



NARUC

*Serving the consumer interest
by seeking to improve the
quality and effectiveness
of public utility regulation
in America.*

Solar and Other New DG Technologies

Susan K. Ackerman
Chair, Oregon Public Utility Commission
Second Vice President, NARUC

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Challenges

- **Intermittency** - safety & reliability
 - Resource adequacy – ramp rate, over generation, cycling
 - System stability – frequency, voltage
 - Transmission flow – constraints, protection and coordination
 - Need grid support – e.g. Smart inverters, with 2-way communication
 - **Fairness & equity** - cost shifts to non-participants
 - Net metering credits generally allow Solar PV customers to avoid paying fixed costs – and those costs are shifted to non-participating customers through higher utility bills
 - **Shared cost recovery**
 - Net metering and FIT rules are unlikely to require Solar PV hosts to pay equivalently for fixed costs
 - Death Spiral?
 - **Utility investor**
- inextricably
linked***



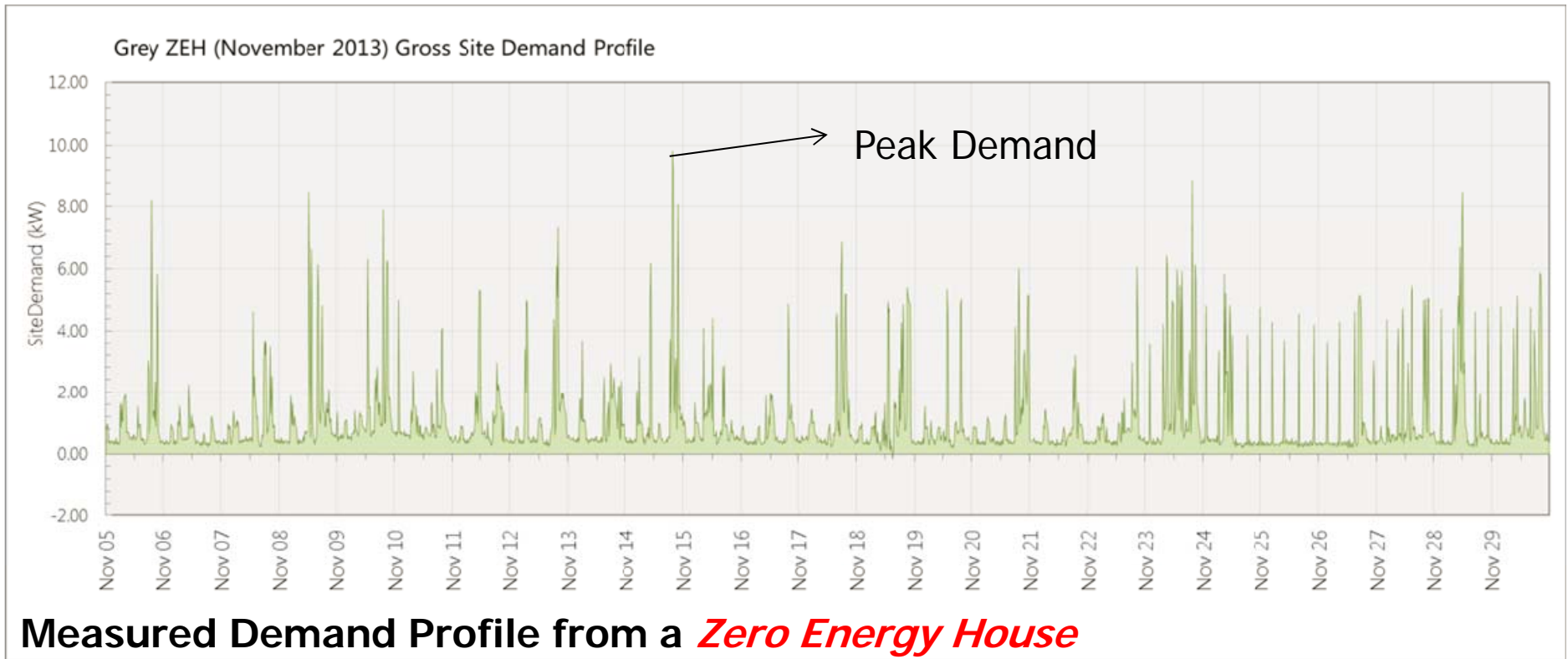
What are the options for addressing these challenges?



Example Challenge: Safety & Reliability of Intermittent Resources

- How much intermittent resource can the grid absorb without violating safety or reliability metrics?
 - Significant disruptions if Solar PV approaches 20% of total energy on local grid
 - Need feeder-by-feeder power system impact study to assess costs & benefits
- Analysis → impact of Solar PV on distribution system
 - Overvoltage and voltage variations
 - Solar PV masks demand on system: net zero *energy* is **not** net zero *demand*
 - Impact on equipment operation – feeder regulators, load tap changes, switched capacitor banks
 - System protection - relay desensitization, unintentional islanding
 - Each feeder has unique hosting capacity and at increasing penetration levels, violations can happen (voltage, protection, power quality, thermal)

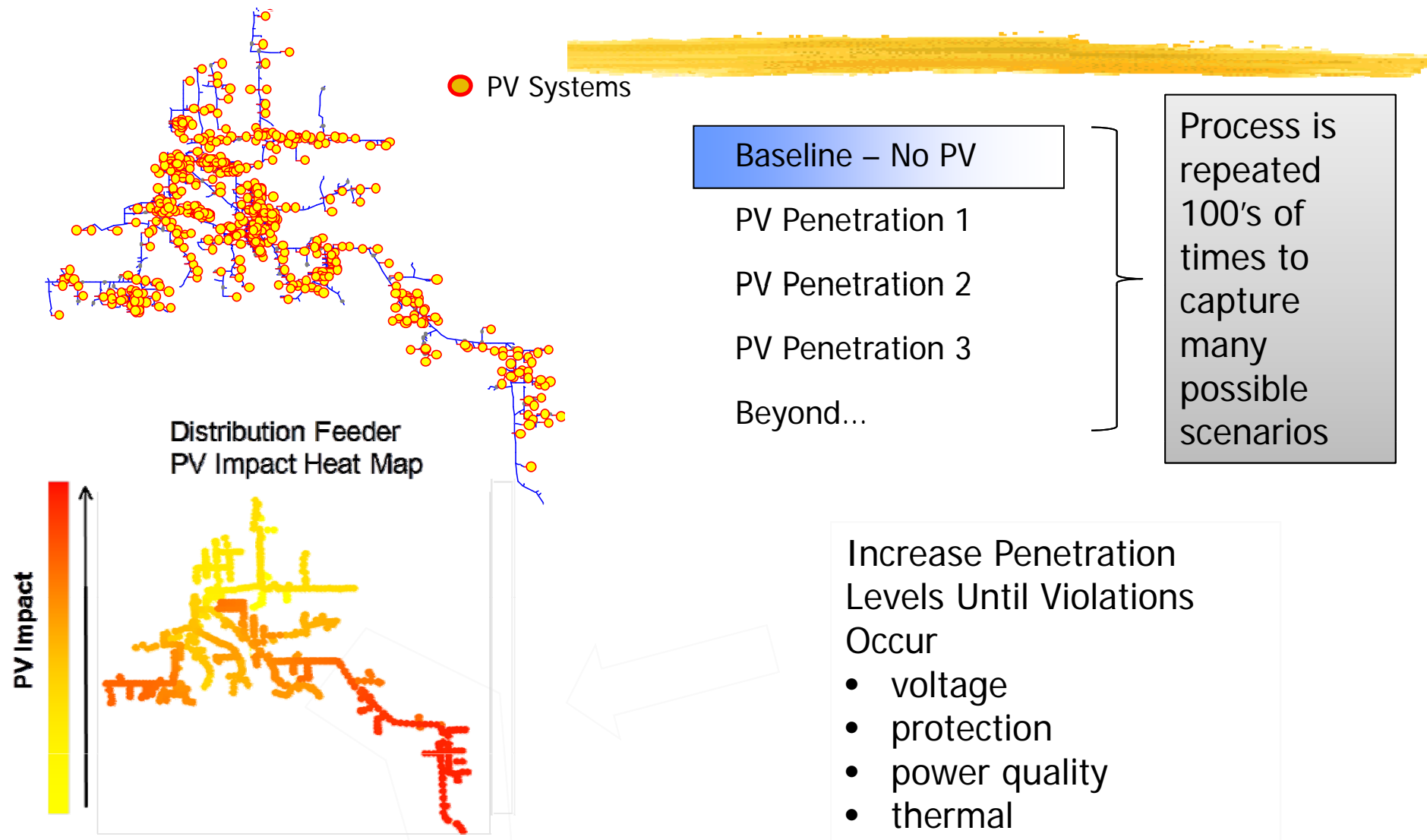
Demand versus Energy



Energy Rich but Capacity/Demand Poor

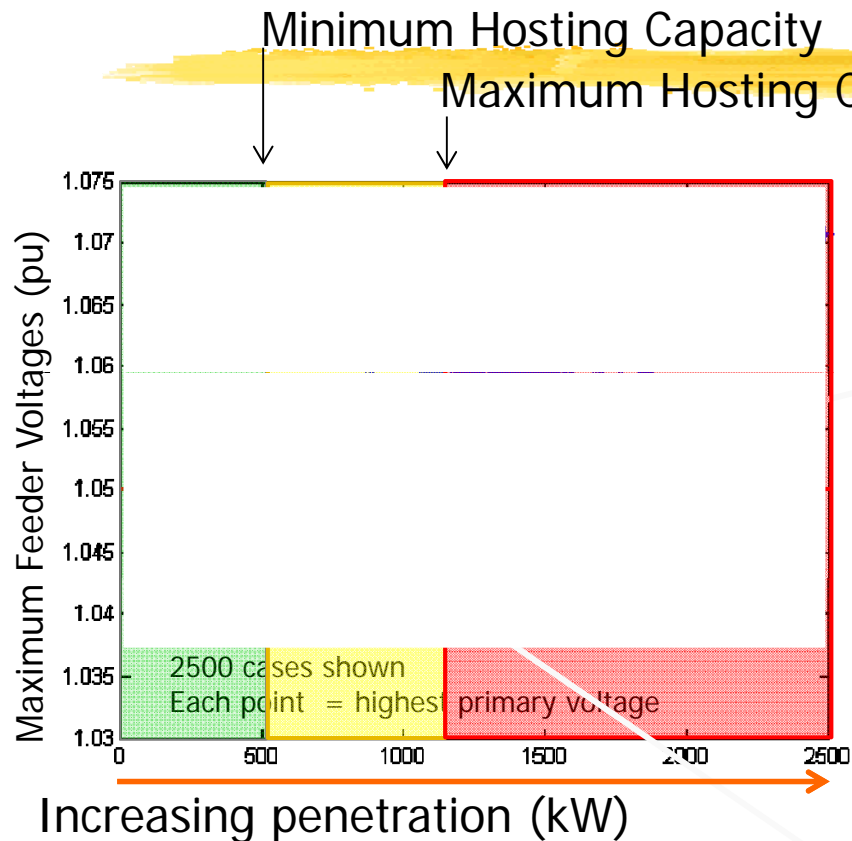
Assessing Distribution System Impact

Feeder Hosting Capacity: A Brief Primer



Hosting Capacity – Sample Results

Overvoltage Results Shown for Feeder J1



No observable violations regardless of size/location

Possible violations based upon size/location

Observable violations occur regardless of size/location

Total PV:
1173 kW

Voltage violation

Total PV:
540 kW



Potential Solutions Safety & Reliability

- Examine interconnection standards & refresh
- Ability to require smart inverters with two-way communication
 - Smart inverters enable grid supportive Solar PV and permit more Solar PV
 - Safety & reliability codes currently prohibit smart inverters – this will change
- Let utility “throttle” amount of Solar PV on feeders
 - Distribution planning
 - Ability to say “no” (or, “not on this feeder but on this other feeder”)
 - Saying “no” based on operational metrics



Potential Solutions Fairness & Equity

➤ Fairness & equity

- Addressing shared cost recovery may also address fairness & equity issues
- Third party leasing may bring in more participants that are not as wealthy
- Lawmakers incentivize Solar PV – lawmakers could also fund bill payment assistance
- Can be a difficult and frustrating issue in US



Potential Solutions Shared Costs

- Contributor to “fairness & equity” challenge
- Even net-zero buildings use the grid and the utility’s central station generation
 - Exception: generation with batteries/storage and complete disconnection from the grid
- Predominantly a rate design issue
 - “Price per kWh sold” rate designs shift shared fixed costs to others (non-participants)



Potential Solutions: Rate Design Alternatives to per kWh sold pricing

Three Example Alternatives:

➤ **Straight fixed-variable rate design**

- Imposes a fixed charge to customers, designed to recover all of a utility's fixed costs

➤ **Customer demand charge**

- May include fixed charges and a volumetric rate for each kilowatt-hour of consumption, but may also include a variable charge based on the individual customer's peak demand
- May accurately allocate non-energy costs of serving customers because utility must design its system and plan for the ability to meet customers' peak needs

➤ **Performance Based Ratemaking**

- Utility's revenues adjusted based on performance and incentives set for utilities to meet or exceed benchmarks determined for certain operations
- If a benchmark is not met, the utility must absorb the extra costs.
- If benchmark met or slightly better, utility keeps the profits and shares them with shareholders;
- If benchmark exceeded by determined margins, money is returned to customers



Strategies for Utilities

- Regulators cannot protect utilities from disruptive competition
- How to adapt is up to the utility (in large part)
 - e.g., Hawaii
- Utility adaptation:
 - Focus on fixed cost recovery may be a losing long-term strategy
 - Creating value for customers will be key
 - Create value for shareholders outside regulated business
 - Anticipate how current investments will support a more distributed future



Strategies for Regulators

- Remember your role: adequate and reliable service at just and reasonable rates
- Role does not change, unless your statutes change
- Economic regulators cannot protect utilities from disruptive competition
- Economic regulation not intended to *forestall* or *foster* disruptive competition
- Regulators must find the right balance between “policy changes and market innovation that can maintain sector stability and encourage innovation.”



Strategies for Regulators

- In striking the balance, remember that facts are your friends:
 - Are customers being served well now?
 - Can customers be better served with new entrant/product/non-utility service?
 - Is there or will there be adequate competition to discipline the market for the new entrant, product or service?
 - Is the utility presence helping or hindering new entrant/product/service?
- What replaces the old model, if the current one isn't working?



Strategies for Regulators

Hallmarks of good regulation next 5-10 years:

- Understand the facts on the ground in your jurisdiction
- Anticipate, but not too much
 - Regulatory change takes time
- Gradualness, if possible*
- Patience and attention to detail
- Willingness to experiment and change course

*Depends on the facts on the ground



Questions?

