# The Evolving New England Electricity Landscape: Navigating an Era of Rapid Change

Peter Kelly-Detwiler, Principal – NorthBridge Energy Partners, LLC

**NorthEast Public Power Association Annual Meeting**

Stowe VT August 15, 2022

## The Future is Coming to You in 3D:

Decarbonization

Digitalization

Decentralization

# State Mandates Are Driving the Dynamic

## State Laws Target Deep Reductions in $CO_2$ Emissions and Increases in Renewable and Clean Energy

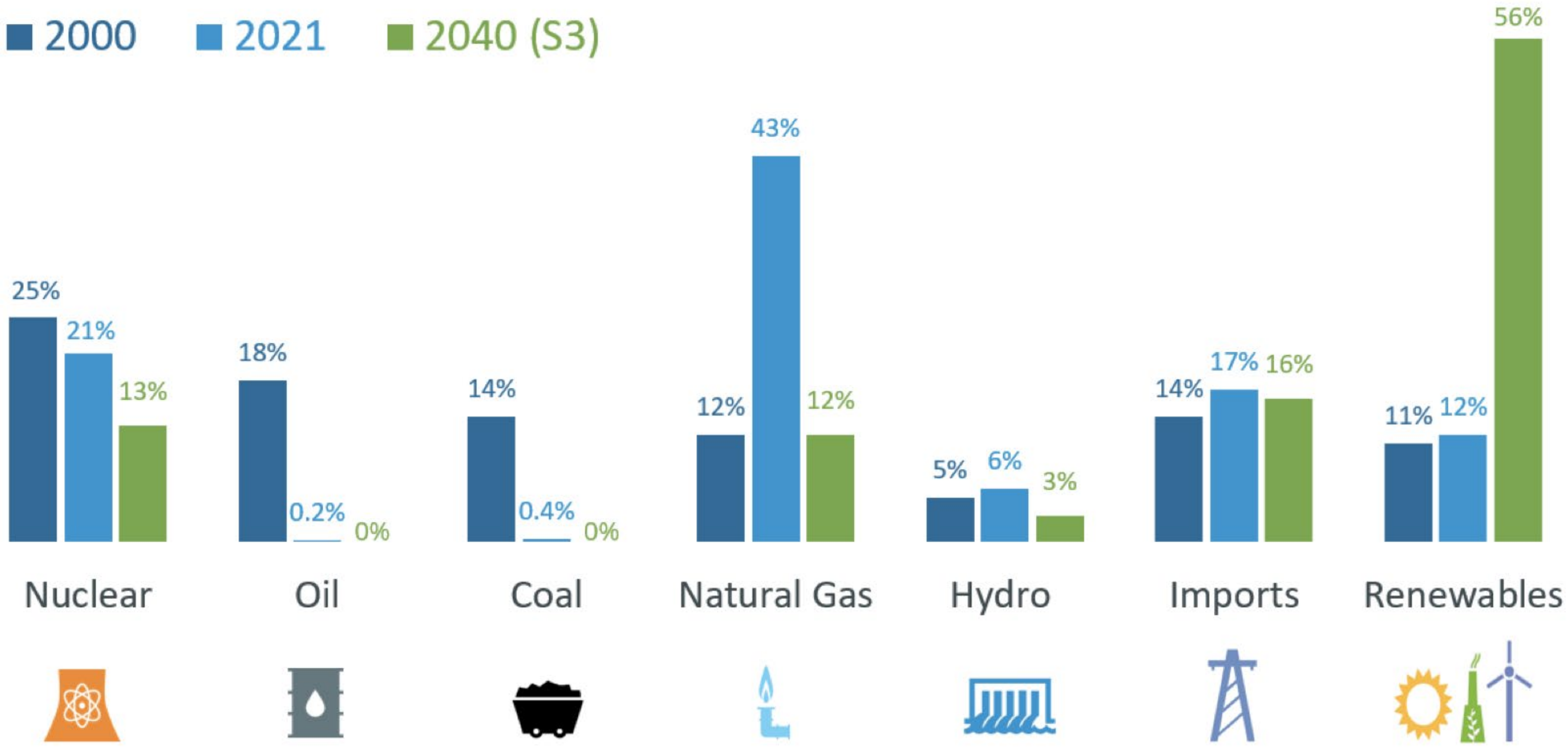
| | |
|---|---|
| ≥80% by 2050 | Five states mandate greenhouse gas reductions economy wide: MA, CT, ME, RI, and VT (mostly below 1990 levels) |
| Net-Zero by 2050<br>80% by 2050 | MA emissions requirement<br>MA clean energy standard |
| 90% by 2050 | VT renewable energy requirement |
| 100% by 2050<br>Carbon-Neutral by 2045 | ME renewable energy goal<br>ME emissions requirement |
| 100% by 2040 | CT zero-carbon electricity requirement |
| 100% by 2030 | RI renewable energy requirement |

https://www.iso-ne.com/static-assets/documents/2022/07/2021_economic_study_future_grid_reliability_study_phase_1_report.pdf

# $369 Bn of New Federal Incentives Will Accelerate the Dynamic

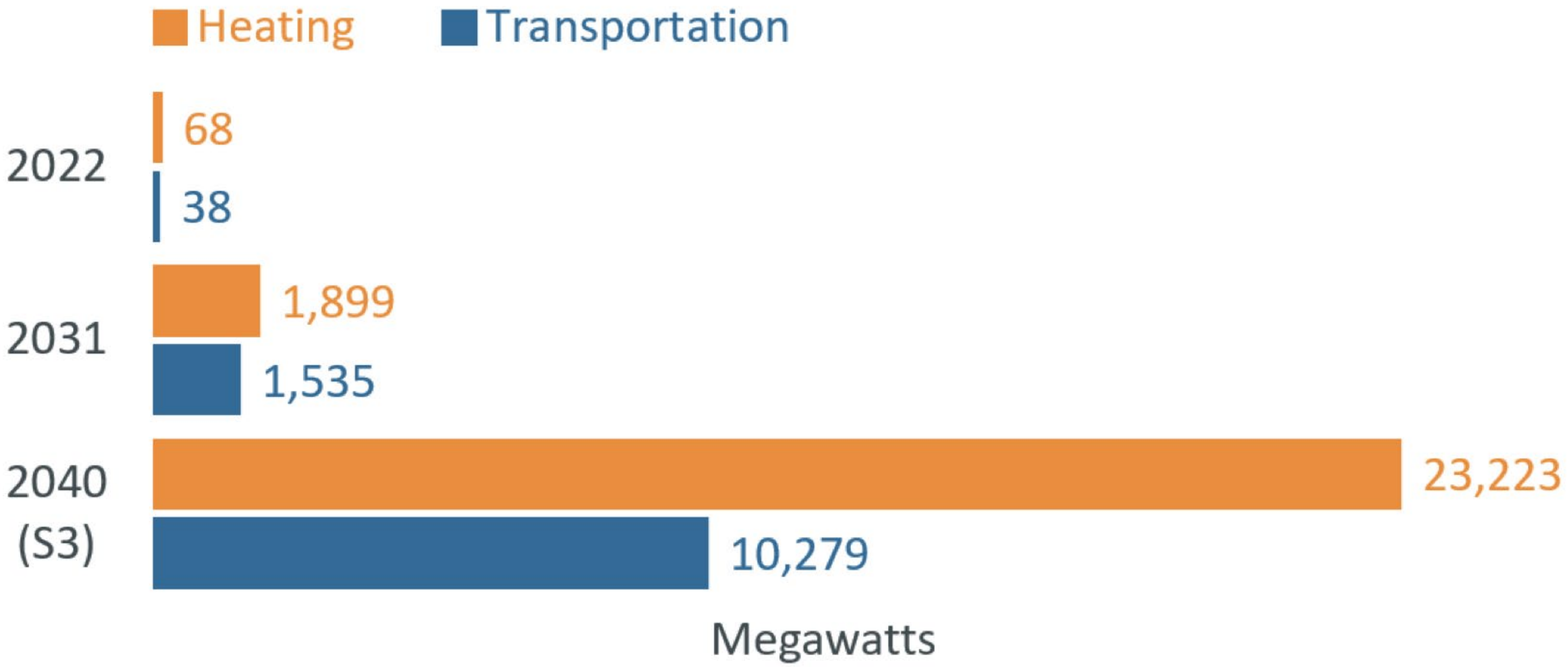

https://www.bbc.com/news/uk-england-gloucestershire-60765050

# The Critical Planning Challenge - Intermittent Renewables




https://www.iso-ne.com/static-assets/documents/2022/07/2021_economic_study_future_grid_reliability_study_phase_1_report.pdf

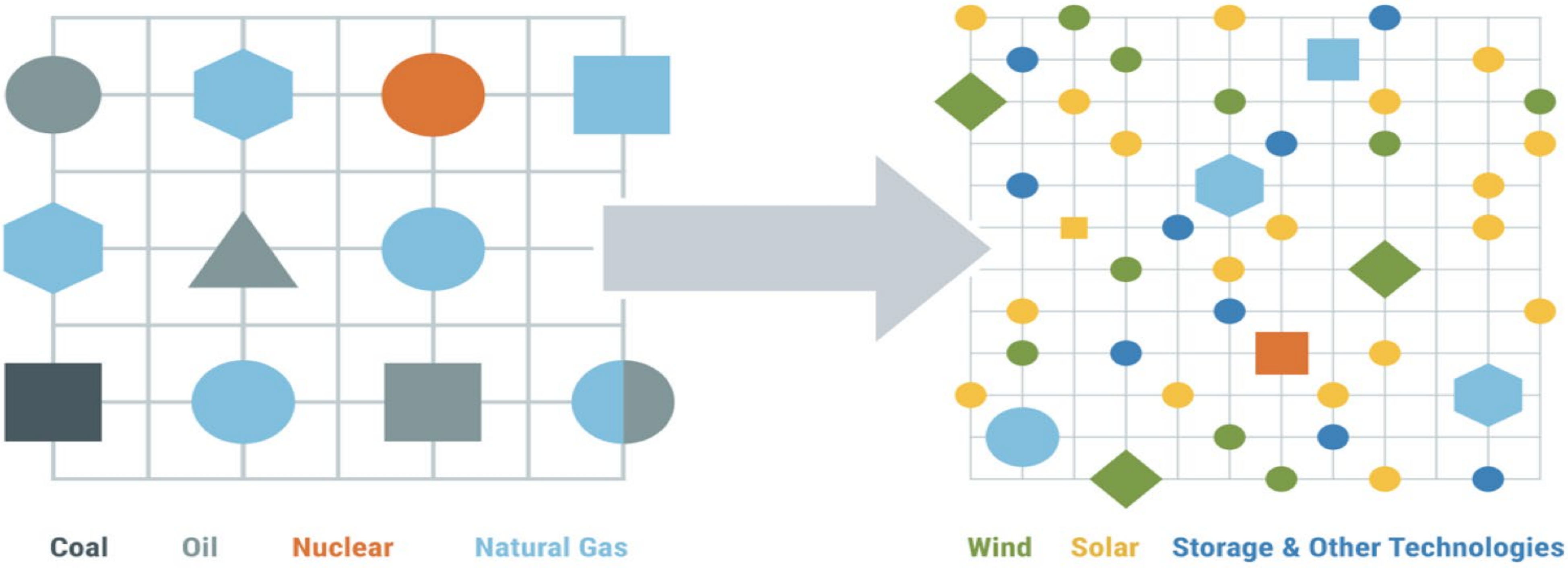
# Another Critical Planning Challenge – Increasing Demand




https://www.iso-ne.com/static-assets/documents/2022/07/2021_economic_study_future_grid_reliability_study_phase_1_report.pdf

# Centralized vs Decentralized: Which Dynamic Predominates?

## What Does the Future Grid Look Like?




**There are two dimensions to the transition, happening simultaneously:**

1. A shift from conventional generation to renewable energy
2. A shift from centrally dispatched generation to distributed energy resources

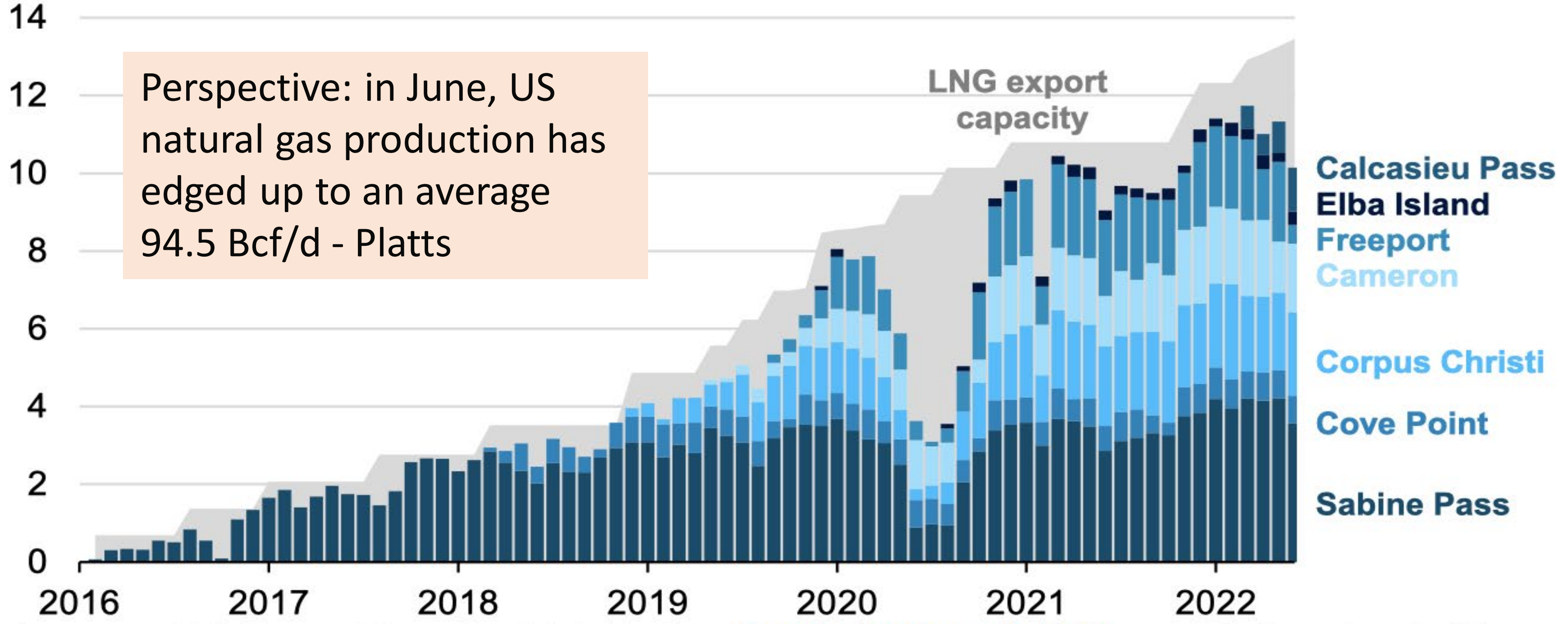
https://www.iso-ne.com/static-assets/documents/2022/07/2021_economic_study_future_grid_reliability_study_phase_1_report.pdf

# Macro - LNG Exports: A New “Liquid Market” and Floor  for Gas?

JULY 25, 2022

## The United States became the world’s largest LNG exporter in the first half of 2022

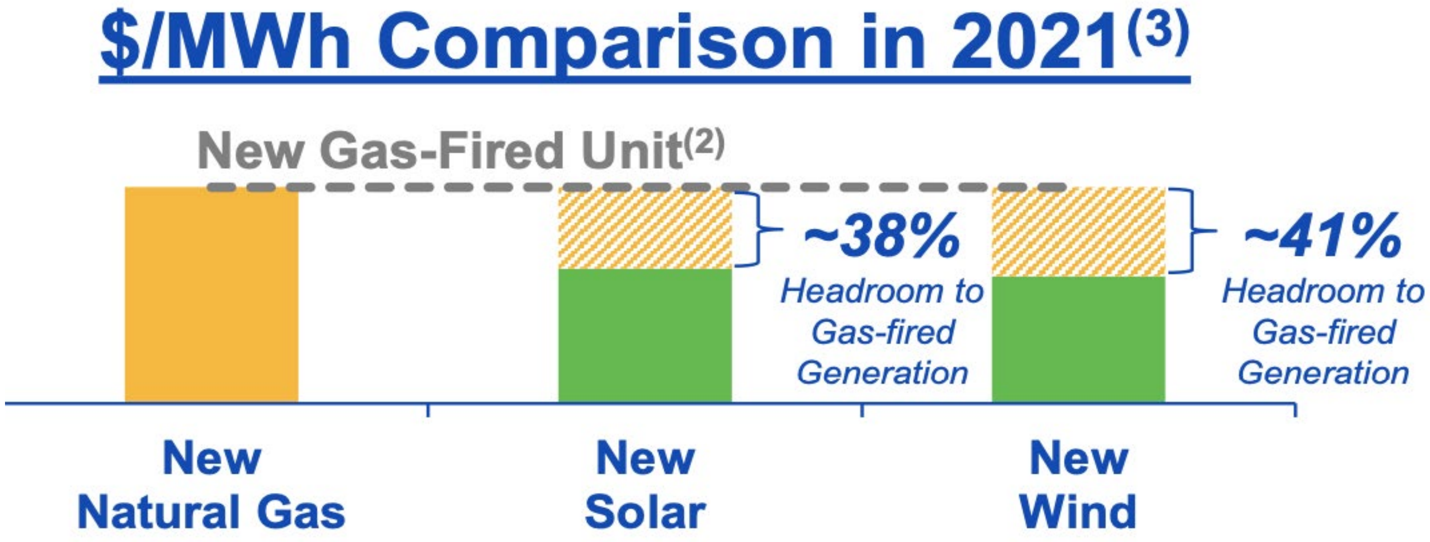
**Monthly U.S. liquefied natural gas (LNG) exports (Jan 2016–Jun 2022)**
billion cubic feet per day

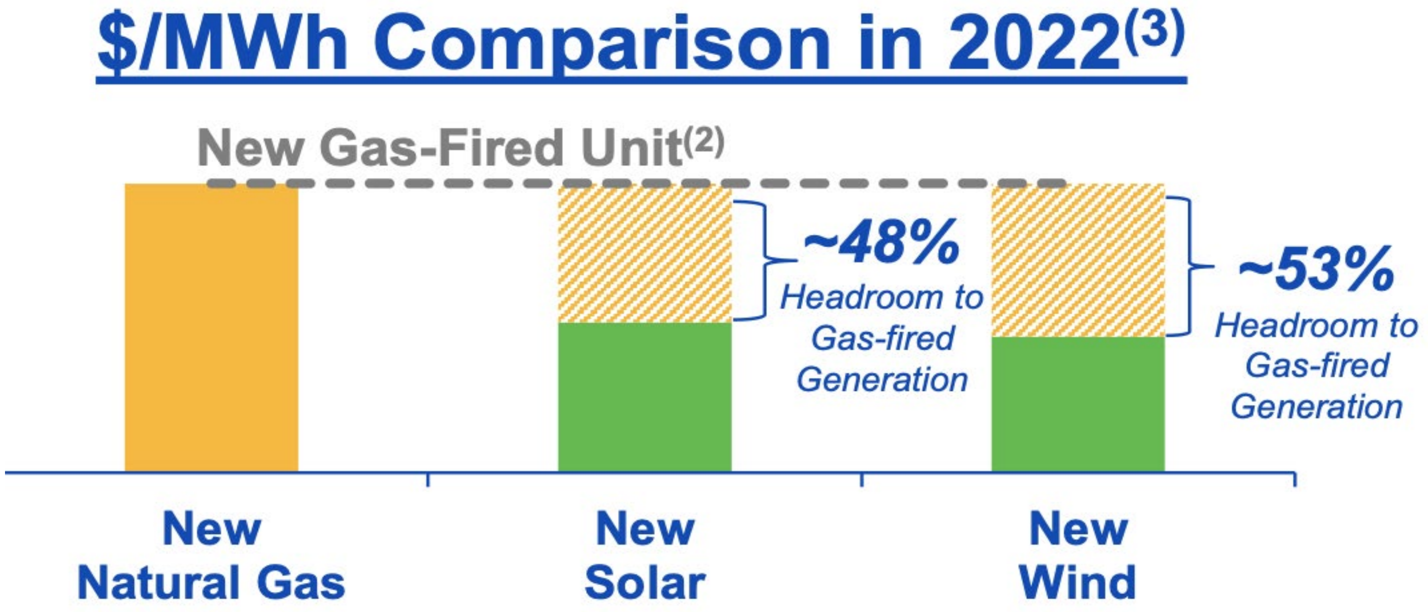



**Data source:** U.S. Energy Information Administration, *Liquefaction Capacity Table*, and U.S. Department of Energy *LNG reports*

https://www.eia.gov/todayinenergy/detail.php?id=53159

# Recent Inflationary Trends Favor Renewables



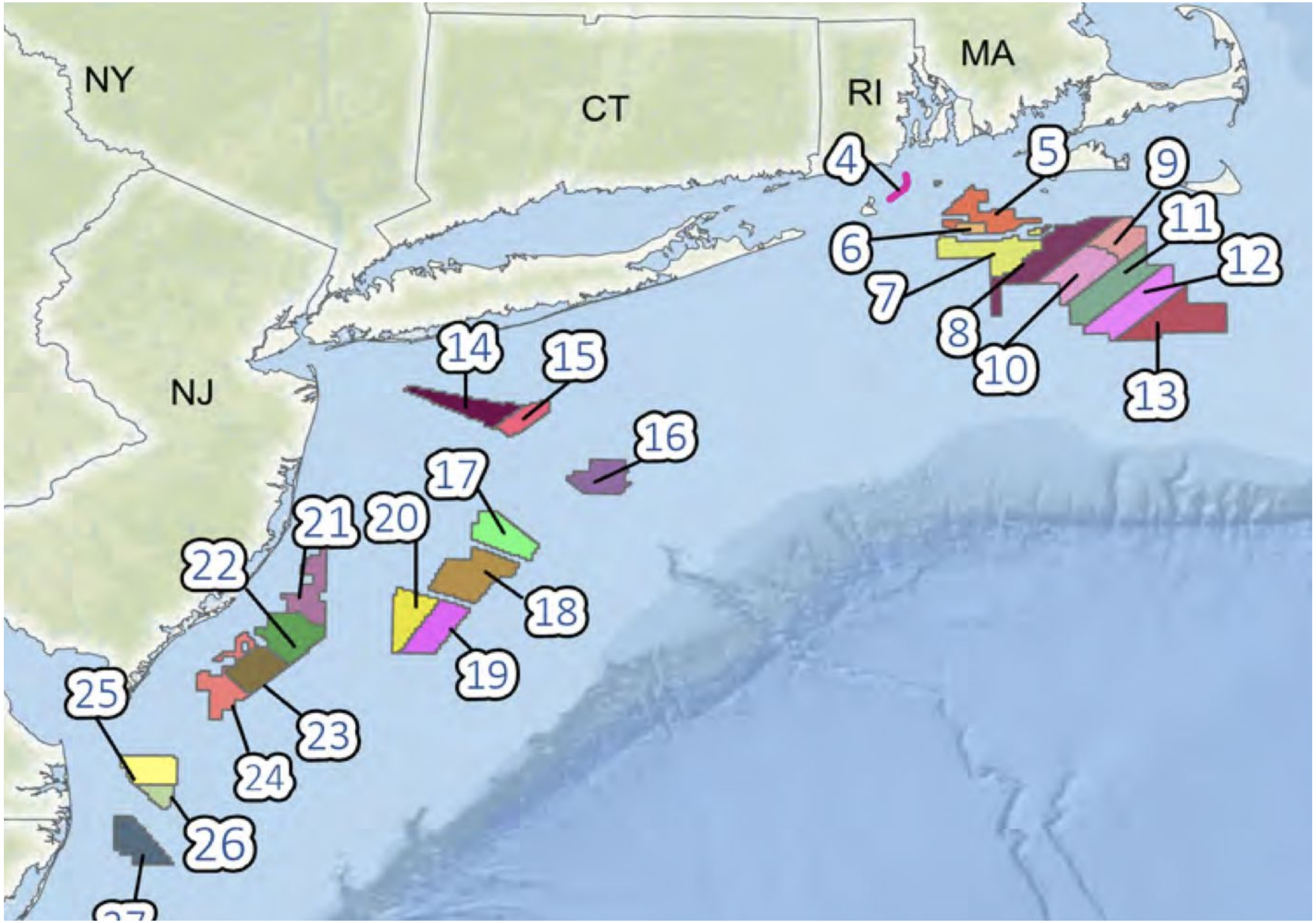




https://www.investor.nexteraenergy.com/~/media/Files/N/NEE-IR/news-and-events/events-and-presentations/2022/06-14-2022/June%202022%20Investor%20Presentation_Website_vF.pdf

# Supply Resources: Big Question Marks


https://www.mainepublic.org/business-and-economy/2019-12-13/questions-swirl-on-foreign-influence-in-maine-elections-as-canadian-energy-company-readies-campaign

# Increasing Amounts of Offshore Wind




https://www.boem.gov/sites/default/files/documents/renewable-energy/Leases-Map-Book-July%202022.pdf

# The Growing PV Resource: Both Sides

## December 2021 Cumulative PV Totals

*State-by-State*

The table below reflects statewide aggregated PV data provided to ISO by regional Distribution Owners. The values represent installed nameplate as of 12/31/21.

| State | Installed Capacity ($MW_{AC}$) | No. of Installations |
|---|---:|---:|
| Massachusetts* | 2,953.43 | 130,040 |
| Connecticut | 809.08 | 63,735 |
| Vermont* | 434.24 | 17,296 |
| New Hampshire | 156.88 | 12,186 |
| Rhode Island | 288.38 | 12,641 |
| Maine | 125.05 | 7,403 |
| **New England** | **4,767.06** | **243,301** |

https://www.iso-ne.com/static-assets/documents/2022/04/final_2022_pv_forecast.pdf

# Where the Solar is Located

## December 2021- Cumulative PV Totals (1 of 2)

*Summary of Distribution Owner PV Data*

| State | Utility | Installed Capacity ($MW_{AC}$) | No. of Installations |
|---|---|---|---|
| | | | |
| CT | Connecticut Light & Power | 627.53 | 46,726 |
| | Connecticut Municipal Electric Energy Co-op | 13.43 | 7 |
| | United Illuminating | 168.11 | 17,002 |
| | **Total** | **809.08** | **63,735** |
| | | | |
| MA | Braintree Electric Light Department | 5.47 | 35 |
| | Chicopee Electric Light | 13.17 | 38 |
| | Unitil (FG&E) | 43.26 | 2,123 |
| | National Grid | 1,608.59 | 69,114 |
| | NSTAR | 820.18 | 43,101 |
| | Reading Municipal Lighting Plant | 8.25 | 195 |
| | Shrewsbury Electric & Cable Operations | 6.46 | 115 |
| | SREC I | 54.21 | 589 |
| | SREC II | 96.60 | 1,672 |
| | Western Massachusetts Electric Company | 297.24 | 13,058 |
| | **Total** | **2,953.43** | **130,040** |
| | | | |
| ME | Central Maine Power | 114.29 | 6,309 |
| | Emera | 10.77 | 1,094 |
| | **Total** | **125.05** | **7,403** |

https://www.iso-ne.com/static-assets/documents/2022/04/final_2022_pv_forecast.pdf

# Where the Solar is Located, Cont'd

## December 2021 Cumulative PV Totals (2 of 2)

*Summary of Distribution Owner PV Data*

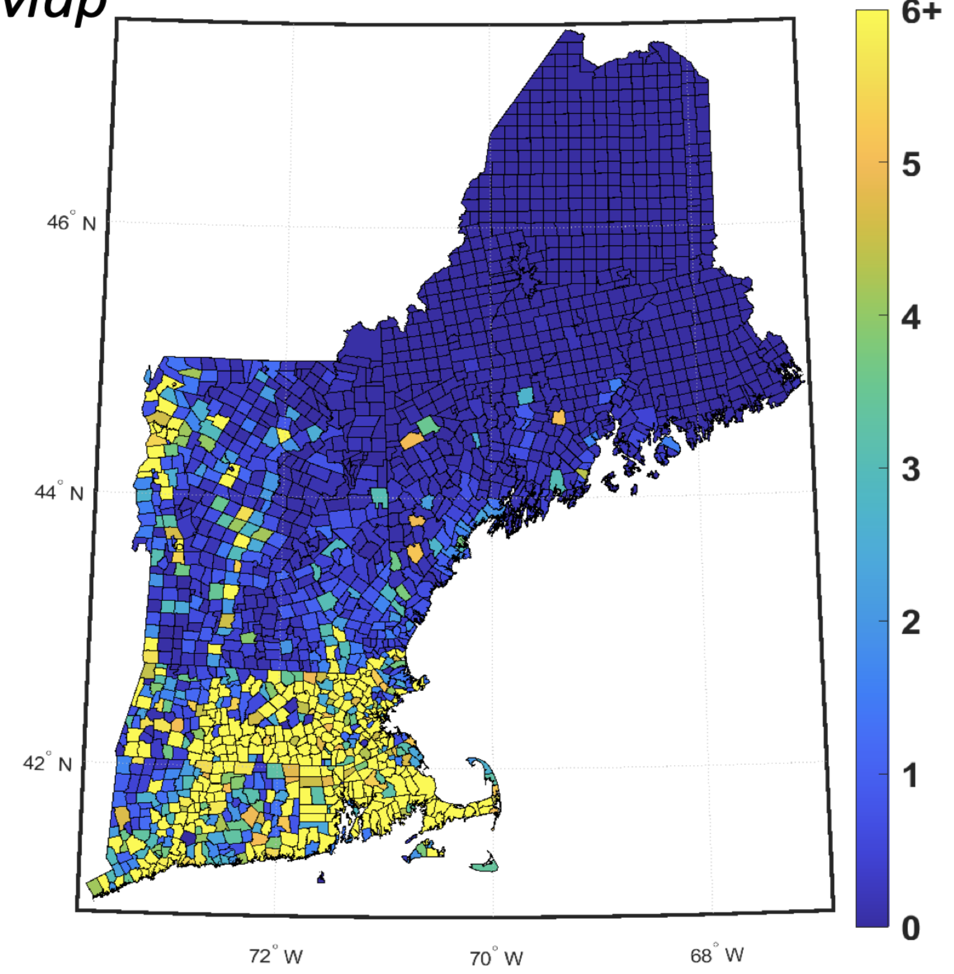
| State | Utility | Installed Capacity ($MW_{AC}$) | No. of Installations |
|---|---|---|---|
| NH | Liberty Utilities | 12.57 | 831 |
| | New Hampshire Electric Co-op | 15.54 | 1,398 |
| | Public Service of New Hampshire | 115.46 | 8,779 |
| | Unitil (UES) | 13.31 | 1,178 |
| | **Total** | **156.88** | **12,186** |
| RI | National Grid | 288.38 | 12,641 |
| | **Total** | **288.38** | **12,641** |
| VT | Burlington Electric Department | 8.81 | 343 |
| | Green Mountain Power | 358.28 | 13,398 |
| | Stowe Electric Department | 2.74 | 113 |
| | Vermont Electric Co-op | 38.36 | 2,085 |
| | Vermont Public Power Supply Authority | 18.12 | 668 |
| | Washington Electric Co-op | 7.93 | 689 |
| | **Total** | **434.24** | **17,296** |
| **New England** | | **4,767.06** | **243,301** |

https://www.iso-ne.com/static-assets/documents/2022/04/final_2022_pv_forecast.pdf

# PV Concentrated Mostly in MA

## Installed PV Capacity as of December 2021

*Regional Heat Map*

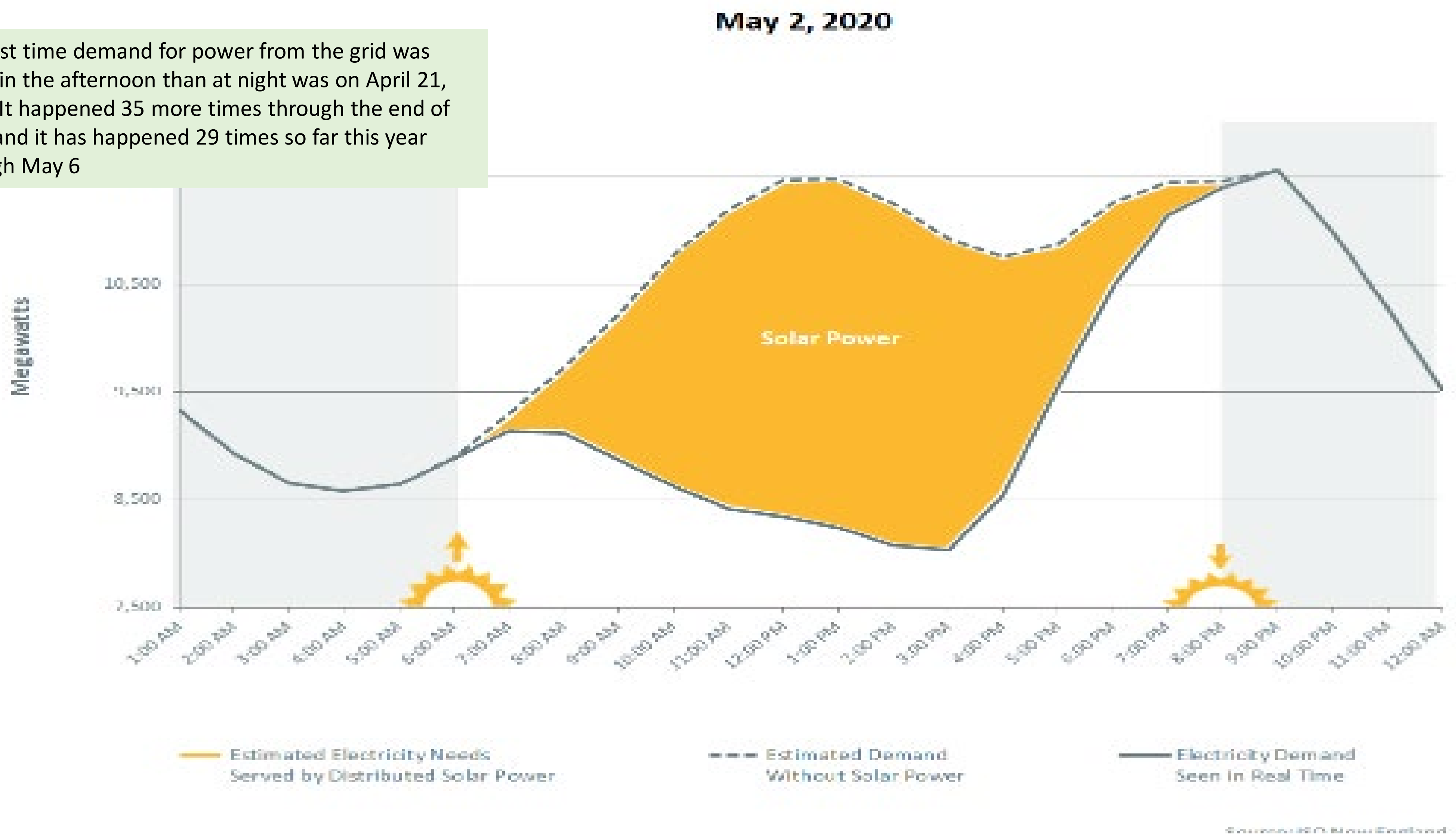



*<u>Note</u>: Legend to the right of heat map shows color scale of nameplate megawatts per town*

https://www.iso-ne.com/static-assets/documents/2022/04/final_2022_pv_forecast.pdf

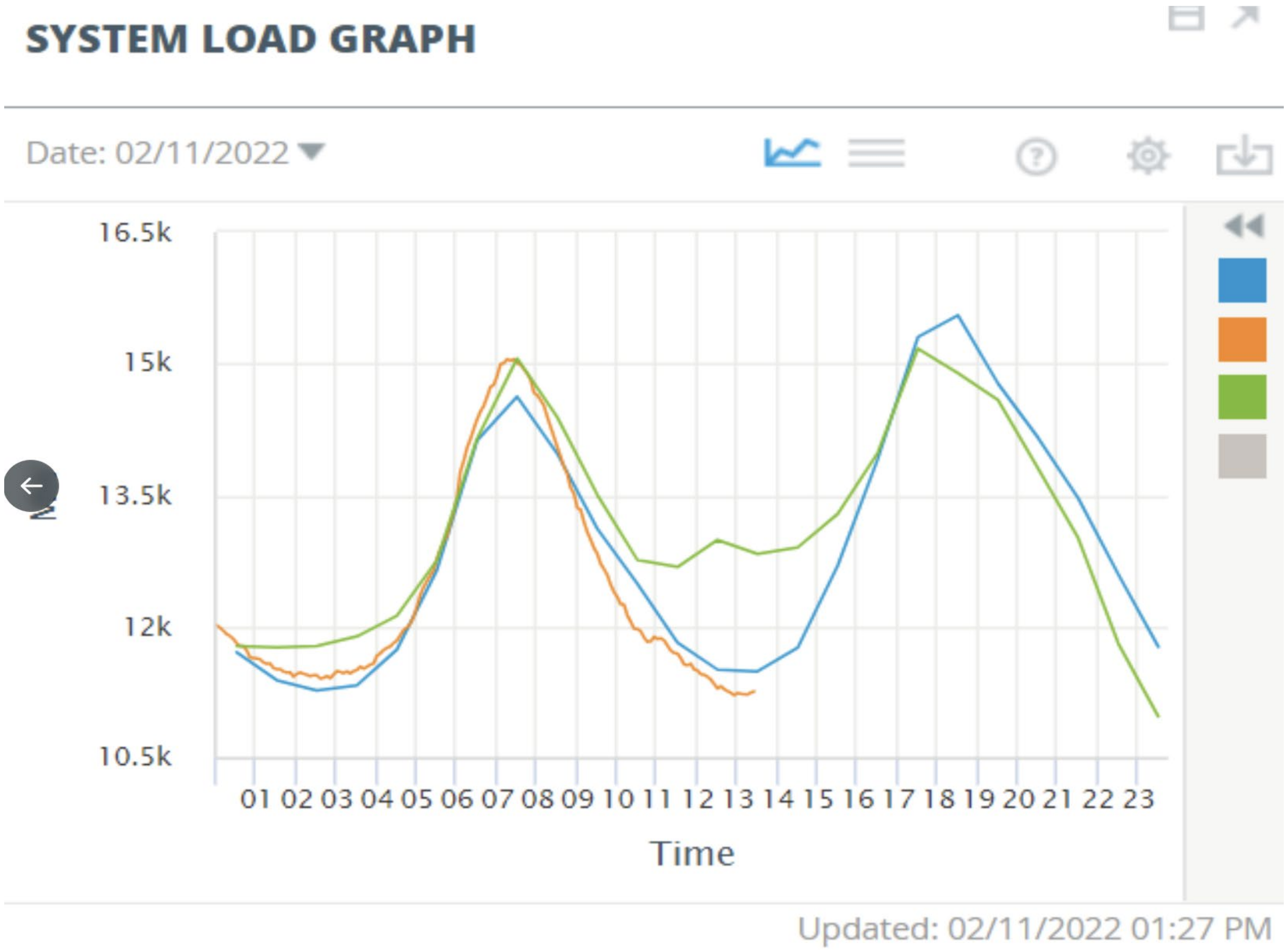
# The Duck Is Landing Everywhere These Days…

The first time demand for power from the grid was lower in the afternoon than at night was on April 21, 2018. It happened 35 more times through the end of 2021 and it has happened 29 times so far this year through May 6




http://isonewswire.com/updates/month/may-2020

# New England’s February Duck

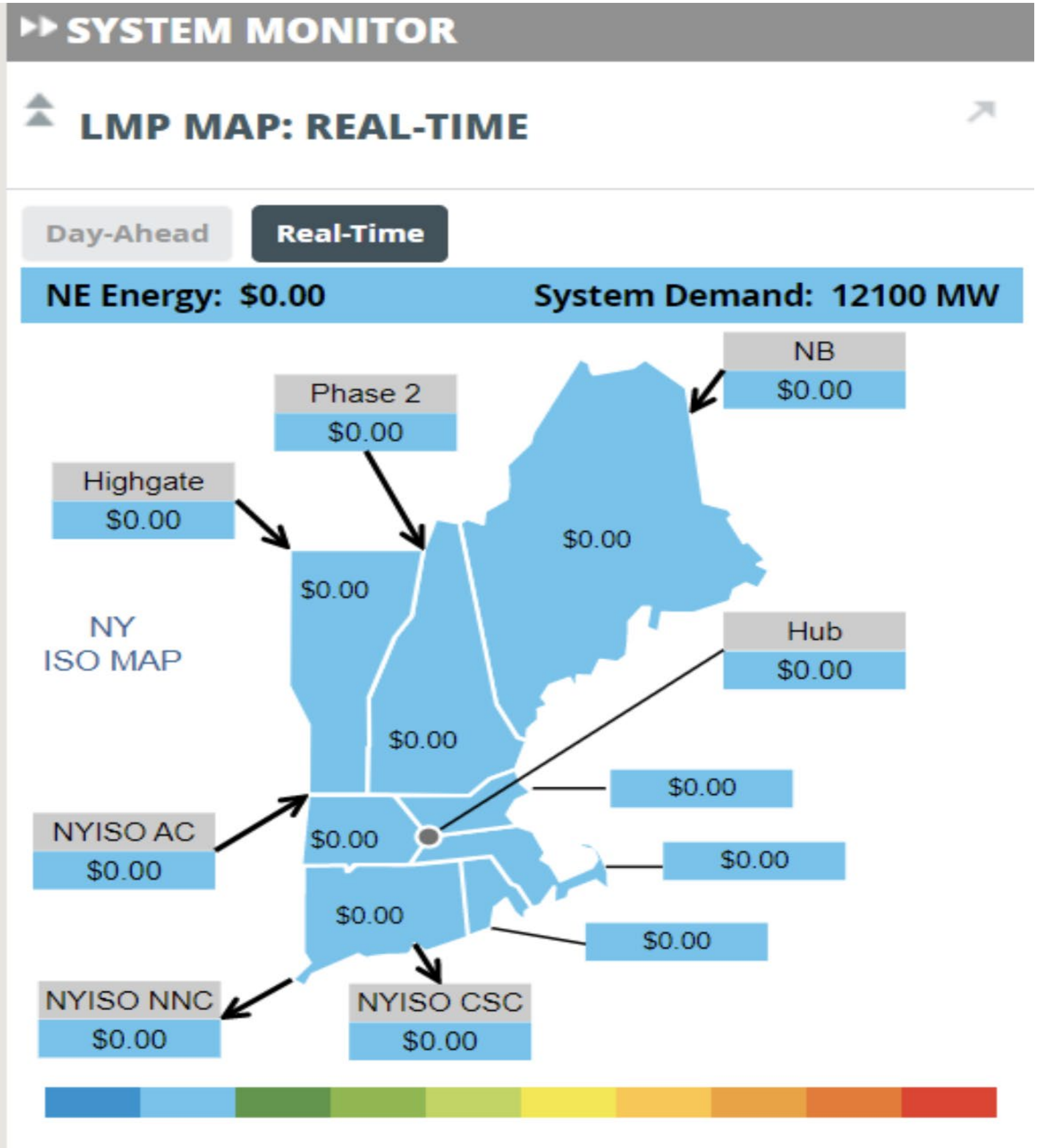



https://www.iso-ne.com

# Knocking Prices Down

2/11/22

1:27 PM

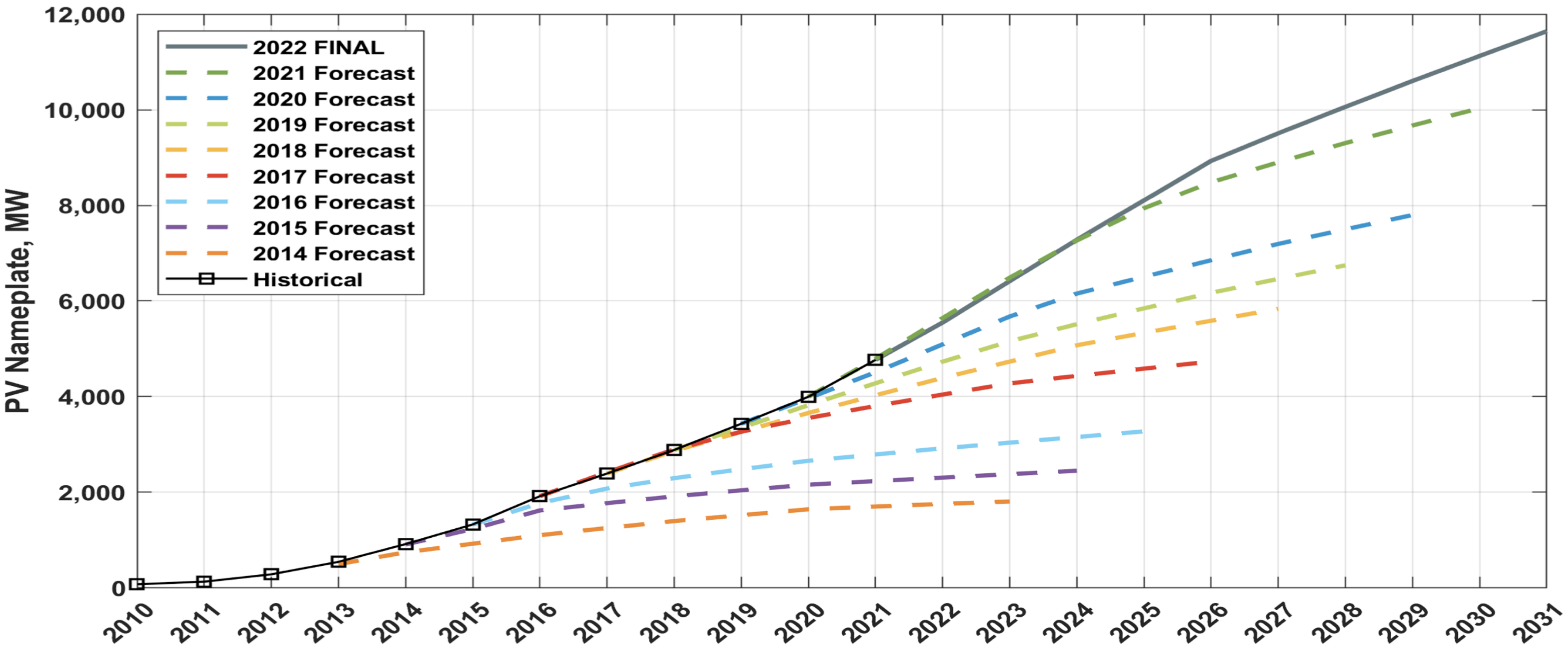



https://www.iso-ne.com

# We Keep Underestimating the Adoption Dynamic

## Total PV Nameplate Capacity Growth

*Reported Historical vs. Forecast (FCM+EOR+BTM), $MW_{ac}$*




https://www.iso-ne.com/static-assets/documents/2022/04/final_2022_pv_forecast.pdf

# Storage of Various Durations Will Be Increasingly Necessary

## Form Energy claims aqueous air battery provides 150 hours of storage

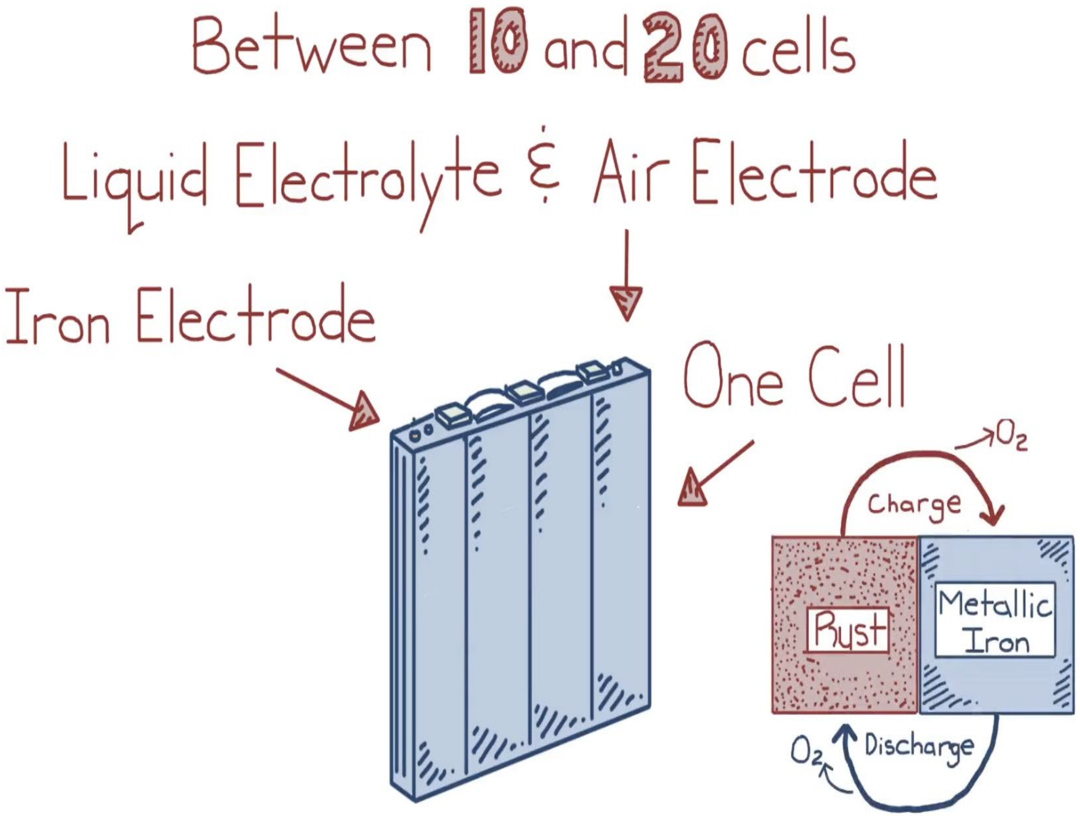
The holy grail of energy storage has always been low-cost and long-duration. Form Energy intends on deploying a 1 MW/150 MWh system with a Minnesota utility before 2023, an unprecedented energy storage duration if successful.

Stable

No need for lithium, nickel, or cobalt

10% cost per kWh vs li-ion

100+ hours




https://formenergy.com/technology/battery-technology/

# The Grid Edge Will Become Increasingly Active

# One Nissan Leaf Earned $4,200 Summer 2021 in V2X


https://chargedevs.com/newswire/nissan-leaf-earns-4200-in-fermata-energy-v2x-pilot/

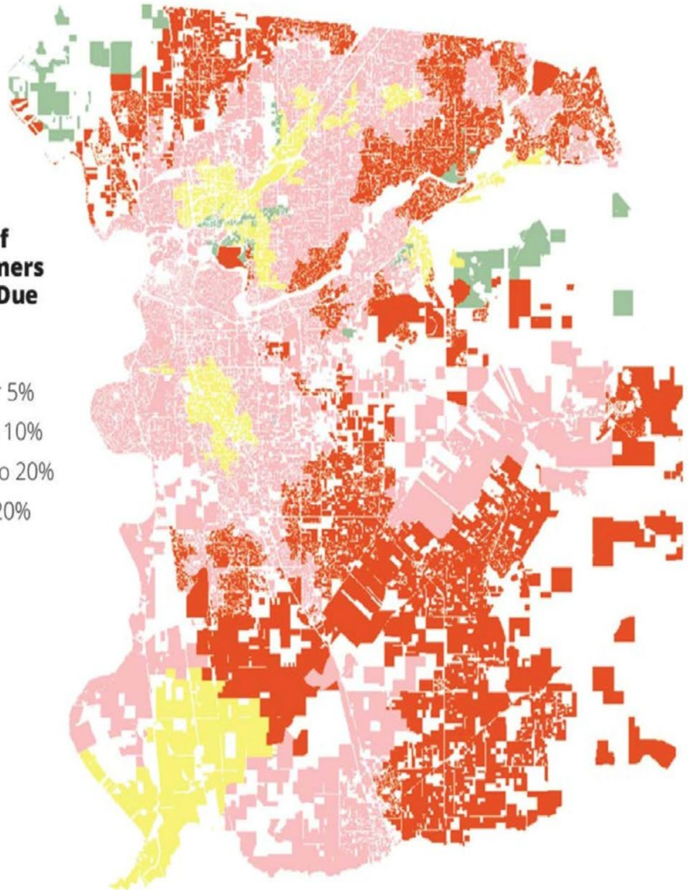
# The Impact on You May be Significant

## EV Impact on SMUD Transformers through 2030

- **Under current assumptions, distribution impacts could cost *$50M to $100M+* to address**
- **Potential mitigation solutions include EV managed charging**

**Percent of Transformers Stressed Due to EVs**

- under 5%
- 5% to 10%
- 10% to 20%
- over 20%

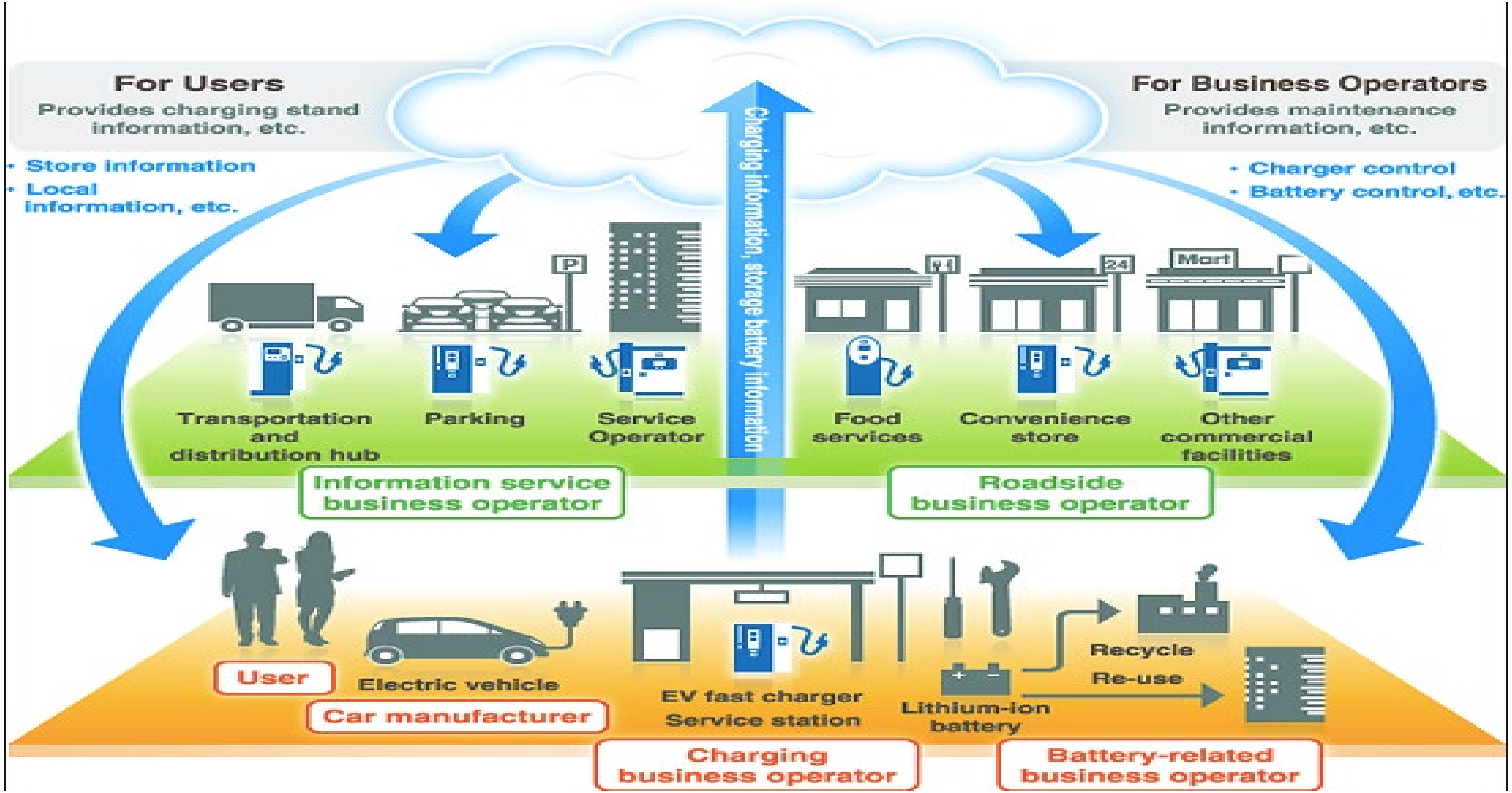


Source: Smart Electric Power Alliance, Black & Veatch, and SMUD, 2017

www.sepapower.org

https://www.peakload.org/assets/36thConf/A1.SEPA&NVENERGY-%20Managed%20Electric%20Vehicle%20Charging.pdf

# Smart Charging: Early Stage - Mostly Uni-Directional



# But Bi-Directional Will Arrive Quickly


155 kWh batteries – can be aggregated and deployed for back-up power or to sell grid services

Montgomery County, MD – 326, w/ 1st 25 for 2021/22; Con Edison 5; CPower/Amply/Logan Bus for NYC DOE

# The Coordination Challenge w/Competitive Markets

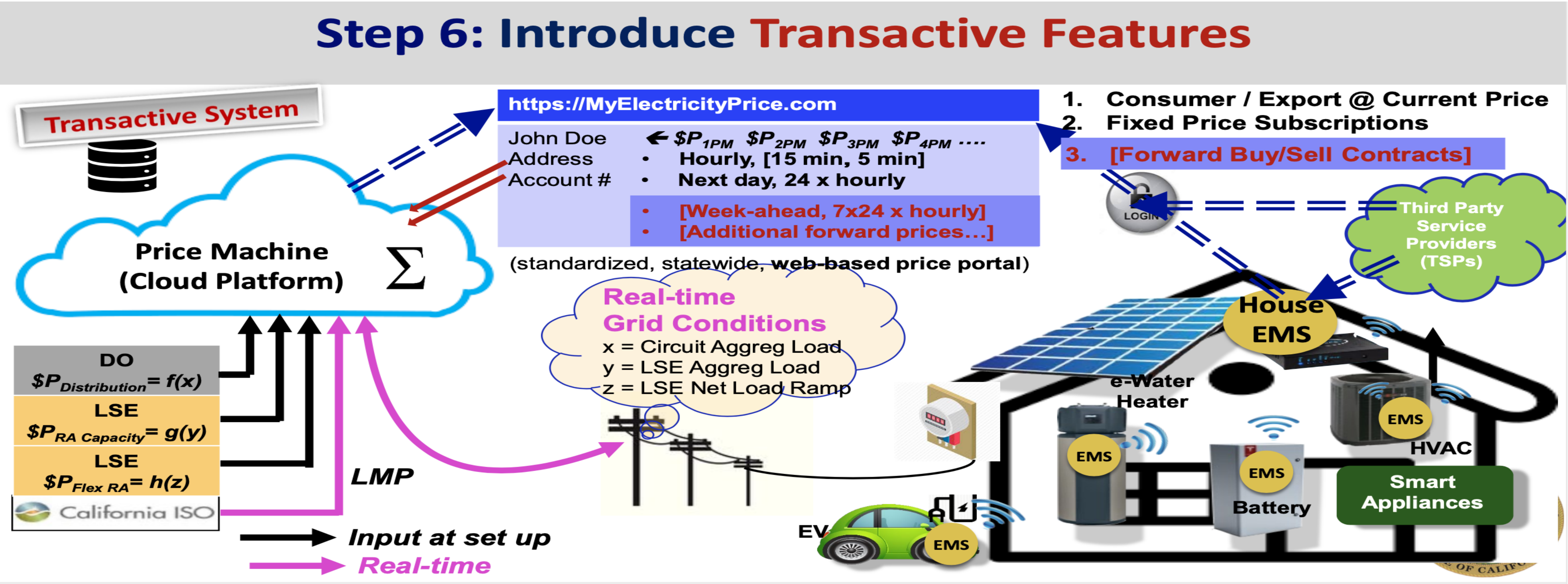
## Lack of Visibility, Situational Awareness and Control

GRIDWORKS

- DO and the ISO do not have visibility and situational awareness about location, status and output of DERs
- DER Operator does not have visibility into distribution system to ensure exported energy is feasible and deliverable
- DO need better visibility into own distribution systems
    - Predict DER behavior
    - Real time DER response
    - Forecast DERs' impacts on grid


https://pubs.naruc.org/pub/67F0F5A8-F49D-9E86-FD4D-EDDE825B007E

# What Might This Eventually Mean for the Customer?



# A Possible Future 'Plug and Play' Approach

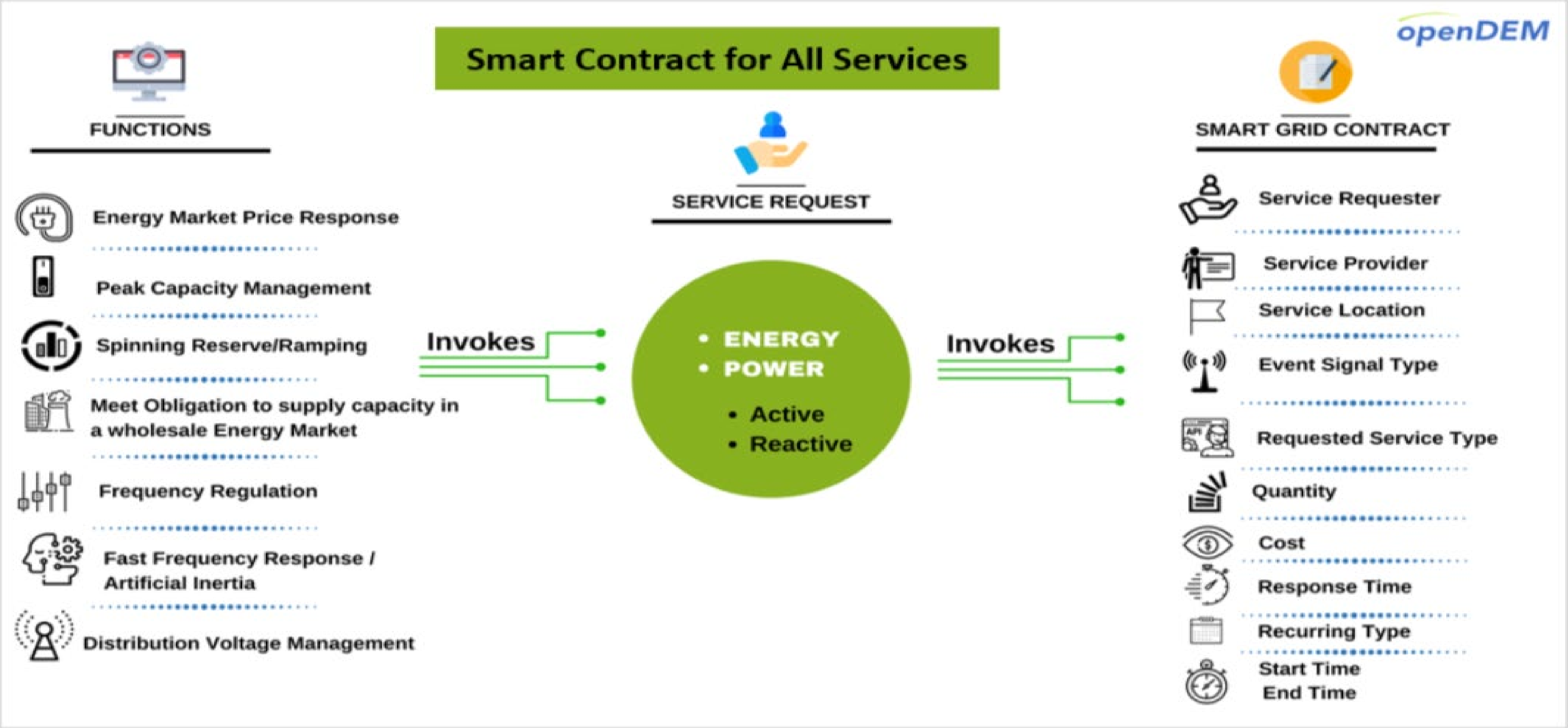
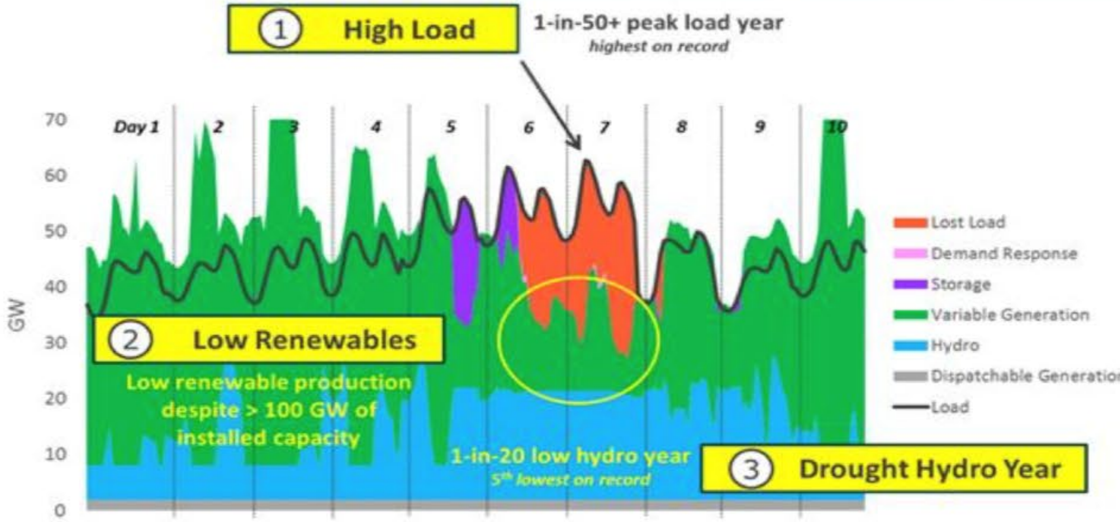



Figure 13 Smart Grid Contracts

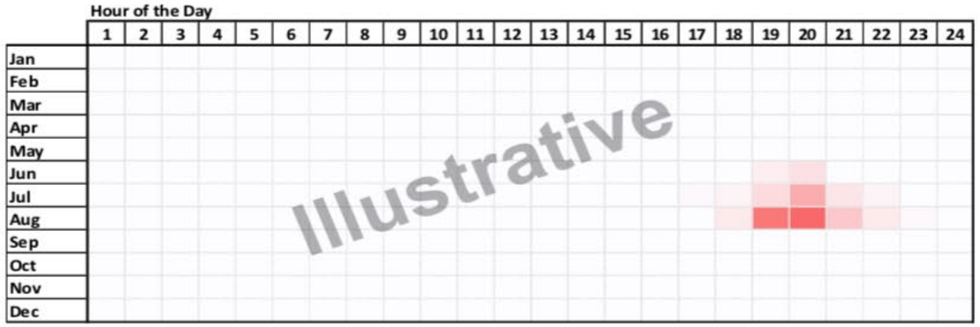
# The nature of the resource adequacy challenge is changing

- **Resource adequacy is a measure of the ability of the bulk grid (generation) to meet a reliability standard across a wide range of system conditions**
  - NY uses a 0.1 day / year standard
- **As renewable penetration grows, planning problems shift from traditional need to meet peak demand hours (e.g., summer) to new questions of meeting net demand (e.g., over multi-day low renewable events)**
  - The timing of these needs will change
    - From summer gross peak to winter net peak
    - To account for unexpected high load and low renewable output during planned outages in the shoulder months
- **This new planning problem highlights the need to assess reliability in a time-sequential way over full spectrum of system conditions**

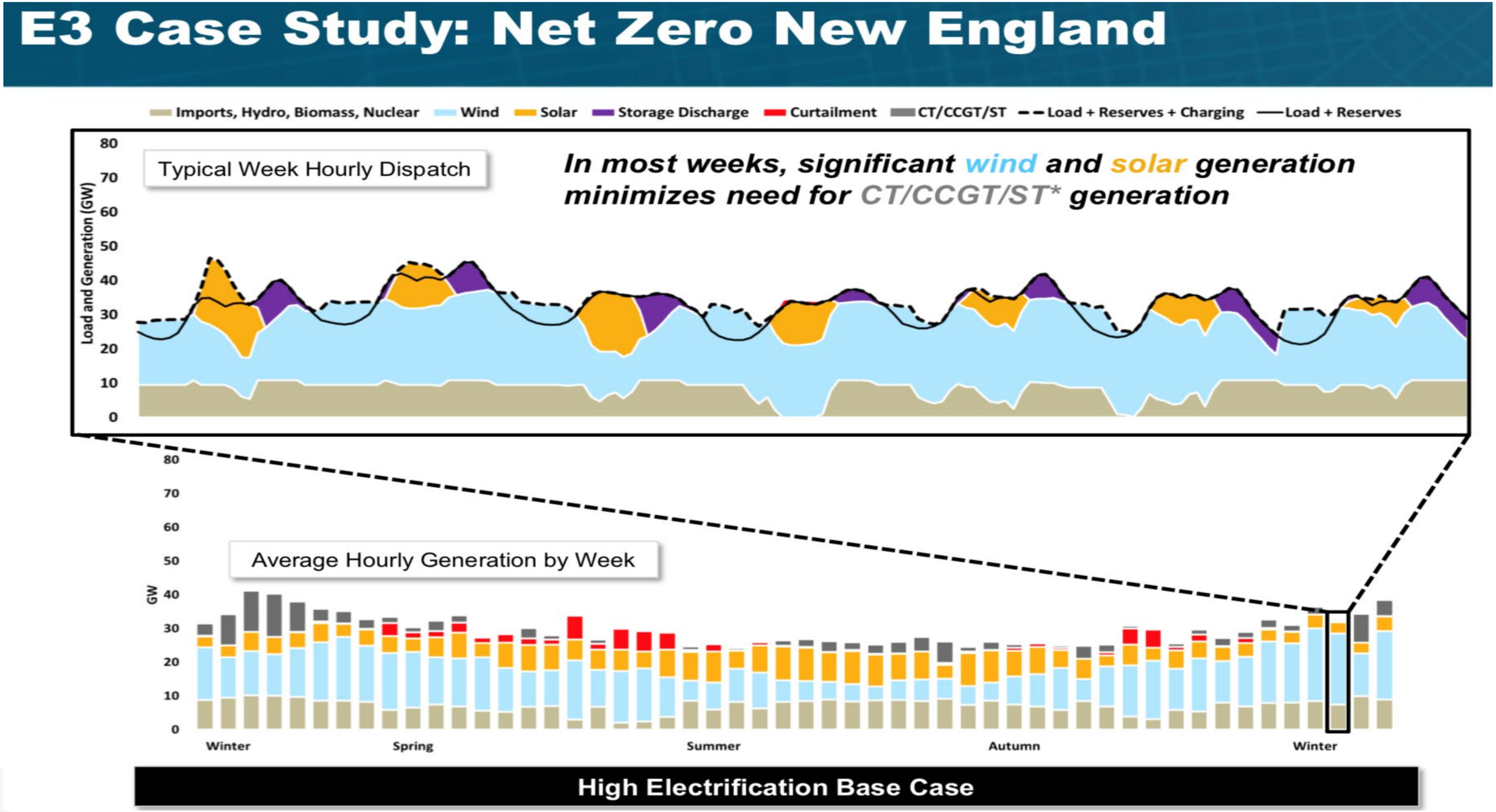



## Loss of Load Probability Table

Identifies the probability of each hour to be deficient

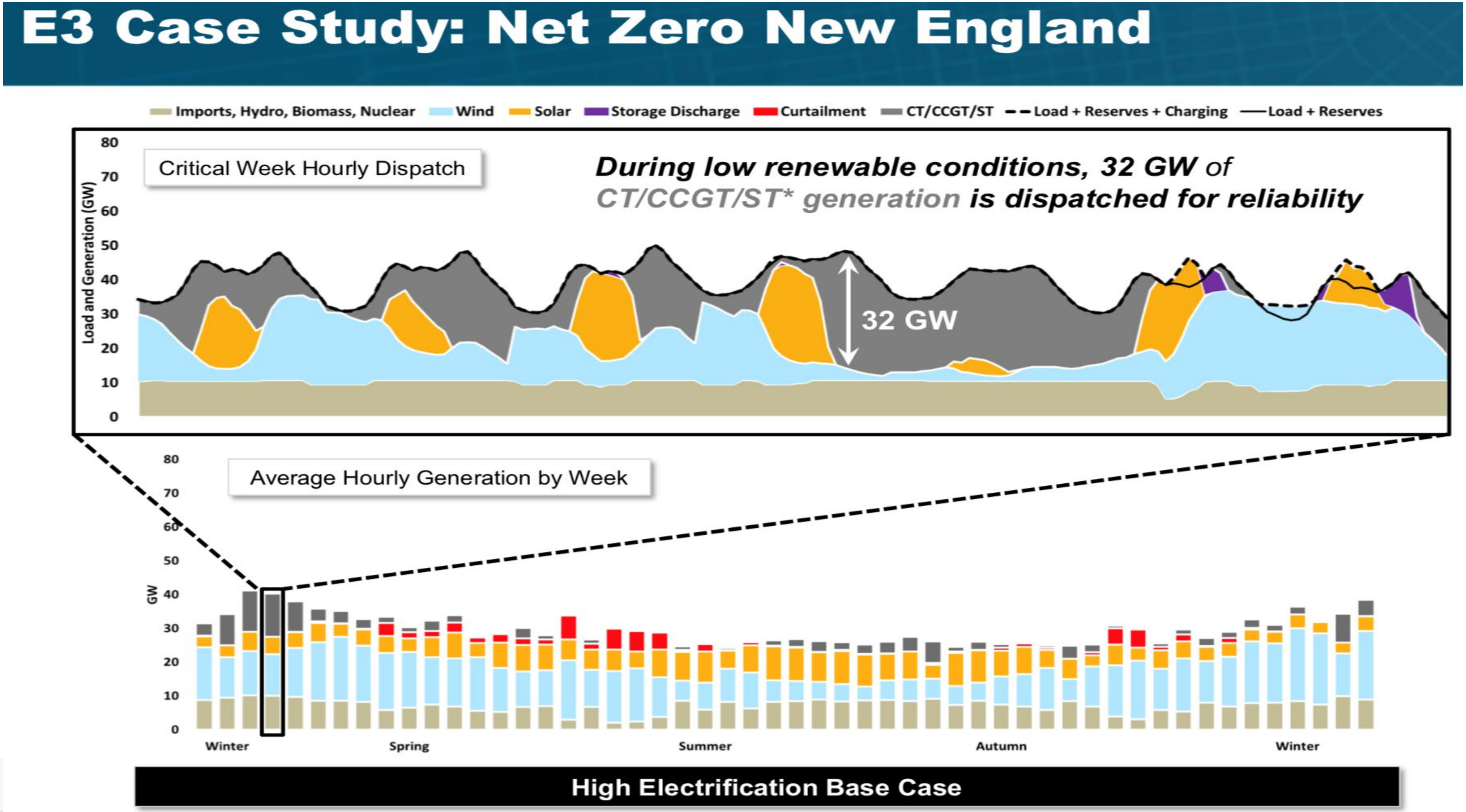


# Most of the Time, You're OK (and Dispatchable Resources Struggle)




https://www.nyiso.com/documents/20142/24172725/NYISO%20ELCC_210820_August%2030%20Presentation.pdf

# But Then There are Those Days…The Resources MUST Show Up




https://www.nyiso.com/documents/20142/24172725/NYISO%20ELCC_210820_August%2030%20Presentation.pdf

# We Can’t Not Make Decisions, But We Can Strive to Preserve As Much Optionality as Possible