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Overview of PV-connected distribution system planning and impact analysis

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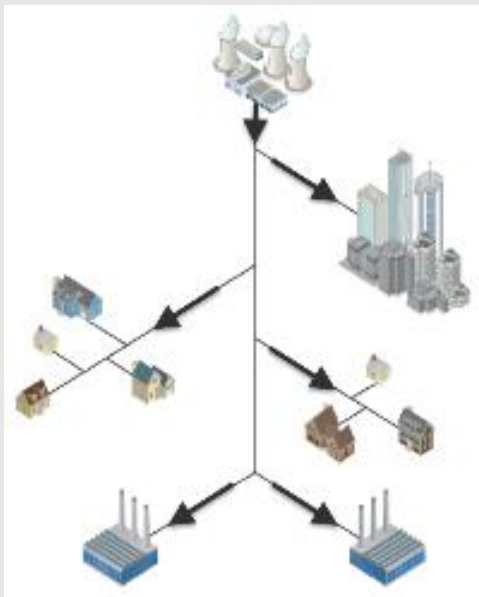
October 24, 2019

Overview

1. Evolving energy landscape
2. Major utility concerns
3. Mitigation
4. Interconnection capacity and mapping
5. Beyond hosting capacity
6. Interconnection impact studies
7. Integrated distribution planning

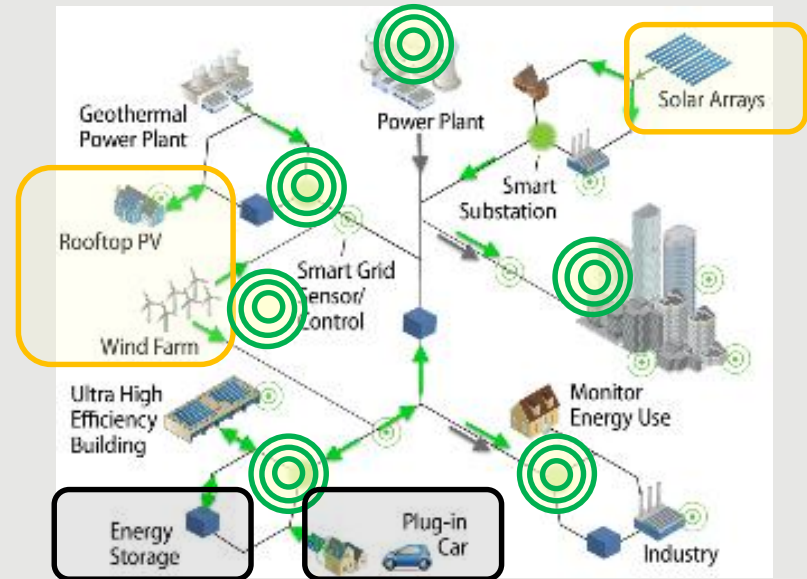
Evolving energy landscape

Traditional Power System



- Large Generation
- Central Control
- Highly Regulated

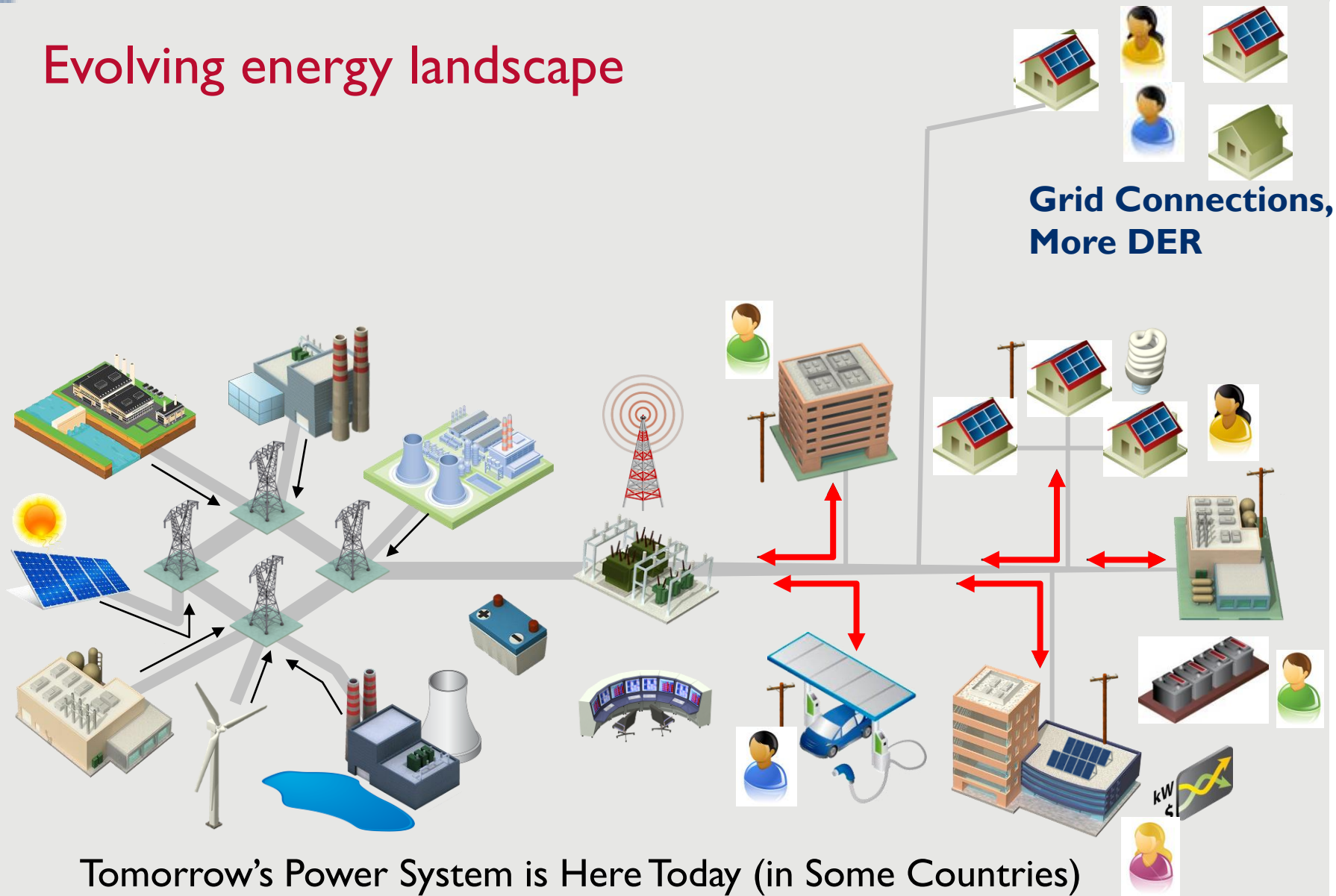
Emerging Power System



DRIVERS

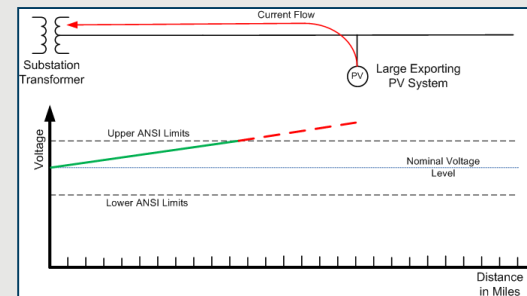
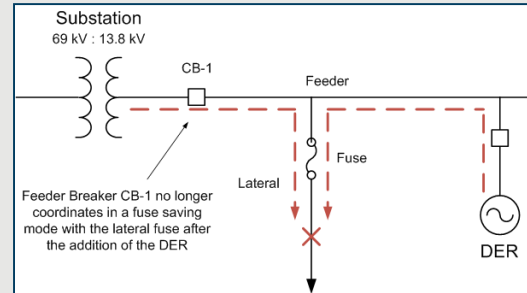
- Increased variable generation
- More bi-directional flow at distribution level
- Increased number of smart/active devices
- Evolving institutional environment

Evolving energy landscape



Major utility concerns

- Voltage regulation
- Reverse power flow
- Protection system coordination
- Unintentional islanding
- Excessive LTC and regulator tap operations
- Load masking



Now Wait
Just a
Minute!



Mitigation : goal

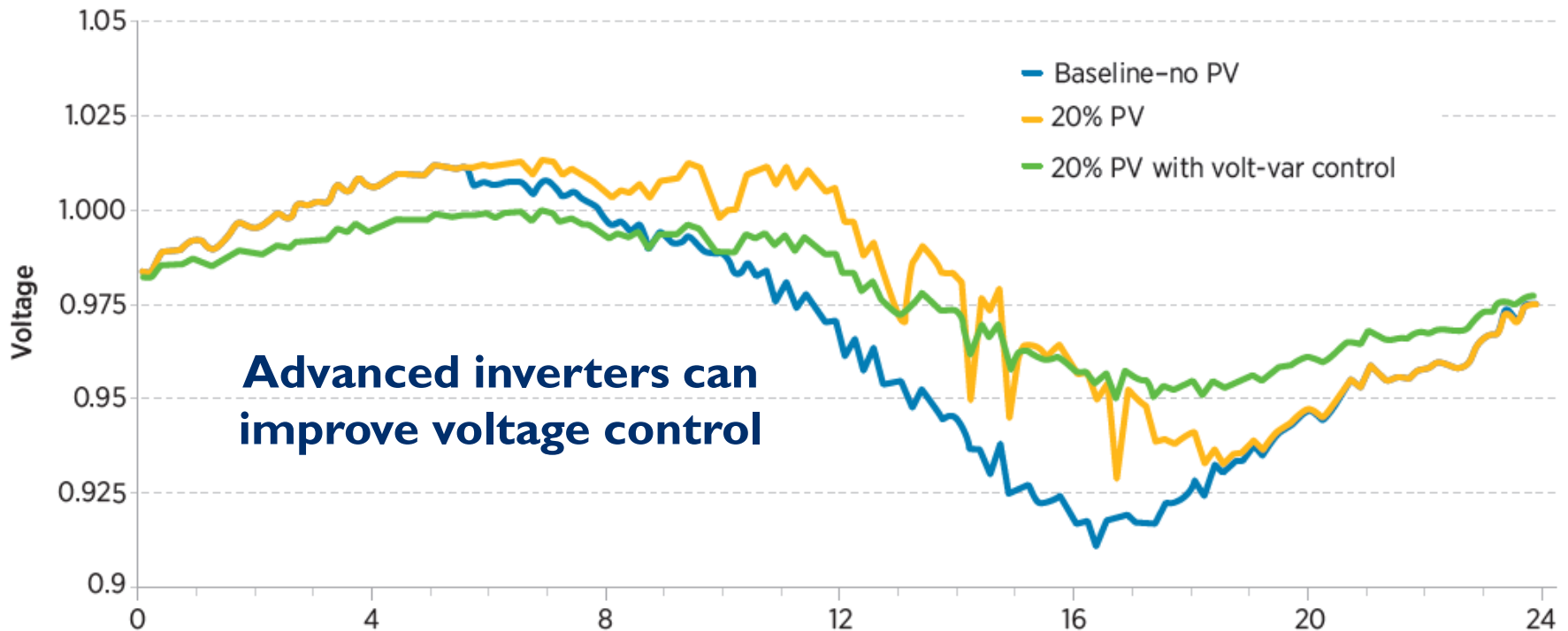
Ensure DPV installations are “good grid citizens” that help

- Voltage and frequency match utility specs
 - Reactive power control helps support voltage
- Voltage ride through and frequency ride through
 - Stay online during grid voltage or frequency dip
 - Improve system stability with high DG saturation
- No unintentional islanding
- Provide excellent power quality
- Maintain system protection and reliability
- Dynamic control
 - Ramp rate and curtailment of real power
 - Communication allows PV to be part of the utility system

Mitigation : strategies

- Advanced inverters (aka smart inverters)
- Modify protection settings/fuses
- Voltage regulation devices and controls
- Upgrades to the conductor
- Direct transfer trip (DTT) of the PV system
- Battery energy storage systems
- Other “smart grid” devices

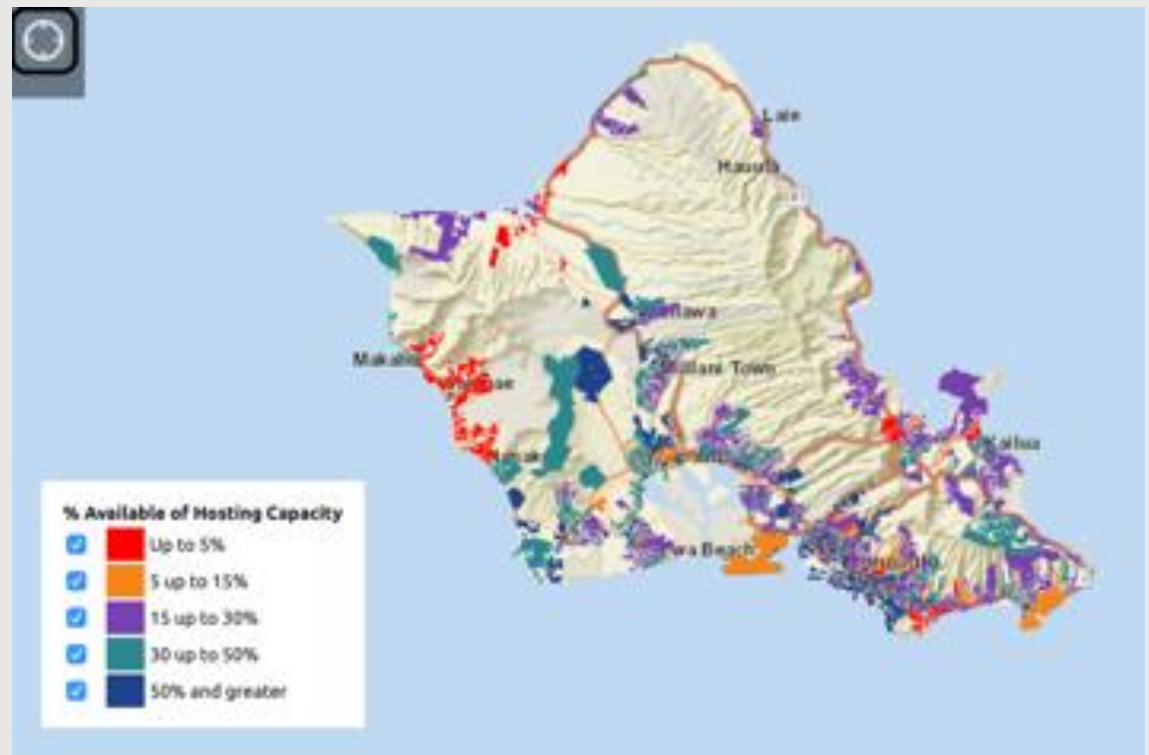
Benefits of Advanced Inverters



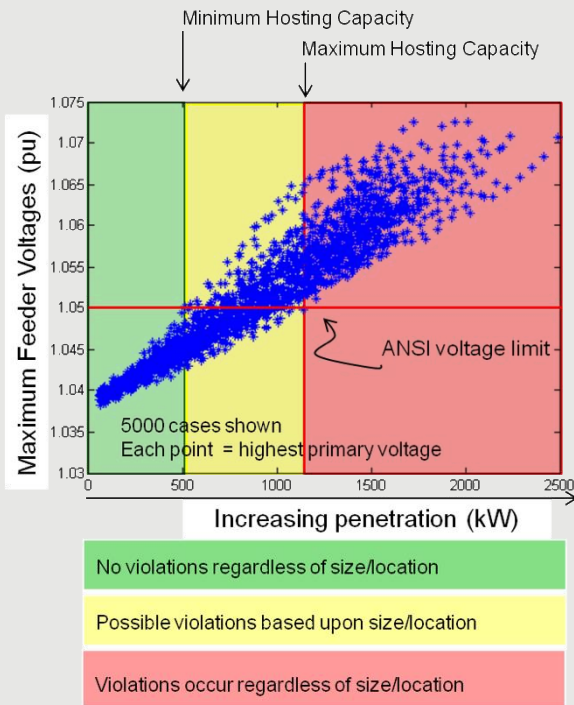
Interconnection capacity and mapping

Three Levels of Sophistication

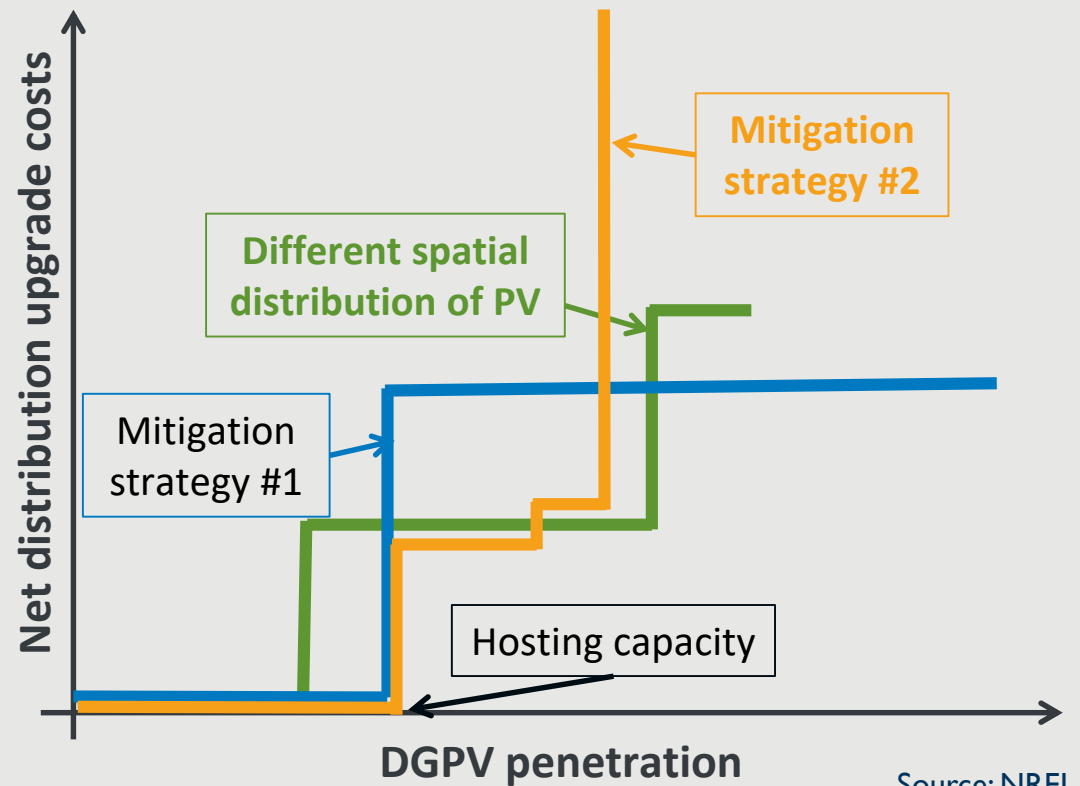
- Restricted zones (Where can't I build a system?)
- Address-level search (Can I build a system here?)
- Feeder mapping (Where should I build a system?)



Beyond hosting capacity – DG integration costs



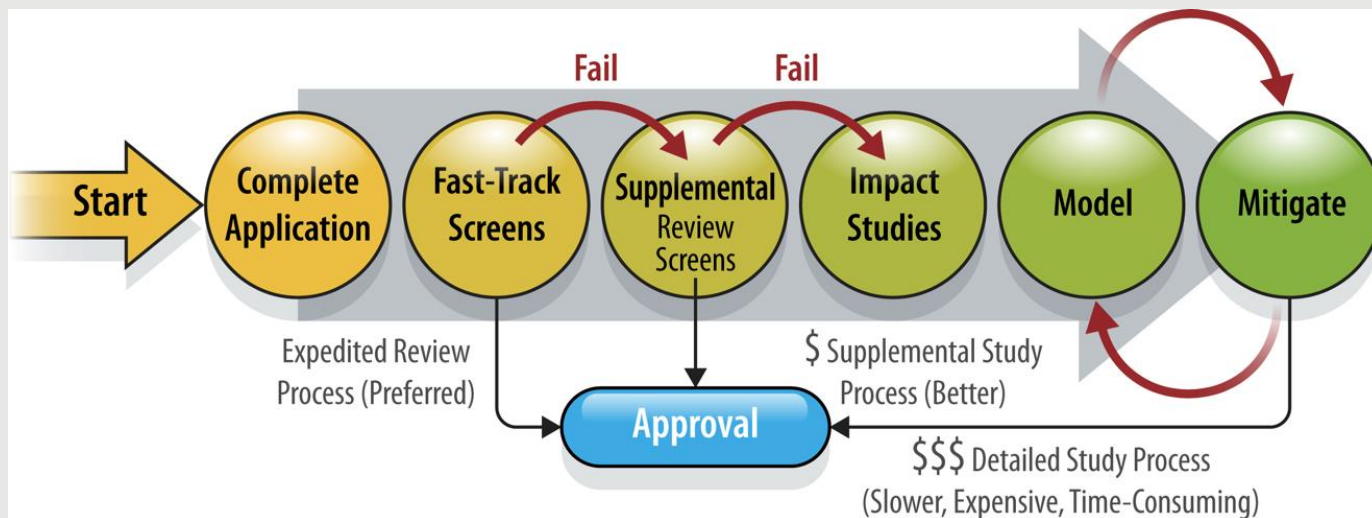
Source: EPRI



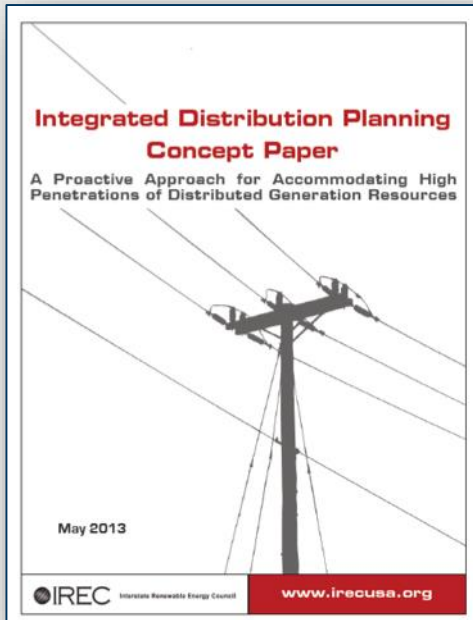
Source: NREL

Interconnection impact studies

- Impact studies are part of the modeling and mitigation process for systems that fail fast-track screens and supplemental reviews
- Modeling allows you to see any issues (e.g. voltage) and come up with a solution
- Most models are simple voltage models.



Integrated distribution planning concept



Forecast DG growth on each circuit

Establish the hosting capacity and allowable
“penetration level”

Determine available capacity on each
distribution circuit

Plan upgrades and expedite interconnection
procedures based on IDP

Publish the results

Integrated distribution planning : Interconnection transparency

Where
can I build
a system?

How big
of a system
can I build?

**How
difficult**
will it be to
interconnect?

**How
much**
will it cost to
interconnect?

How soon
will my system be
interconnected?

Capacity Analysis and Mapping

Performance Tracking and Reporting

**Cost
Certainty**

Public Queues



Questions?

THANK YOU

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Questions

THANK YOU

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NREL at a Glance

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