



Connecting to the Grid

Interconnection Best Practices

Sahm White

Director, Policy & Economic Analysis

Clean Coalition

sahm@clean-coalition.org

Mission

To accelerate the transition to renewable energy and a modern grid through technical, policy, and project development expertise.

Board of Advisors

Jeff Anderson

Co-founder and Former ED, Clean Economy Network

Josh Becker

General Partner and Co-founder, New Cycle Capital

Pat Burt

*CEO, Palo Alto Tech Group;
Councilman & Former Mayor, City of Palo Alto*

Jeff Brothers

CEO, Sol Orchard

Jeffrey Byron

Vice Chairman National Board of Directors, Cleantech Open; Former Commissioner, CEC

Rick DeGolia

Senior Business Advisor, InVisM, Inc.

John Geesman

Former Commissioner, CEC

Eric Gimon

Independent Energy Expert

Patricia Glaza

Principal, Arsenal Venture Partners

Mark Z. Jacobson

*Director of the Atmosphere/Energy Program &
Professor of Civil and Environmental Engineering,
Stanford University*

Dan Kammen

Director of the Renewable and Appropriate Energy Laboratory at UC Berkeley; Former Chief Technical Specialist for RE & EE, World Bank

Fred Keeley

Treasurer, Santa Cruz County, and Former Speaker pro Tempore of the California State Assembly

Felix Kramer

Founder, California Cars Initiative

Amory B. Lovins

Chairman and Chief Scientist, Rocky Mountain Institute

L. Hunter Lovins

President, Natural Capitalism Solutions

Ramamoorthy Ramesh

Founding Director, DOE SunShot Initiative

Governor Bill Ritter

Director, Colorado State University's Center for the New Energy Economy, and Former Colorado Governor

Terry Tamminen

Former Secretary of the California EPA and Special Advisor to CA Governor Arnold Schwarzenegger

Jim Weldon

Technology Executive

R. James Woolsey

Chairman, Foundation for the Defense of Democracies; Former Director of Central Intelligence (1993-1995)

Kurt Yeager

Vice Chairman, Galvin Electricity Initiative; Former CEO, Electric Power Research Institute



Sahm White

Economics and Policy Analysis Director
Clean Coalition

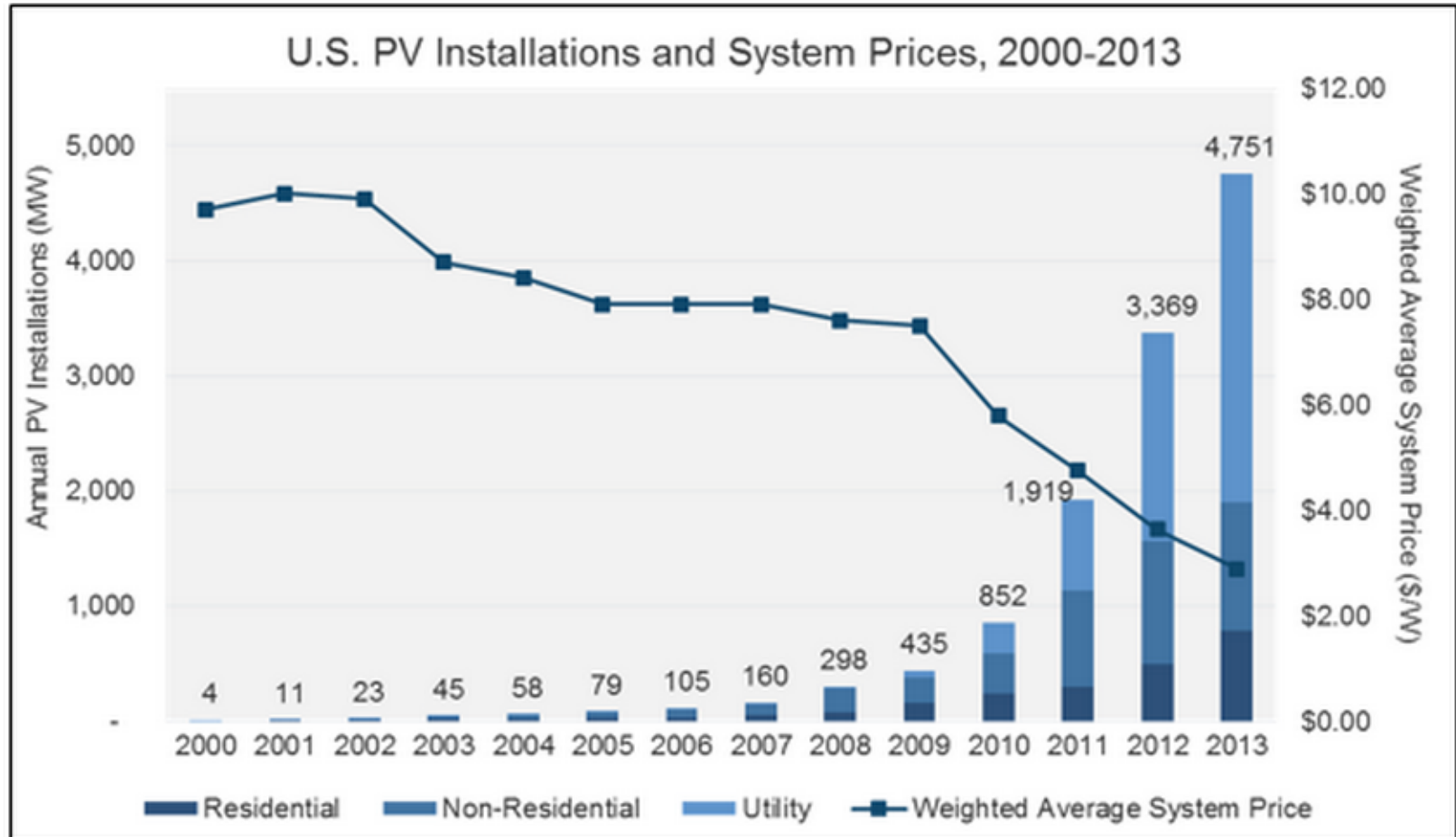
- Introduction
- Why Interconnection Matters
- Policy Approach
 - Goals
 - Barriers
 - Solution Principles
- Proven Strategies
- Solutions
- Looking Ahead

A Modern Power System



Addressing growing demand

- 245,358 solar projects in California as of Oct 8, 2014

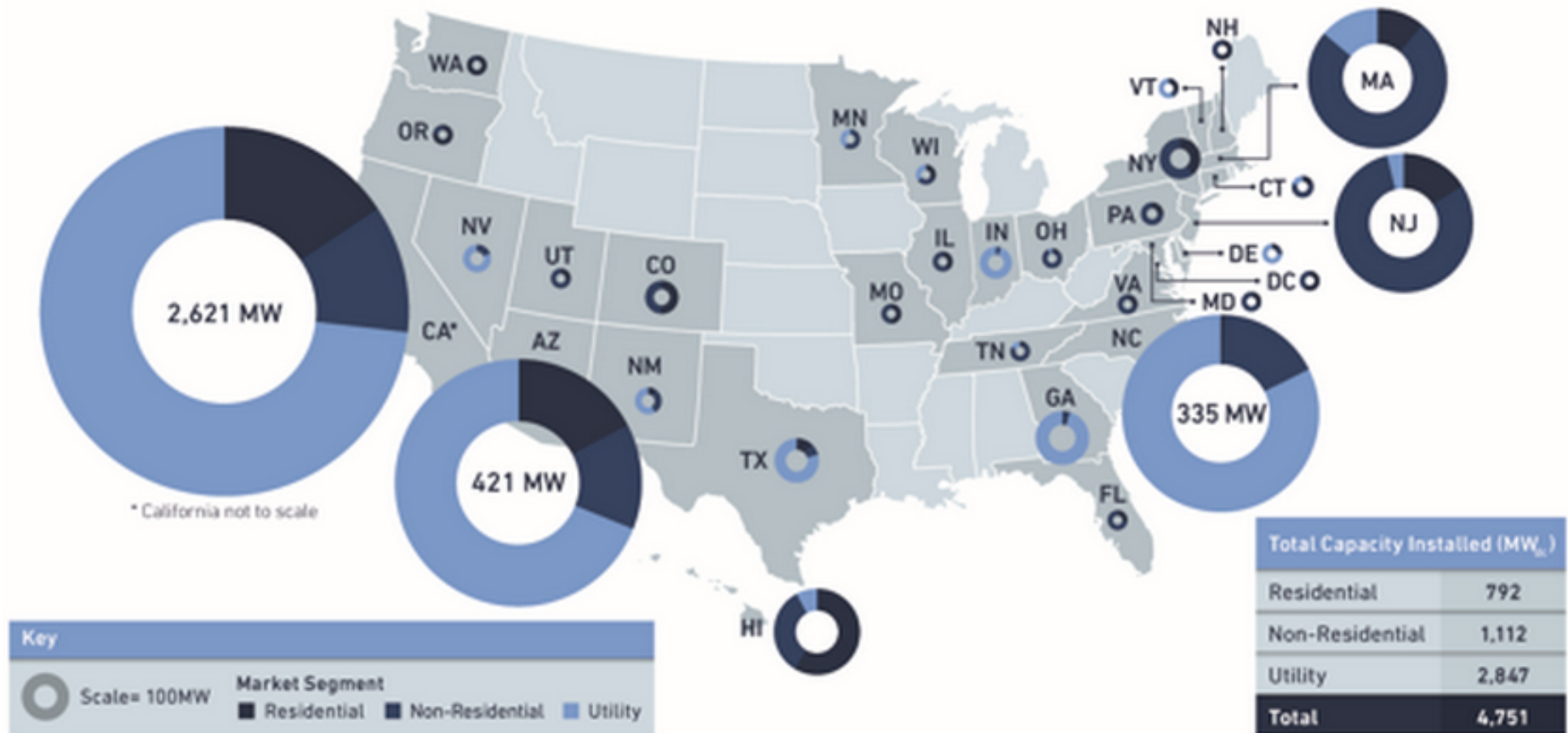


Source: CSI, SIEA US Solar Market Insight: 2013 Year-in-Review

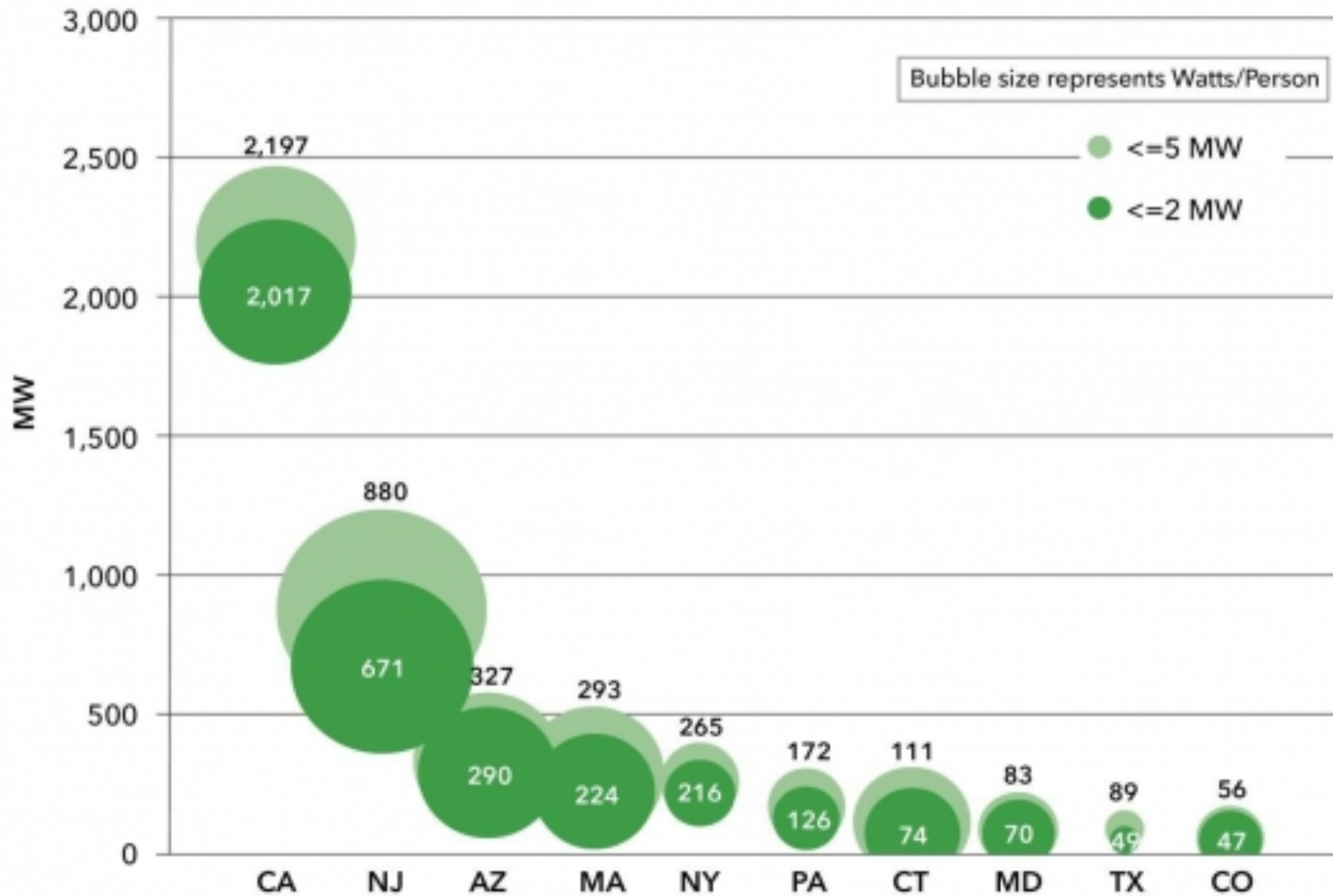
Why Interconnection Matters

Some states are leading the curve but all states are on a similar curve

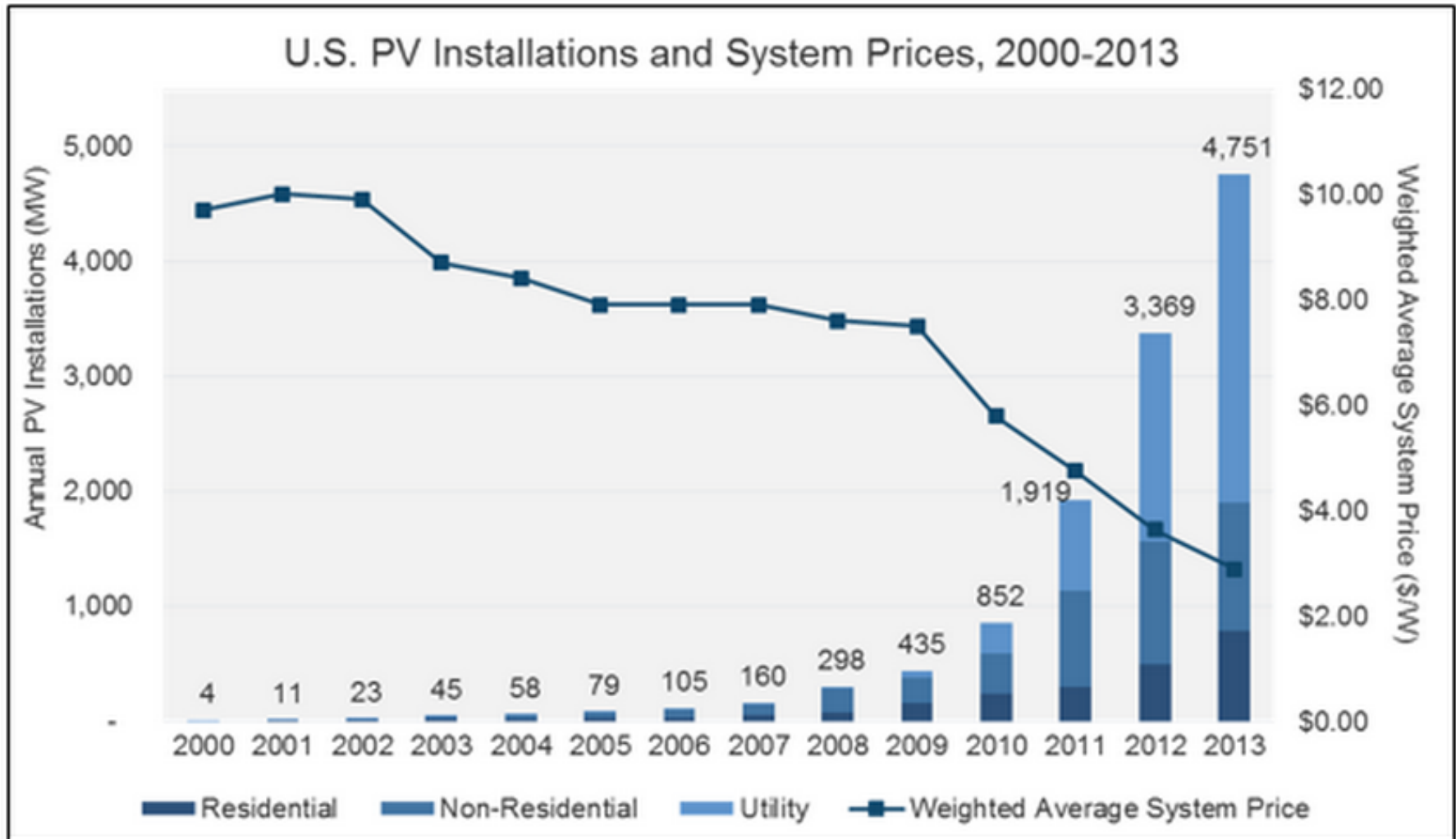
U.S. Solar Installations by State and Market Segment, 2013



Per Capita Levels of Distributed Generation 2013



State Leaders: Distributed Generation (All Types)



Source: SIEA US Solar Market Insight: 2013 Year-in-Review

Project Size

50+ MW

500 kW

5 kW

Retail DG
Serves Onsite Loads



Wholesale DG
Serves Local Loads



Central Generation
Serves Remote Loads



Behind the Meter



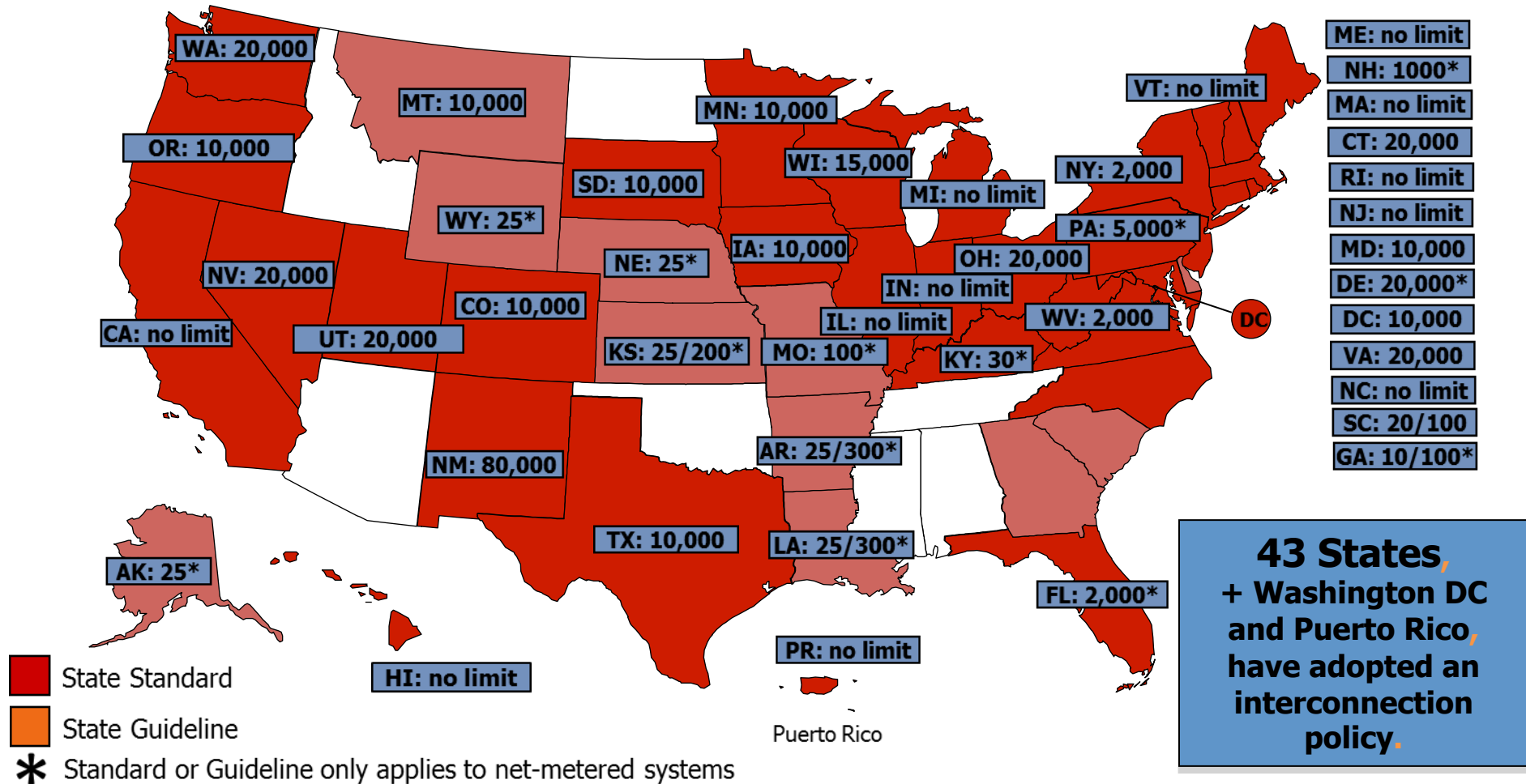
Distribution Grid



Transmission Grid



Interconnection Policies Vary Nationwide

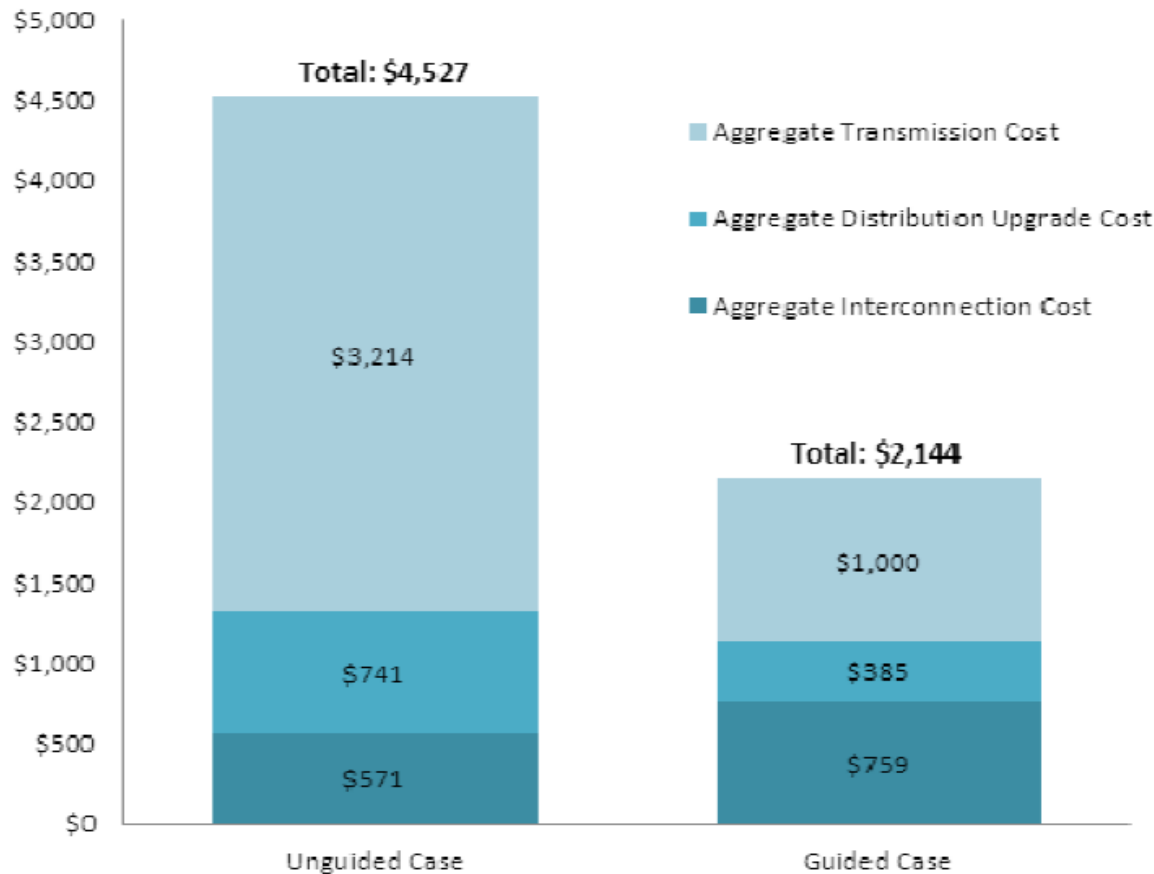


Notes: Numbers indicate system capacity limit in kW. Some state limits vary by customer type (e.g., residential versus non-residential). "No limit" means that there is no stated maximum size for individual systems. Other limits may apply. Generally, state interconnection standards apply only to investor-owned utilities.

From www.dsireusa.org, 2013

Location Matters for Applicants & Ratepayers

- Southern California Edison found that siting renewables projects closer to consumers could reduce their T&D upgrade costs by over \$2 billion



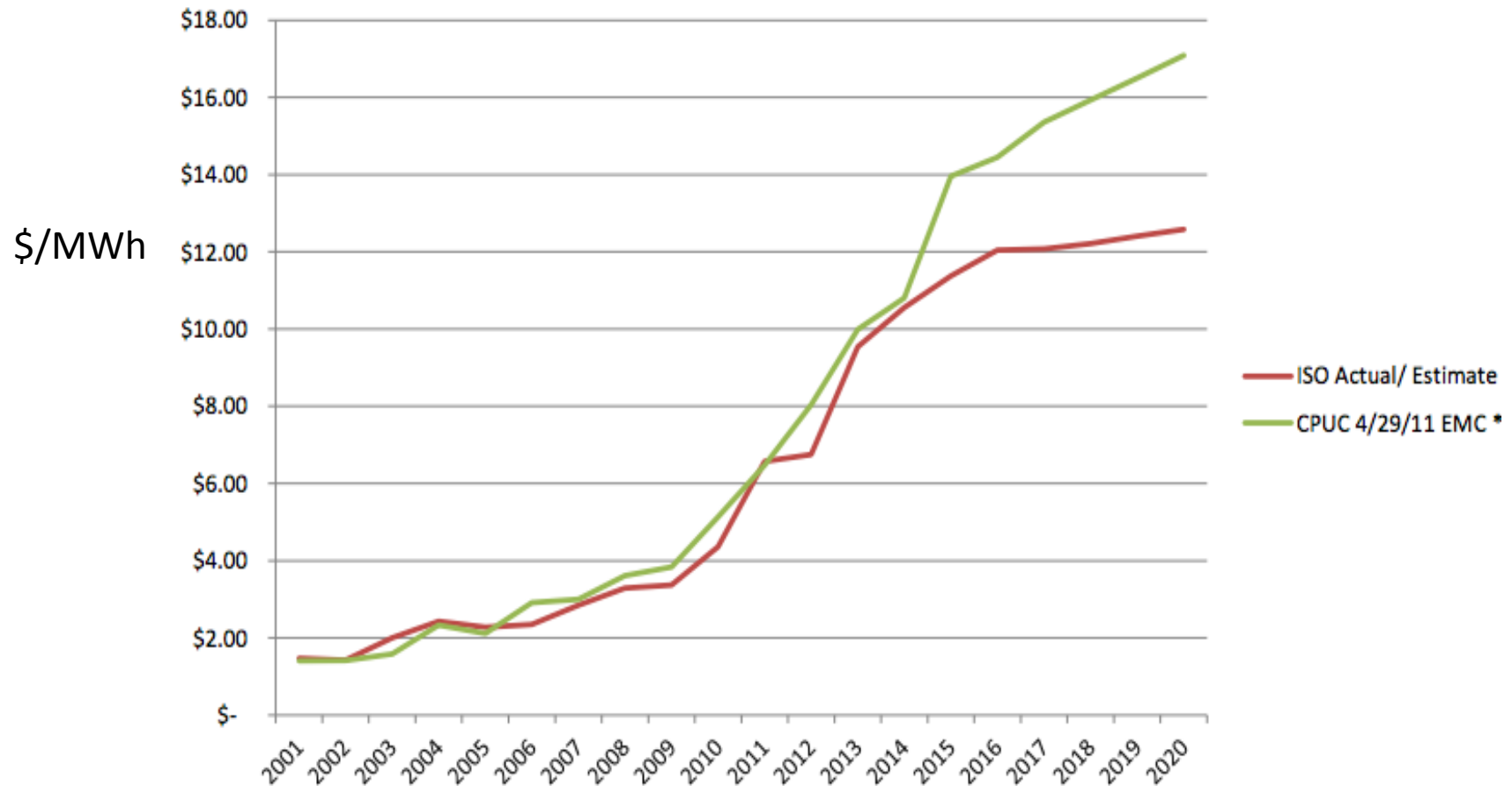
Source: Southern California Edison (2012)

Transmission costs would be borne by ratepayers

Opportunity to reduce transmission costs

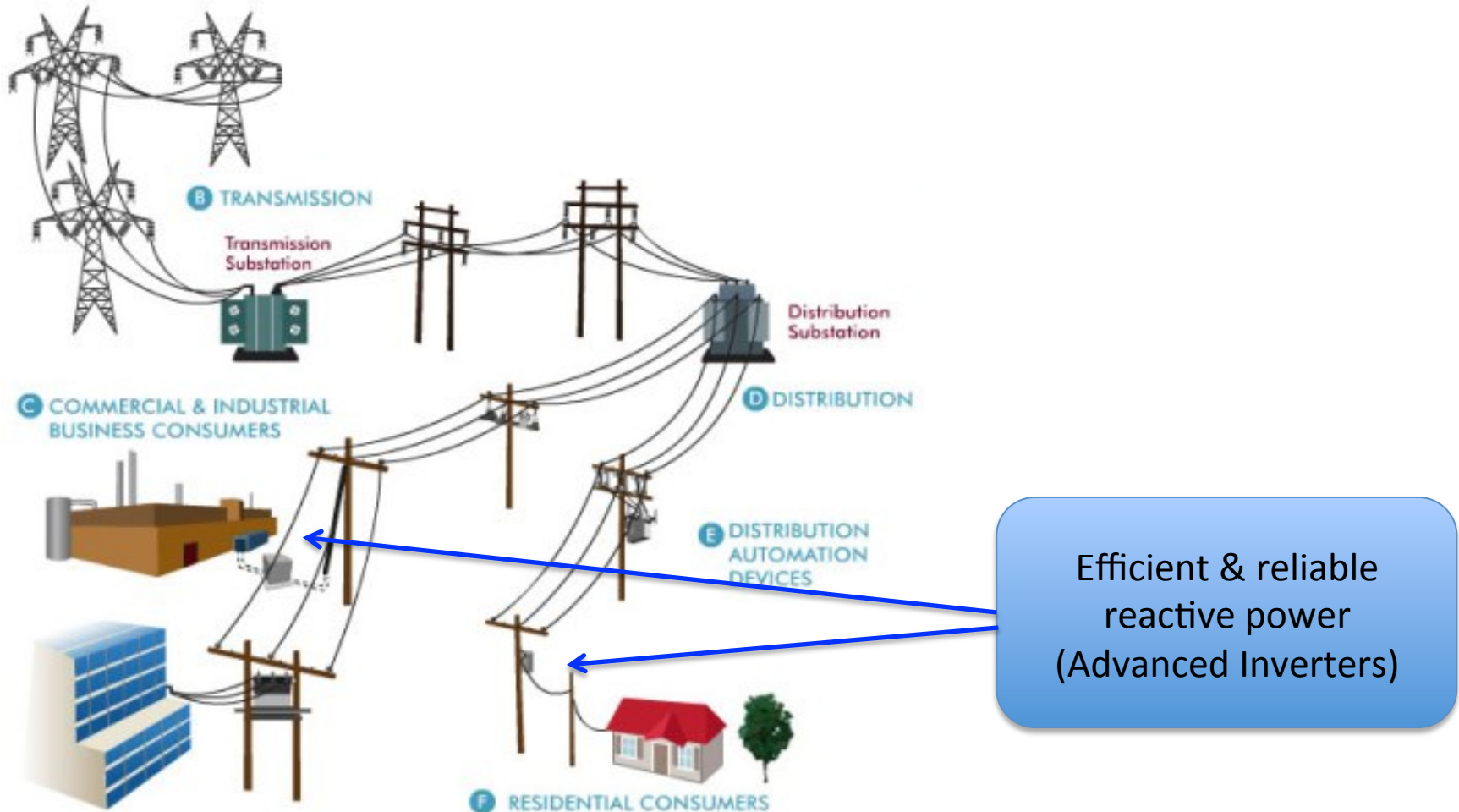
Historical and Projected High Voltage Transmission Access Charges

(Does not include comparable Low Voltage Transmission Access Charges)



Supports distributed voltage regulation to:

- Enhance system reliability by providing reactive power where needed
- Improve system efficiency by avoiding line losses and reducing congestion



Goals:

- Efficiently incorporate appropriately sited DG as a major clean energy source in a secure, resilient and cost effective electric grid
- Help customers make timely decisions about where to apply, whether to apply, and to commit to interconnect.

Mechanisms:

- Transparency
- Accessibility
- Simplicity
- Speed
- Certainty

What to avoid

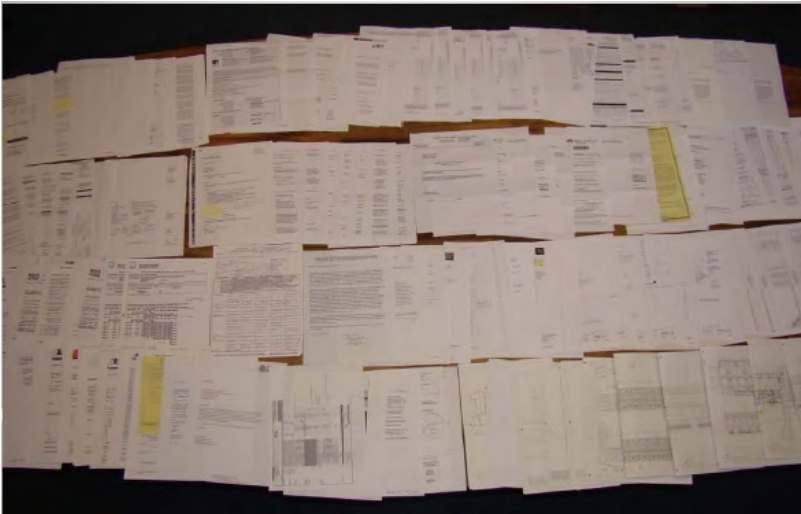


Interconnection processes and cost determinations that are:

- Unpredictable
- Unwieldy
- Untimely
and ultimately....
- Uncertain



Typical California paperwork for one project



Could be a 1kW-sized project, but maximum 1MW (via CSI program). Even more paperwork for California projects larger than 1MW (via RPS program).

Typical Germany paperwork for one project



Could be a 1kW or 20MW-sized project, or bigger.

Source: Gary Gerber, President of CalSEIA and Sun Light & Power, June 2009

Reducing bureaucracy alone can shave costs by 20%

Customer hurdles in applying for interconnection:

- ✦ Information about the application process, requirements, costs, and timelines
- ✦ Access to grid information for siting and system design
- ✦ Utility response time
- ✦ Consistency among utility personnel
- ✦ Schedule delays – application review, site visits, studies, inspection, installation
- ✦ Requirement standards – equipment and upgrades
- ✦ Complex contracts and agreements
- ✦ Dispute resolution

Utility hurdles in applications for interconnection:

- ✦ Errors in application materials
- ✦ Excessive application submission and subsequent withdrawal rates
- ✦ Utility access to accurate grid information
- ✦ Performing grid impact studies
- ✦ Coordinating electrically related applications
- ✦ Inappropriate system designs triggering additional study
- ✦ Scheduling field work – site review, inspection, installation
- ✦ Customer negotiation and dispute resolution

Plan, prepare and communicate

Utilities can:

- Anticipate future interconnection demand
- Provide clear usable information to support submittal of viable interconnection requests
- Make information highly accessible
- Standardize processing and evaluation of requests to provide efficient, rapid, consistent and predictable results
- Plan integrated solutions to capture benefits of local distributed resources

Offer Clear Information

Help customers make a decision quickly about where to build, what to build, and when to commit *before submitting an application*. This can be achieved through:

- ▶ Accountable standards and processes
 - All parties rely upon known rules, commitments, and timelines.
- ▶ Clear review processes
 - Review processes should emphasize predictability, flexibility and objectivity, including screening and solution options
- ▶ Certainty in costs and responsibilities
 - Clear cost determination means less risk and lower costs for developers, utilities, and consumers alike. Earlier cost determination means faster decisions.
- ▶ Transparent and accessible information
 - Too often, interconnection information is hard to come by

Accountable standards and processes

- ▶ Common statewide and national standards, practices, procedures, and contracts.
- ▶ Interconnection procedures designed to handle the expected scale of requests across all categories of distribution level interconnection.
- ▶ A standard application, review, and timelines, including any necessary studies.

Clear Review Processes

Review processes should emphasize predictability, flexibility and objectivity, including screening and solution options:

1. Simplified review of appropriate projects
2. Default approval of conforming projects
3. Rapid resolution of most common issues
4. Identification of issues that will require further study if they cannot be addressed through supplemental review or simple project modification
5. Determination of specific technical study requirements where needed.

Certainty in costs and responsibilities

Clear cost determination is the overriding issue for customer decisions and for a successful interconnection process.

Address the needs of both customer and utility toward an Interconnection Agreement.

Adopted standards, requirements, and planning should be forward looking.

Reasonable fees, schedules, milestones and enforcement penalties for all parties support timely responses

Transparent and accessible information

Identifying “what can go where” with little or no modification or customer cost.

Current grid information should be maintained and readily available to generation interconnection staff and customers in order to:

- Address qualification screens, predict costs, reduce potential redesign and restudy, and generally know "what can go where" early in the project development process
- Efficiently process interconnection requests
- Track the progress and outcomes of interconnection requests

Current grid information can be made available through:

- Maps, databases, and/or Pre-Application Reports regarding existing and planned system capacities.
- Application queue status and results.

Standards:

- Consistent standards across utilities.
- Open to all customer classes.
- Standardized easy-to-understand forms and agreements.
- Moderate application costs to avoid creating barriers while discouraging speculative submissions.
- Reasonable and enforceable procedural timelines for all parties.
- Clear, transparent technical screens.
- Automatic approval when meeting screening criteria
- No preset limits on capacity - reflect local conditions.
- Additive levels of review for generating facilities based on screens for design, local capacity, complexity and level of certification.
- An effective dispute resolution process.

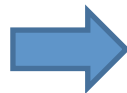
CA Rule 21 – A widely followed standard seeing ongoing improvement

- ✦ Web based info and application process
- ✦ Standardized forms and agreements
- ✦ Publish grid data
- ✦ Enable effective siting and design
- ✦ Implement and expand Fast Track options
- ✦ Implement and/or improve deadlines & accountability
- ✦ Eliminate unnecessary insurance stipulations
 - *New inverter functionality
 - *Cost Certainty
 - *Cost effective telemetry standards
 - *Guide development
 - *Plan DG compatible modernization

(*) remaining issues being addressed in Rule 21 and Distribution Resource Planning

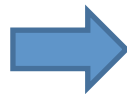
Industry Outcomes of the Rule 21 Updates

Pre-Application Report, integrated queue, and interconnection capacity maps



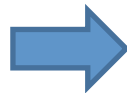
Inform siting decisions and manage expectations

Specific standards permitting higher penetration levels of generating capacity



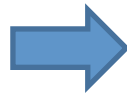
Permit more generation to be sited in cost-effective locations associated with load

Clear timelines and defined eligibility for study tracks



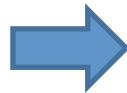
Improve predictability and transparency of interconnection process

Financial security requirements



Reduce stagnation of queued-ahead requests

New dispute resolution tools



Permit more efficient resolution of timeline-related disputes

Utility Outcomes of Rule 21 Updates

Defined study tracks based on technical characteristics



Deploy engineers efficiently, improve ability to manage interconnection workload

Safety and reliability tests match generating capacity against minimum coincident load



Ensure safety and reliability while maximizing distributed generation penetration levels

Clear timelines and financial security requirements



Ensure that only viable projects remain in the queue, simplifying studies

Tests to identify interdependency with transmission system



Ensure that interconnection studies conducted under state and federal tariffs are based on the electric grid's engineering realities

Clear Review and Dispute Resolution processes



Faster processes, + happier customers

Benefits of Online Forms & Agreements

Online forms:

- Ensure applications are fully completed
- Efficient and accurate utility data capture
- Accessible application status tracking for utility and customer schedules
- Automated communications for customers and utility staff
- Verification of receipt
- Faster turnaround times

Interconnection 3.0

A roadmap to the Future

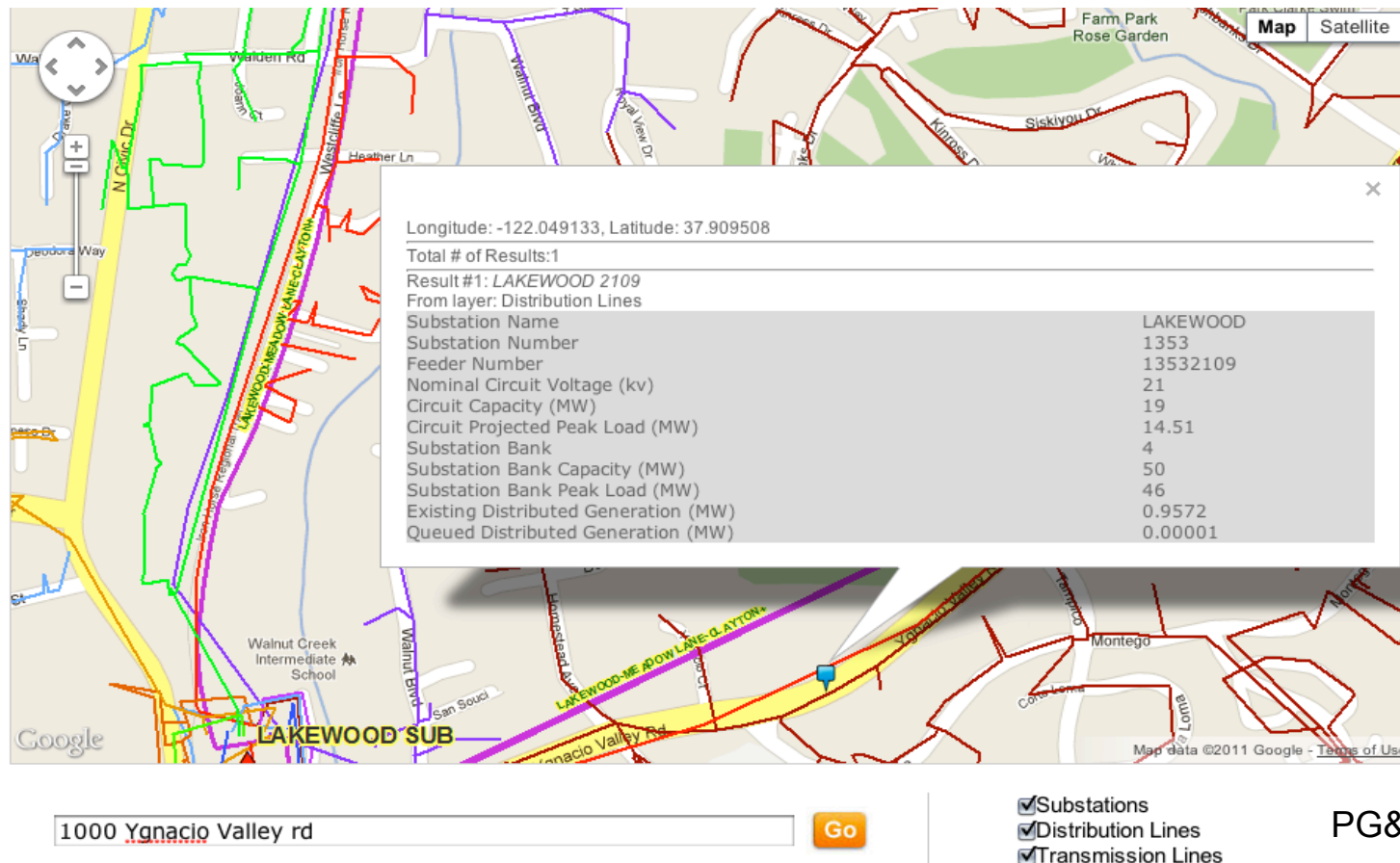
- Guiding generation to where it's most useful
- Recognizing locational benefits,
- Integration with ADR, EVs, Storage, D-grid upgrades and Smart Grid development
- Eventual goal is “1 click” instant study results – fully automated, or largely automated, interconnection review.

Optimal locations = highest net value to the grid over relevant time period

- Lowest cost
 - Grid upgrade costs
 - Interconnection costs, regardless of who directly pays these costs
- Highest value
 - Avoided/deferred distribution upgrades
 - Avoided/deferred transmission investments
 - Avoided T&D line and congestion losses
 - Avoided transmission access charges
 - Improved grid reliability and power quality
 - Local capacity value

	Lowest costs	Medium costs	High costs
Highest value	Best locations	Good locations	Subprime locations
Medium value	Good locations	Average locations	Poor locations
Lowest value	Subprime locations	Poor locations	Worst locations

How can developers find optimal locations?



Examples available at:

PG&E: <http://www.pge.com/b2b/energysupply/wholesaleelectricssuppliersolicitation/PVRFO/pvmap/>

SCE: <http://www.sce.com/EnergyProcurement/renewables/renewable-auction-mechanism.htm>

SMUD: <http://www.smud.org/en/community-environment/solar-renewables/Documents/InterconnectionMap.pdf>

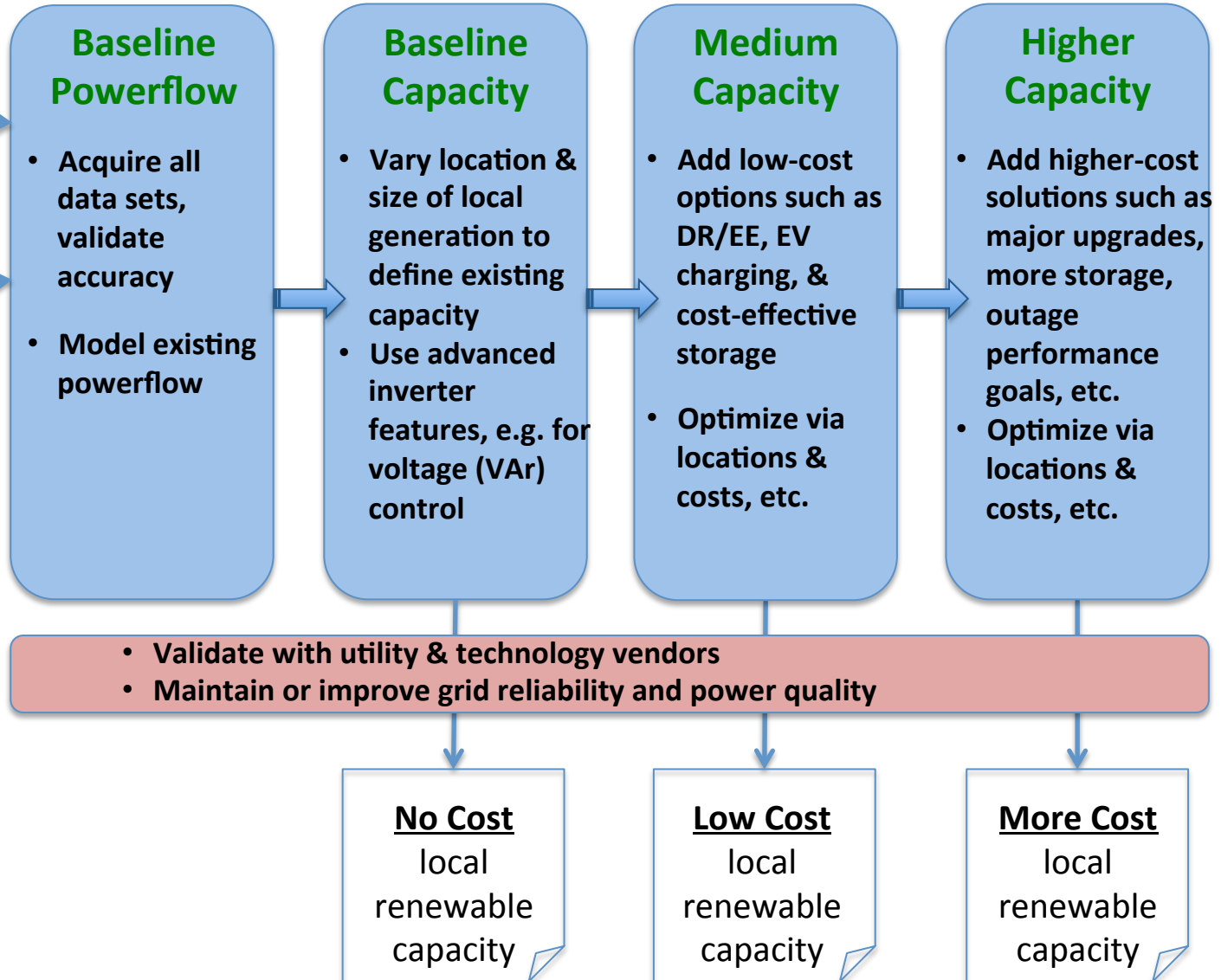
Local Capacity Optimization

Utility Data

- Customer & transformer loads
- Network model & circuit map
- Equipment list & upgrade plans
- O&M schedule

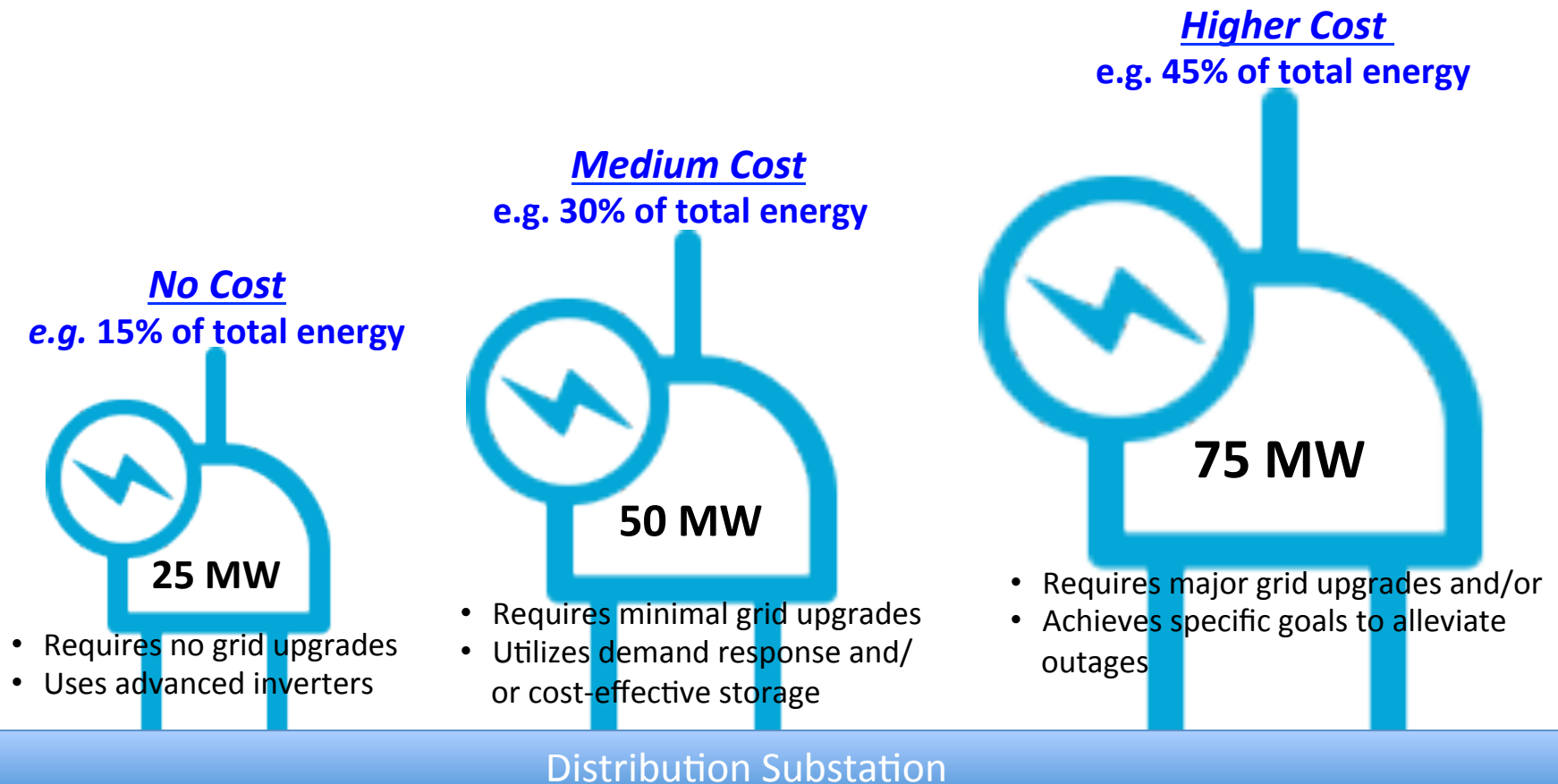
Other data

- Solar insolation
- Weather forecasting
- Assumptions for DR/EE/EV charging, etc.
- Product performance specs, e.g. storage



Capacity Modeling for “Plug-n-Play” Deployments

The industry can achieve scale and simplicity by planning for cost-effective local renewable capacity. This “Capacity Planning” enables renewables to connect in bulk – a “Plug-n-Play” model – and analogous to how the industry plans for transmission capacity. Connecting “one rooftop at a time” is much more expensive and disruptive.



Further reading:

- ▶ Clean Coalition's *Model Interconnection Tariff and Procedures*
<http://www.clean-coalition.org/resource/the-resource-hub/single-utility-resources/model-tariffs-and-contracts/>
- ▶ Resource Hub
<http://www.clean-coalition.org/resource/the-resource-hub/state-level-resources/interconnection/>

Thanks for listening

- ▶ Questions, thoughts, ideas?