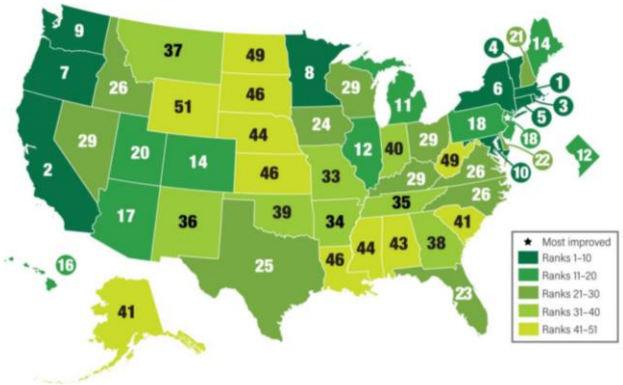
ISO new england

2018 State Energy-Efficiency Scorecard



Key Success Factors for Green, Resilient, and Affordable Electrical Energy Delivery

Damir Novosel

IEEE PES Immediate Past President

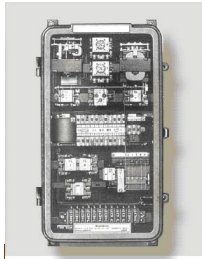
Quanta Technology President

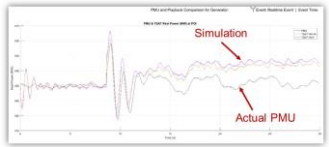
September 2019

IEEE PES Power & Energy Society®

IEEE

If Edison and Tesla came back…





Getting the Grid Modernization Priorities Right

- **Resilience and Asset Management**
  - Aging Infrastructure
  - Reliability and Security (Cyber & Physical)
  - Hardening for weather events/climate change
  - Gas and electrical interdependency
- **Distributed Energy Resources, Microgrids, Energy Storage**
- **Smarter Grid**
  - Energy Efficiency/Demand Response (DR)
  - Electrification, Smart Cities, and Villages
  - Data Analytics, Grid Visibility, etc.
- **Achieve reliability and economic targets by a new market design that will utilize mixed resource portfolio**

New York City July 13, 2019

Balanced Investment Strategy

Value of DER and Storage

- Values recognized (e.g. non-wire alternatives)
- Formalized or mandated for examination in some jurisdictions

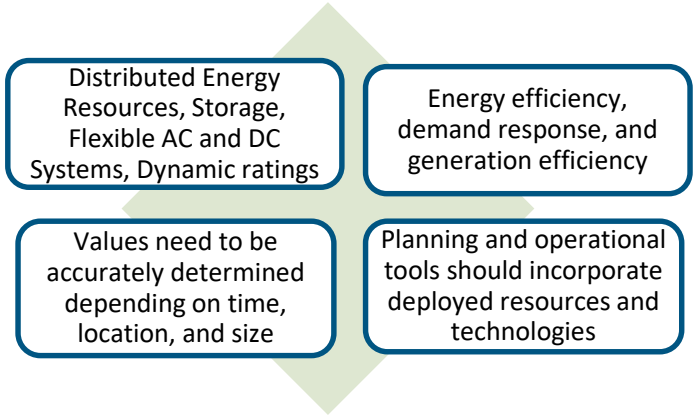
Appropriately compare DER/Storage benefits and costs with Grid benefits and costs

Value of the Grid

- Increase penetration of renewables
- Increased Electrification
- Improve Resilience
- Market Access for DER/Lower Market Prices
- Transactive Energy/Customer Choice

New Investments and Technologies Affecting Grid Performance

Investment alternatives and operating practices (e.g. non-wire alternatives) to defer or avoid traditional T&D projects (e.g. installing new wires and transformers)



Having subsidized asset provide market services has to be evaluated based on regional differences

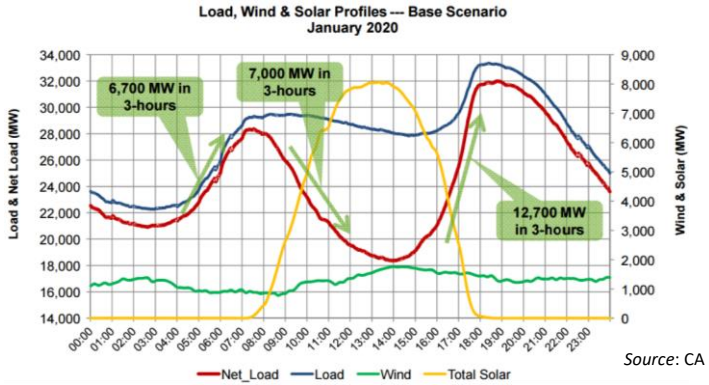
Is Storage a New Asset Class?

- **Generation Bucket – Market products (frequency regulation, reserve, voltage mgmt., restoration)**
- **T&D Bucket – Asset deferral, reliability, DER integration, congestion mgmt., power quality**
- **Consumer Bucket – PV Integration, backup, resilience**
- **Supply & Demand Bucket – Buffering variable "inventory" to achieve balance across different times and locations**
- **Transportation Bucket - Charging infrastructure of Busses, Trains, Cars/Trucks**

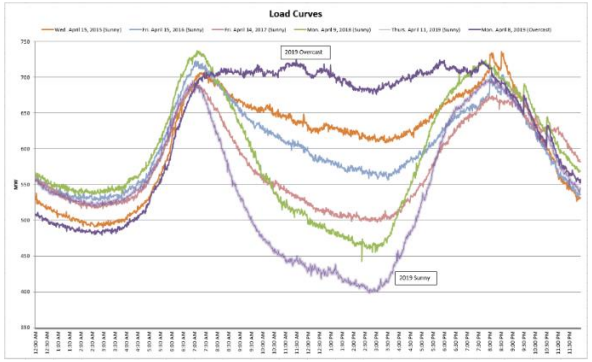
Stacking benefits for achieving a better business case

Regulation and proper market design are key factors to monetization of all possible benefits

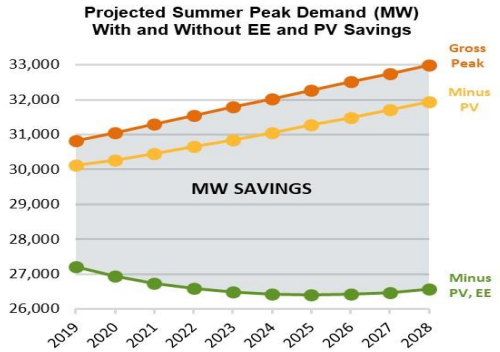
Changing Generation and Consumption



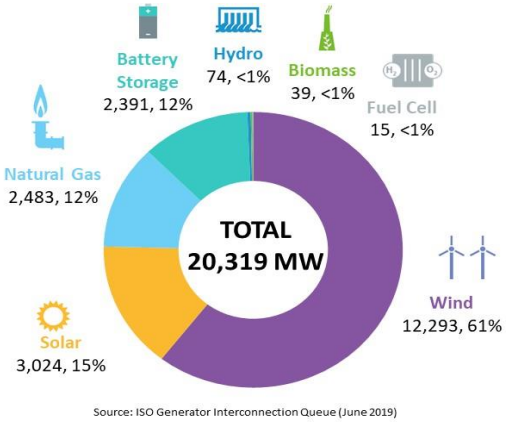
Source: CA ISO



Source: VELCO



Source: ISO NE



Source: ISO Generator Interconnection Queue (June 2019)

Wind Power Comprises More Than Half of New Resource Proposals in the ISO Interconnection Queue (mostly off-shore)

Achieving Desired Resilience and Reliability

Resilience Targets & Metrics

- Fast changing environment requires adaptive response (e.g. cyber risks, DER integration)
- Priorities to invest time and funds (Hurricane risk vs. High-altitude Electro Magnetic Pulse)
- Metrics and Industry Standards
  - System dependent (e.g. hurricane vs. snow-storm)
  - Base and future states to define metrics - data analytics
  - Reliable system is more resilient
- Solutions to improve current state:
  - DER, storage, microgrids integration
  - Advanced monitoring, control, and protection
  - Tools, processes, training, etc.

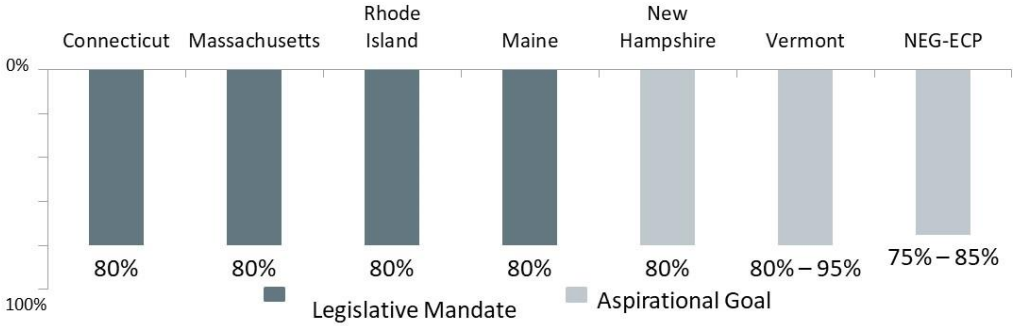
Inverter Based Resources (IBR) → Less Inertia → Things Happen Faster!

Essential Reliability Services (ERS)

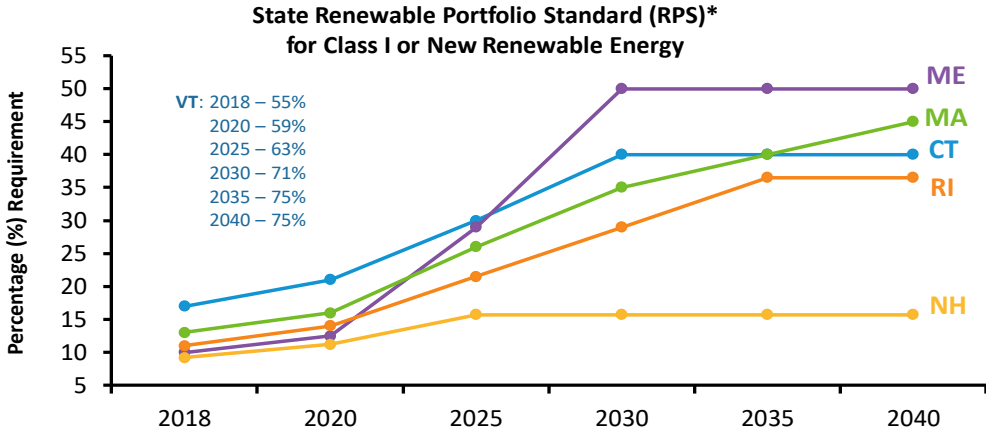
- Quantifying the value in a technology neutral manner, mix of conventional generation + Inverter Based Resources to improve reliability and resilience
- IBR can provide reserve margins if recognized by the system operators and in the marketplace
- Market mechanisms would require reliability standards to price the services - IEEE Std. 1547-2018 defines the ERS (i.e. frequency response, ramping and voltage support)
- Increased visibility and communication needs - Improved Control, Protection, Synchronized data

Source: IEEE Testimony to FERC Docket No. AD18-11-000

New England Greenhouse Gas Reduction and Renewable Portfolio Standards Targets



Percent Reduction in Greenhouse Gas (GHG) Emissions Economy Wide by 2050*



Source: ISO NE

Society Targets and Solutions

Targets

- **Decarbonization**
- **Reliability and resilience**
- **Affordable electrical energy prices**

New York Clean Energy Standard
- Reduce greenhouse gas 85% by 2050
- 70% renewables by '30 and 100% carbon-free by '40
- Energy storage: 1.5GW 2025, 3GW 2030
- Doubling energy efficiency by 2025

California Senate Bill 100
- 50% renewable energy by 2026, 60% by 2030
- 100% renewable and zero-carbon resources by 2045

Germany	2020	2030	2050
Greenhouse gas reduction (1990)	40%	55%	80%
Renewable energy share	18%	30%	60%
Energy efficiency increase (2008)	20%		50%

US: ~10 ¢/kWh
CA: ~15 ¢/kWh
EU: ~27 ¢/kWh

Solutions

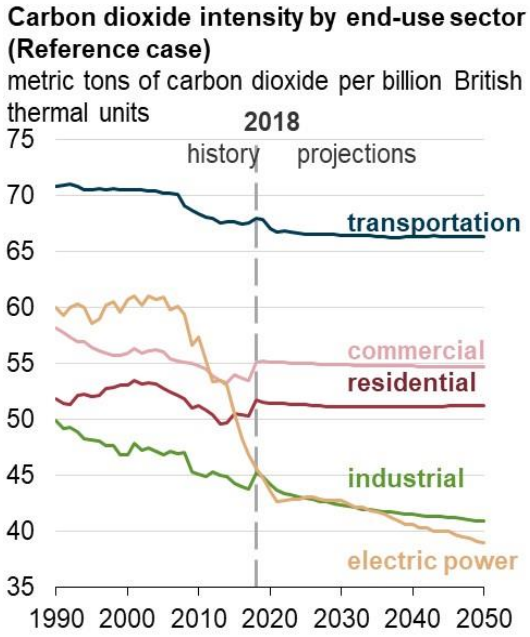
Energy/Fuel Transformation
- Renewable generation (solar, wind, etc.)
- Electrical Storage

Energy Efficiency

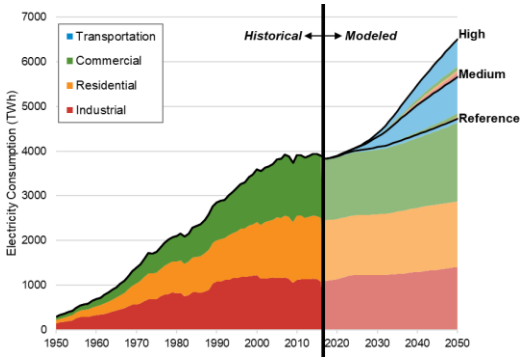
Electrification
- *Transportation:* Light-, Medium-, Heavy-Duty, Buses, Infrastructure
- *Buildings:* Residential & Commercial
- *Industrial and Agriculture*

1891: First successful electric car
1904: ~1/3 cars were electrical

Electrification Impact



Source: US EIA



Source: NREL

- Peak load growth even with managed charging, e.g. transformer overloading
- Understanding impact on increased loading on entire load profile - accelerate re-rating and replacement
- Building sector heat pump conversion results in increased winter load

Amazon, UPS, FedEx, PepsiCo have alternative vehicle programs

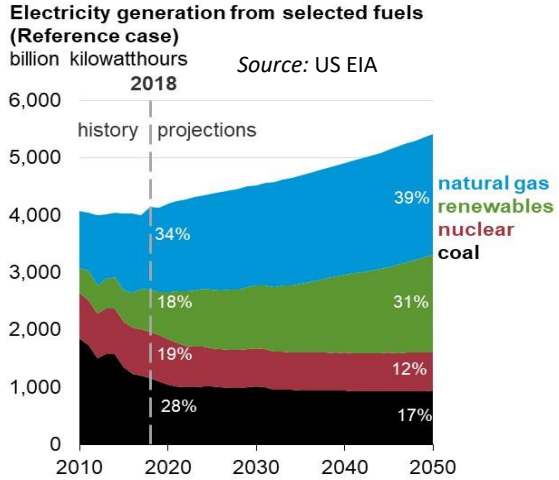
- Total system load is OK, but impact at the charging point needs to be managed
- 30 UPS Trucks charging at 650 kW = 19.5 MW
- A big driver is cities aiming for zero emission zones

Key for de-carbonization is electrification that requires investments in a robust, hybrid grid

Key Success Factors for the Energy Future

- **Electricity is key for achieving societal and economic goals, such as decarbonization and growth**
  - ➞ *Demand for electricity will increase - electrification and fuel transformation*
  - ➞ *Need for clear and balanced society & regulatory policies*
- **Hybrid, modernized grid is key for resilient, safe, reliable, and efficient energy delivery**
  - ➞ *Mix of synchronous generation, Inverter-Based Resources (DER, energy storage, microgrids), and dynamic/active distribution grids with conventional and new loads (e.g. electrical transportation and home heating)*
  - ➞ *Innovations and optimal utilization of technologies and processes enabled by wholesale markets*
- **Prioritize investments to achieve reliability and resilience targets in the most cost-effective way**

Key factors for Resilient Grid: Technology Advancements, Educated Workforce, Standards, and Sharing Global Best-Practices



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