Flexible Market Participation Models for the Future

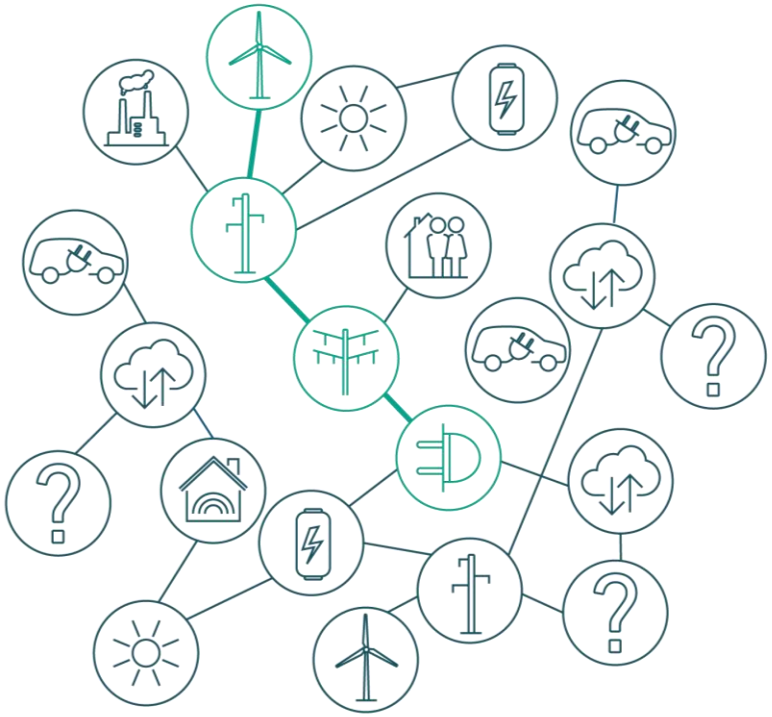
Does flexibility cause us to rethink roles and products?

Mark Ahlstrom, ESIG and NextEra Energy Resources

ESIG

ENERGY SYSTEMS INTEGRATION GROUP

The future is complicated



From Peter Jørgensen, Energinet

Participants are increasingly digital, dynamic, intelligent and programmable

We want solutions that are fair, performance-based, system-optimal, technology-agnostic and scalable

What can decades of software engineering teach us?

Today, focusing on two timely topics:

- Flexible market participation models
- Substitution of services in ancillary service co-optimization

The digital disruptor – battery energy storage

We may only need modest amounts of battery energy storage on the bulk power system, but this will dramatically alter our approaches to power system operations and electricity markets

FERC Order 841 requires electricity markets to create an energy storage market participation model that allows a resource to:

- Provide all capacity, energy, and ancillary services that the resource is technically capable of providing
- Be dispatched and set price as both a wholesale seller and buyer
- Use bidding parameters for physical and operational characteristics

Traditional approach to new resources

Increasing complexity and rate of innovation, moving toward digital pace of innovation

Solar + Storage | Wind + Storage | Wind + Solar | DER Aggregation | Innovative New Ideas

Battery Energy Storage Plant *(much more extensive use of bidding parameters)*

Pmax=40MW, Pmin=-40MW, Ramp rate=20MW/s, Startup time=300ms, Max Energy Limit=160MWh, …
State of charge=80%, charge/discharge times, transition time between charging/discharging, …
(+ participate in regulation reserve, spinning reserve, online supplemental reserve, quick start, etc.)

Wind or PV Solar Plant

Pmax=*forecast*, Pmin=0, Ramp rate=100MW/min, Startup time=30 seconds, …

Minor redefinition of existing bidding parameters, but largely forced into the existing models

Conventional Plant

Pmax=500MW, Pmin=200MW, Ramp rate=5MW/min, Startup time=24hours, …

Some bidding parameters, but many assumptions and customizations are programmed into energy management and market software (such as for natural gas combined cycle plants)

General Tariff and Bidding Parameters

Cost curves, Pmax, Pmin, Ramp rate, Startup time, …

Based on the world as we knew it (mostly steam and hydro generators)

Alternative – One parameterized resource type

Technology-independent qualifications and performance expectations

Idealized model of a highly flexible generator/load resource

Pmax, Pmin, Ramp rate, Startup time, Max Energy Limit, State of charge, …
Charge/discharge times, transition time between charging/discharging…
Ancillary services: regulation reserve, spinning reserve, online supplemental reserve, quick start, …

Software (EMS, MMS, etc.) implements and tests for this single resource type and full range of its parameters

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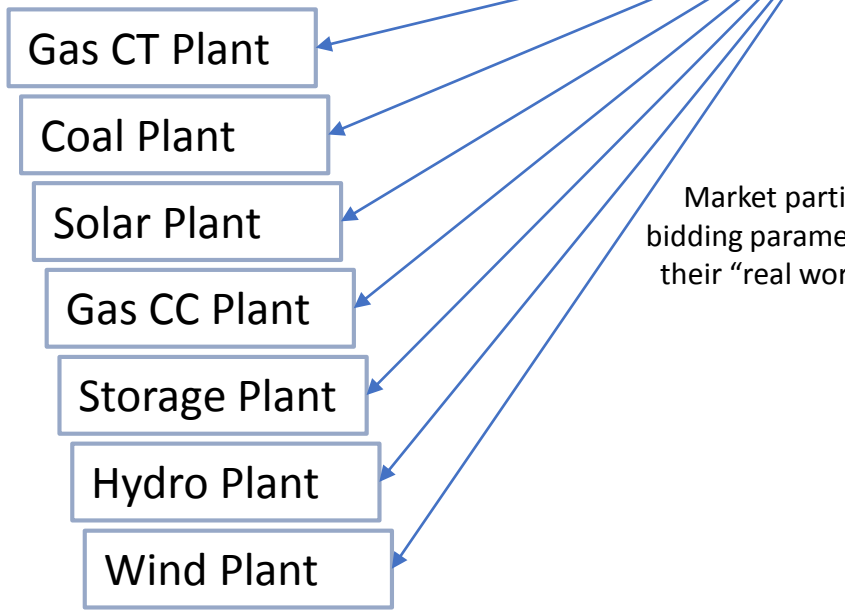
Market participant's role is to create, bid and perform based on their offers



Market participant sets bidding parameters to match their "real world" resource

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Market participant's role is to create, bid and perform based on their offers

- Gas CT Plant
- Coal Plant
- Solar Plant
- Gas CC Plant
- Storage Plant
- Hydro Plant
- Wind Plant

Market participant can also use bidding parameters to create novel and useful resources without needing new resource types or market participation models

- Solar + Storage Plant
- Wind + Storage Plant
- Innovative Hydro Plant
- Dual Fuel Plant
- Combined Heat/Power
- Virtual Power Plant
- DER Aggregate Plant

Energy behind an inverter

A battery storage system is energy (and load) behind an inverter

Order 841 does not require all energy to come from or return to the grid

Many things can be energy behind an inverter

- PV solar, wind, or even conventional resources
- Distributed, load responsive, and behind-the-meter resources
- Generation tie lines (AC or DC)
- HVDC lines that cross seams or interconnections

Some of them might even have some “real” battery storage

Substitution of services – not a new idea

Allow substitution of higher quality service if it lowers overall cost

- Part of the CAISO Market Redesign going back to 2007

Implemented through co-optimization of energy and ancillary services

- Applied to regulation, spinning reserve, and non-spinning reserve

A new world – need a new perspective?

With conventional resources, we are used to thinking about getting services from a small number of slow resources

- For a six-hour ramp, let's use resources that can continuously ramp for six hours
- For four-hour capacity needs, let's use resources that can sustain for four hours

With today's software capabilities and larger fleets of faster resources, we can emulate a wide range of services

- Build the highest value services from a larger population of smaller building blocks

Substitution of services – a hypothesis

What can we build with a larger population of smaller, faster building blocks?

- Pretty much whatever we want…
  - We need to understand the critical time periods and the available resources (like now)
  - We need to understand what is most valuable for a given time period (like now)
  - We need to move past thinking of services in terms of “baseload blocks” of simple capabilities
  - Smaller blocks should be cheaper, and their “optionality” makes them more valuable

Using co-optimization and substitution of services, and building the highest value services from a larger population of smaller building blocks, I posit that we can emulate the full range of ramping and capacity services

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