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ILLINOIS POWER AGENCY

The Modern Grid

October 27, 2023

Agenda

1. Housekeeping and Introductions
2. Overview: The Modern Grid
3. Challenges and Opportunities
4. Utility-Grid Trends and ComEd's Deployment of Modern Grid
5. Q&A

IPA Power Hour Webinars

- **Introduction and Scope**
- **Power Hour is a series of educational and informative presentations on a wide range of clean energy topics and emerging issues**
- **Today's Power Hour:**
  - Examine how technology can play a key role in making the grid smarter, optimizing sustainable technologies, and solutions to build a more efficient grid.

The Illinois Power Agency

Vision:
"A clean, reliable, and cost-effective energy future for residents and businesses across Illinois"

- Independent State Agency created in 2007
- Responsible for the development of an annual Electricity Procurement Plan for customers of electric utilities
- Supports the Illinois Renewable Portfolio Standard (RPS) through the development and implementation of:
  - Long-Term Renewable Resources Procurement Plan
  - Competitive procurement for utility-scale projects
  - Solar incentive programs for homes and businesses

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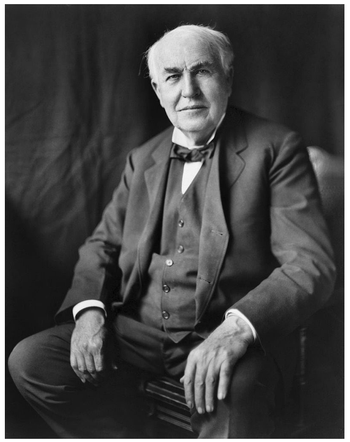
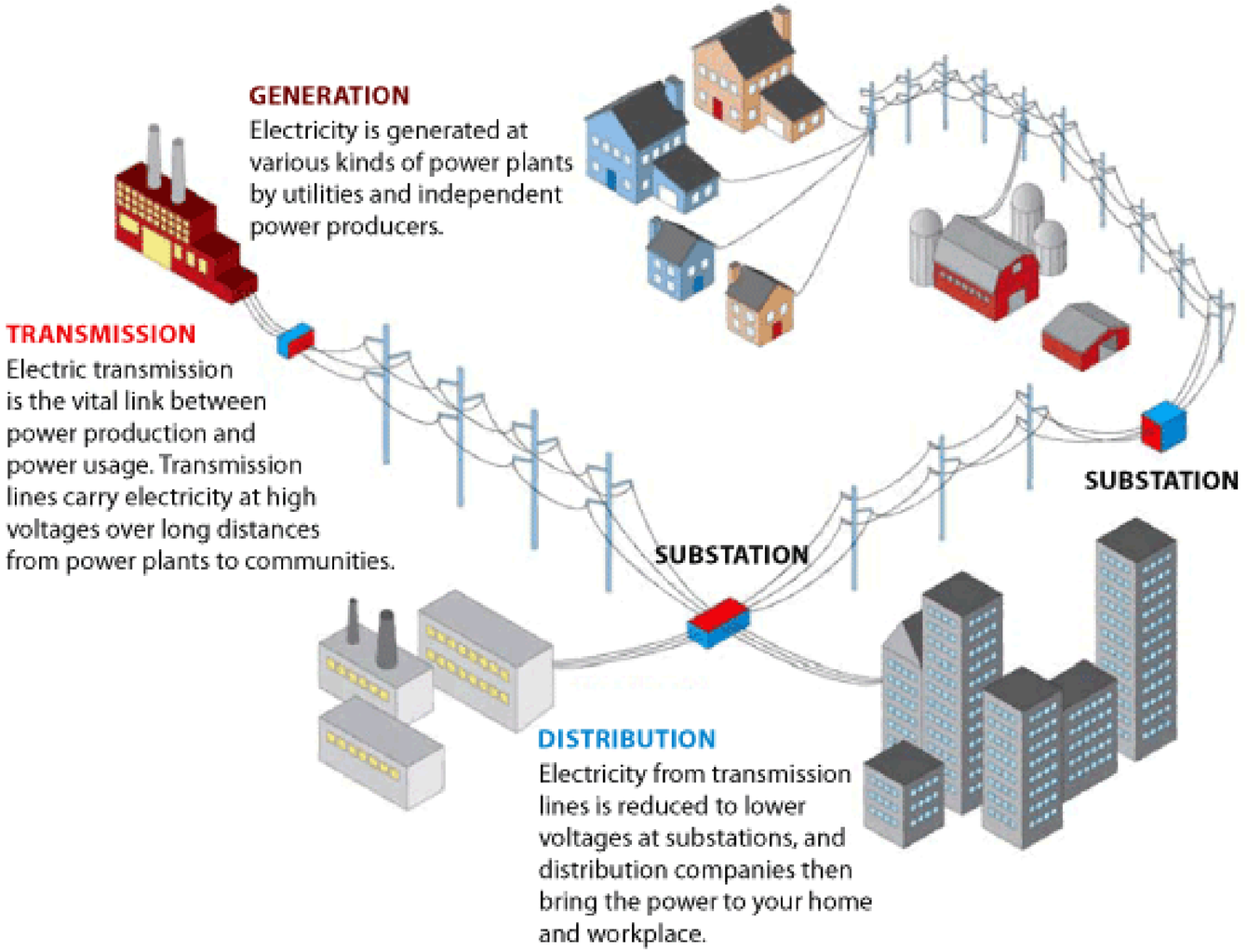
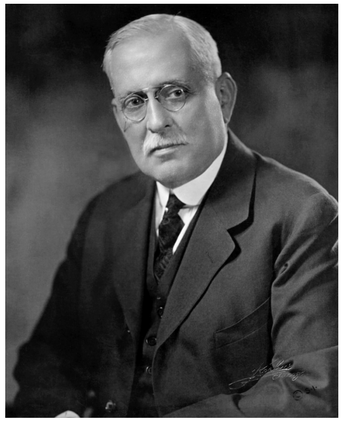
Overview: The Modern Grid

The Not Modern Grid

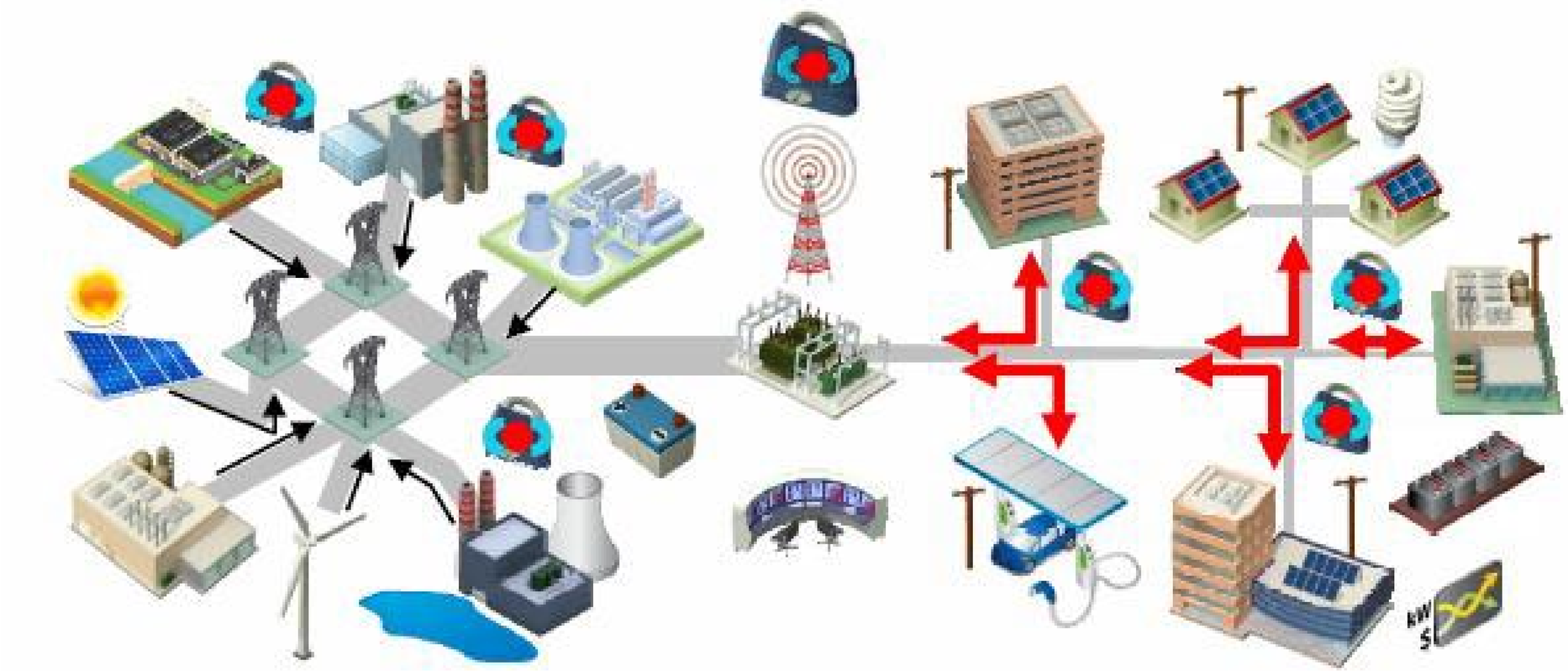






Source: https://medium.com/age-of-awareness/frozen-in-time-6cb8aa2d5ce

The Modern Grid



Source: https://www.energy.gov/articles/launch-grid-modernization-laboratory-consortium

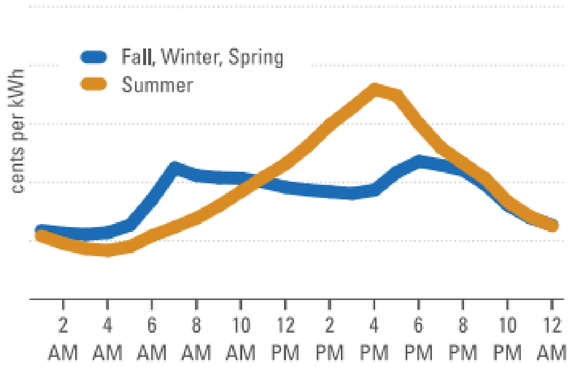
Measurement and Information is Key

~1900

~2000

Today

What the Modern Grid Can Do



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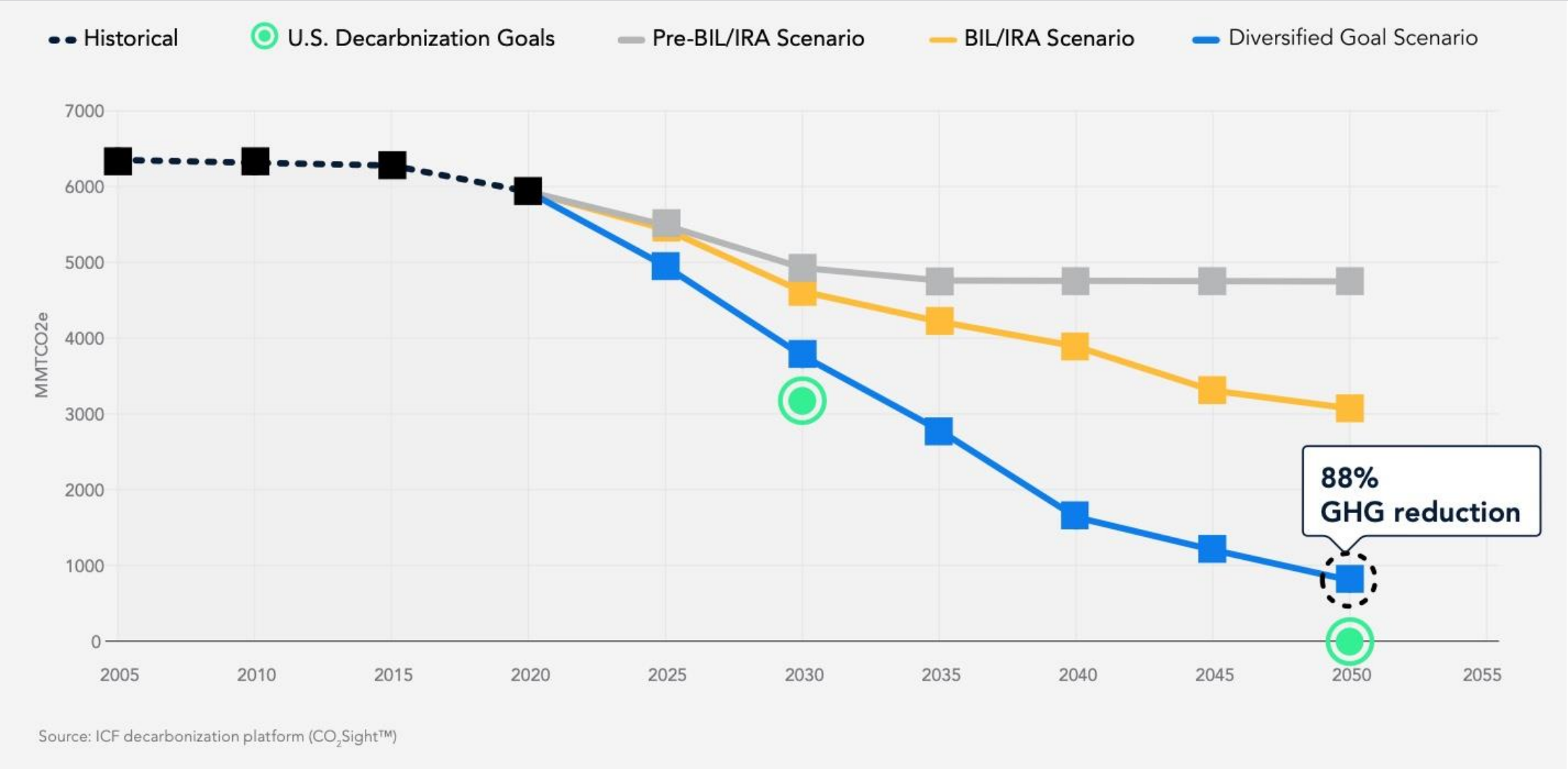
Challenges and Solutions

The Modern Grid

Illinois Power Agency, Power Hour Webinar, 27 Oct 2023
Michael Jung, Executive Director, ICF Climate Center

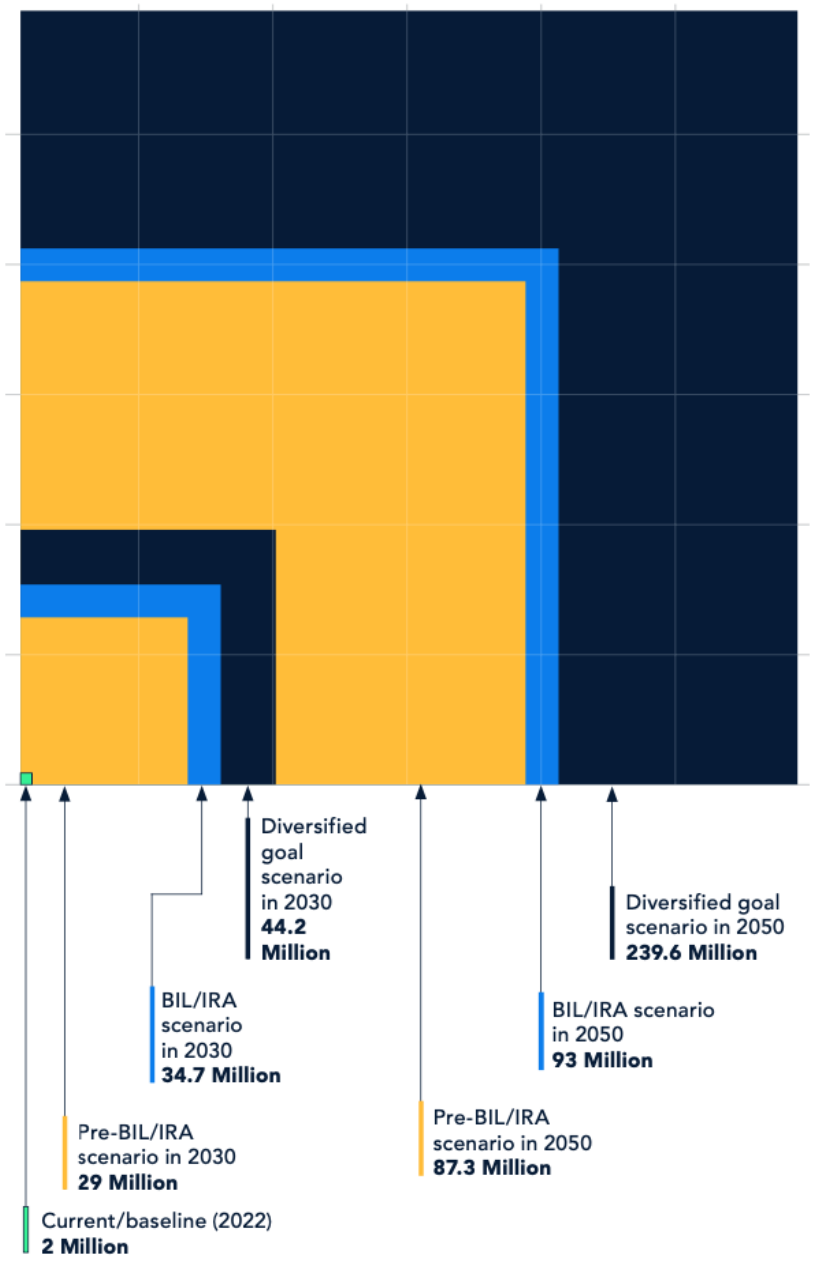
The Grid is the Key to Meeting Climate Goals



Source: ICF decarbonization platform (CO_2Sight™)

EVs, everywhere, all at once

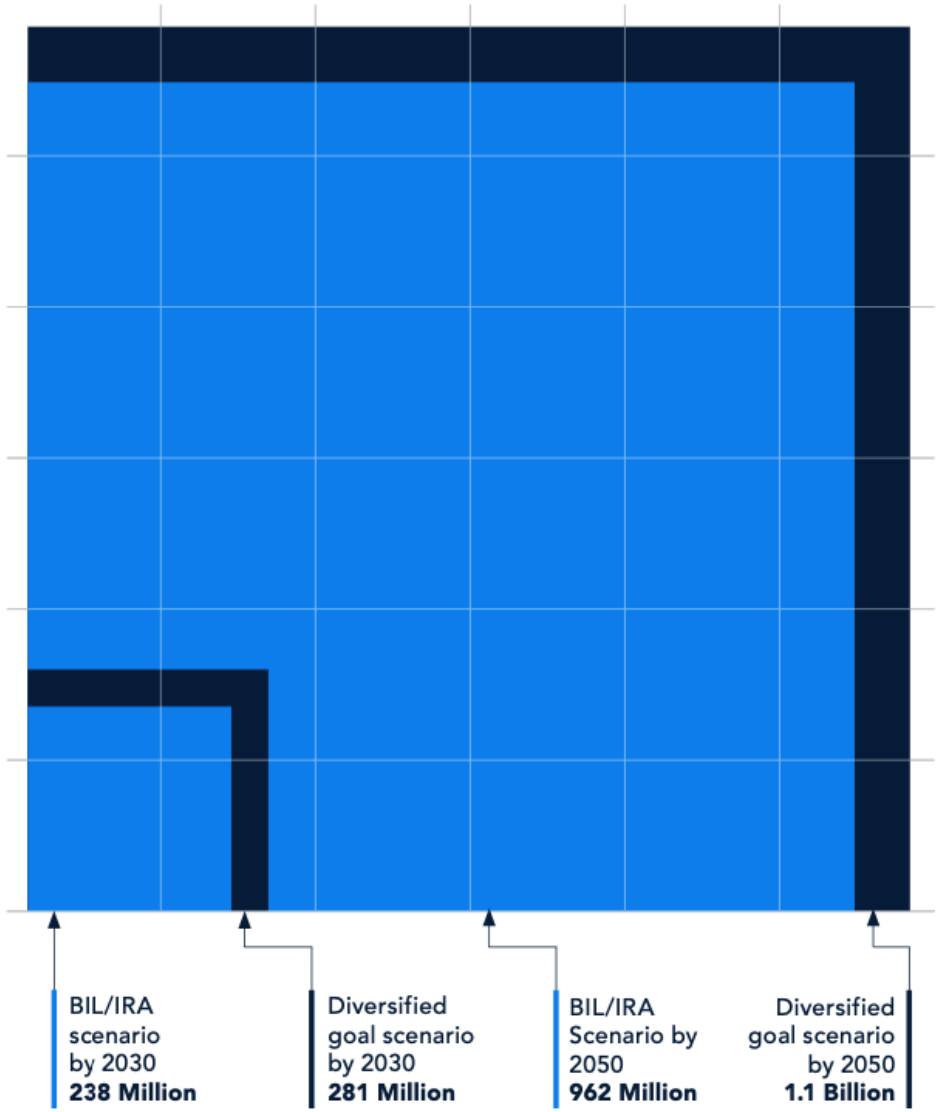
100X current EV fleet by 2050



Source: ICF analysis using CO2Sight™decarbonization platform

Big-Time Building Decarbonization

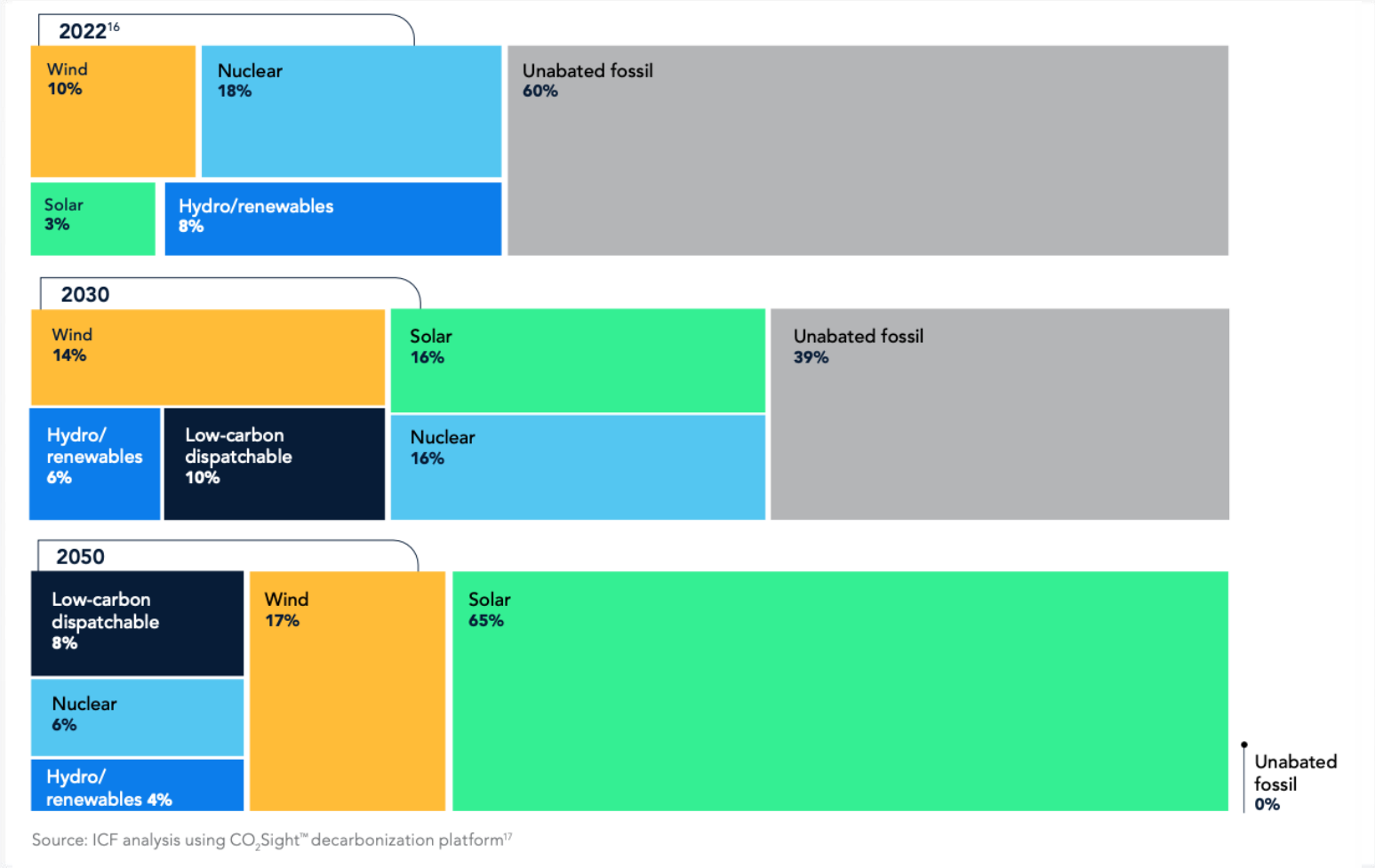
1.1B measures deployed by 2050



Source: ICF analysis using CO_2Sight™ decarbonization platform

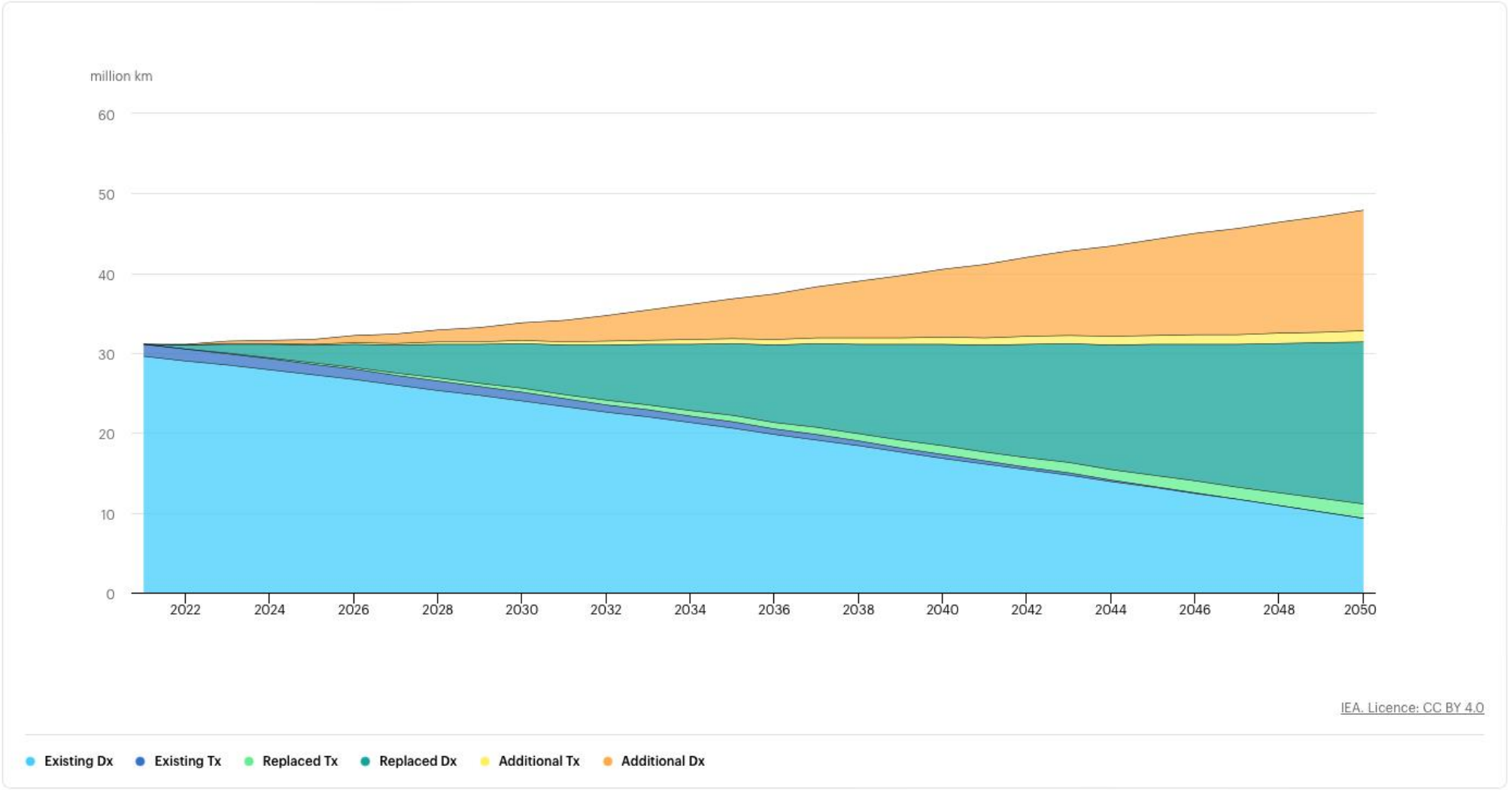
Greening The Grid

Generation mix
85% renewable by
2050

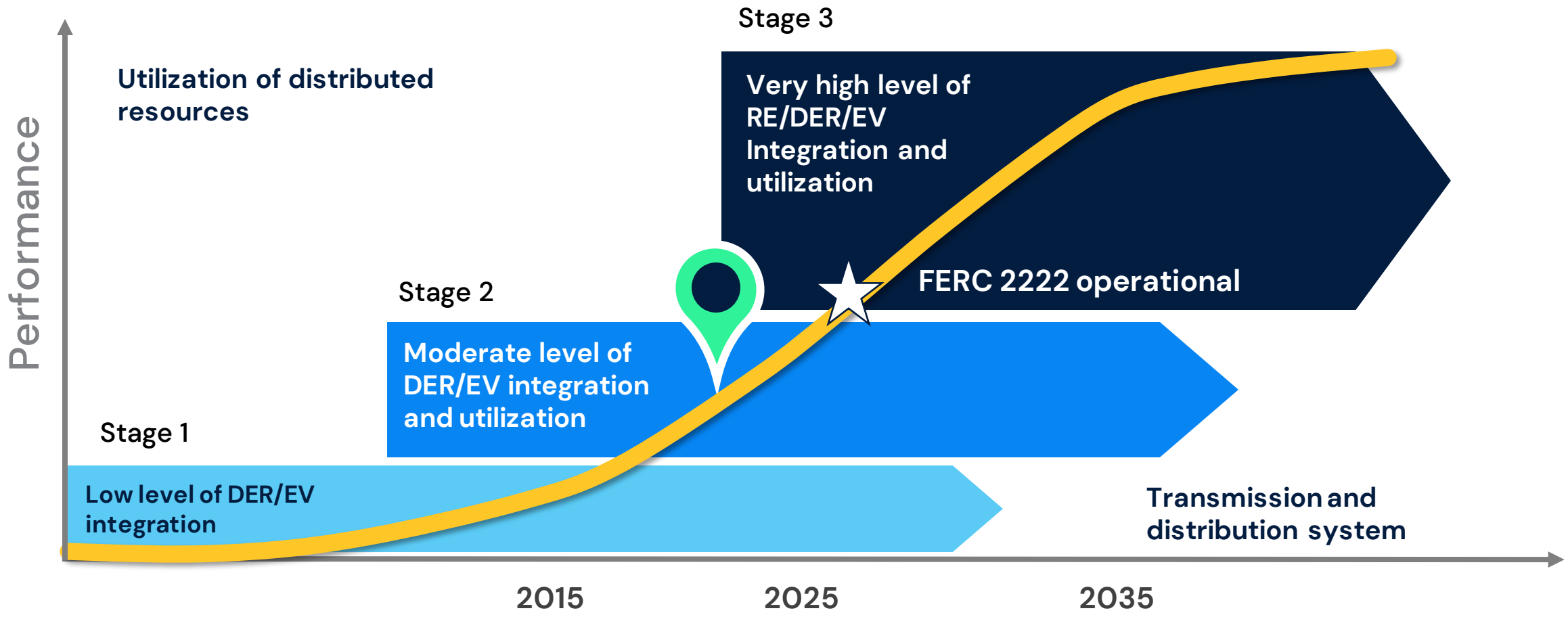


Replace, Rebuild. Rinse, Repeat.

Grid Length Development in Advanced Economies under IEA Announced Pledges Scenario



Grid System Evolution

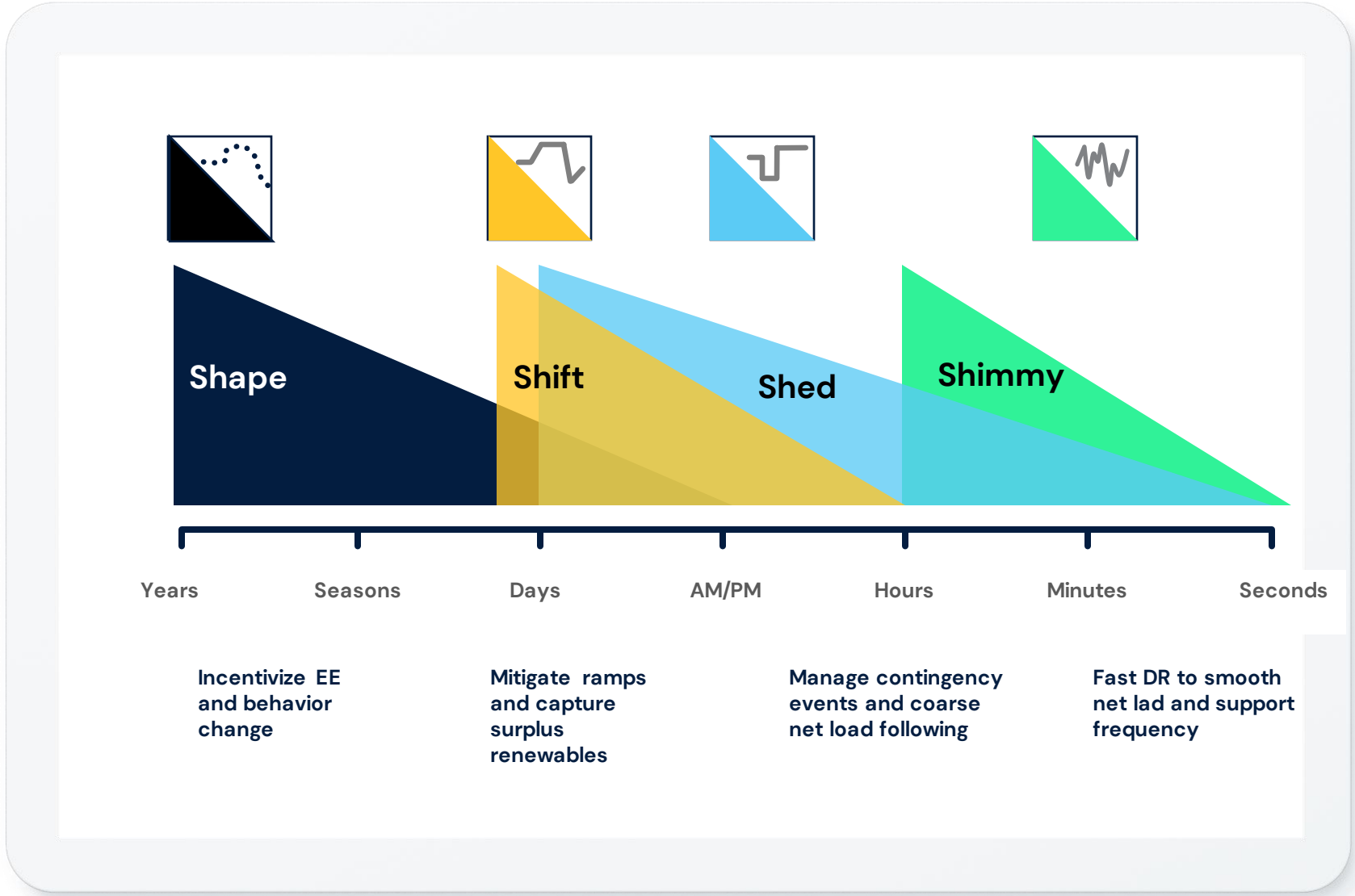


Source: P. De Martini

Timing Is Everything

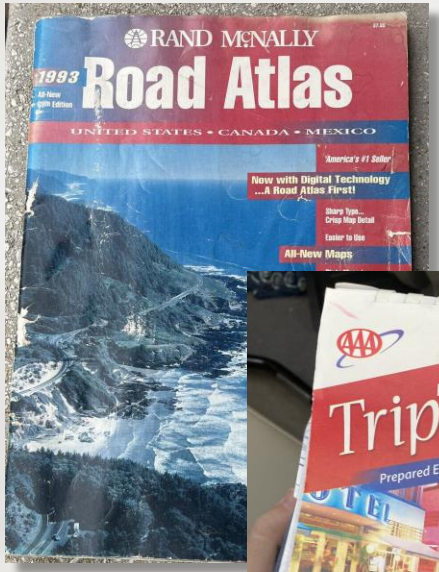
The lines between generation, transmission distribution, and behind-the-meter infrastructure are becoming blurry.

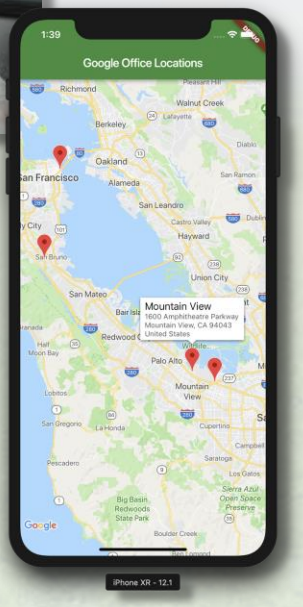
Adapting the data-limited, one-way grid of the past to the data-rich, multi-directional grid of tomorrow requires the grid to think and react faster than ever before



Source: LBNL

Digital Twins: GPS for The Grid





Digital Twins for the Grid: Good, Better, Best

Good

Visualized

- Communications to/from the grid-edge
- Ubiquitous sensing
- Data collection and access
- Descriptive

- *"AAA Trip Tik"*

Better

Predictive

- Anomaly detection
- Topology mapping
- What-if analysis
- Comprehensive asset visualization, management
- Prescriptive

- *"Early Dashboard GPS"*

Best

Autonomous

- Transactive DERs
- Instant DER interconnection studies
- Real-time, dynamic scenario planning
- Interactive

- *"Waze"*

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Utility-Grid Trends and ComEd's Deployment of Modern Grid

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IPA Power Hour 9: The Modern Grid

Grid Modernization

Sainab Ninalowo| Sr. Manager, Smart Grid & Innovation, ComEd

Agenda

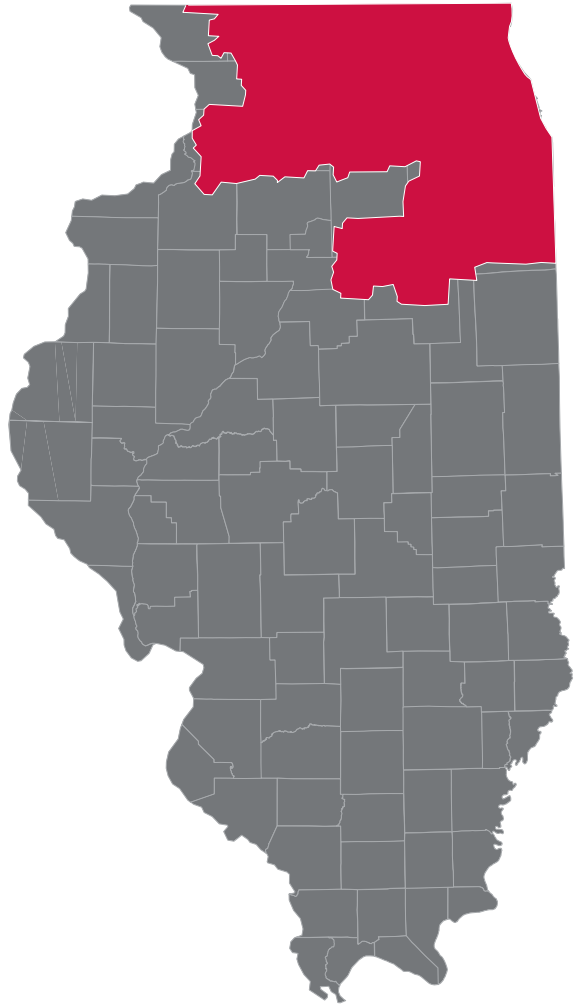
- ComEd background
- Changing Grid – Diverse Needs
- Bronzeville Community Microgrid
- Phasor Measurement Units
- Battery Energy Storage
- DERMS

ComEd, An Exelon Company

Our Company:
- One of six utilities owned by Exelon
- 6,400 employees
- Service territory: 11,428 square miles

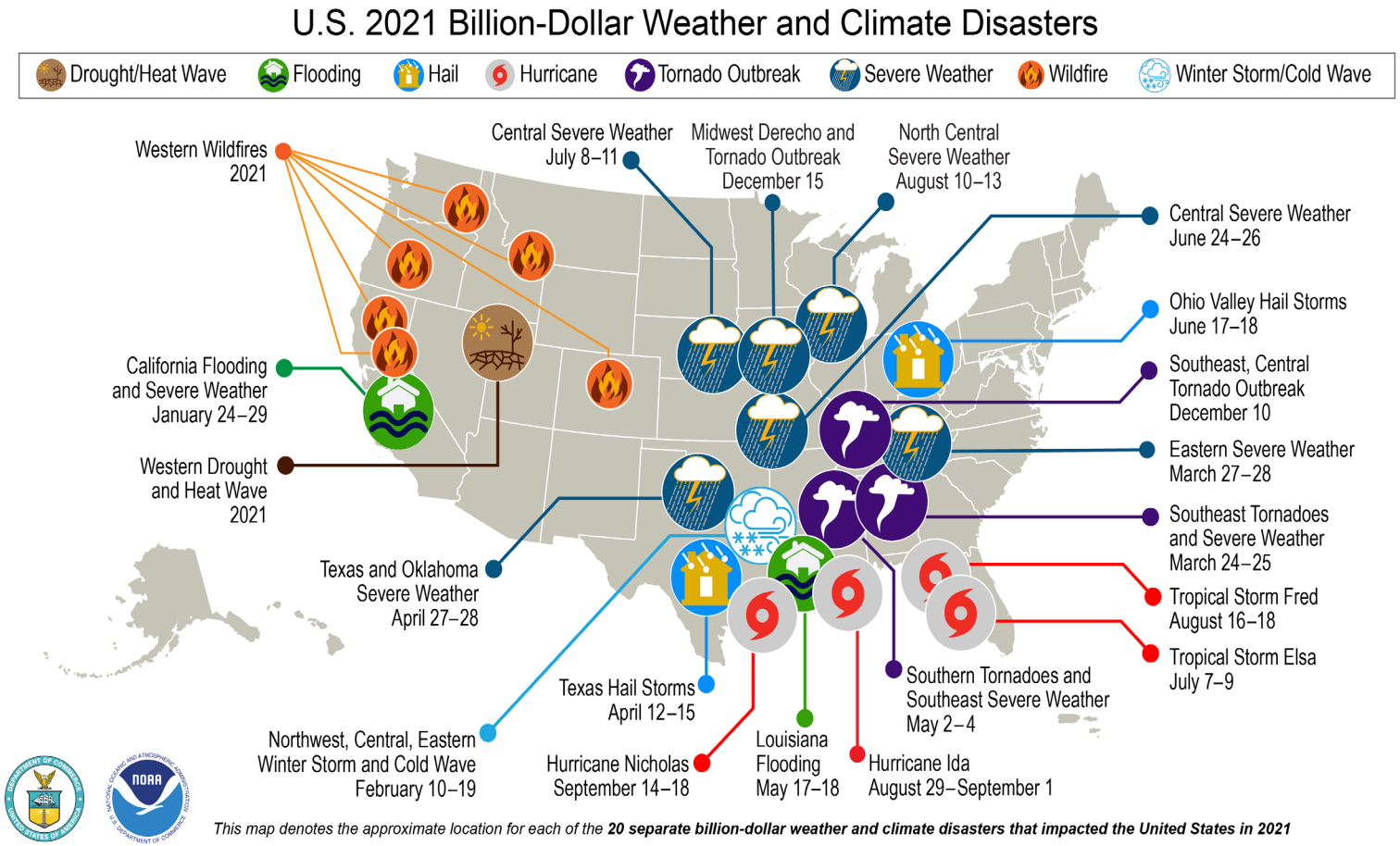
Our Customers:
- More than 4.1 million customers in northern Illinois including the city of Chicago

Our Grid:
- Peak Load: 23,753 MW (Summer)
- 553,800 distribution transformers
- 66,200 circuit miles of primary distribution
- 52% overhead, 48% underground in distribution
- 5,800 circuit miles of transmission
- 93% overhead, 7% underground in transmission
- Interconnected DER: 916 MW



Climate Change Impacts Increasing Pressure for Change

- 2021 is the seventh consecutive year (2015-2021) in which 10 or more major weather and climate disaster events have impacted the United States
- Over the last 40 years the years with 12 or more separate billion-dollar disaster events include 1998, 2008, 2011-2012, and 2015-2021

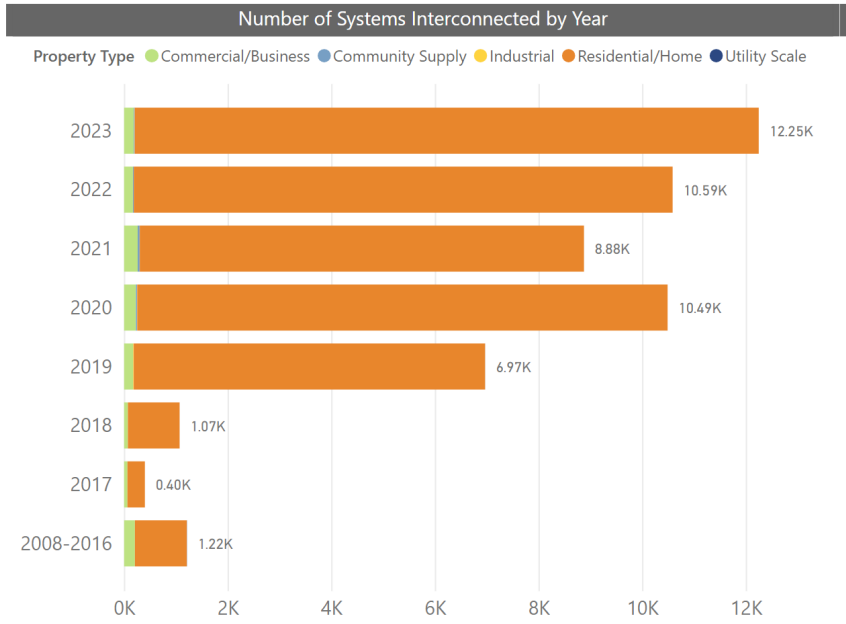


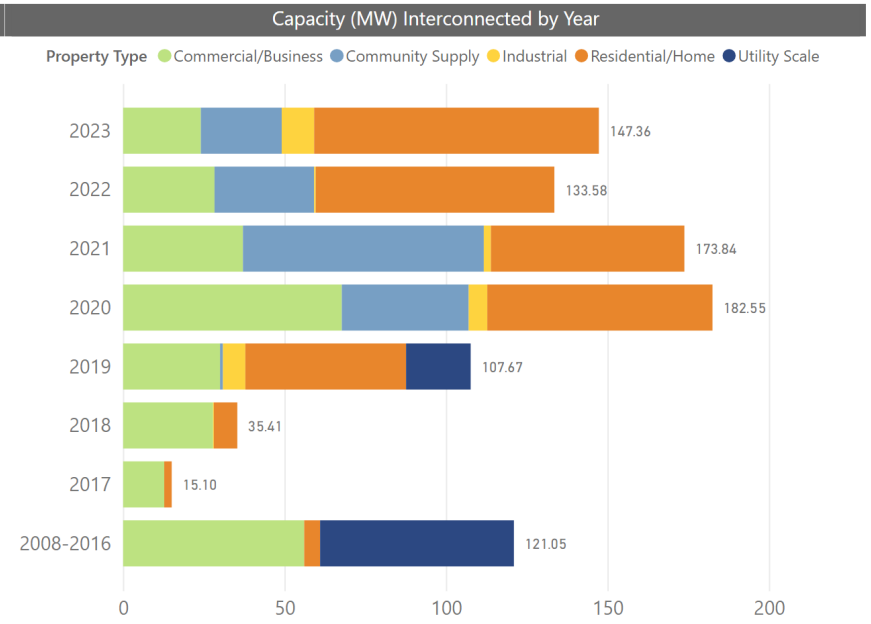
Source: NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2021).

Utility Grid Trends

- Trend #1: Entire sectors of our economy are electrifying
- Trend #2: Renewables require a more decentralized approach to supplying and managing the flow of power
- Trend #3: Volatile weather and other external forces present risks to the grid
- Trend #4: Technology is enabling customers to become more sophisticated energy consumers
- Trend #5: Technology is enabling utilities to become better operators

- With the passage of FEJA, ComEd saw an increase in interconnection applications beginning in 2018
- Residential projects make up over 95% of interconnection requests received
- Incoming solar applications are on a record pace in 2023 with anticipated volumes of 20,000+ by end of year





Program to Date Interconnected Systems Count

Commercial/Business	Community Supply	Industrial	Residential/Home	Utility Scale	Total
1392	89	23	50367	4	**51875**

Program to Date Interconnected Application Capacity (MW)

Commercial/Business	Community Supply	Industrial	Residential/Home	Utility Scale	Total
284.27	170.65	25.66	355.98	80.00	**916.56**

One System with Varying Needs

Every circuit has unique customer needs and evolving load profiles

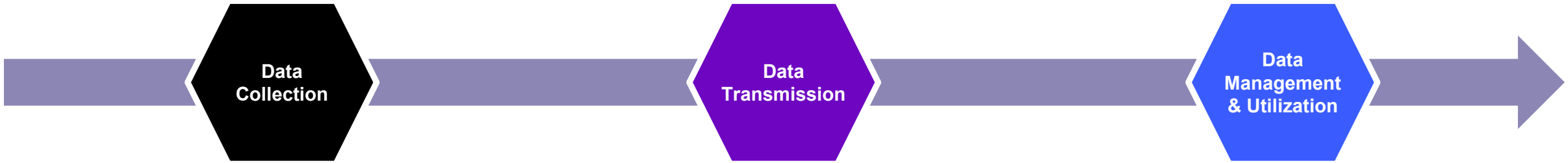
Rural

Suburban

Urban

Diverse Load Profiles

Components that Enable an Evolving Grid



Data

Data sources will continue to evolve providing ComEd with critical information needed for grid of the future improvement

- Smart inverters
- Distribution PMUs
- Distribution equipment sensors
- Smart meters
- Modern microprocessor relays
- Mid-circuit device sensors
- Line sensors
- Weather sensors
- Grid edge devices

Communications

Communications networks will be required to *expand* to connect to any new data source or control any smart device. *Volume*, *speed*, and *quality* of data along with *security* requirements will determine the network architecture requirements

- Fiber backhaul – high speed and large bandwidth
- Wireless last mile options including 5G

Automation/Control

Converting data into additional utility and customer capabilities, efficiencies, and savings will increase the value of the enterprise

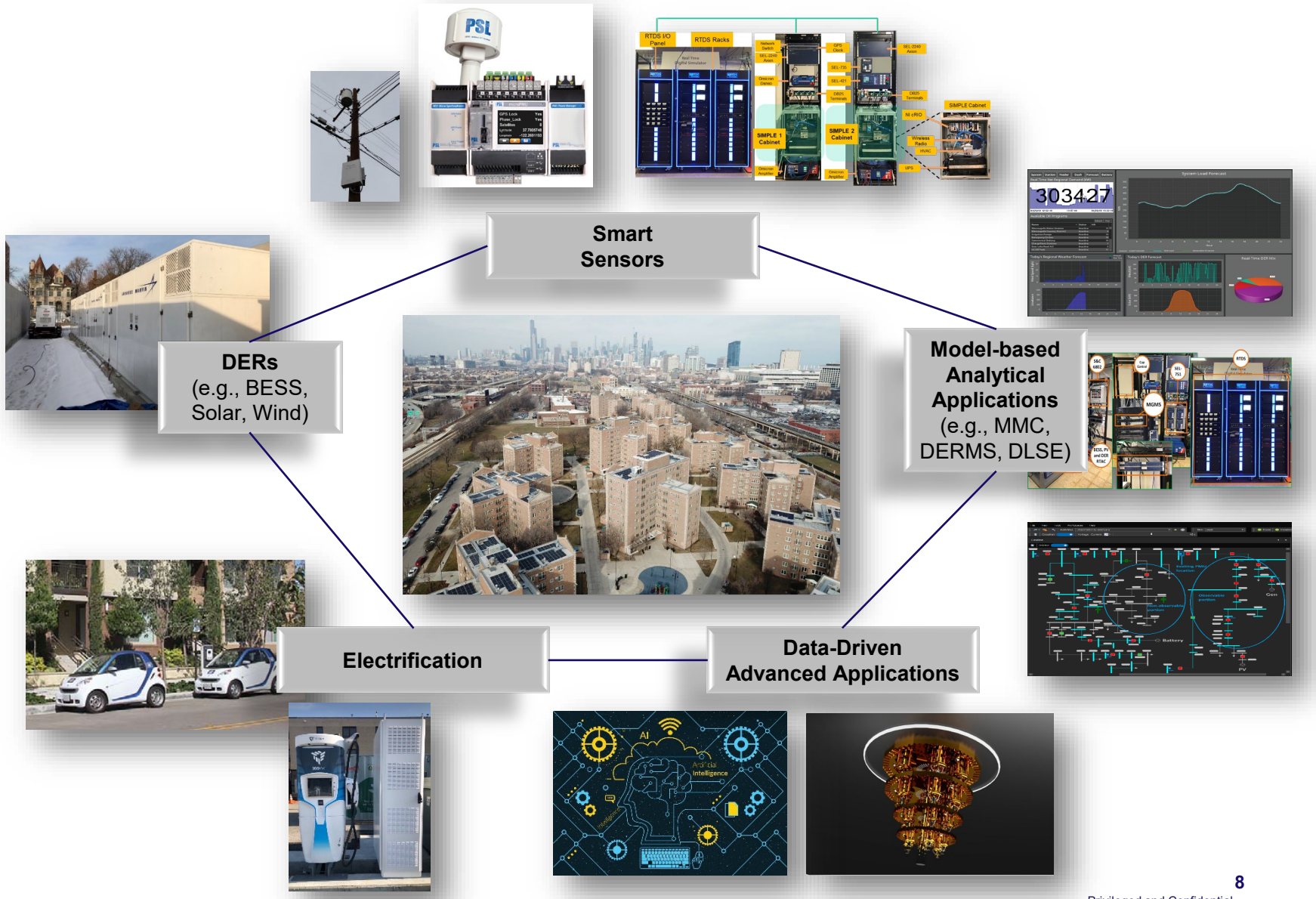
- DER management
- Utility-Customer IoT applications
- Advanced asset health
- Situational awareness
- Utility device coordination
- Storm readiness
- Automated fault location
- Distributed Intelligence
- Smart Cities applications

Solutions for an Evolving Grid

DERs introduce significant complexity to grid planning and operation.

Sustaining the level of reliability and performance that customers expect requires advanced:

- Monitoring
- Protection
- Automation
- Controls
- Communications
- Software applications & analytics



Demonstrating Emerging Technology as Solutions

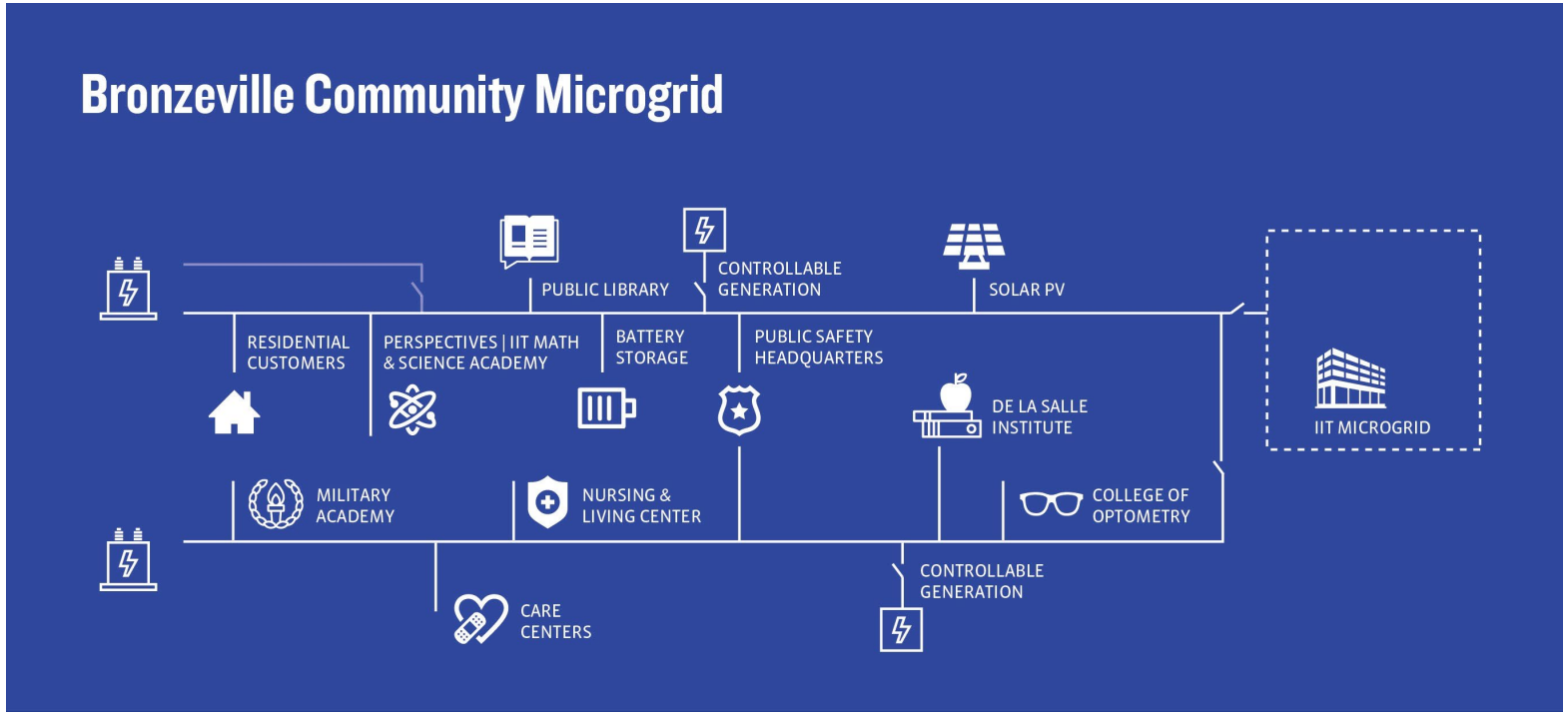
ComEd is preparing for the future by working with 50+ external collaborators including national labs, universities and vendors on 20+ DOE/NSF/DOD projects to demonstrate cutting-edge

- DER coordination within community microgrids
- Extreme fast electric vehicle charging
- Behind-the-meter DER analysis
- Preventive maintenance
- Advanced state estimation
- AI-enabled Grid Control
- Cyber-security

A Diverse Ecosystem of Partners

Bronzeville Community Microgrid (BCM)

- The Bronzeville Community Microgrid enables a green, resilient, sustainable neighborhood for consumers
- 7 MW aggregate load, serving approximately 1,000 residences, businesses and public institutions
- Installation of first utility-operated microgrid cluster powered by DERs including 750 kW solar PV, 500kW/2000kWh battery energy storage, and controllable gas generation
- Microgrid Master Controller operates microgrid in grid connected mode when main grid is available and switches to an islanded mode when the main grid outage occurs
- Demonstration of advanced technologies supported by the Department of Energy grants, and in collaboration with universities, vendors, and national labs



Phasor-Measurement Units

- Synchro phasors are time-synchronized measurements of voltage and current phasors and the frequency of the AC signal. PMUs (Phasor Measurement Units) are the “sensors” that provide synchrophasor data.
- Distribution synchrophasor deployments are part of a long-term strategy to help ComEd better incorporate advanced monitoring equipment and software into modeling and operational systems.
  - PMUs provide high resolution of data collected and will enhance reliability, resiliency, and situational awareness
  - PMU data will allow for enhanced monitoring of DER integration & impact strategically across key feeders in ComEd service territory
- PMUs in BCM area: 25 MicroPMUs and 2 Substation PMUs (currently 2 Substation PMUs and 2 MicroPMUs streaming data)
- Total Substation PMUs : 224 streams enabled

A Three-Tiered Approach

Substation Level PMU

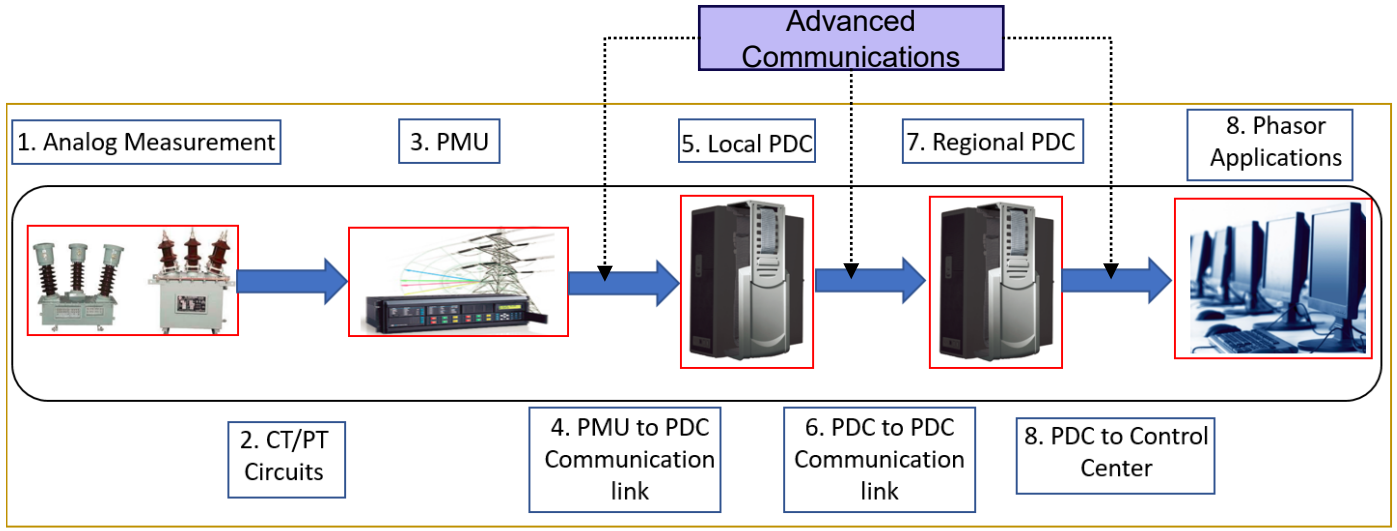
- 12kV and 34kV feeder relays
- Transformer relays
  - Situational awareness of feeder heads and medium voltage busses

Feeder Main-Stem PMU

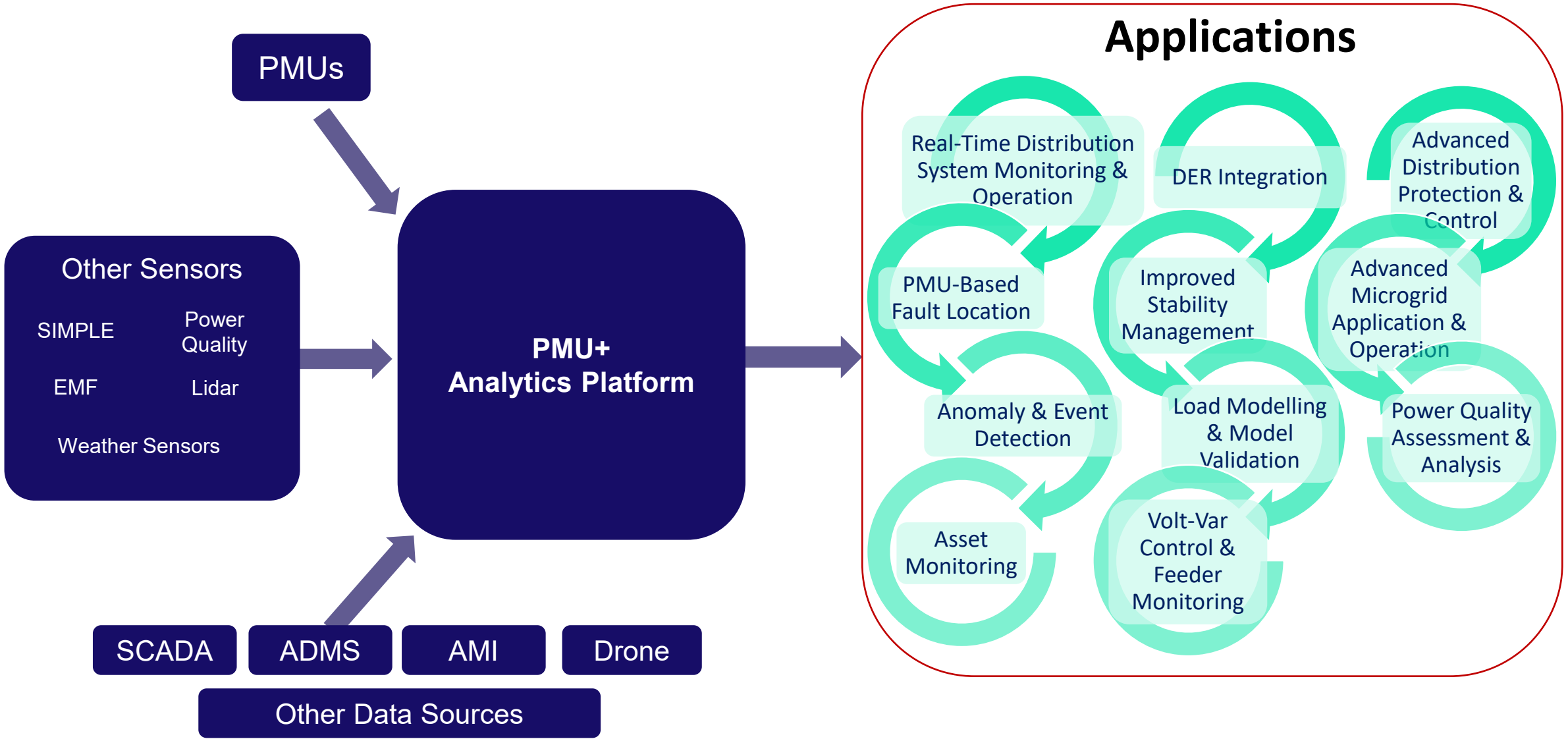
- Distribution automation devices (S&C IntelliRupters)

Feeder Edge PMU

- Standalone microPMU
- Distributed generation



PMU Analytics Platform and Application



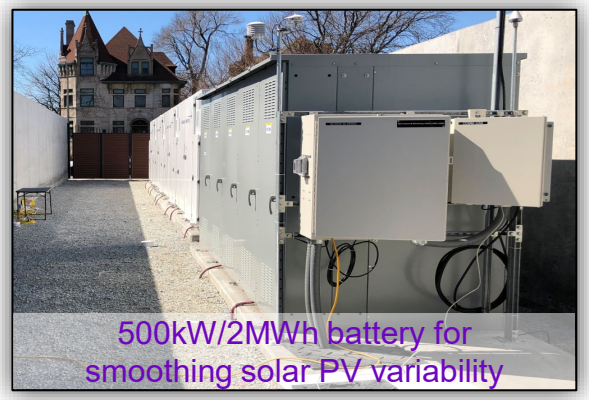
Battery Energy Storage Systems as a Tool for Grid Planning and Operation

ComEd is preparing for the future by demonstrating the use of batteries as a tool

Use Case	Rating	Operating Setpoint
Capacity deferral for substation XMFR	2MW / 2MWh	N-1 Transformer Logic
Higher penetration of renewables	500kW / 2MWh	PV output variation
Capacity deferral for distribution feeder	500kW / 750kWh	Feeder load > 360A (7.9MW)
Outage Management and Power quality	25 kW / 25kWh	Feeder outages & PQ events
Outage Management and Power quality	25 kW / 50kWh	Feeder outages & PQ events
Improve reliability for customer target (CT) candidates	7kW / 32kWh	Seamless Transition to battery during Customer/Feeder Outage
Improve reliability for customer target (CT) candidates	130kW / 460kWh	Seamless Transition to battery during Customer/Feeder Outages
Improve reliability for customer target (CT) candidates	130kW / 230kWh	Seamless Transition to battery during Customer/Feeder Outages
Demonstrate a way to cost-effectively integrate high penetration distributed Behind the Meter (BTM) solar and energy storage in the power grids	250 kW / 250 kWh	

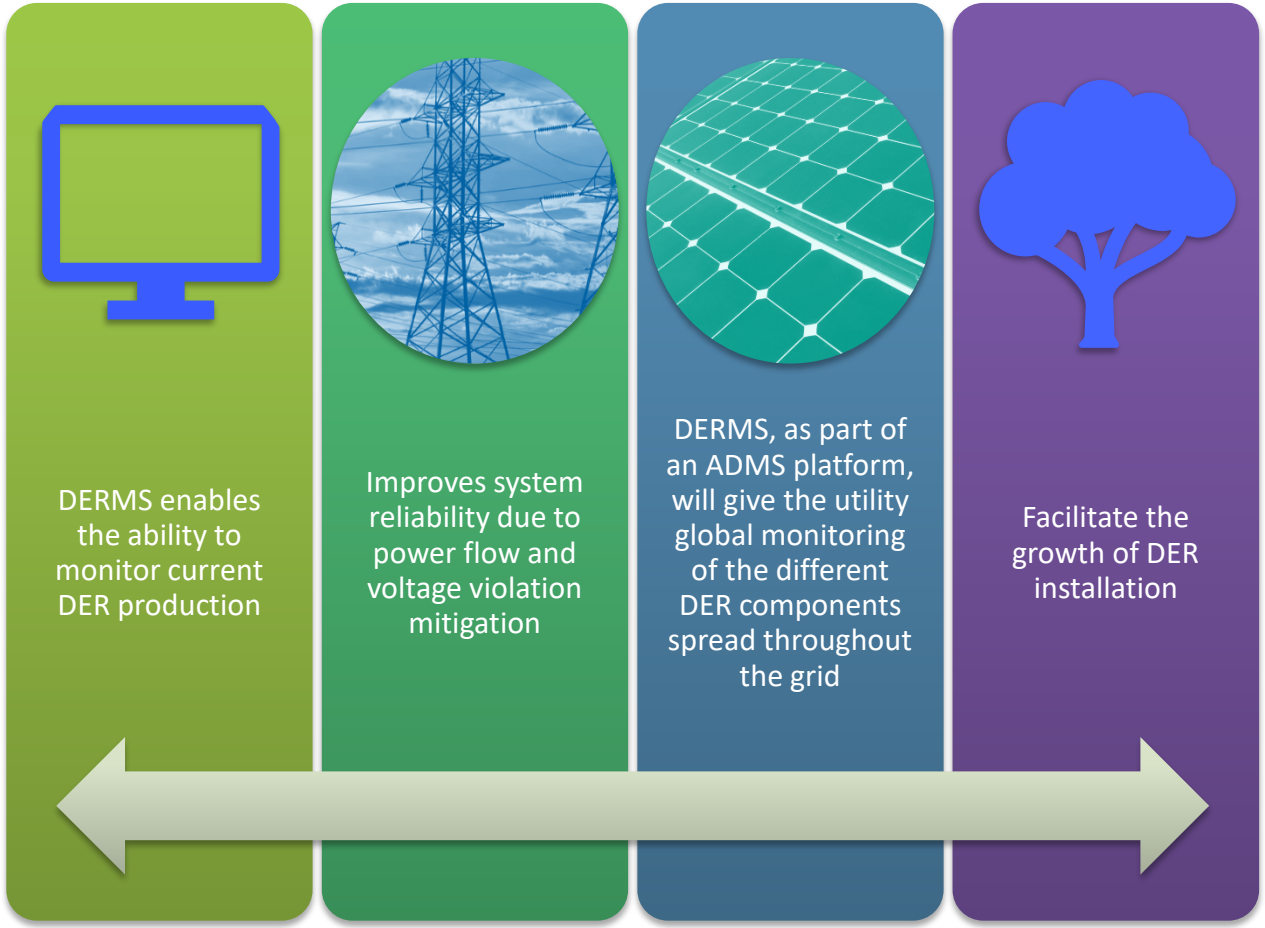
2MW/2MWh battery for Substation capacity deferral


500kW/750kWh battery for feeder capacity deferral


500kW/2MWh battery for smoothing solar PV variability

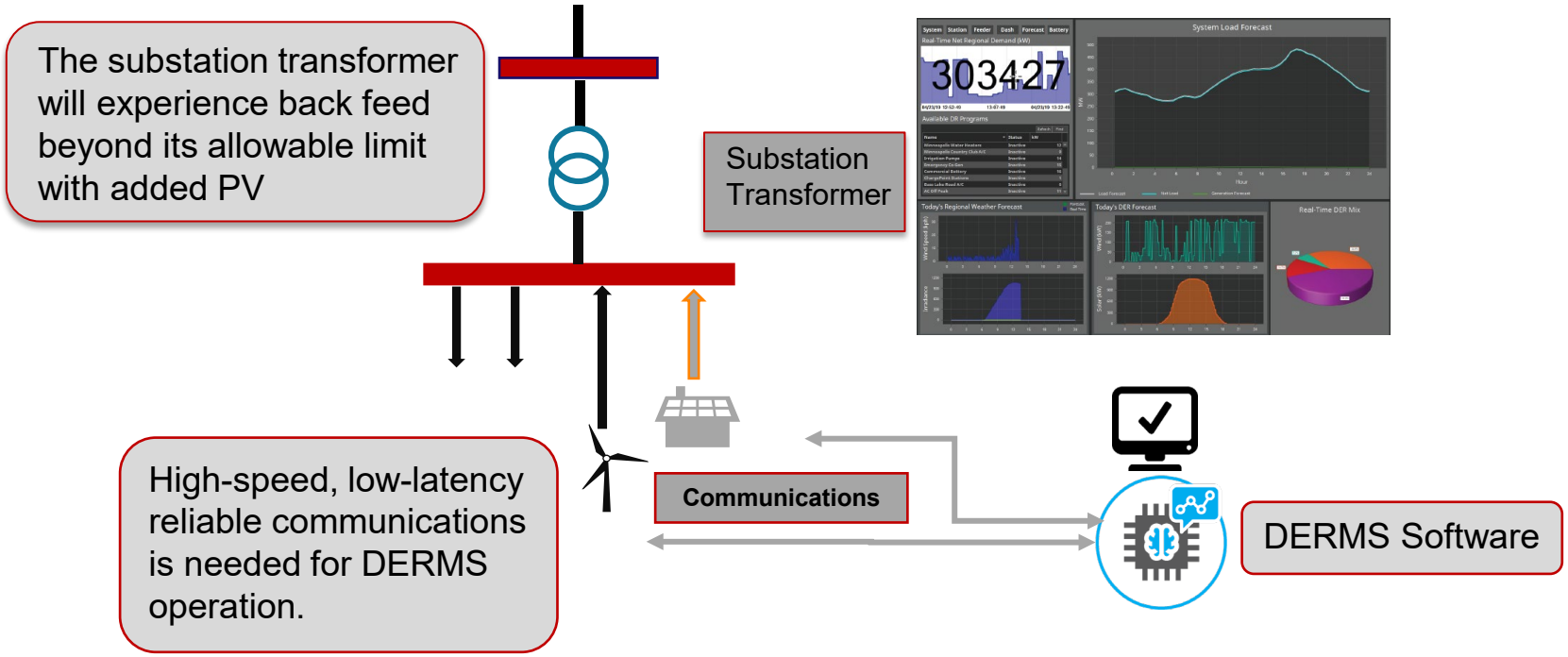
DERMS Background

- DERMS is a software platform that provides localized forecasting, monitoring, and coordinated control of DERs on distribution system
- DERMS benefits customers and utility by allowing more DER interconnection while maintaining power quality
- It can work independently or as part of ADMS
- ComEd is evaluating DERMS in pilot projects
  - Ongoing pilot – mitigate reverse power flow
  - Pilot planned for 2024: Mitigate voltage issues



Ongoing DERMS Demonstration for Renewables Integration

- ComEd is deploying DERMS as a non wire alternative (NWA) to mitigate the reverse power flow overloading of substation transformer due to higher level of PV integration.
- DERMS monitors transformer loading, DER output, system conditions, and will send signals to manage DERs if any system violations occur.



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Thank you

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Q&A

Contact Us!

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