NEW YORK STATE OF OPPORTUNITY. | Department of Public Service

Zero Emissions by 2040 Technical Conference

15-E-0302

Dec. 11-12, 2023

Agenda (1st day)

- Introduction: 0x40 proceeding, conference scope and objectives
- Panel: Gap Characterization
- Panel: Just Transition / Climate Justice
- Lunch ---*please return promptly*---
- Panel: Demand-Side Resources and Virtual Power Plants
- Panel: Long-Duration Energy Storage

- Use the **chat** function to ask questions for Q&A
- Today's recording and presentation materials will be posted on DMM

Agenda (2nd day)

- Quick welcome back
- Panel: Methane-consuming resources
- Panel: Hydrogen
- Panel: Nuclear
- Closing

- Use the **chat** function to ask questions for Q&A
- Today's recording and presentation materials will be posted on DMM

Next Steps

- Yes, the conference is being recorded
- All filings for this proceeding are under Case 15-E-0302 on the Dept.'s Document and Matter Management System (DMM)
- Deadline for responses to the October 20, 2023 Notice Seeking Further Comments is January 19, 2024
- Post-conference comments that respond to points made – or missed – by conference participants are welcome

New York ISO
Independent System Operator

Dispatchable Emission-Free Resources (DEFRs)

Zach Smith

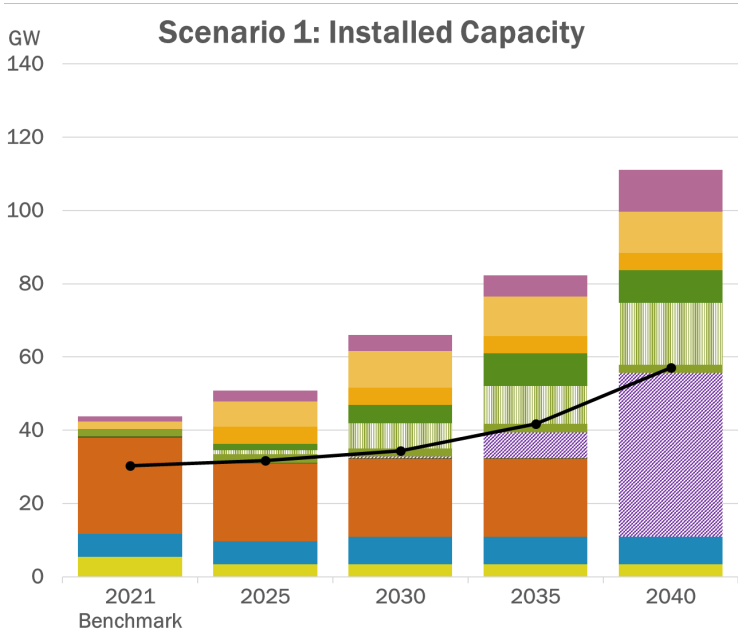
Vice President, System & Resource Planning

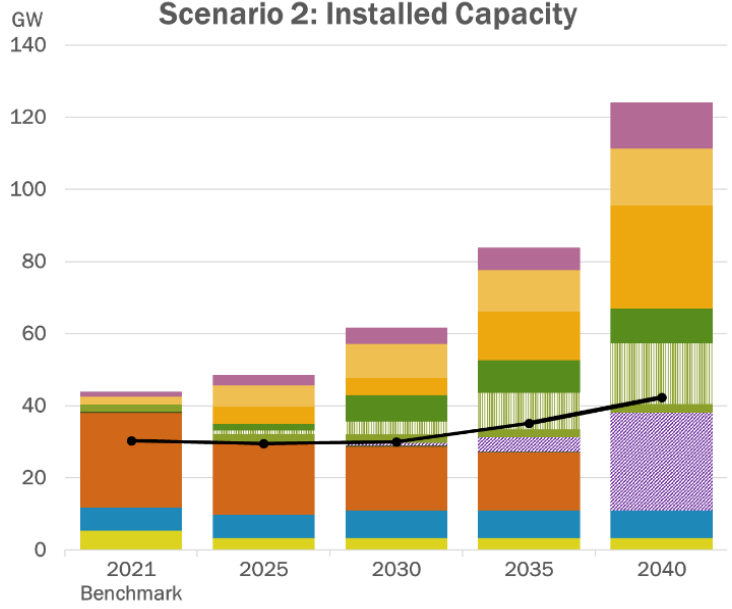
DPS Technical Conference

December 11, 2023

Resource Outlook:

✓ Significant new resource development will be required to achieve CLCPA energy targets.



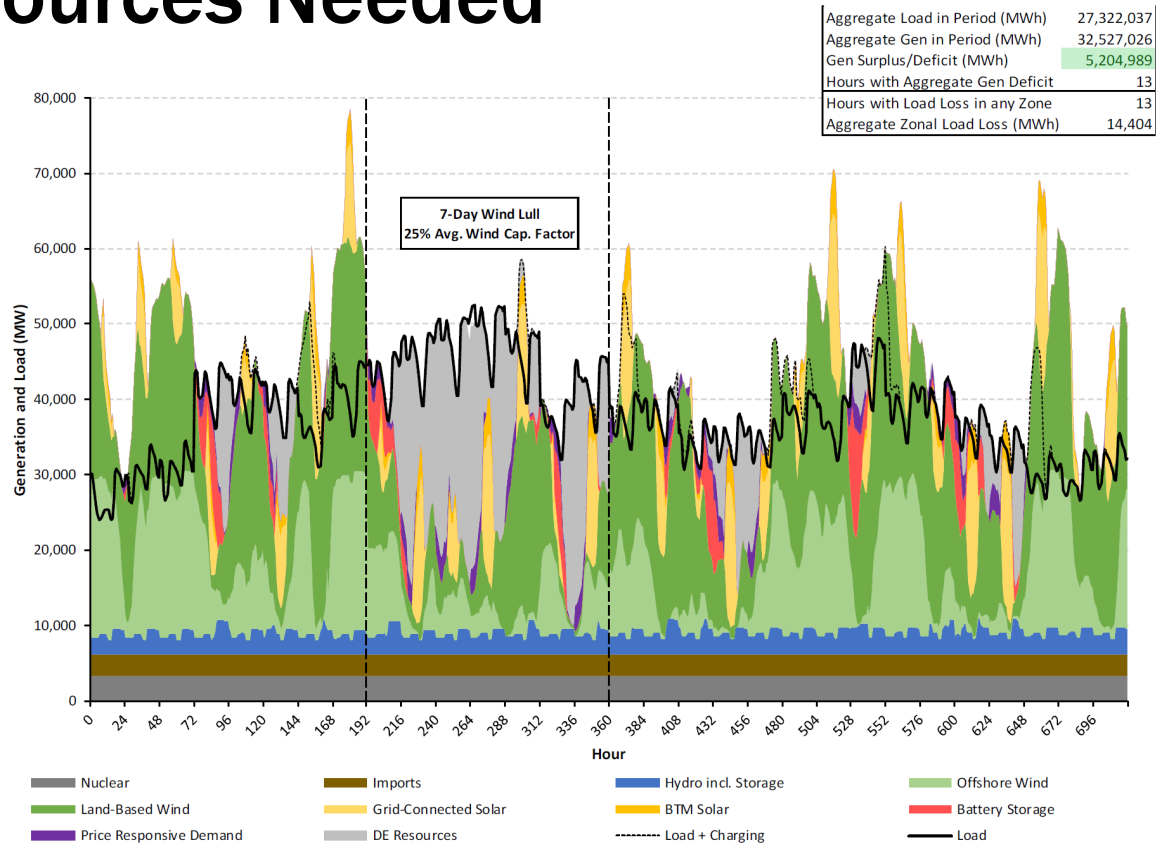


ExistingNuclear NewNuclear Hydro ExistingFossil NewFossil Other DEFR
ExistingLBW NewLBW OSW UPV BTM-PV ESR Peak Load

ew York ISO

Dispatchable Resources Needed

- Large quantity of installed dispatchable resources are needed in a small number of hours
- Dispatchable resources must be able to come online quickly, and be flexible enough to meet rapid, steep ramping needs



New York ISO

Dispatchable Emission-Free Resources

✓ **To achieve an emission-free grid, dispatchable emission-free resources (DEFRs) must be developed and deployed throughout New York.**

- As resources shift from fossil generators to zero emission resources, essential grid services, such as operating reserves, ramping, regulation, voltage support, and black start, must be available to provide New Yorkers with a reliable and predictable electric system that consumers require.
- DEFRs will be required to provide both energy and capacity over long durations, as well as the reliability attributes of retiring synchronous generation. The attributes do not need to be encapsulated in a singular technology, but in aggregate the system needs a sufficient collection of these services to be reliable.

New York ISO

Attributes for Reliability

1. **Dependable Fuel Sources** that are carbon free and allow these resources to be brought online when required
2. **Non-Energy Limited** and capable of providing energy for multiple hours and days regardless of weather, storage, or fuel constraints
3. **Dispatchable** to follow instructions to increase or decrease output on a minute-to-minute basis.
4. **Quick-Start** to come online within 15 minutes
5. **Flexibility** to be dispatched through a wide operating range with a low minimum output
6. **Fast Ramping** to inject or reduce the energy based on changes to net load which may be driven by changes to load or intermittent generation output
7. **Multiple starts** so resources can be brought online or switched off multiple times through the day as required based on changes to the generation profile and load
8. **Inertial Response and frequency control** to maintain power system stability and arrest frequency decline post-fault
9. **Dynamic Reactive Control** to support grid voltage
10. **High Short Circuit Current contribution** to ensure appropriate fault detection and clearance

New York ISO

Attributes of Sample Technologies

		2023 NYCA Summer Capacity (MW)	Energy Attributes						Other Reliability Attributes			
			Carbon Free	Dependable Fuel Source	Non-Energy Limited	Dispatchable	Quick Start	Flexible	Multi Start	Inertial Response	Dynamic Reactive Control	High Short Circuit Current
Sample Technology	Fossil	25,667	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Hydro	4,265	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Pumped Storage	1,407	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Hydrogen Fuel Cell	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
	Hydrogen Combustion	0	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Nuclear	3,305	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
	Modular Nuclear	0	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes
	Battery	0	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No
	Solar	154	Yes	No	No	No	Yes	Yes	Yes	No	Yes	No
	Wind	2,051	Yes	No	No	No	Yes	Yes	Yes	No	Yes	No
	Demand Response	1,234	Yes	Yes	No	No	No	Yes	No	No	No	No
	Synchronous Condenser	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes	Yes	Yes	Yes

*see figure 39 of the CRP report for more detail

New York ISO

Reference Material

https://www.nyiso.com/library

- 2023-2032 Comprehensive Reliability Plan
- 2021-2040 System & Resource Outlook
- 2022 Reliability Needs Assessment
- Climate Change Impact & Resilience Study

Stakeholder discussions: https://www.nyiso.com/espwg

New York ISO

Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

New York ISO

Demand flexibility & VPPs

How to unlock and accelerate DERs to achieve zero-carbon generation

December 2023

OhmConnect

We know how to fight climate change...

Reaching a zero-carbon emissions energy economy is possible, but will require a new energy paradigm encouraging flexibility and dynamic responsiveness.

Zero-carbon electricity

US set goal to be 100% carbon-free generation by 2035.

Electrify everything

Massive $856B in federal and state investments into building and transport electrification

Load Flex

Load flexibility sets us on a path to reduce GHG by 75%, lowers customer cost, and improves grid reliability.

...but we are on the brink of failure.

Ratepayers' ability to pay increasing costs is faltering and grid operators are struggling to keep the lights on.

Majority Mainstream Consumers

Consumers have clearly voiced a need for better control over electricity costs and relief on bills.

Behind on bills

One in four Americans are behind on energy bills with no relief in sight.

Cost Surge

Electricity bills are skyrocketing upwards of 50% in some regions.


Bloomberg

Subscribe

Businessweek + Equality

A 'Tsunami of Shutoffs': 20 Million US Homes Are Behind on Energy Bills

Surging electricity prices spur worst-ever crisis in late utility payments.

Grid Operators & Utilities

The grid is buckling under increasing demand, accelerating climate impact, and aging infrastructure.

Failing Reliability

Blackouts have increased 64% in recent years due to extreme weather.

Aging Infrastructure

Grid will need to cope with 20x renewable intermittency by 2050


THE WALL STREET JOURNAL.

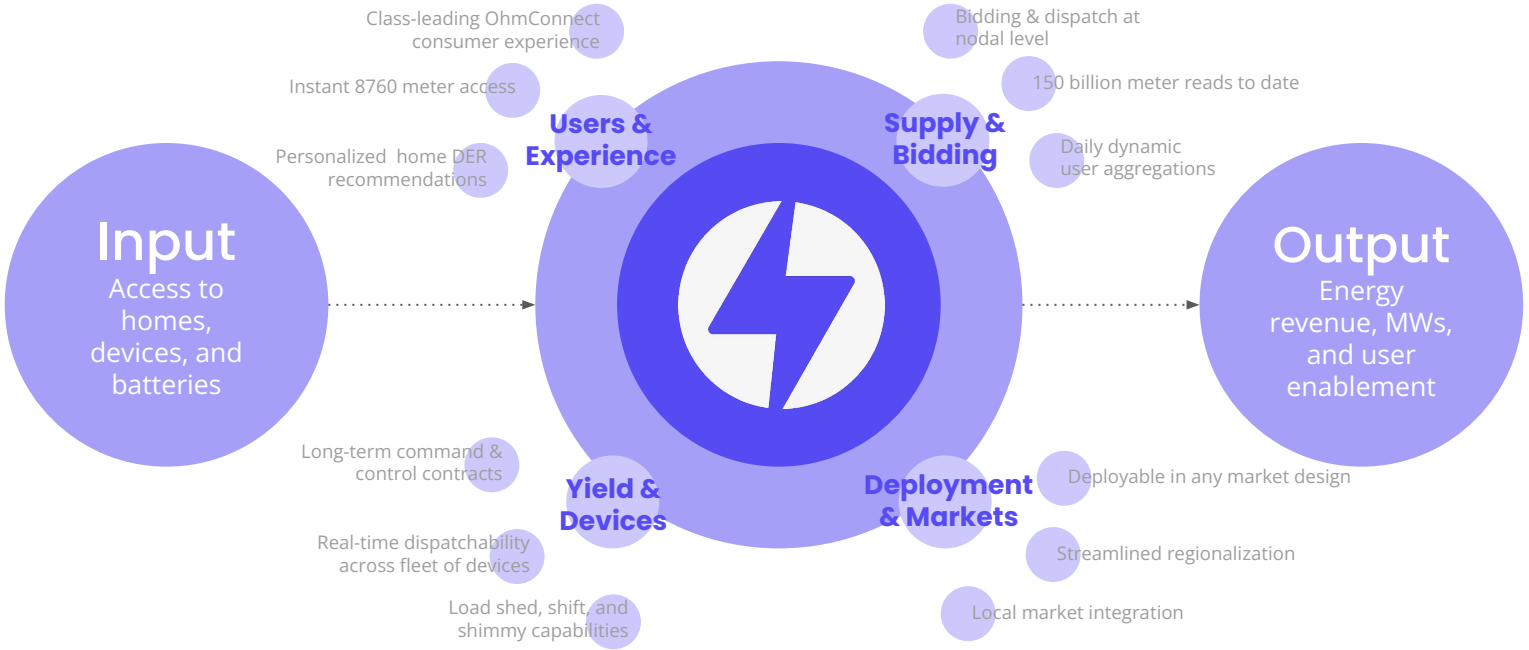
BUSINESS

America's Power Grid Is Increasingly Unreliable

Behind a rising number of outages are new stresses on the system caused by aging power lines, a changing climate and a power-plant fleet rapidly going green

Software-based VPP connects home devices to the grid.

Through four key operational pillars, OhmConnect generates grid value from storage, EVs, thermostats, smart plugs, and homes.



Tremendous grid value remains latent in home.

Market design and residential restrictions limit the rate payer value of current energy flexibility programs

Assets Required

Three pillars to fully optimize the home and grid of future.

Residential Design

Tremendous amount of flexibility is being stifled due to C&I-centric market design.

Data Access

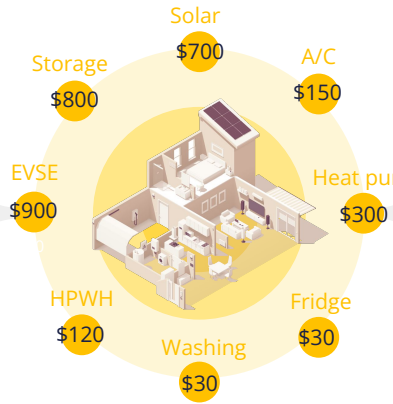
Meter data, user enrollment information, and device-level telemetry needs to be accessible.

Home Electrification

Facilitate adoption and low-cost financing efficient electric appliances within residences.

Home Management System

Lower bills. Clean energy. Increased comfort. Big annual customer value.



*Approximate total consumer energy value of device

Grid Services

Three potential paths to bring the EMS to market efficiently and profitably.

Load Shift

Optimize residential load to maximize renewable consumption and mitigate GHG emissions.

Dynamic distribution

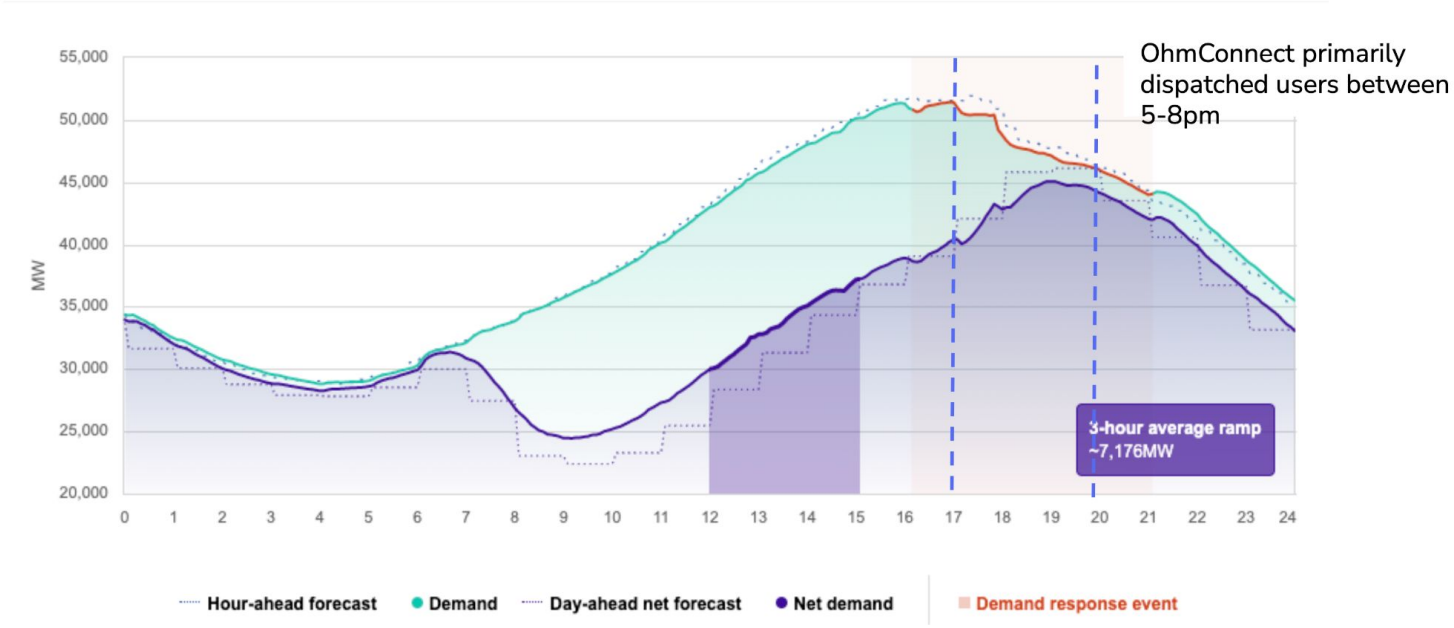
Localized flexibility to deliver load relief, network awareness, and reliability while offsetting investment costs.

RA & wholesale energy

Transmission based resource adequacy and DA and RT economic dispatch.

Flexible demand has proven successful at scale.

During California's heatwave in 2022, which broke demand records, flexible demand was dispatched to avoid reliability issues. Customers showed up and delivered.



Local flexibility & visibility enable next generation relief.

With the proliferation of flexible residential assets and highly distributed nature of homes, unprecedented precision can be achieved to balance demand at local levels.

Generation

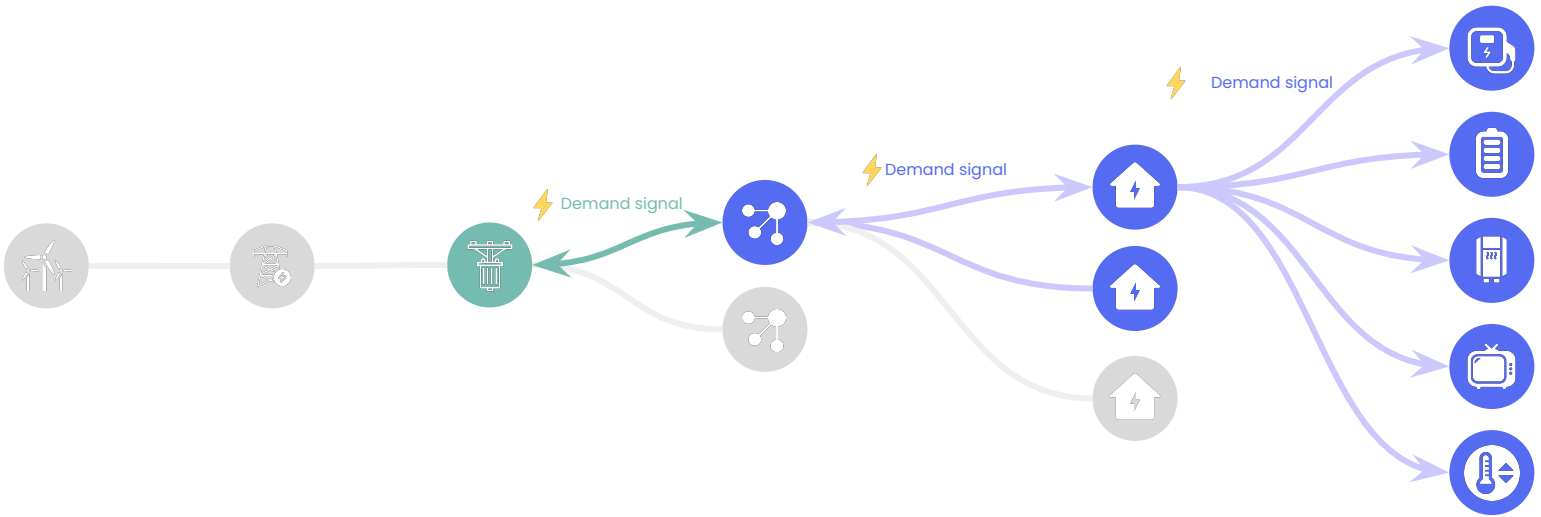
Bulk transmission

Distribution system operator

Inter-network Balancing
DER aggregator balances load between discrete networks based on demand signal from DSO.

Intra-network Balancing
DER aggregator balances load between homes co-located on a single network.

Household balancing
DER aggregator balances load depending upon customer preferences and grid conditions.



Distributed residential aggregator

OhmConnect

Three key issues remain to catalyze NYS flexible demand.

While VPPs have begun to deploy, key issues remain that need to be resolved to unlock the full potential of VPPs and flexible energy.

Data Access & Enrollment

1. Access to full suite to required customer information to enroll in flexibility programs
2. Streamlined “one-click” customer enrollment

Market design & integration

3. Reasonable telemetry requirements for residential NYISO DER participation
   - Net metered participation
4. using gross consumption
   - Qualified device-level data
5. used for settlement purposes
   - Consider DSO construct to
6. better manage sub-nodal balancing & relief

DER Adoption & Equitable Benefits

7. Require grid-responsive capabilities for certain devices / appliances
8. Facilitate point-of-sale rebates & discounts to minimize customer confusion
9. Increase LMI / DAC incentives for procurement of grid-responsive storage

Thank you

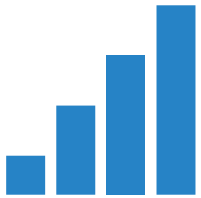
curtis@ohmconnect.com

UNLEASHING VIRTUAL POWER PLANTS AND DISTRIBUTED ENERGY RESOURCES FOR 0 X 2040

DECEMBER 11, 2023

STACK ENERGY CONSULTING

AGENDA



Maximizing Distribution-Connected Front-of-Meter DERs

Create Department for Project Expediting

Unlocking Flexibility

MAXIMIZING DISTRIBUTION-CONNECTED FTM DER

As of December 2022, only 130 MW of storage completed. 87% of projects targeted to 14% of NYC due to 16x charging cost difference

1

Finalize storage roadmap expeditiously with large initial block sizes for upfront incentives; prioritize downstate

2

Significantly increase 15 MWh incentive cap for upfront incentive

3

To enable development in the other 86% of NYC, restart entry to Con Edison's Modified High Tension program for network-connected storage; LIPA

DEPARTMENT FOR PROJECT EXPEDITING

Attack difficulty of developing in NY; 354 MW of storage approved for bridge incentive prior to Dec 2019 were incomplete in December 2022

1

Create a cross-state-city team focused on expediting project installations (while meeting safety/reliability) and attracting/retaining developers

2

Go to resource for developers with relationships and knowledge of agencies and utilities; “account executive” model with bonus compensation for reducing installation timeframe and customer satisfaction

3

Ability to influence agency and utility budgets, hold prompt hearings to resolve disputes, and provide bonuses or fines to utilities

UNLOCKING FLEXIBILITY

Boosting participating in grid services programs

1

Create a "Total System Benefit" option that provides differentiated hourly compensation for MWh across all value streams, with certain value streams fixed for 5-15 years

2

Before building new transmission or undertaking major upgrades, analyze what penetration of new VPPs, dispatching during what hours, in what locations, in what years, would it take to defer investments and create programs and obligations to meet the need

3

BTM: Enable device-level submetering for settlement; dedicate staff to resolving data access issues; increase installation incentives for technologies that facilitate curtailment; pro-active, dynamic approach to rate reform; continued NYISO engagement

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STACK ENERGY
CONSULTING

NY DPS Zero-Emissions: Tech conference

Ben Hertz-Shargel

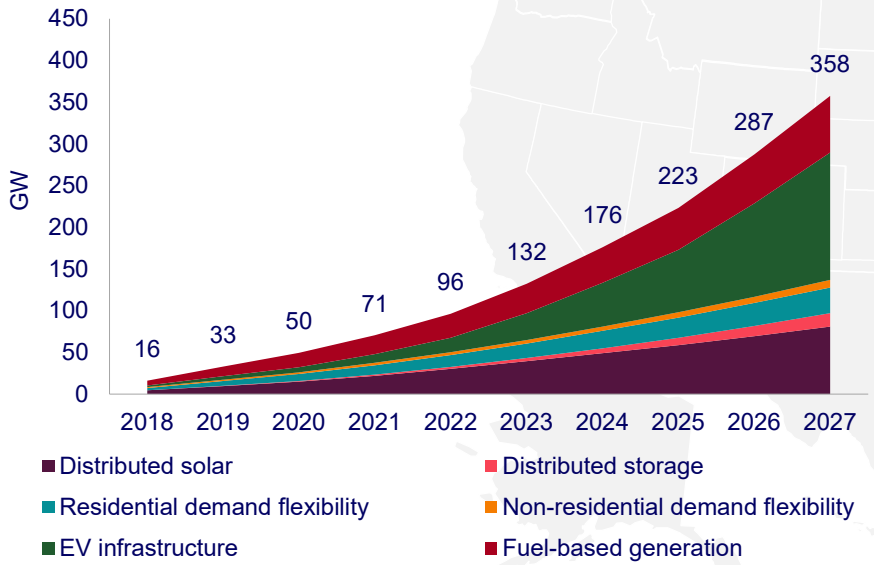
Global Head of Grid Edge

12/11/2023

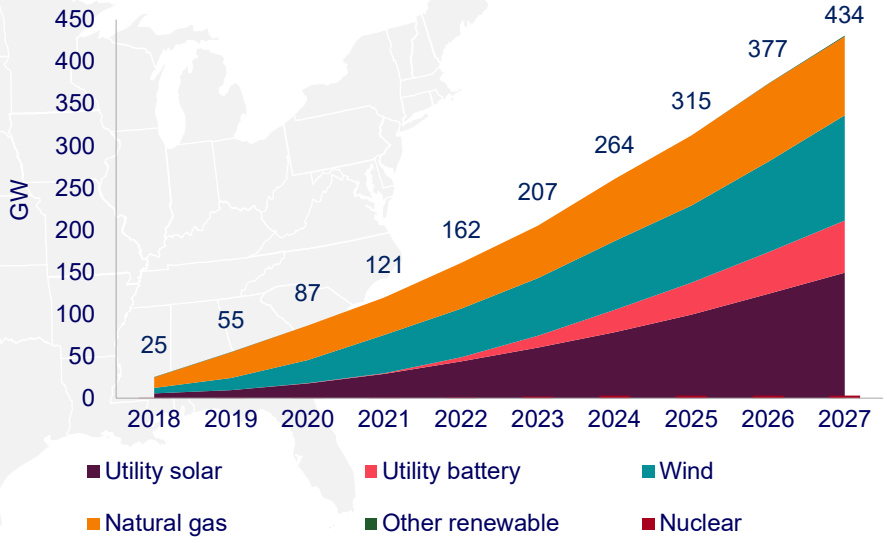
DERs represent a vast, inexpensive, and politically attractive flexibility resource

It is easier to justify paying customers than generators

Cumulative DER capacity additions since 2018



Cumulative bulk generation capacity additions since 2018



Source: Wood Mackenzie Grid Edge, US Distributed Solar, and Energy Storage Service

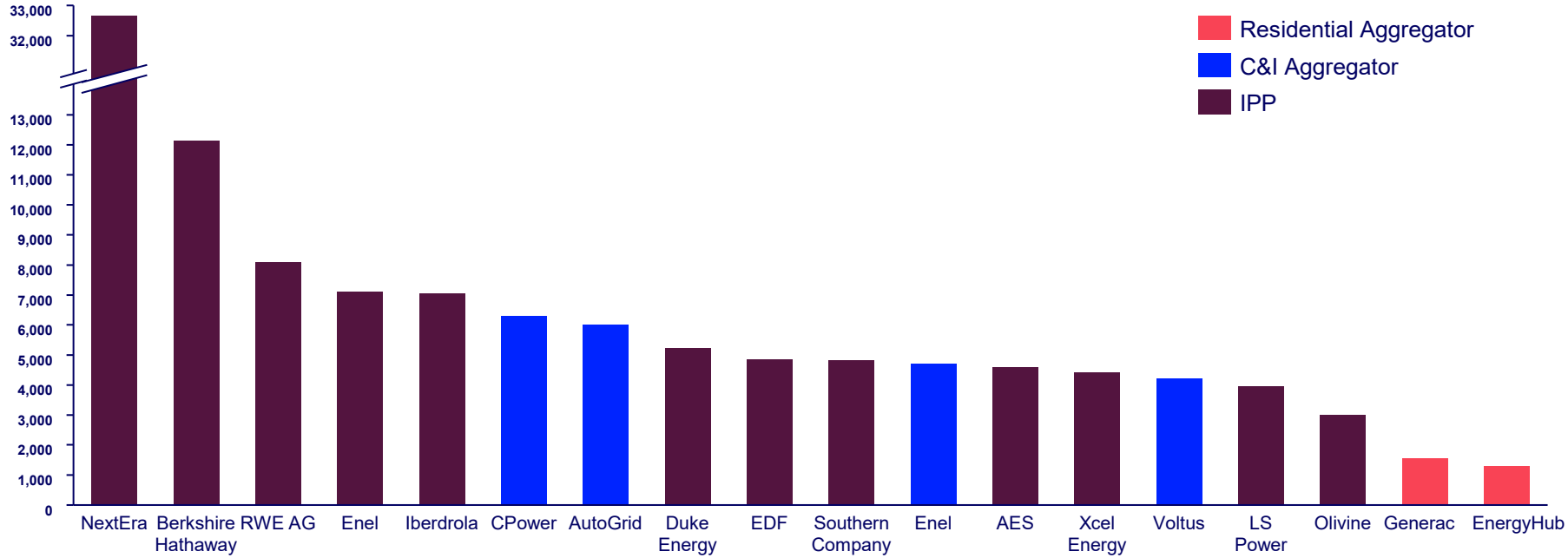
Source: Wood Mackenzie North American Power Service

Wood Mackenzie

Rise of the Independent Power Reducers

DER aggregators' portfolios are reaching the scale of IPP portfolios, making them valuable partners

Capacities of largest solar, wind, and storage portfolios vs largest VPP portfolios (MW)

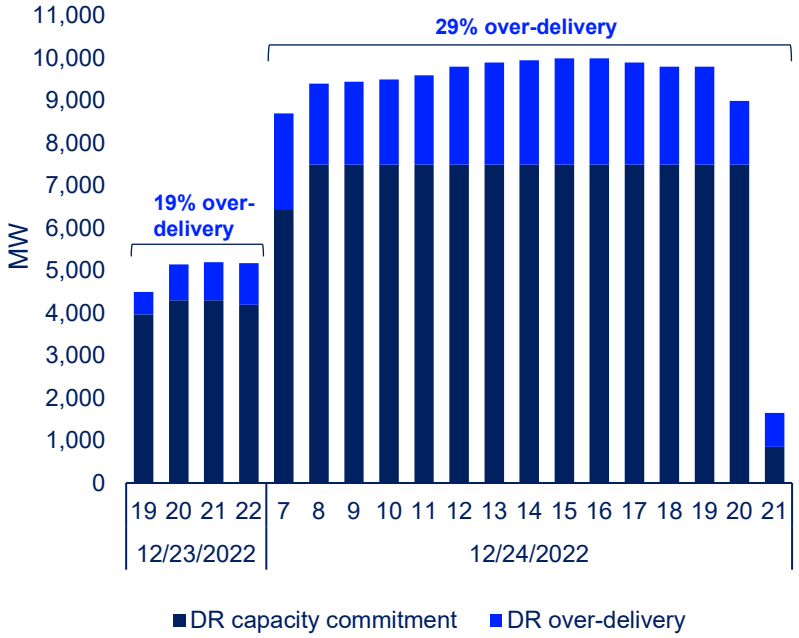


Source: Wood Mackenzie Grid Edge Service

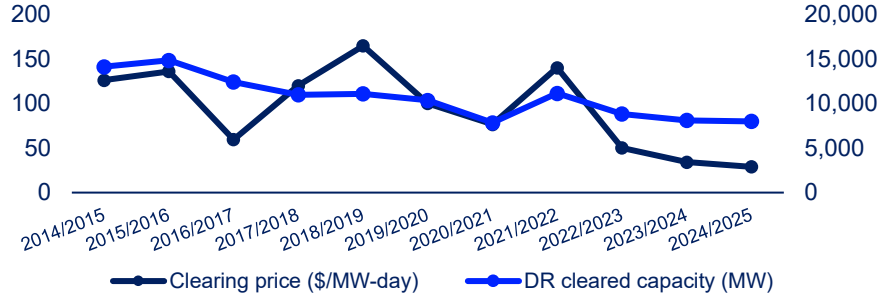
PJM is slowly losing a critical reliability resource

DR over-delivered during Winter Storm Elliot, but capacity price declines have made it increasingly hard for aggregators to enroll and retain C&I customers

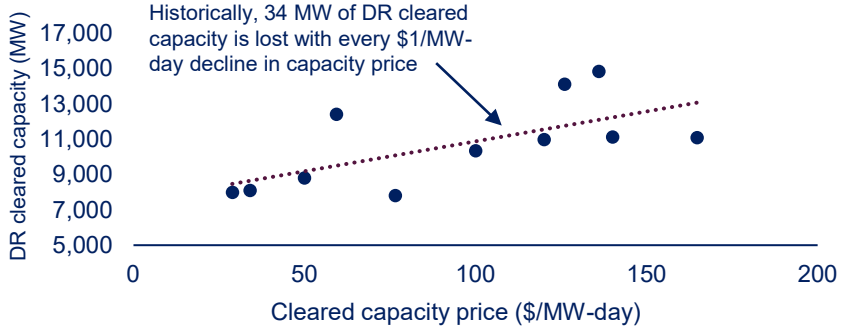
DR capacity commitments and over-delivery by hour during Winter Storm Elliot



PJM capacity prices and DR cleared capacity by delivery year



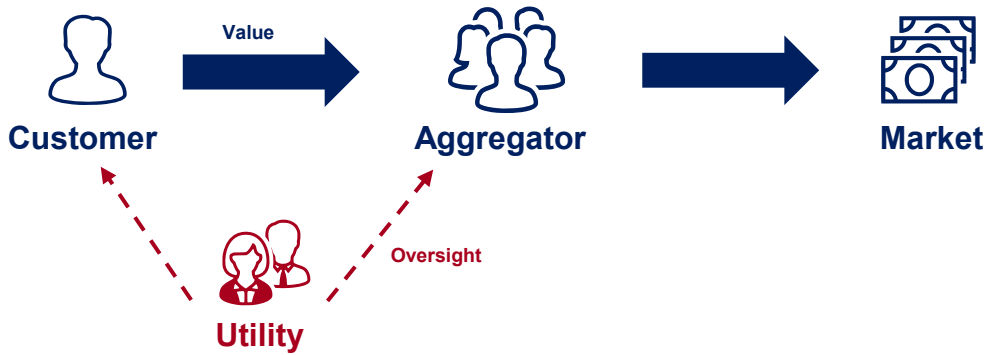
Relationship between capacity price and DR cleared capacity



Source: Wood Mackenzie Grid Edge Service, PJM

Both aggregators and utilities would benefit from an alternative to the 2222 model

Utility disintermediation model (FERC 2222)



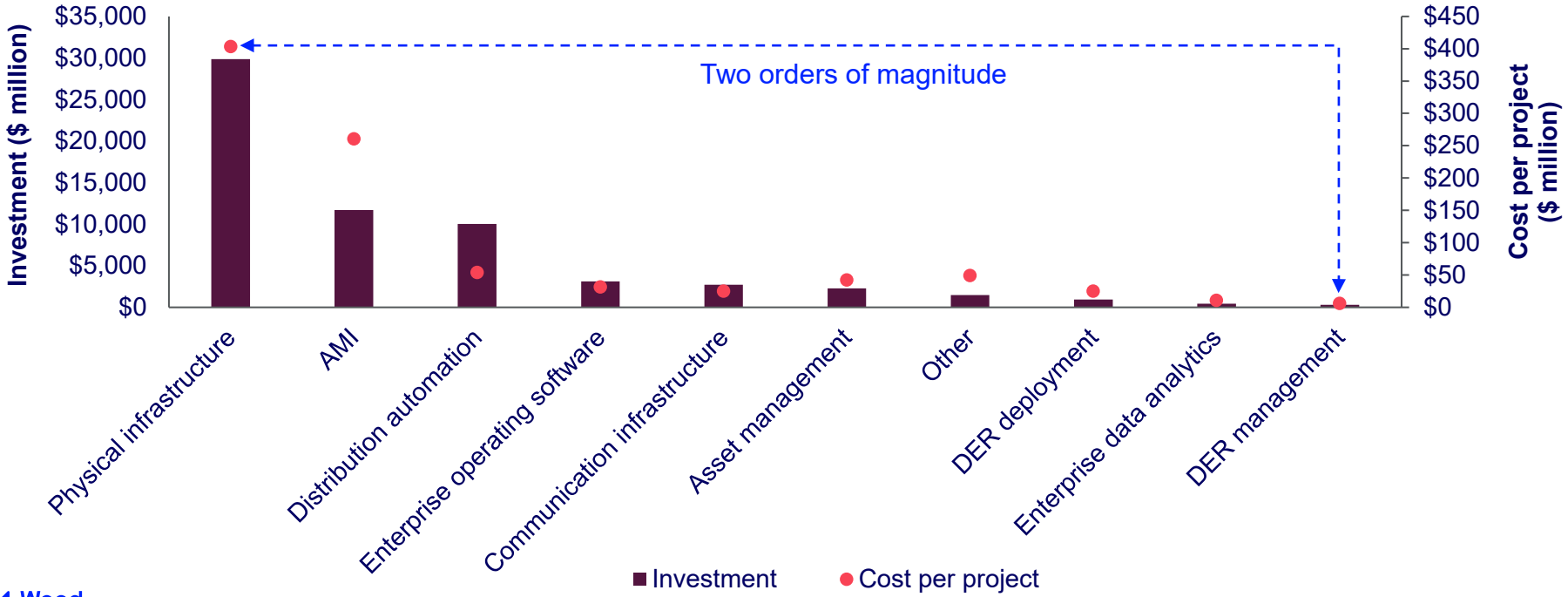
Utility-centric model

Source: Wood Mackenzie Grid Edge Service

It is much cheaper to make the grid smarter than stronger

DER management investments are 100x less expensive than physical infrastructure, but utilities spend 100x less on it

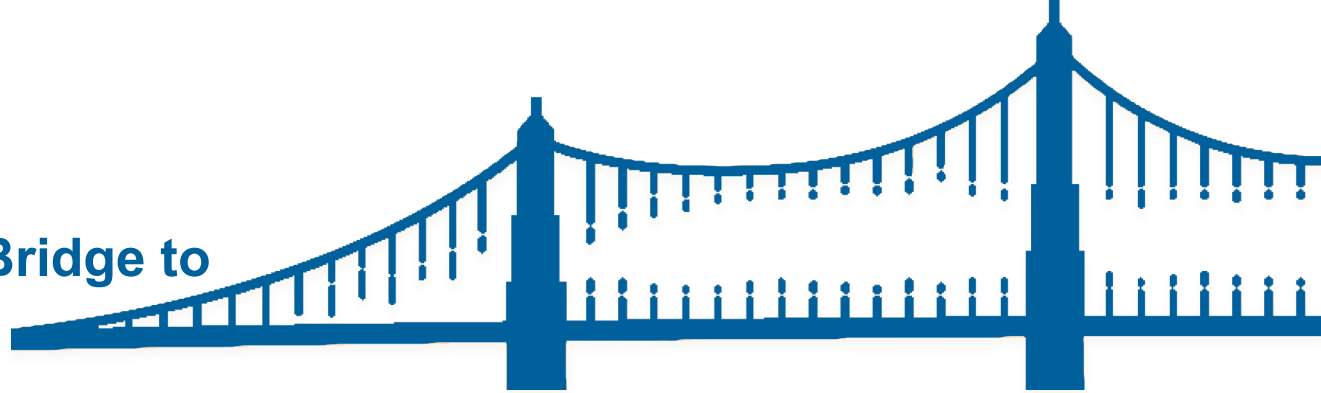
Grid modernization investment and the average cost per project by category



Source: Wood Mackenzie Grid Edge Service

Loan Programs Office

Building a Bridge to Bankability



Real *Money for* Virtual *Power Plants*

NYDPS *Zero by 2040*: Technical conference

12/11/23

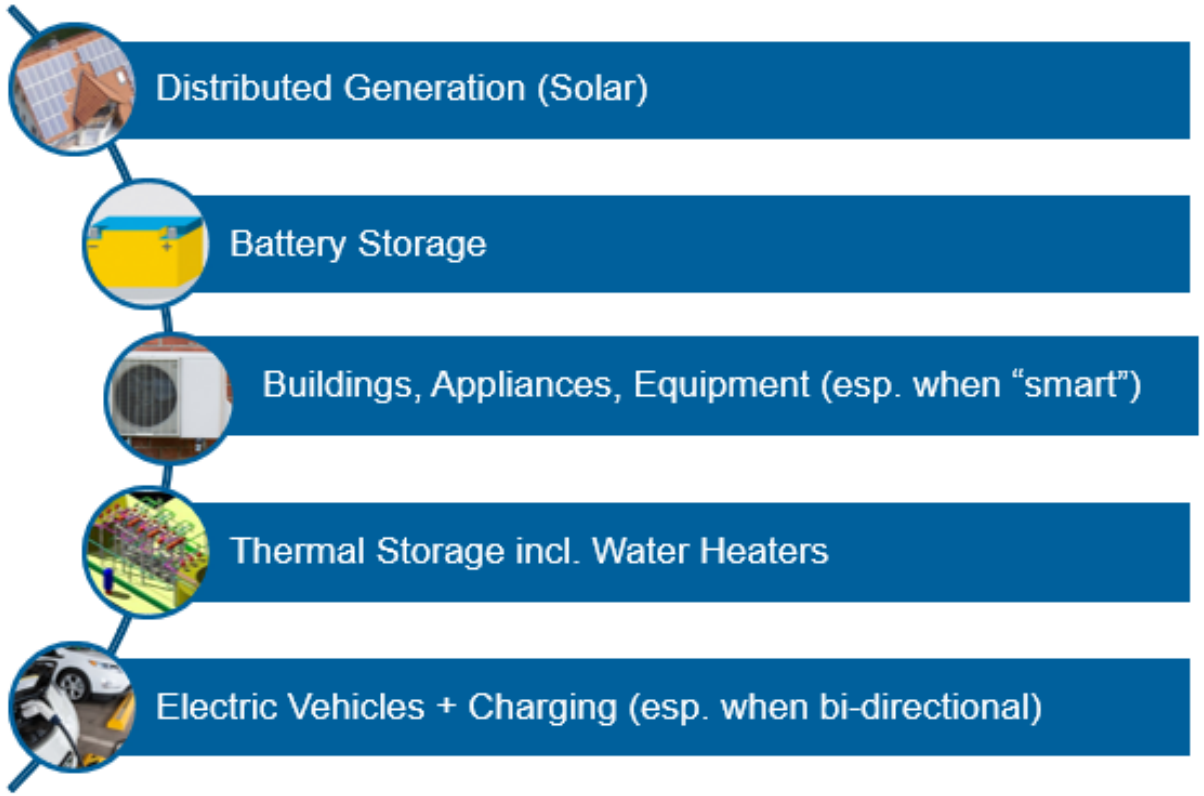
Innovative Clean Energy
Advanced Transportation **Tribal Energy**
CO_2 Transportation Infrastructure
Energy Infrastructure Reinvestment

David Nemtzow
Loan Programs Office, U.S. DOE

What are Virtual Power Plants?

*VPPs are aggregations of clean distributed energy resources (solar, storage, efficiency, EVs, etc.) that act like a powerplant…large enough to be **utility scale**, and connected, controllable & reliable enough to be **utility grade**. Each VPP has DERs in multiple locations and are connected virtually.*

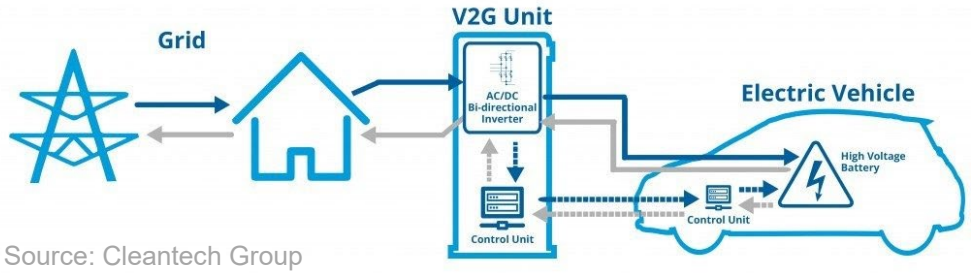
- ✓ Respond to a grid signal, price signal, and/or pre-set optimization algorithm, etc.
- ✓ Non-co-located assets scaled into a holistic demand-side and/or supply-side resource
- ✓ Entitle the VPP participants to financial (and other) bene-fits, potentially including compensation, for services rendered
- ✓ Can be organized & managed by various parties, incl. utilities, aggregators, OEMs, etc…wide array of business models
- ✓ (Non-utility) VPP provider may receive payments from retail utility and/or wholesale markets.
- ✓ VPPs serve numerous key customer, grid, societal functions (see later slide)



VPPs are utility-scale and utility-grade

VPPs come in many varieties (and trim levels)

Source: www.swellenergy.com/hbrmaui

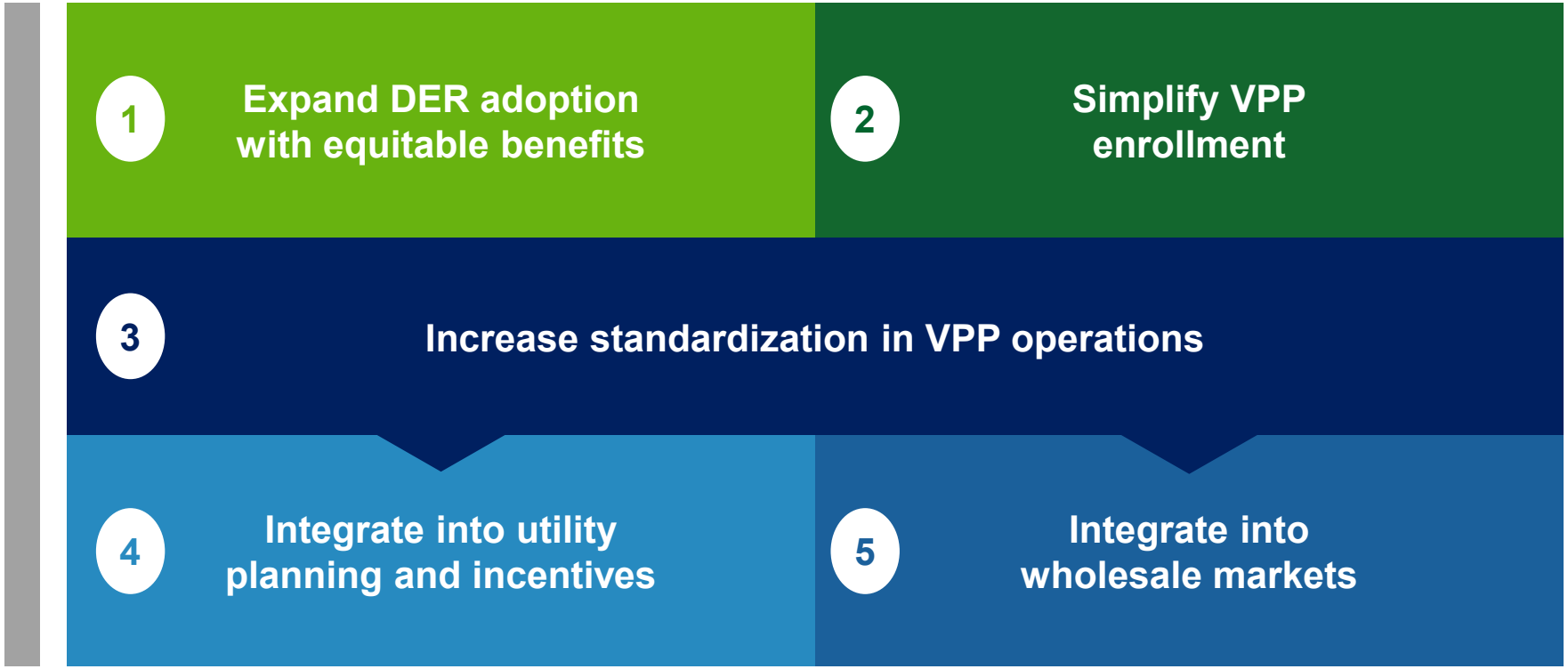


Source: Cleantech Group

CTA-2045 module (Source: Virtual Peaker)

Five imperatives will accelerate Liftoff for VPPs

Imperatives for VPP liftoff



For discussion: PSCs potential roles accelerating VPPs (& DERs)

Investigate / Adopt / Engage / Consider re: role of VPPs by state or service territory:

- **Performance-based regulation** – to help avoid conflicting signals re: non-capex options
- **Distribution system planning** requirements that include all resource options including DERs
- **Energy efficiency resource standards** or other EE procurement requirements – include, as allowable, peak management, demand flexibility etc.
- **Peak demand management** goals/requirements
- **Time-sensitive valuation** – for sizing rebates/incentives, to focus utility technical assistance, potentially for tariffs/charges
- Standardize access to **utility and customer data** to promote deployment of DERs
- Utility-supported **financing mechanisms**, e.g. on-bill financing
- Ensuring that **all Americans**, including LMI households, have access to clean DERs/VPPs
- Utility-supported **consumer education, technical assistance**, etc. for end users

Loan Programs Office

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david.nemtzow@hq.doe.gov

Low-emissions methane? Generation resources and fuels

- **Generation Resources**
  - Combustion (with CCS?):
    - CCGT, SCGT
    - Reciprocating engines
    - Boilers
  - Fuel cells

- **Fuels**
  - Biogenic (but be careful):
    - Biogas
    - Biogas-derived renewable natural gas
  - Synthetic
    - Power-to-gas renewable natural gas
  - Fossil methane

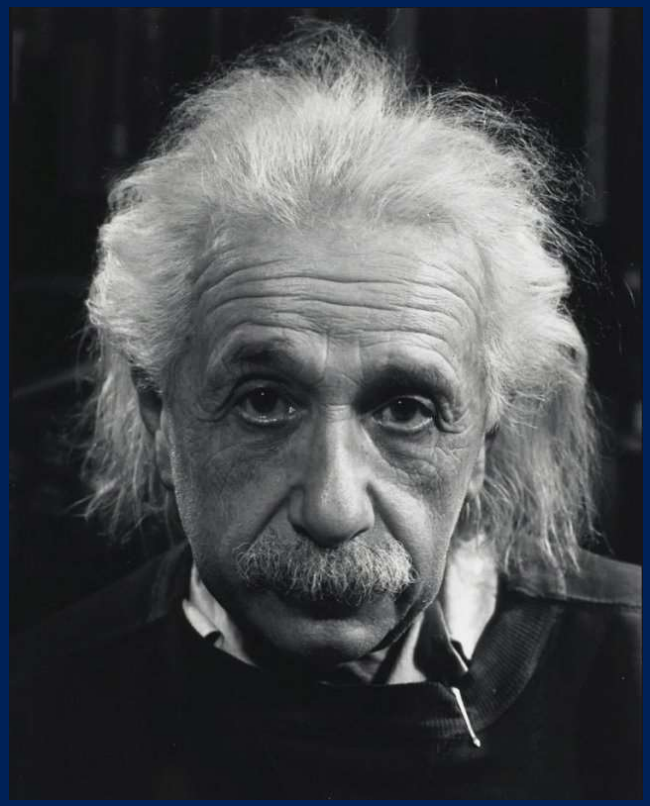
Passion, Challenges & Future

of Nuclear Energy

Emily Liu, Ph.D.

Professor, Nuclear Engineering and Engineering Physics
Professor, Industrial and Systems Engineering
Rensselaer Polytechnic Institute

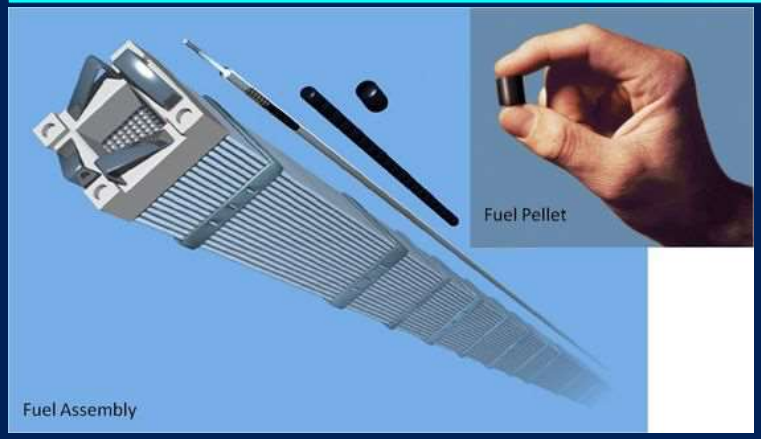
History of Nuclear Science and Engineering

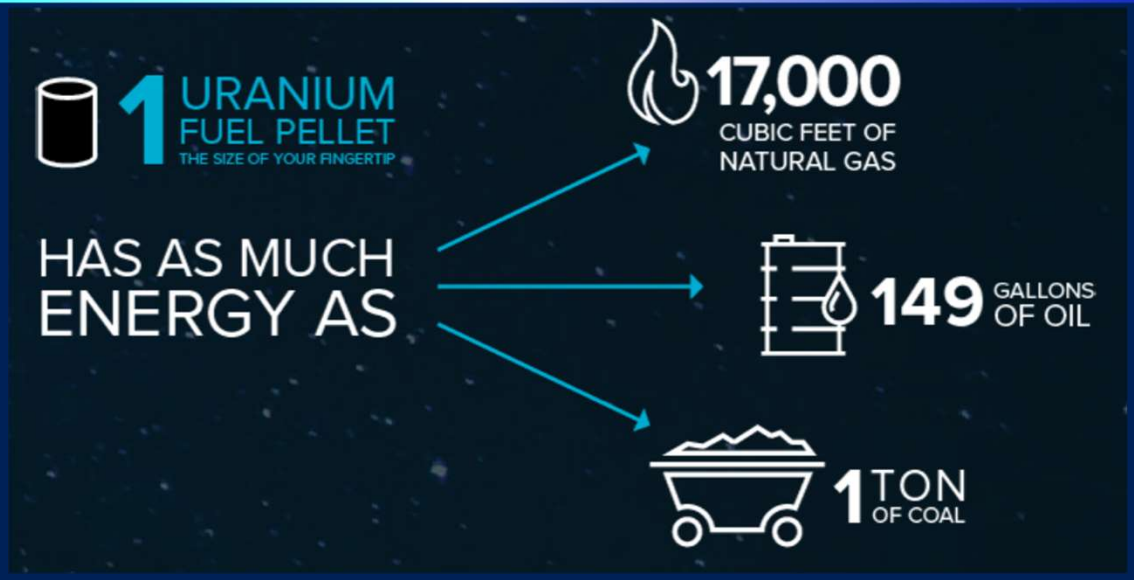


Modern Physics, 1920s

Radiation, ~1896

Passion, Motivation, and Opportunities



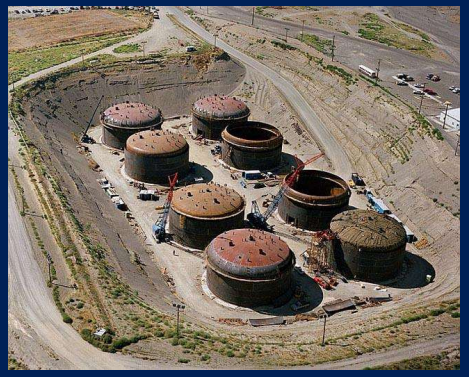


- Thanks to the energy density of uranium fuel and efficient operations, 93 reactors generate nearly 20% of all U.S. electricity.
- As a clean, low-carbon and efficient base-load energy source, nuclear power plays an important role in the achievement of the UN 2030 Agenda for Sustainable Development.
- Of all low carbon energy sources, nuclear power is one of the few that can generate electricity, heat, and hydrogen (and clean water).
- Microreactors can be extremely instrumental to power remote community and disaster relief.

References:
- ✓ https://www.nei.org/fundamentals/nuclear-fuel
- ✓ Report: "Nuclear Energy for a Net Zero World," IAEA.

Challenges!!

Waste; Cost; Safety; Communication; Implementation of Innovation; Education; Nonproliferation; Global Connection…



If I Had the Ability to Build One New Plant, It Would Be…

Status Quo?

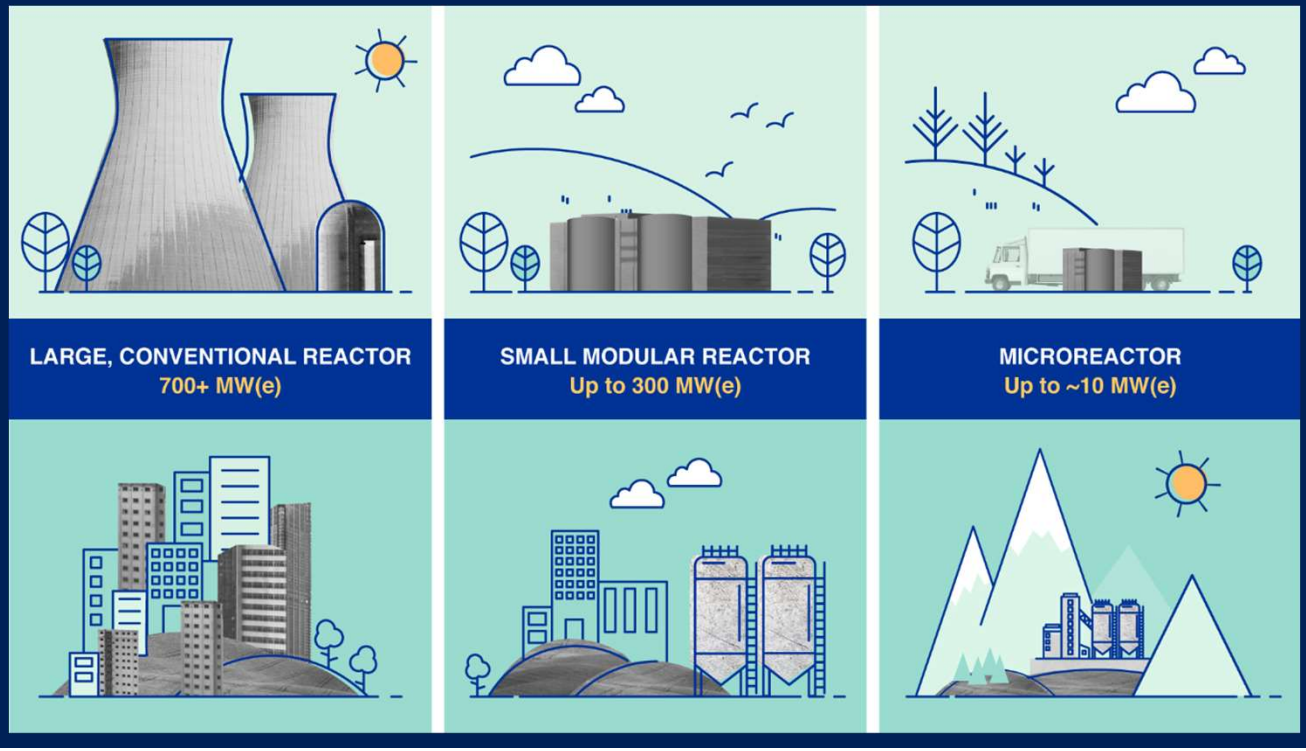
- Light Water Reactor
  - PWR
  - BWR
  - ESBWR
- Heavy Water Reactor
  - CANDU
- HEU / LEU / MOX

Gen IV?

- Lead Fast Reactor
- Sodium Fast Reactor
- Gas Fast Reactor
- Very High Temp. Reactor
- Supercritical Water Reactor
- Molten Salt Reactor

Something Else?

- Thorium
- Travelling Wave
- Inertial Fusion
- Magnetic Fusion
- Cold Fusion
- Other



Ref: INL and IAEA