DER Deployment: Technology Trends, Tools and REV

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NY Solar + Storage Summit

Sustainable CUNY and
John Jay College, NYC

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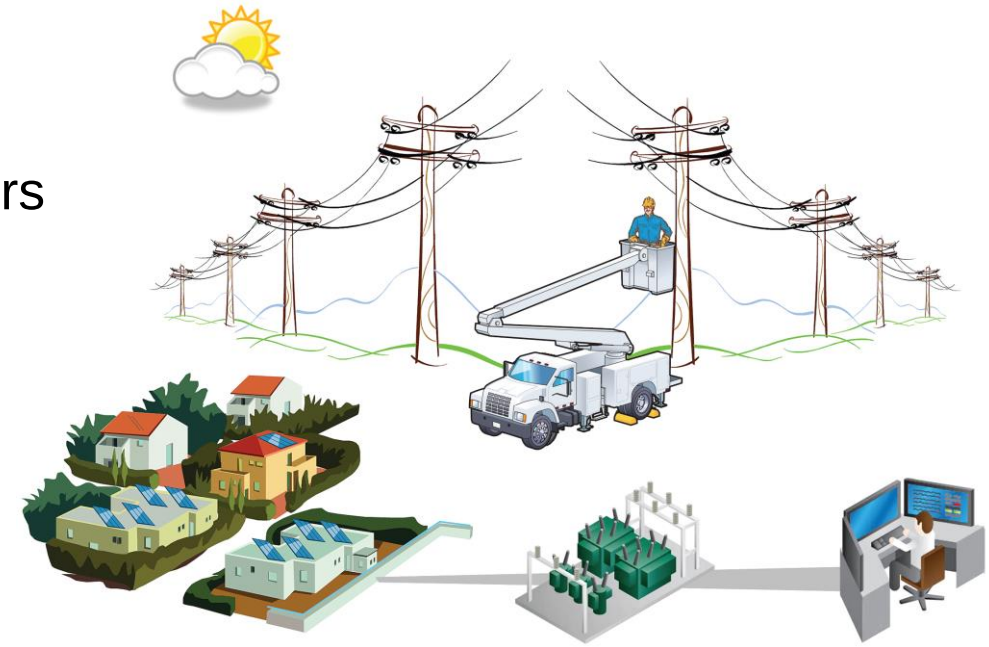
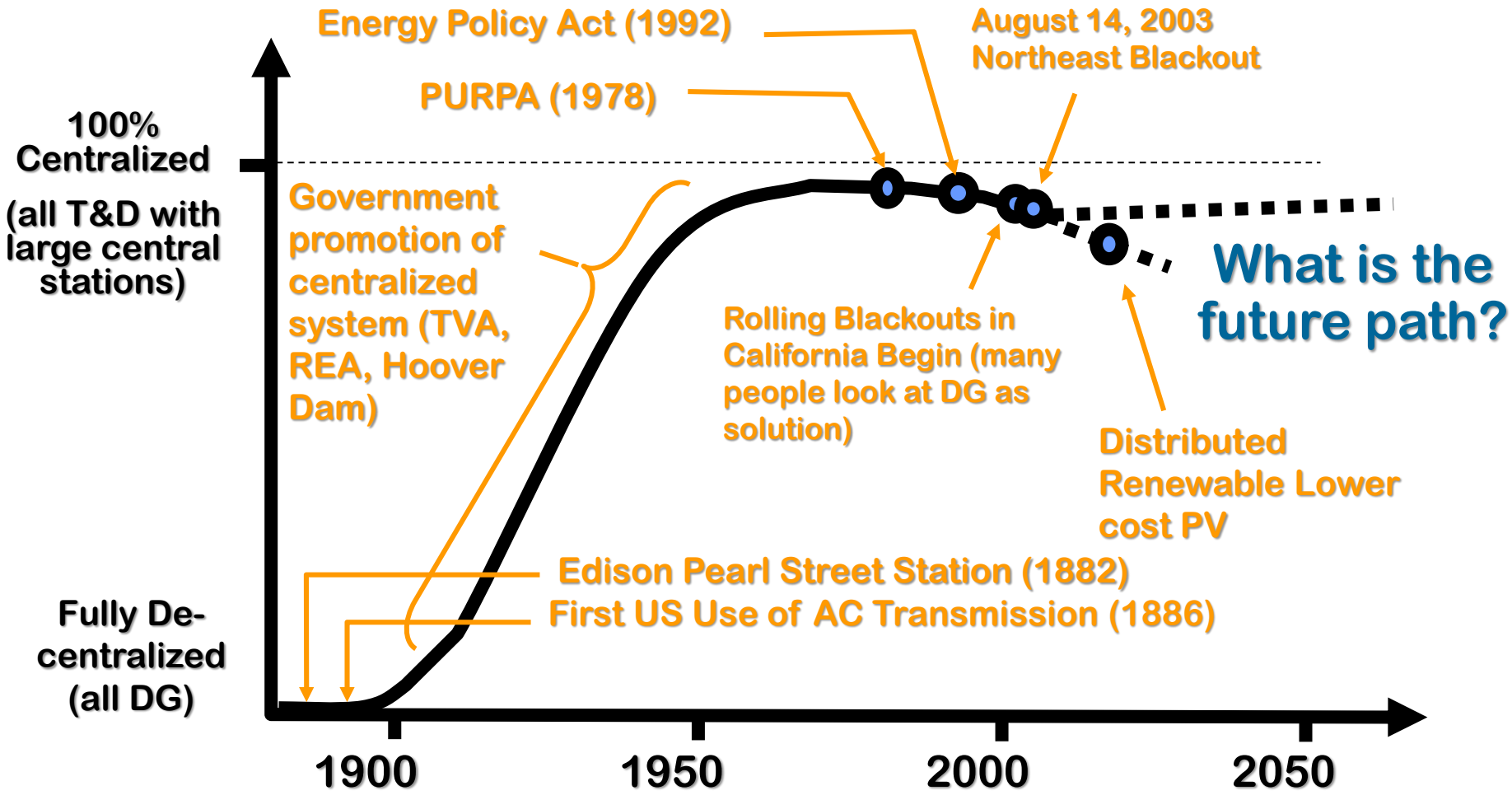
DER Topics (*with some History*)

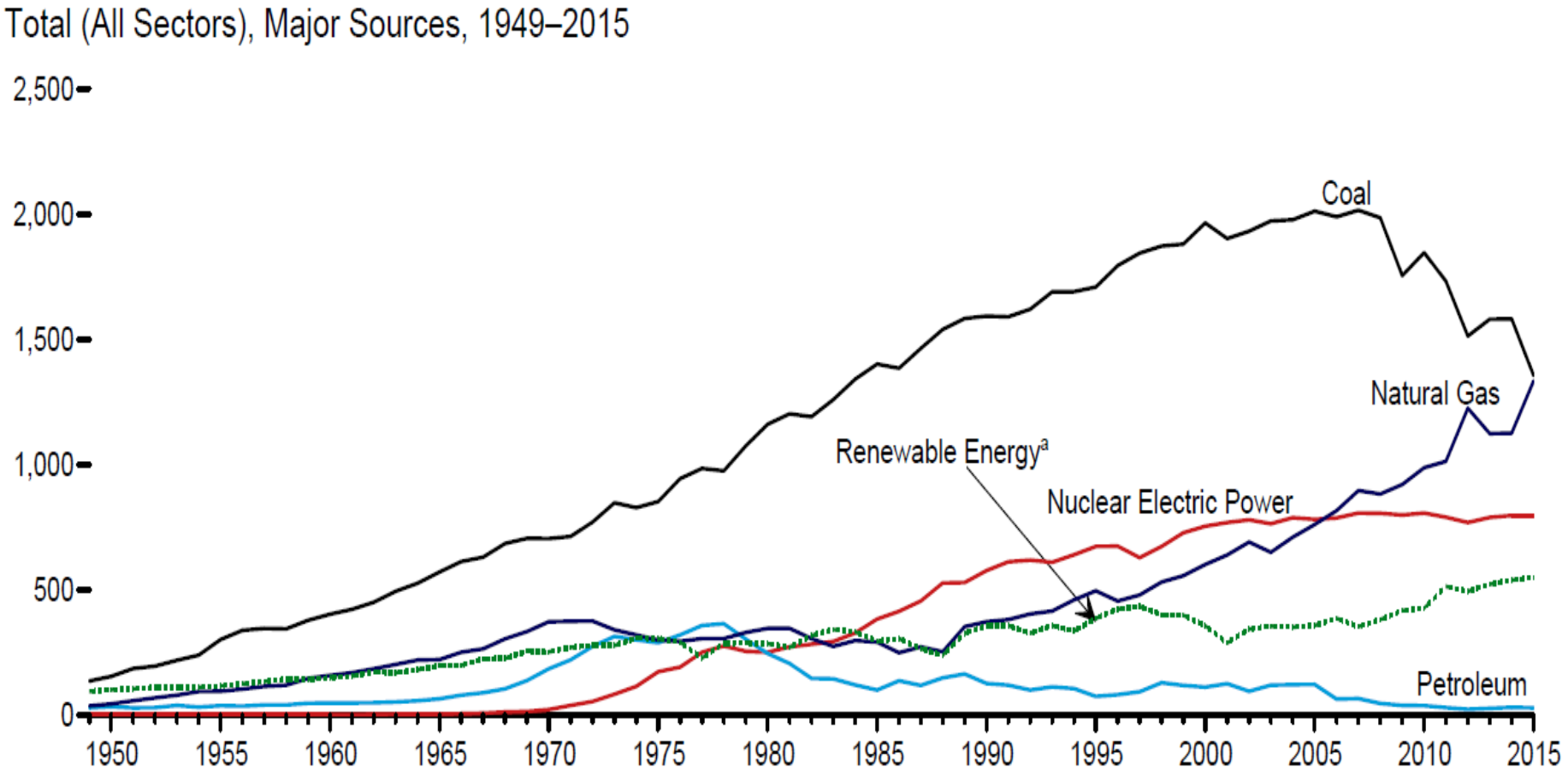
- US Generation and DER
- PV Trends and Grid Integration
  - Evolving standards, inverters and assessment tools
- Grid Storage Update, Valuing Tool
- Grid Modernization and Integrated Energy Network



The electric system started with distributed energy in the US. Are we heading back to Microgrids?

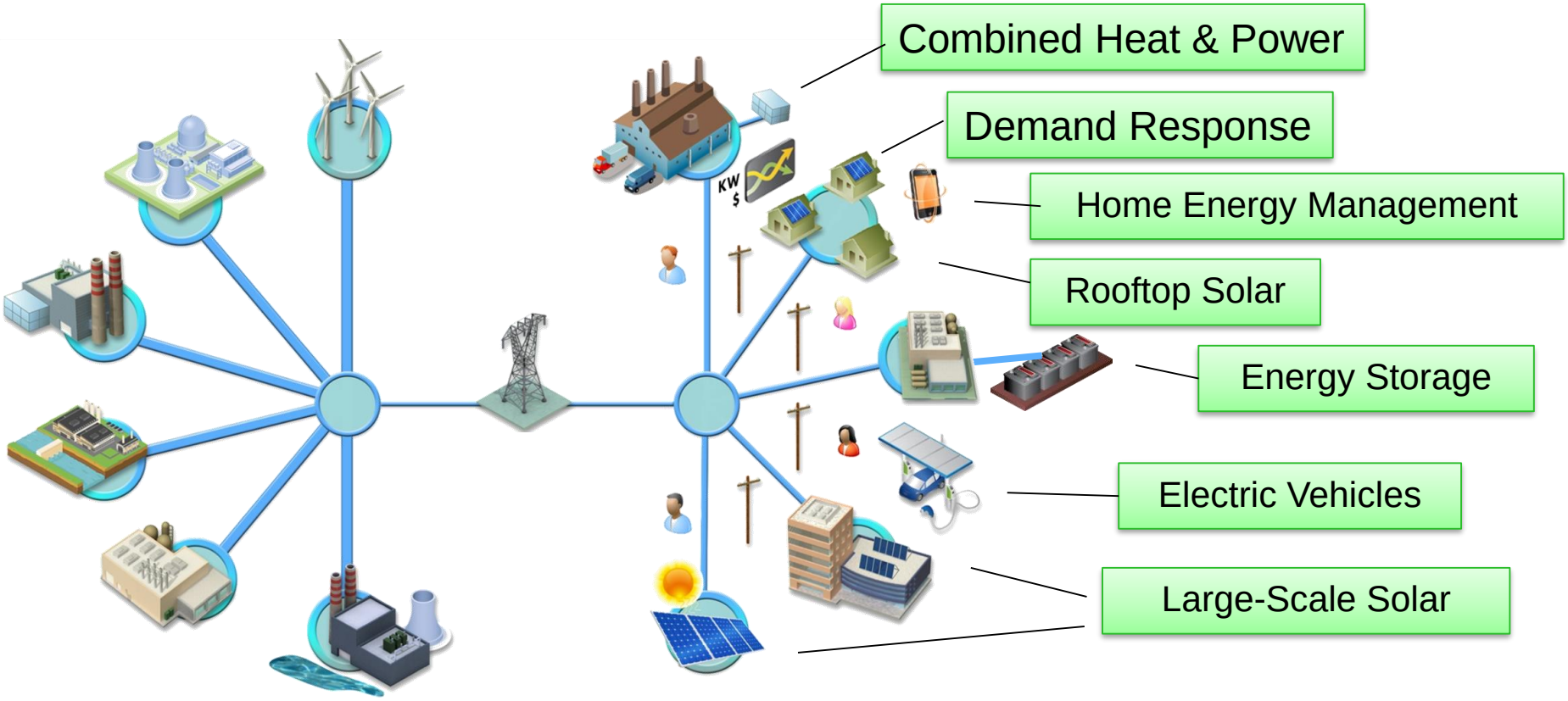


USDOE EIA, Trends in Central Generation (billion kWh) March 2016 Electricity Report



From EIA Database

Changing Landscape with Distributed Energy Resources (DER)



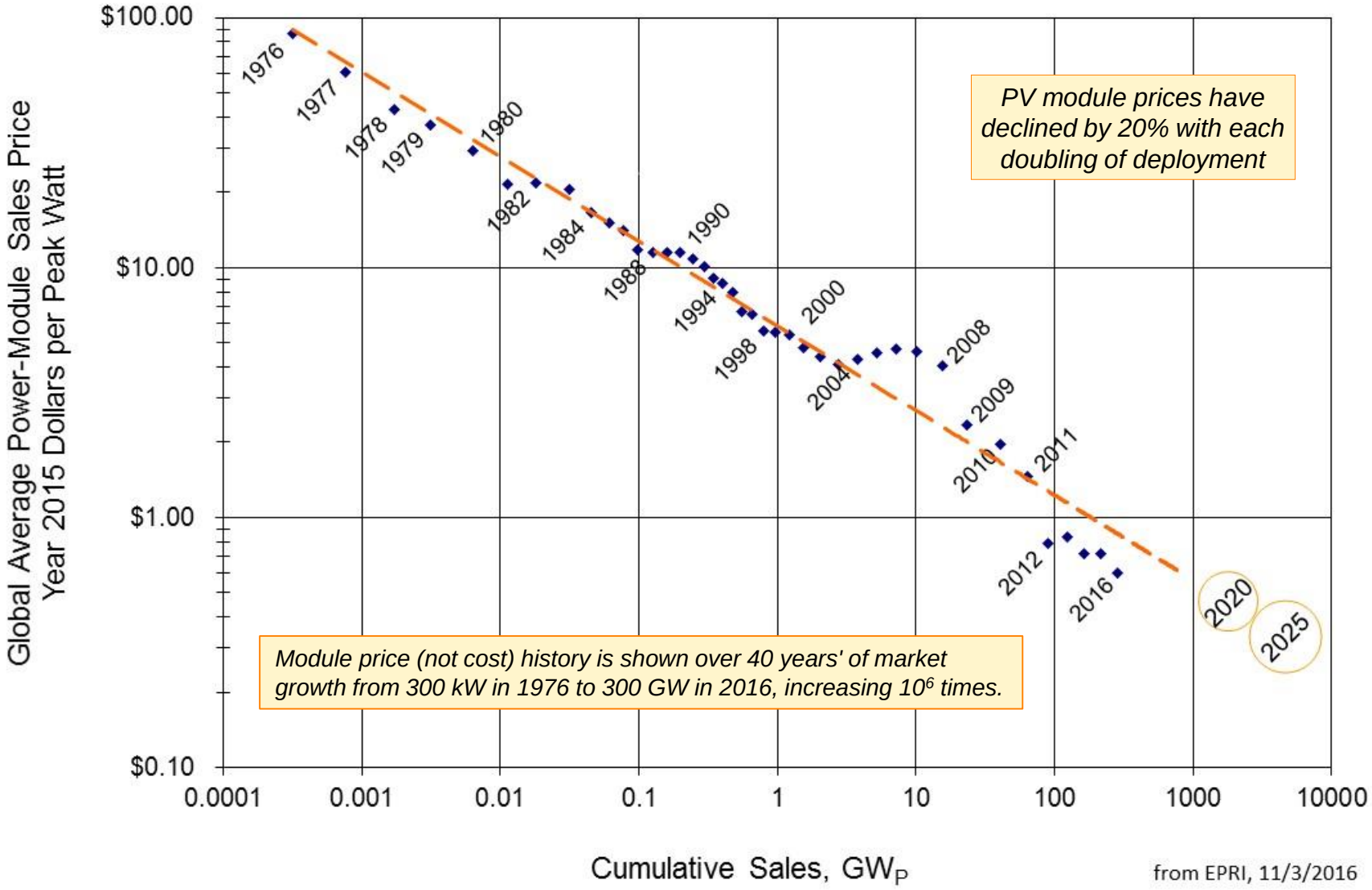
For more information on-line at: ***EPRI, The Integrated Grid***

Notions about *Solar Power Plants* in February 1976

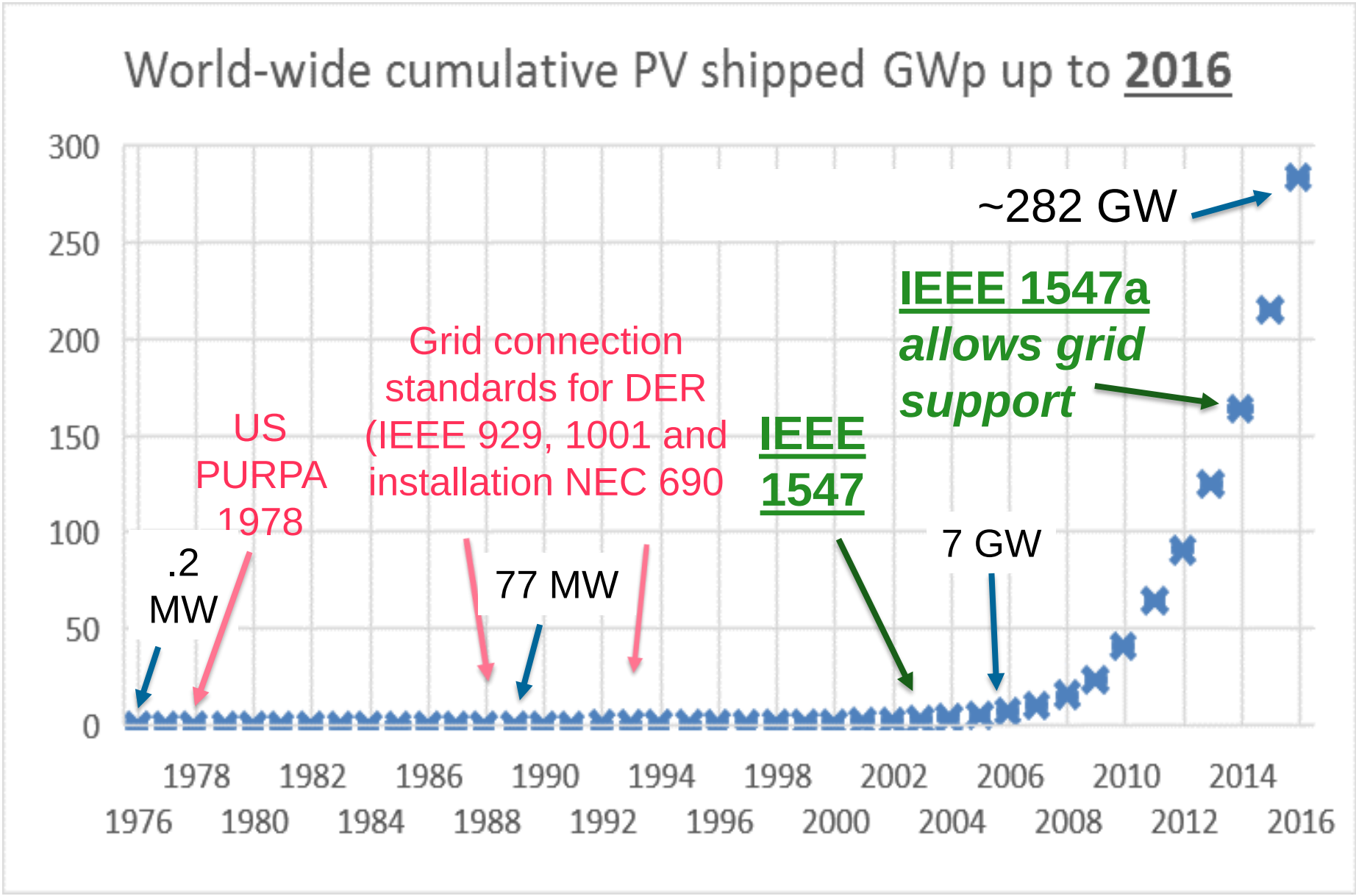
- **Solar-thermal generating stations most promising**
- **Photovoltaic conversion** is attractive but further away
- **A part-time operation with** full time customers needing 24/7 availability
- **Capacity displacement is a concern**
- **Storage the key**

Outlook: 1-2% of the nation's electric power capacity by the year 2000

Noting History… PV Module Price Trajectory

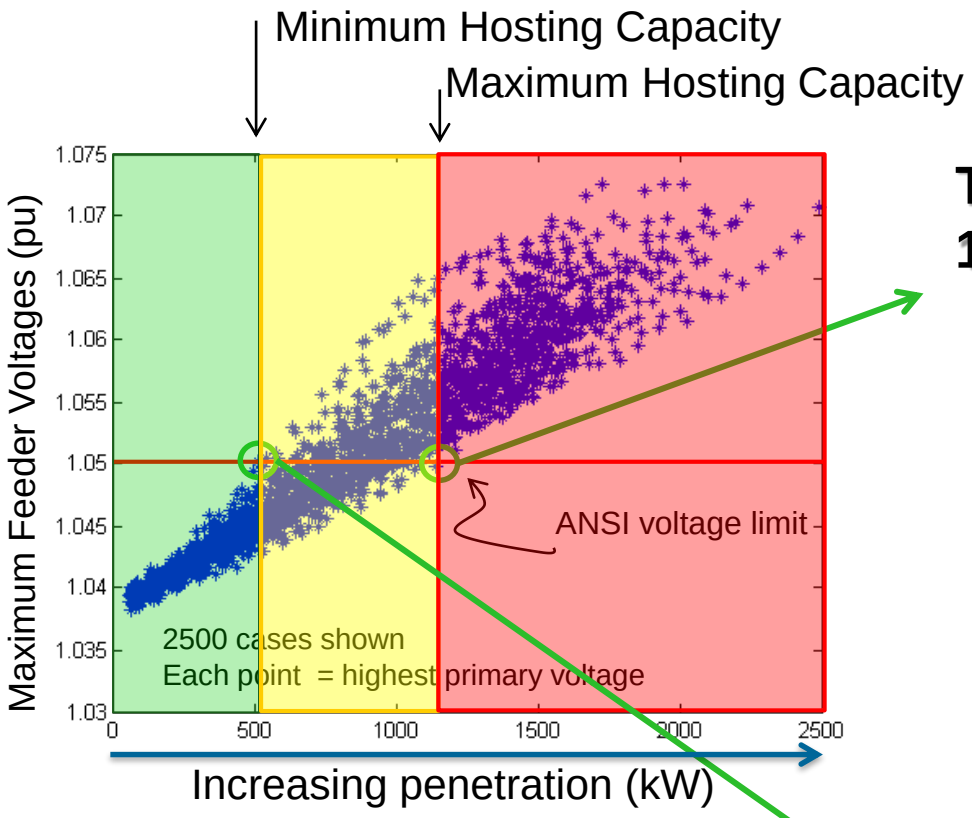


Average sales price and shipments data source: P. Mints, SPV Market Research, www.spvmarketresearch.com



*Average sales price and shipments data source: P. Mints, SPV Market Research, www.spvmarketresearch.com

PV Hosting Capacity Explained (NY Solar Summit 2005)

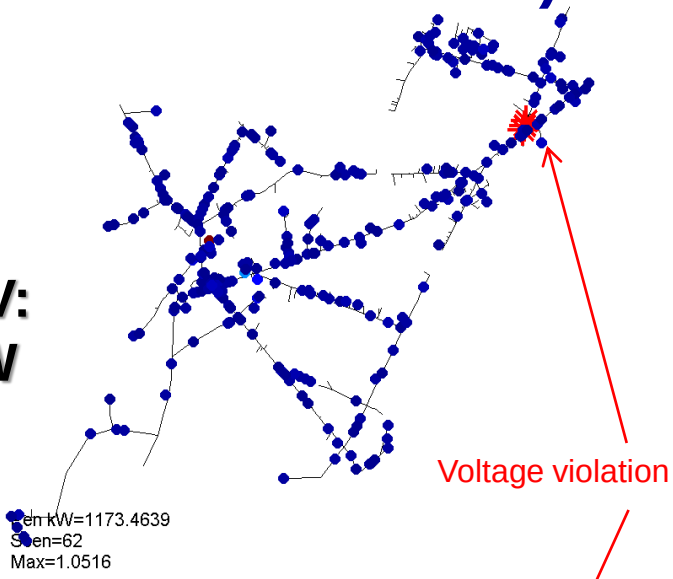


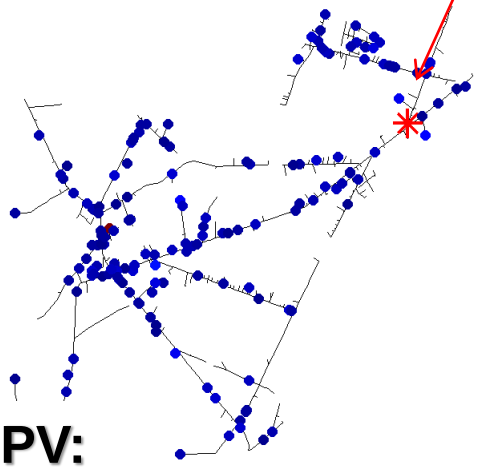
No observable violations regardless of size/location

Possible violations based upon size/location

Observable violations occur regardless of size/location

Total PV: 1173 kW





Total PV: 540 kW

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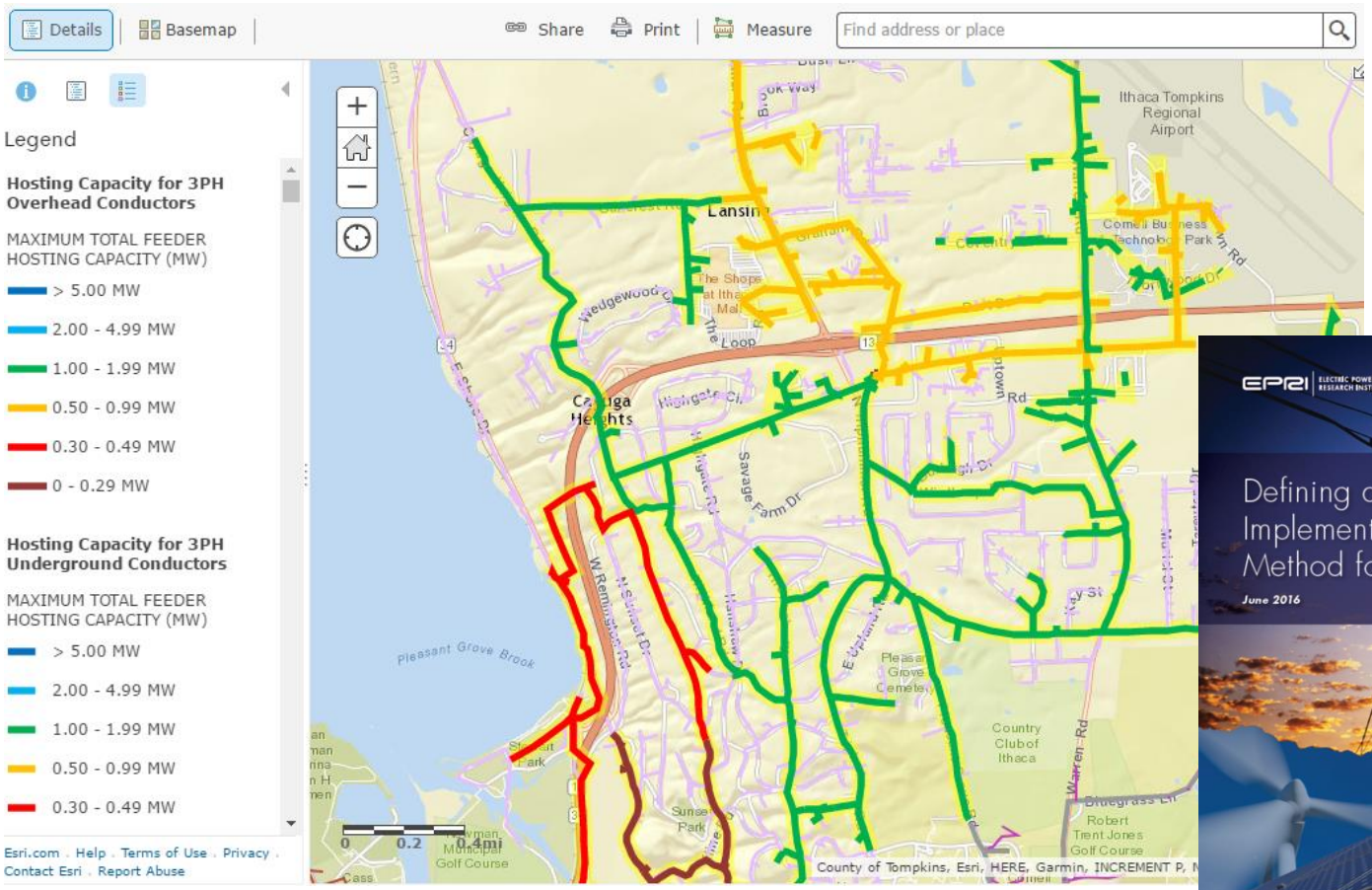
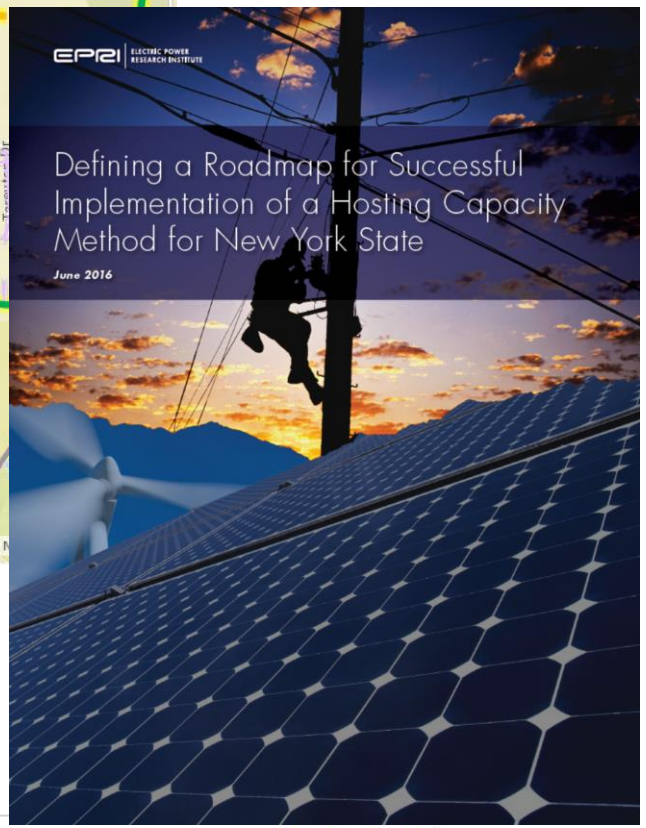
Hosting Capacity Maps Inform DER Developers





Hosting Capacity Maps courtesy of NYSEG/RGE

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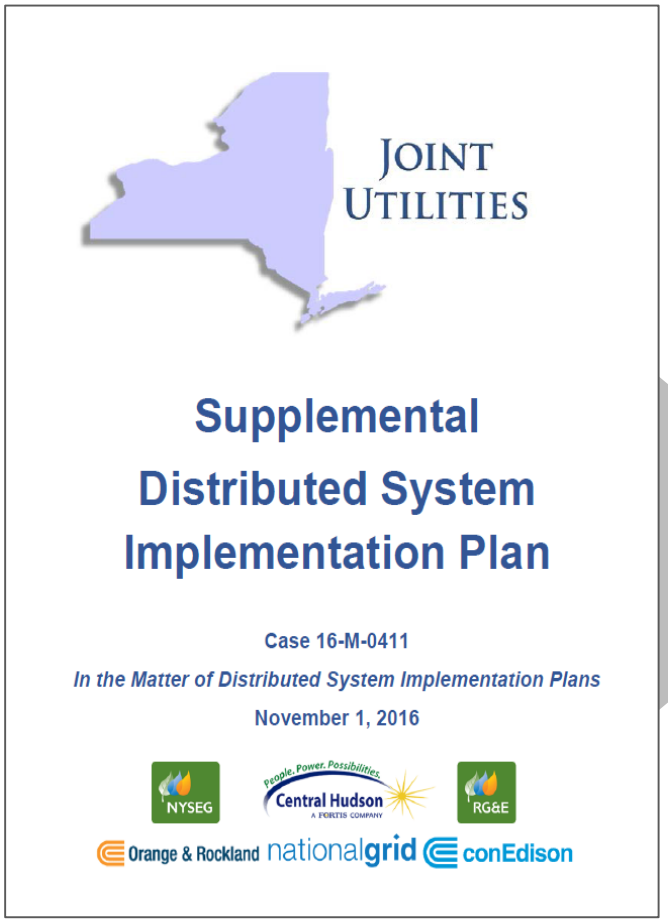
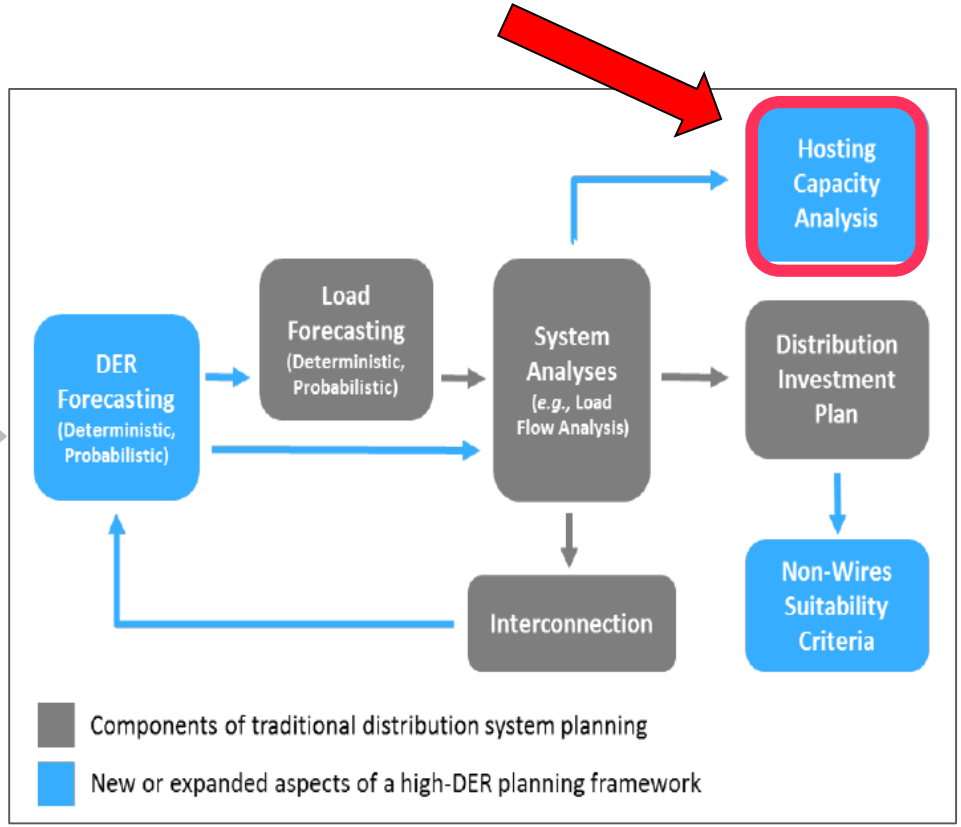
DER being considered in NY utility distribution planning



New technologies will likely increase hosting capacity estimates



Distributed Energy Resource Integration, Valuation, and Estimation Tool (DRIVE)

Input

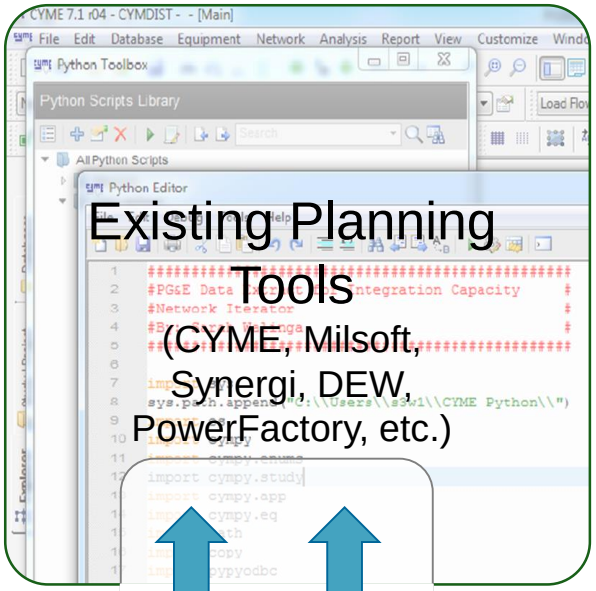
- Load flow data
- Short-circuit impedance data
- Existing DER data

Analysis

- Directly calculates DER impact
- Considers many DER scenarios

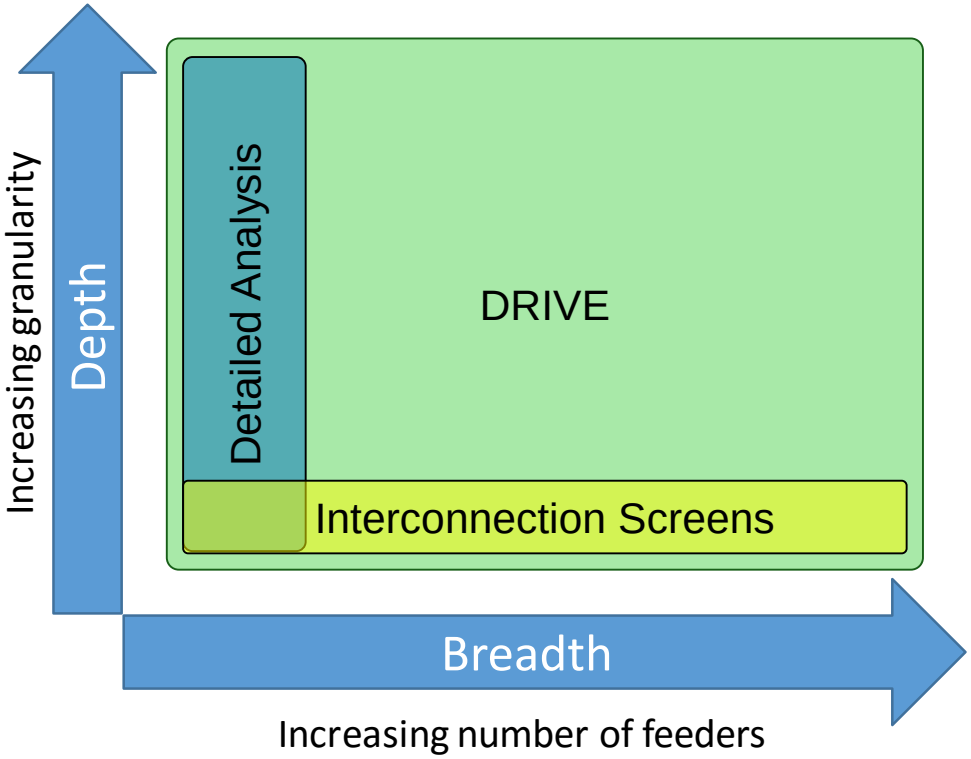
Output

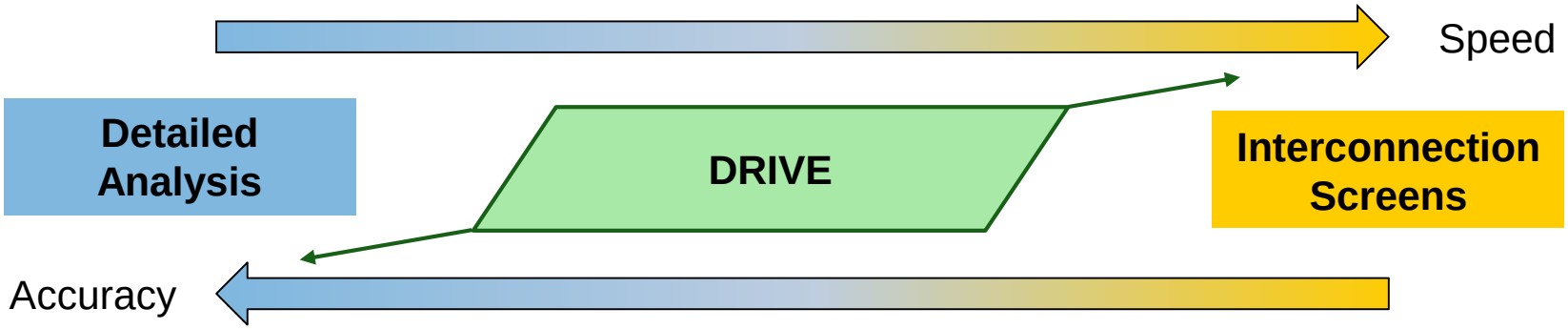
- Node by node DER impact
- System-wide results
- Fraction of the time for analysis



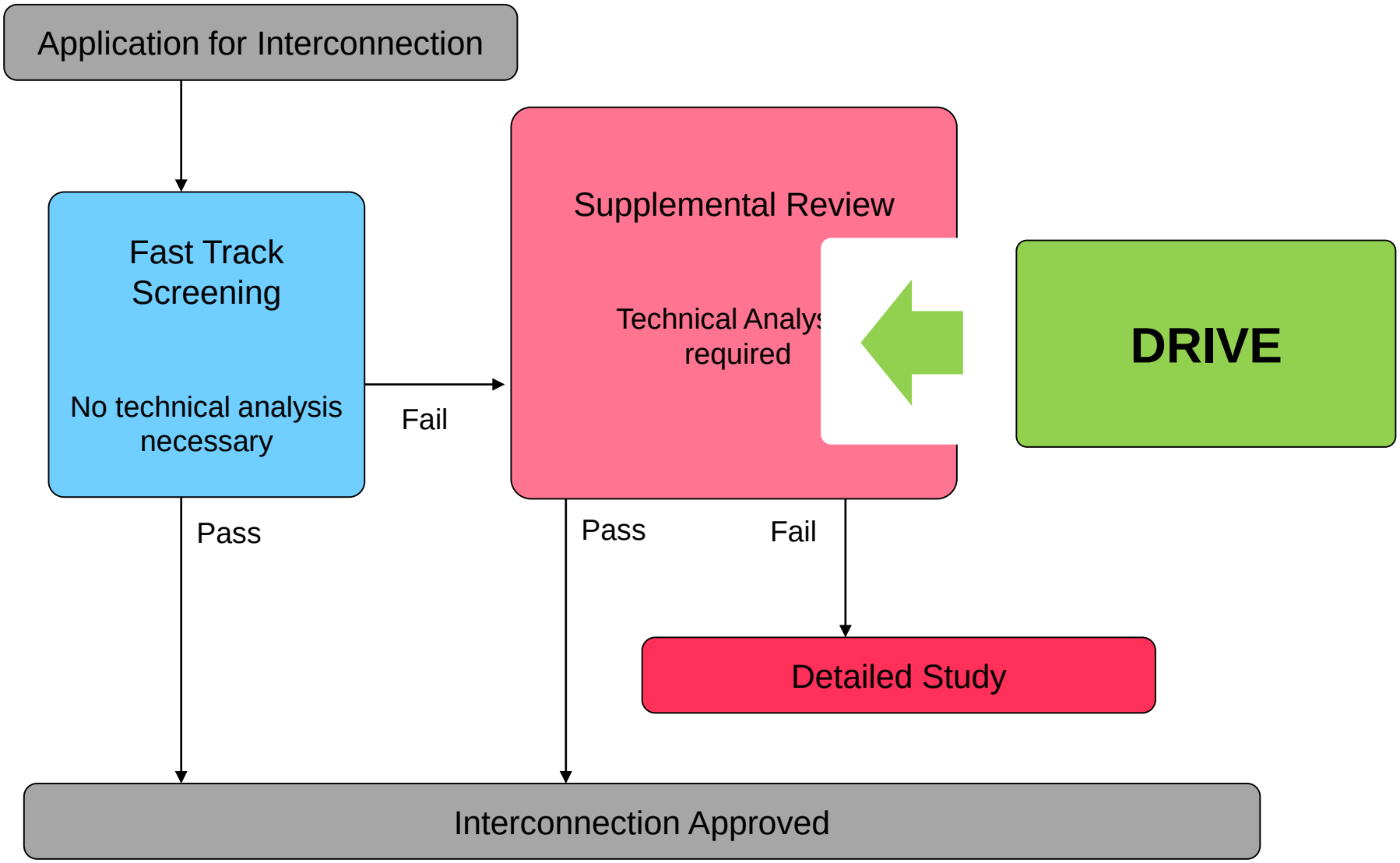
Bridging the Gap in Distribution Planning Between:

- ***Detailed Analysis*** – use of power system analysis software to understand DG and solar impacts based on stochastic analysis
- ***Interconnection Screens*** – such as NY SIR, FERC SGIP fast-track screening or in CA rule 21 screening procedures



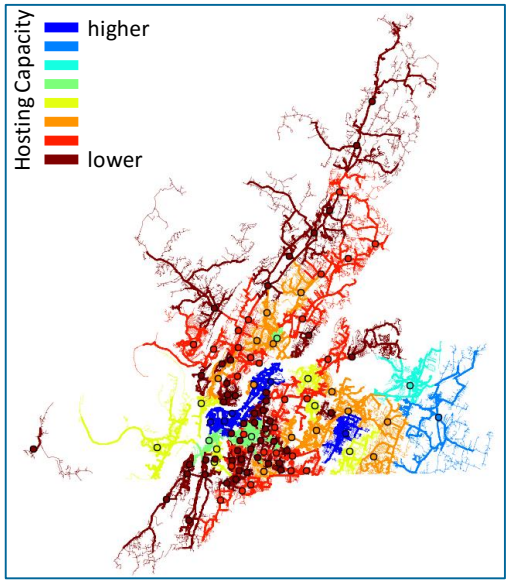


Future application is Automated Interconnection Screening



Tools like DRIVE can point to the best mitigation choice for a particular application (wires or non-wires or operational)

Existing
Hosting Capacity



	Mitigation Solution	Hosting Capacity Violation: Voltage	Thermal	Protection
Grid-Side Enhancements	Reconductoring	Yes	Yes	No
	Voltage uprating	Yes	Yes	Yes
	Transformer replacement	Yes	Yes	Maybe
	Additional voltage regulator	Yes	No	No
	Comm/control (curtailment)	Yes	Yes	Maybe
	Additional relaying	No	No	Yes
Operational Changes	Voltage regulation changes (LTC adjustment, etc.)	Yes	No	No
	Relay setting modification	No	No	Yes
Technology Solutions	Smart Inverter (var control)	Yes	No	No
	Smart Inverter (watt control)	Yes	Yes	Maybe
	Distributed var control	Yes	No	No
	Energy storage	Yes	Yes	Maybe
	PV panel orientation	Yes	No	No
	Demand response	Maybe	Maybe	Maybe

Yes | No | Maybe

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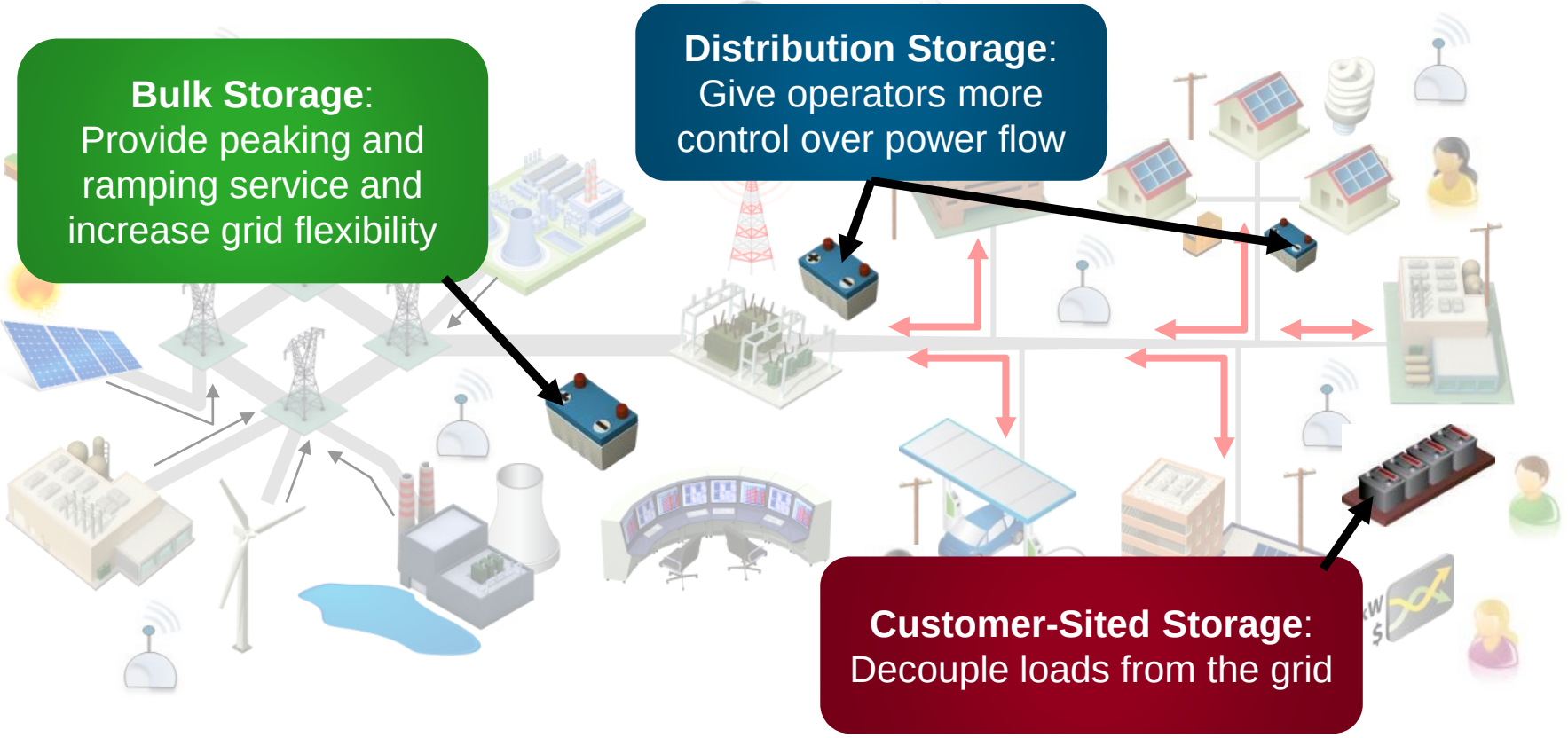
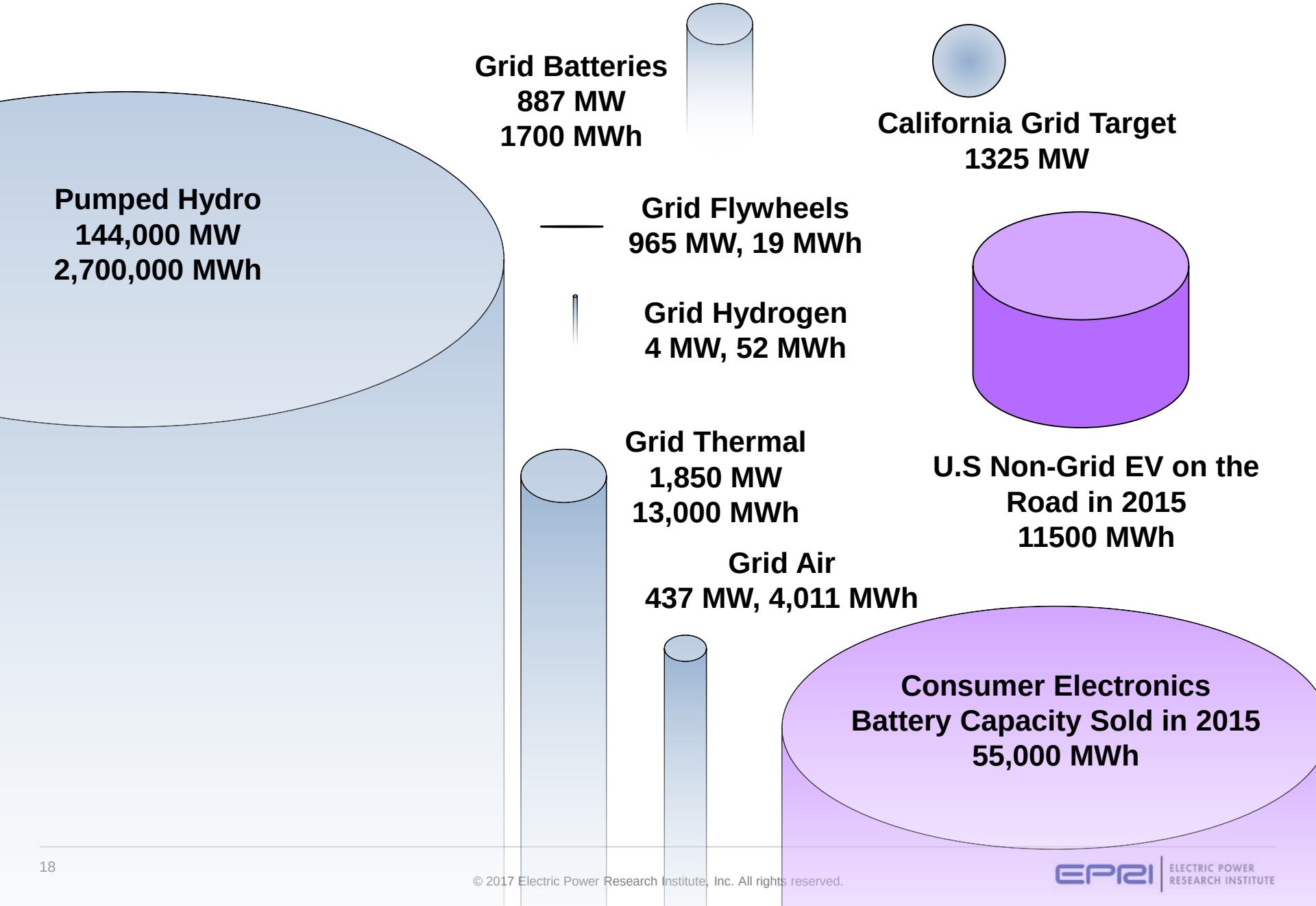
Transformation of the Power System



Energy storage can play key roles across the grid

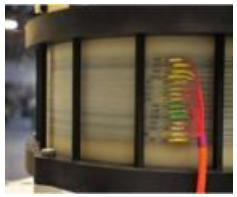
Batteries and the Grid: The Front Runners 1981

Batteries and Grid Storage (worldwide as of 2015)

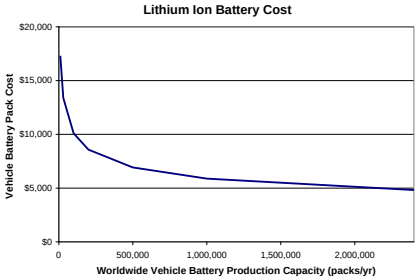


Old challenges are beginning to go away

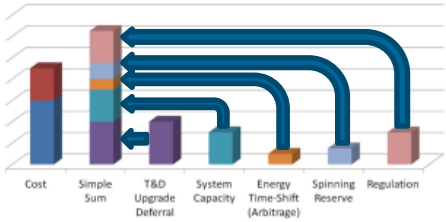
- Technical Challenges
  - Performance
  - Efficiency
  - Life
- Economic Challenges
  - High Cost to Values
  - Need to Small Value Streams
- Regulatory Challenges
  - Lack of clear definition
  - Framework designed for existing grid



Advanced Technologies



New Business Models



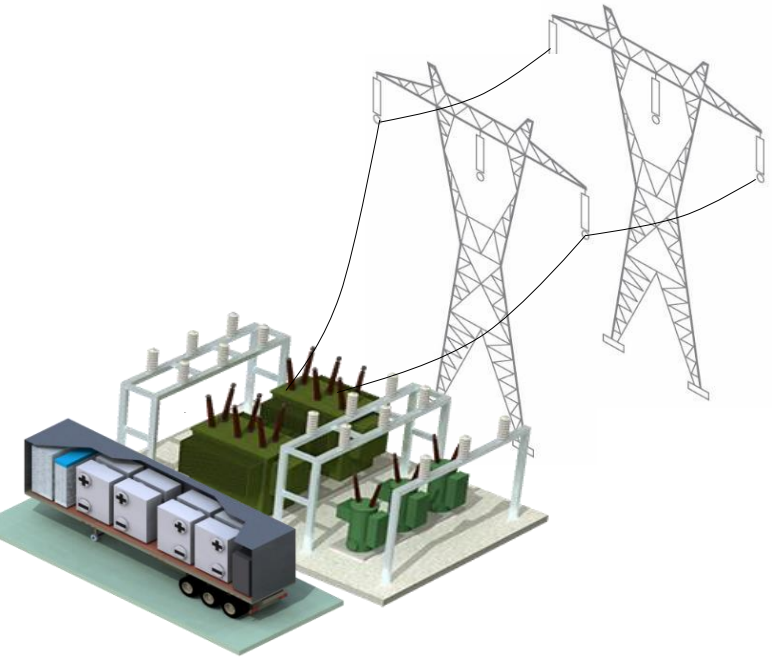
Lower costs

Regulatory Rulings

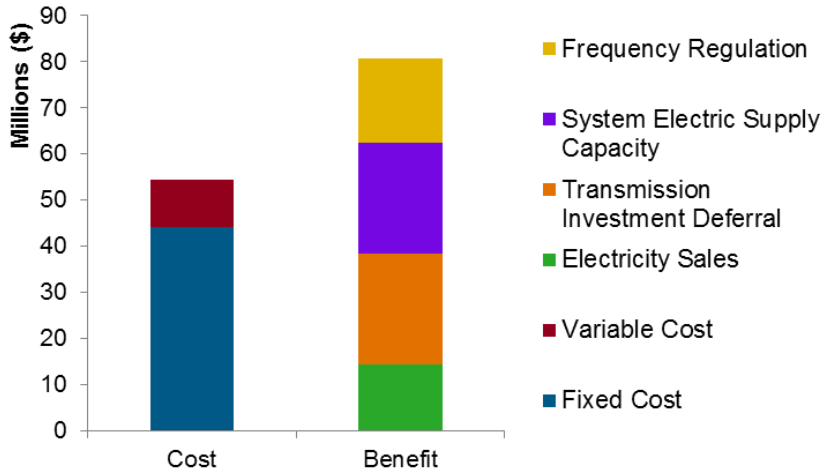
Policy Action

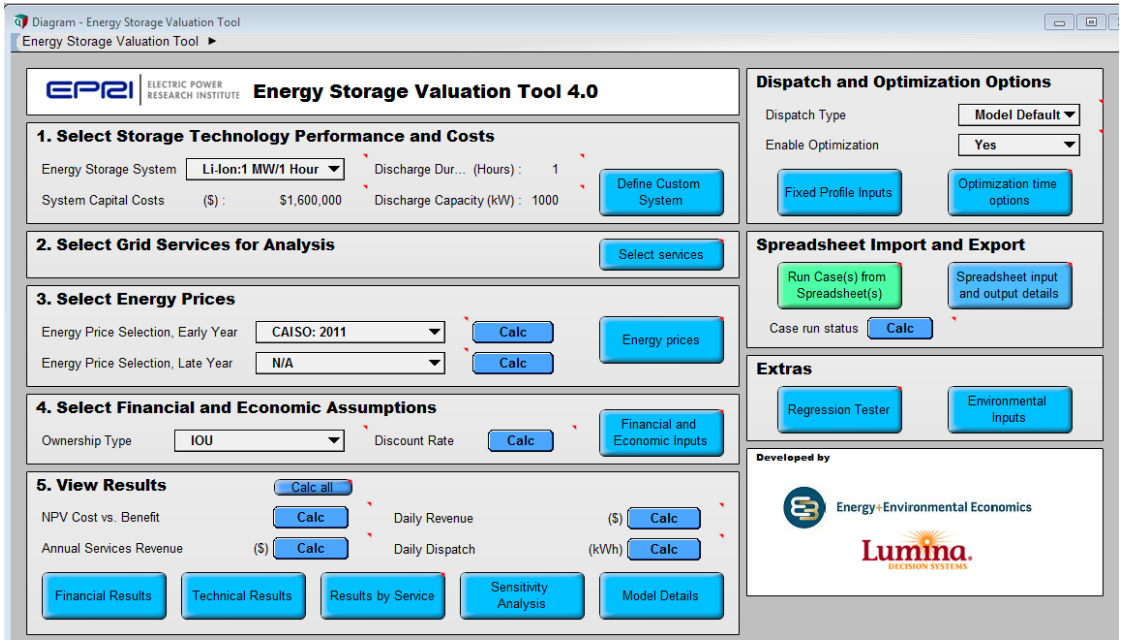
Developing analysis tools

Progress by utilities and industry to develop standard analysis methodologies



ESIC@EPRI.COM





EPRI Energy Storage Valuation Tool (ESVT) 4.0

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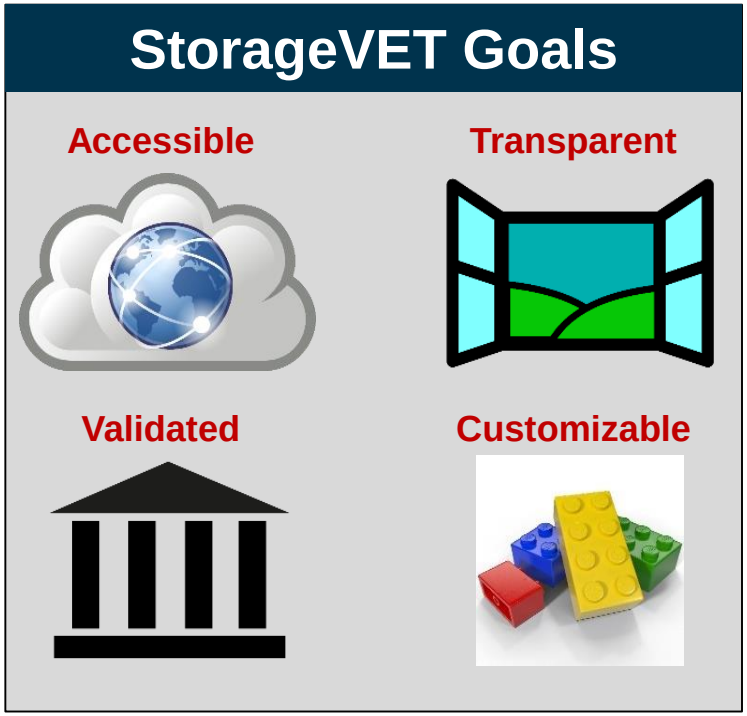
StorageVET™

Storage Value Estimation Tool: www.storagevet.com

- Web-hosted tool, free to the public
- Project cost-benefit analysis
- Time-series constraints and dispatch optimization simulation
- Multi-services optimization and stacked services
- Customizable for location, technology, sizing, use cases
- Made public through funding support from the California Energy Commission (CEC)



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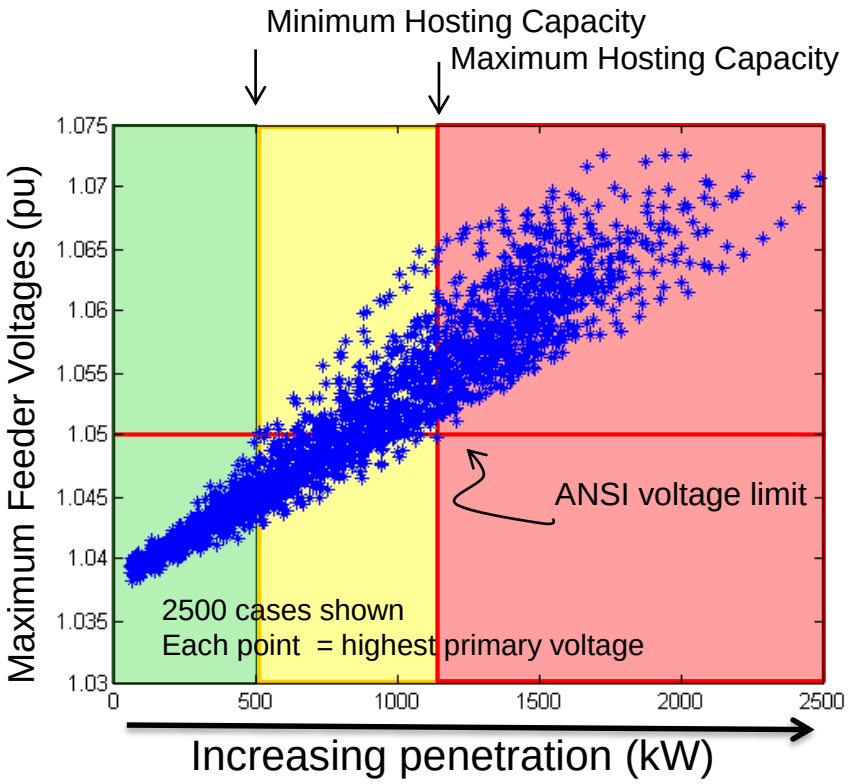
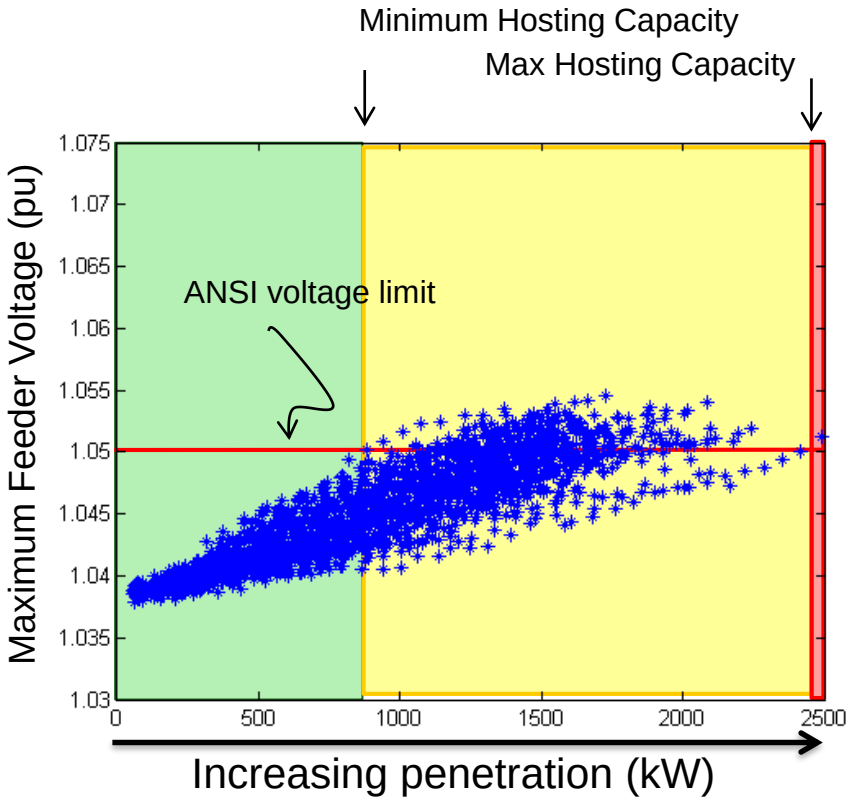
Inverter grid support makes a big difference….reality is settings are critical

PV at Unity Power Factor



PV with Volt/var Control



No observable voltage violations regardless of PV size/location

Possible voltage violations based upon PV size/location

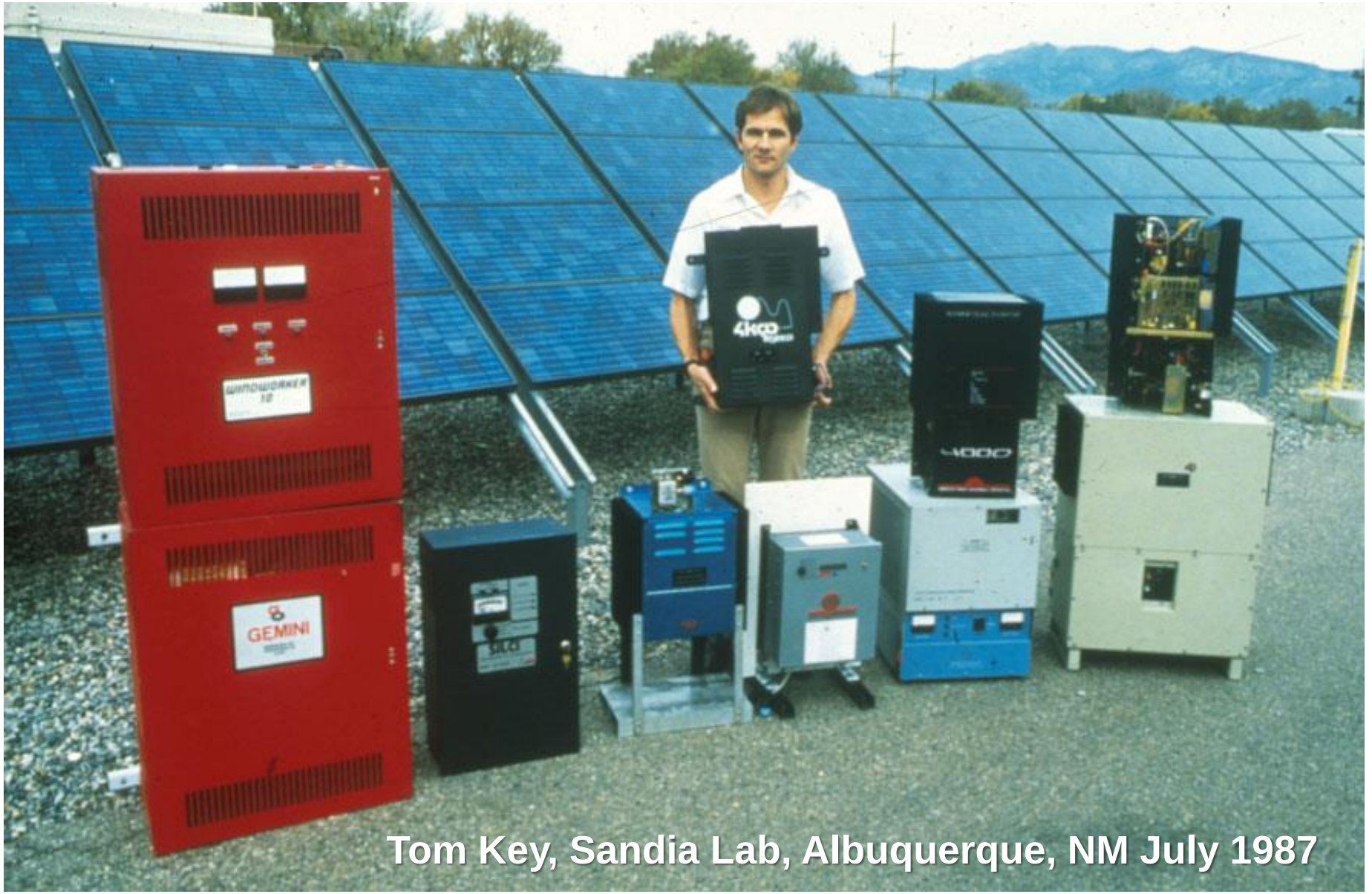
Observable voltage violations occur regardless of size/location

New IEEE 1547 changing expectations for DER

IEEE 1547 – 2003	Revised IEEE 1547 – 20xx
▪ DR shall not actively regulate the voltage at the PCC	▪ DER may actively participate in and must have some headroom to regulate voltage by producing reactive power
▪ DR shall cease to energize if frequency >60.5Hz	▪ DER shall be permitted to provide modulated power output as a function of frequency.
▪ Tighter abnormal V/F trip limits and clearance times	▪ DER is required to ride-thru momentary voltage and frequency excursions and trip limits may be widened under mutual agreement with operators
▪ Communication capability required at 250kW	▪ All DER must have communication capabilities.

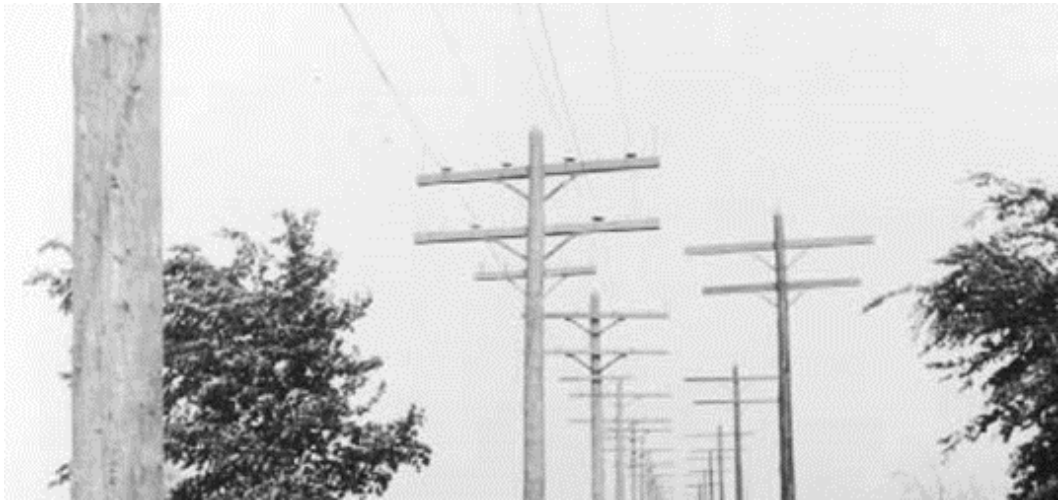
Moving from *Accommodating* to *Integrating* DER

Smart inverters now included in IEEE requirements have been around a while ….Key testing in Albuquerque, 1987



Tom Key, Sandia Lab, Albuquerque, NM July 1987

Grid Modernization Roadmap for NY in Progress



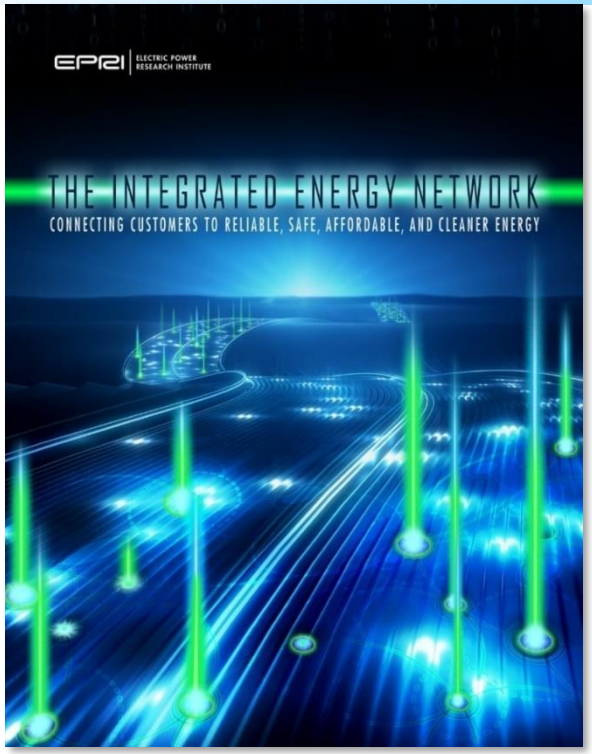
- **Who – NYSERDA, EPRI and stakeholders**
- **How – Look at current vs future states, Gap Analysis leading to state R&D plan**
- **What – Areas of focus are Planning, Operation and Support Systems**

AGILe, an Energy Laboratory in NY: Advanced Grid Innovation Lab for Energy

- Collaboration: NYPA, NYSERDA, NYISO, NYS Utilities and EPRI, to include industry and academia in the future.
- Focus: next generation power system energy management, cyber security, protection, sensing, control, and power electronics.
- Objective: address common challenges facing NY's electric industry to implement REV and modernize grid.
- Research Ideas: So far coming from NYS Utilities and NYISO
- Next Step: going to NYPA Board of Trustees in July for funding approval

NY REV concepts being complimented around the world:

e.g. EPRI's Integrated Energy Network



Available at: http://ien.epri.com

Together…Shaping the Future of Electricity

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