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Reimagining State Interconnection Rules for DG Plug-and-Play Procedures

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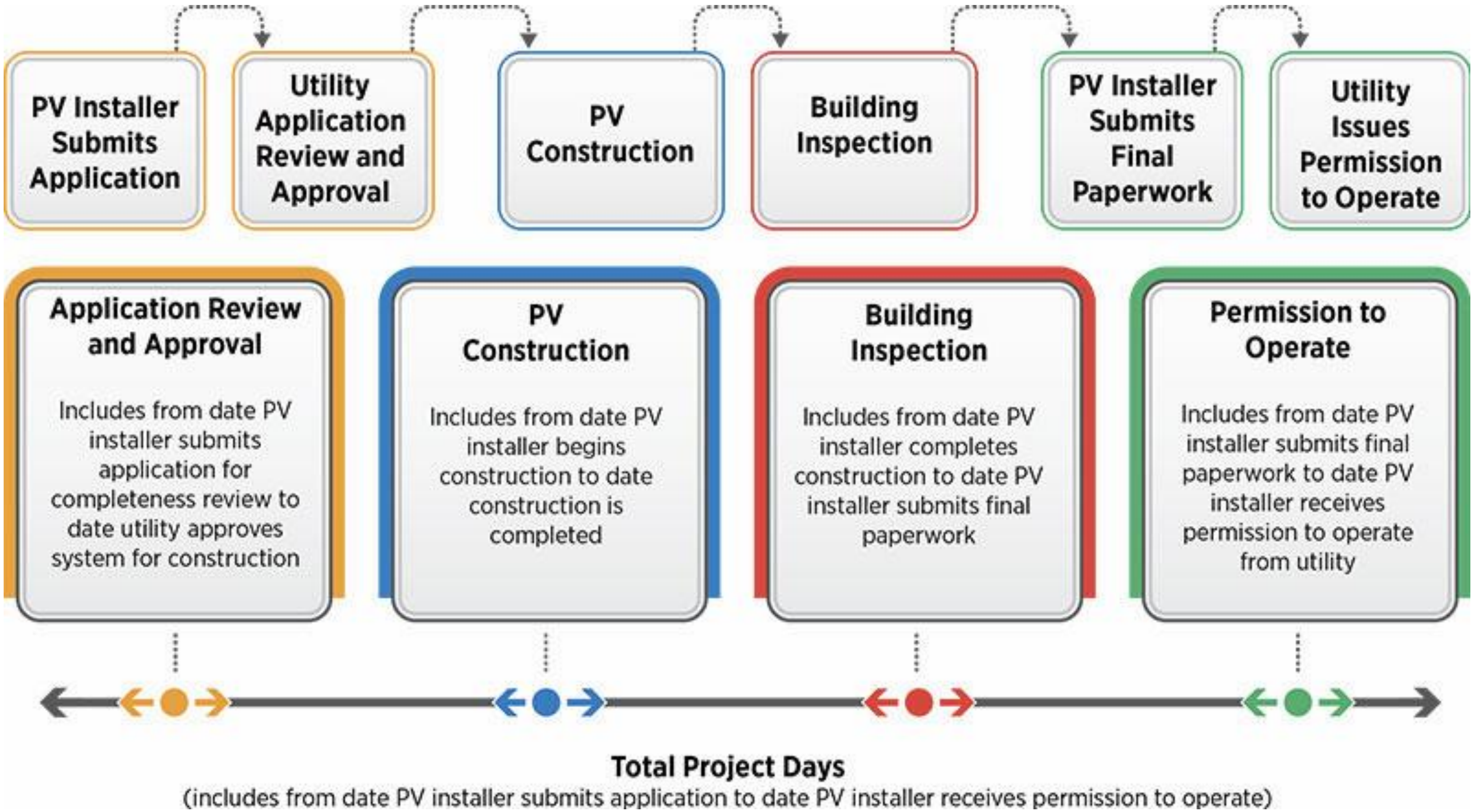
Outline of Presentation

1) How might new technical capabilities affect interconnection standards?
2) How might state rules and procedures be adjusted to reflect new technical standards?
3) How are today's best-practices currently addressing those changes?
4) What are possible future updates to state rules and procedures?

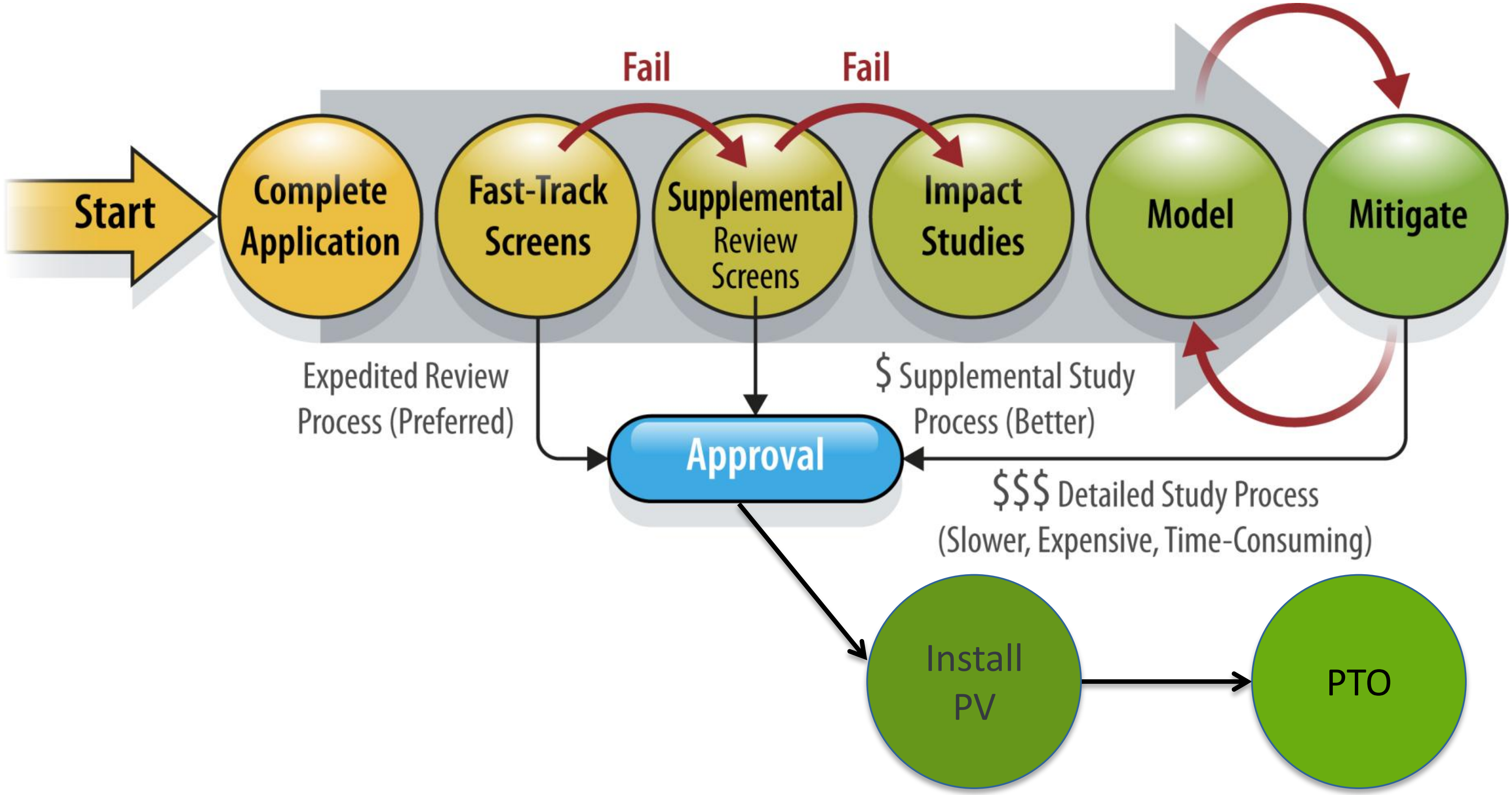
Research paper forthcoming February 2017

Typical interconnection process



Source: Barnes, Barnes, et al., 2016, *Comparing Utility Interconnection Timelines for Small-Scale Solar PV, Second Edition.* EQ Research. http://eq-research.com/wp-content/uploads/2016/10/EQ-Interconnection-Timelines-2016.pdf

Typical utility review process



Source: National Renewable Energy Laboratory, 2016.

Is there a problem? (1)

"[S]tandards activities should be perceived as developing, living documents that will advance in time and in stages… . [M]uch additional work still remain[s] before all major technical and administrative issues [are] resolved."

Source: Basso and DeBlasio, 2003, "IEEE P1547-series of standards for interconnection," In *Transmission and Distribution Conference and Exposition, 2003 IEEE PES* (Vol. 2, 556-61). IEEE. http://ieeexplore.ieee.org/document/1335335/

"Federal and state regulators are faced with the challenge of keeping interconnection procedures updated against a backdrop of evolving technology, new codes and standards, and considerably transformed market conditions."

Source: Fox, Stanfield, Coddington, et al., 2012, *Updating Small Generator Interconnection Procedures for New Market Conditions,* NREL/TP-5500-56790. http://www.nrel.gov/docs/fy13osti/56790.pdf

Is there a problem? (2)

	Residential (up to 10 kW)			Small Commercial (10–50 kW)		
State	Time Req. (business days)	Applications Exceeding Time Req. (%)	Median for Applications that Exceeded Time Req. (business days)	Time Req. (business days)	Applications Exceeding Time Req. (%)	Median for Applications that Exceeded Time Req. (business days)
CA	25	37%	38	25	47%	39
NY	15	38%	49	15	38%	60
NJ	13	52%	18	18	42%	27
CO	25	58%	50	30	45%	59
AZ	[20]*	53%	43	[20]*	54%	43

* 20-day threshold is assumed for analytic purposes, because Arizona has no interconnection timeframe requirements.

Source: Ardani, Davidson, Margolis, & Nobler, 2015, *A State-Level Comparison of Processes and Timelines for Distributed PV Interconnection in the U.S.*, NREL/TP-7A40-63556, http://www.osti.gov/scitech/biblio/1227804/

New inverter technical capabilities

- The goal: “to make inverters integrated grid assets that are interoperable,” and ensure DG will be “*good grid citizens*”
- Advanced Inverters (a.k.a. “Smart Inverters”) can “respond automatically and autonomously *and* respond to direct communications signals from grid operators” to:
  - physically connect to or disconnect from the utility grid;
  - adjust generation level, power factor, reactive power;
  - set parameters for frequency and voltage ride-through; and,
  - maintain and communicate events log & operating history

Source: Reiter, E., K. Ardani, and R. Margolis, 2015, Industry Perspectives on Advanced Inverters, NREL/TP-7A40-65063, http://www.nrel.gov/docs/fy15osti/65063.pdf

New utility capabilities

- Fast, reliable distribution system modeling including all major DER resources
- Easily accessible maps showing substation and feeder "hosting capacity," to help focus attention on low-cost, good, better, and best locations for installing DG
- More and better mitigation techniques are enabling more DG on existing circuits

IEEE 1547 Standards Revisions are Coming

- Entire standard is open for revisions
- Already-identified topics include:
  - Voltage ride-through & frequency ride-through capabilities and variable settings for grid support, including Volt/VAR, Volt/Watt, frequency/Watt, etc.
  - Revised Power Quality settings and requirements
  - Intentional Island and Unintentional Island provisions
  - Secondary Network Interconnection Guidelines
  - Energy Storage systems
  - Grid Support functions and Interoperability

Additional IEEE 2030 Series of Smart Grid Interoperability Standards

- **P2030.1**—guide for electric transportation systems
- **2030.2-2015** (approved)—guide for interoperability of electric storage systems
- **2030.3-2016** (approved)—applications for electric storage, including testing procedures for safety and reliability
- **P2030.4**—guide for electric power systems control and automation installations
- **2030.5-2013** (approved)—communications between the smart grid and consumers
- **2030.6-2016** (approved)—guide for monitoring the effects and evaluating benefits of demand-response programs
- **P2030.7**—specifications for microgrid controllers
- **P2030.8**—standards for testing microgrid controllers

Best-practices to date

- Uniform state rules & procedures for all utilities
- Online & electronic interconnection applications
- Overall streamlined, transparent processes with open communication between utility & developers
- Simple, reliable project-status tracking
- Rapid, robust impact studies approaches, using sophisticated distribution system software modeling
- "Safety valve" approach for simple problems, avoiding impact studies
- Supplemental screening options
- Multiple least-cost mitigation strategies
- "Solar-ready communities" actions to reduce soft-costs

Conclusions

Possible adjustments to state rules

- Implement greater transparency and state-wide consistency
- Tighten time frames for utility procedures, to accommodate improved modeling capabilities
- Incorporate autonomous and controllable advanced (smart) inverter functions for grid support
- Focus on how utilities plan their distribution system to support higher DG levels

Supplementary regulatory approaches

- Rates that reward any kind of DER capabilities that produce and deliver system benefits, through multiple revenue streams if necessary
- Encouraging utilities to fully integrate DER into their electric distribution planning (EDP) and IRP processes