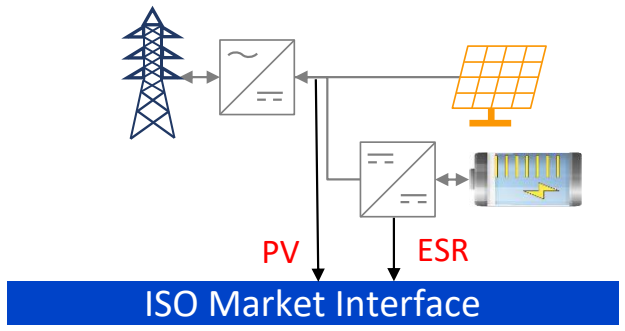
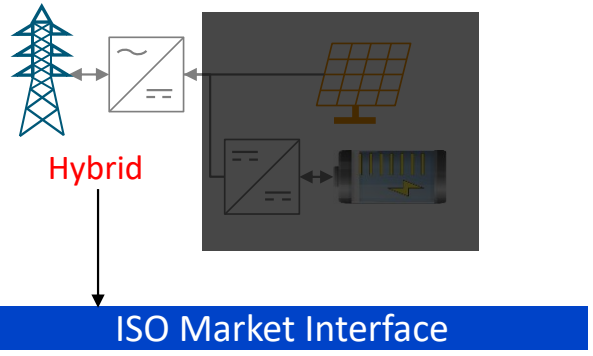
Co-Located versus Hybrid Resource

Separately represent each resource, with minimal changes to existing market designs

Option A: 2R ISO-Managed *Co-located* Model



Option B: 1R Self-Managed *Hybrid* Model



Single offers and operating parameters allows participant bidding strategy flexibility

ESIG Reports and Fact Sheets on Hybrid Resources
https://www.esig.energy/unlocking-the-flexibility-of-hybrid-resources/

FERC Docket AD20-9-000
https://elibrary.ferc.gov/eLibrary/docketsheet?docket_number=AD20-9-000

Image Source: Electric Power Research Institute

Philosophy of Hybrid Resources

An “intelligent agent” approach for a system of technologies that offers energy and services at the grid point of interconnection (POI) like a conventional resource, but with more flexibility and fewer constraints through coordinated use of energy, storage, power electronics and software

Or said another way…

With sufficient energy, storage, electronics and software,
we can emulate any kind of electrical machine that we want or need

Why “overbuild” behind the grid POI?

For the most economical and capable design…

- A 100 MW PV plant contains more than 100 MW of PV panels
- A 100 MW hybrid or co-located plant contains more than 100 MW of solar+storage
- For almost any hybrid (including load hybrids), internal MW will exceed the grid injection limit at the POI

because the grid interconnection is the most expensive component

Who should run these chimeras? And how?

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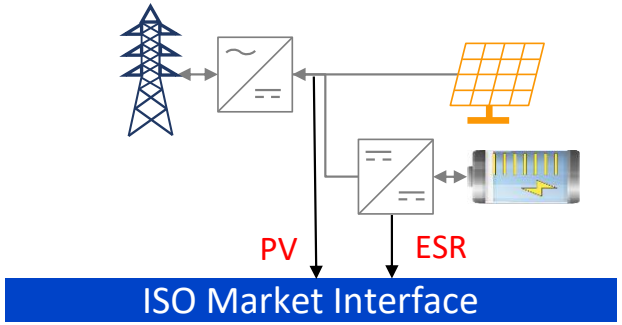

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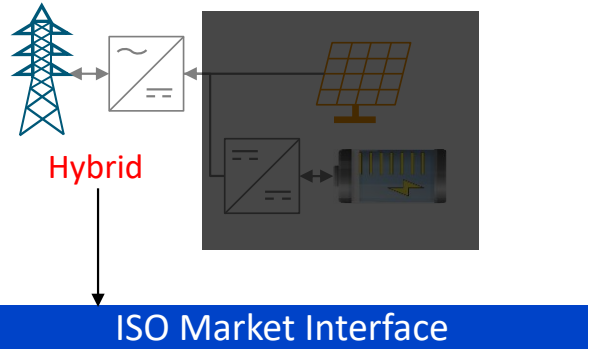


Single offers and operating parameters allows participant bidding strategy flexibility

Option C: 1R ISO-Managed-Feasibility *Hybrid* Model

Add telemetry requirements to allow ISO to limit infeasible schedules during critical times

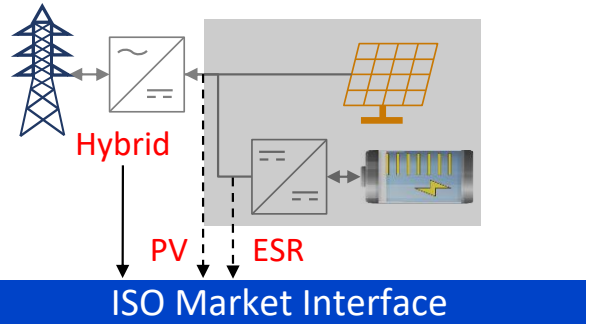
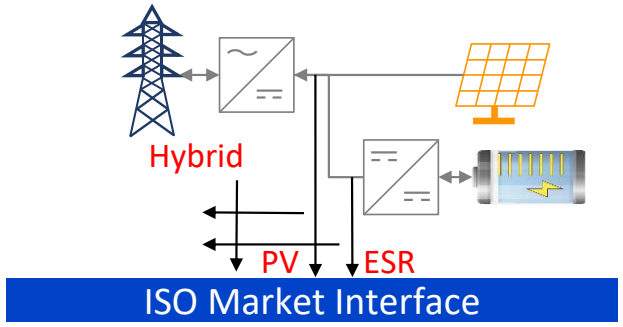


*figure illustrates dc-coupled strategy for demonstration purposes

Option D: 2R Linked *Co-located* Model



Add linking constraint to increase ISO's and asset's ability to operate and represent the resource's dependencies

Source: Electric Power Research Institute

I’ve seen this before…

I’m so old…

- Wrote software programs on punch cards and paper tape
- Toggled the bootstrap code into a PDP-11 minicomputer
- Wrote assembly code to digitize and analyze heart beats and process images
- Designed monolithic, top-down programs to squeeze out every drop of efficiency

- And then learned better

What did we learn from software, the internet, the web, and other complex systems?

- Complexity can and must be managed
- System architecture is important
- A progression of design principles
  - parameterized subroutines
  - object-oriented design and software
  - service-level interfaces
  - Intelligent cooperating agents
- Manage complexity by making parts of it be another expert’s responsibility, even with some cost of “optimal” efficiency

What this means for complex systems in general

- We don’t need to control the internal details of every resource (and ultimately, we can’t).
- By focusing on services and performance, we can have a more reliable and maintainable system even in the face of exponential increase in complexity and participants.
- What is the primary role of the system operator?
- Can grid management and market platforms be simplified and keep up with new capabilities?

What hybrids and challenges are next?

Massive load expansion

- Green and blue hydrogen
- Carbon capture & storage
- ERCOT's Large Flexible Loads
  - Crypto mining
  - Datacenters and AI
  - Hydrogen
  - LNG
  - Electrification
- Long-duration storage

Challenges

- Transmission
- Interconnection complexity
- Grid defection risk
- Legacy grid management and market software platforms
- Exponential increases:
  - innovation and analytics
  - number of participants
  - system complexity

THANK YOU

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