Benefits of the Grid for Distributed Generation

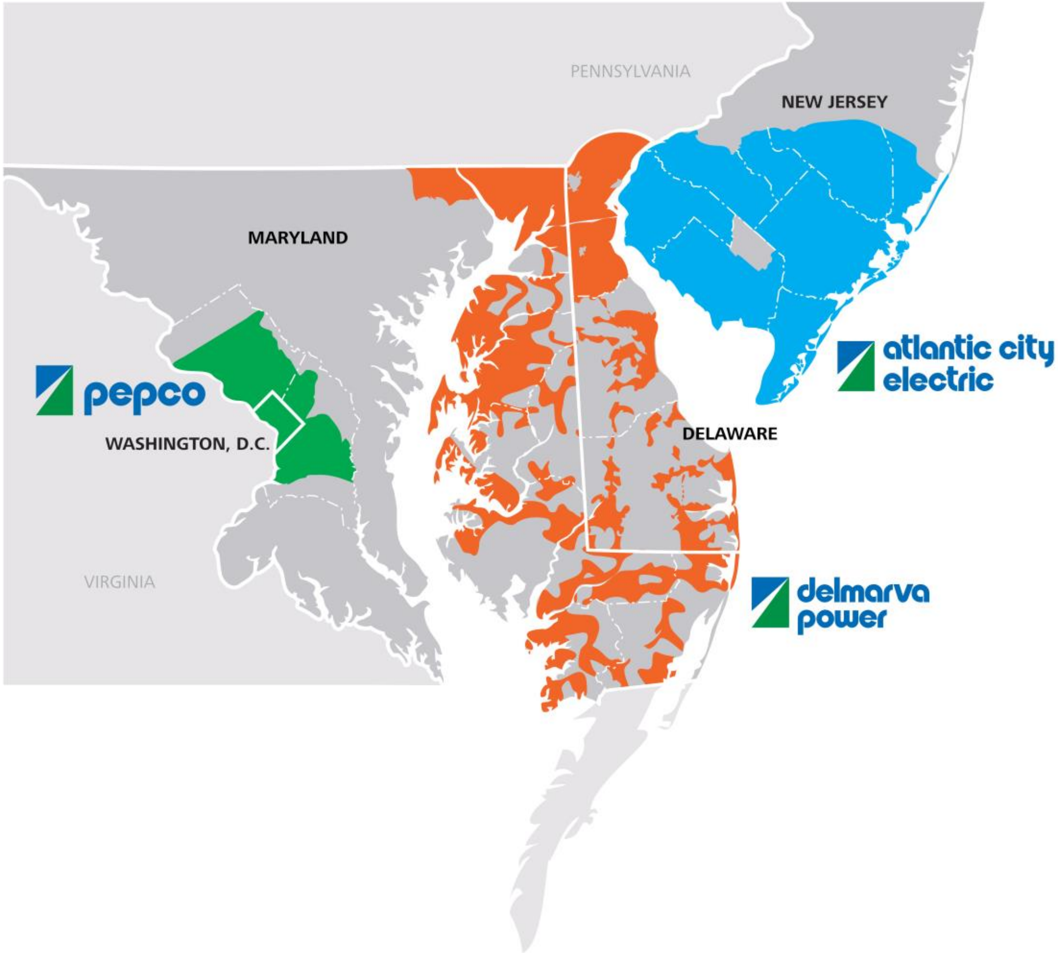
Pepco Holdings, Inc

Presented by: Karen Lefkowitz

December 3, 2013

Pepco Holdings, Inc. Quick Facts

- Incorporated in 2002
- Service territory: 8,340 square miles
- Customers served
  - Atlantic City Electric:
    - 545,000 – electric
  - Delmarva Power:
    - 503,000 – electric
    - 125,000 – natural gas
  - Pepco:
    - 793,000 – electric
- Total population served: 5.6 million



PHI Aspiration

We will become best in class in safety, reliability, customer service and innovation by engaging our talented workforce, leveraging operational excellence and applying advanced technology.

- **BEST IN CLASS**
  OUTPERFORMING OUR PEERS, BALANCING THE NEEDS OF CUSTOMERS WITH THE NEEDS OF THE BUSINESS
- **INNOVATION**
  LEVERAGING EXPERTISE TO OPTIMIZE ENERGY RESOURCES AND USE FOR NON-REGULATED BUSINESS PARTNERS
- **TALENTED WORKFORCE**
  FOCUSING ON LEADERSHIP, TEAMWORK, ENTERPRISE FOCUS, ACCOUNTABILITY AND COMMUNICATION TO BUILD HIGH-PERFORMING TEAMS
- **OPERATIONAL EXCELLENCE**
  DELIVERING A VITAL SERVICE TO CUSTOMERS WHILE BEING FULLY COMPLIANT AND MEETING PHI GOALS

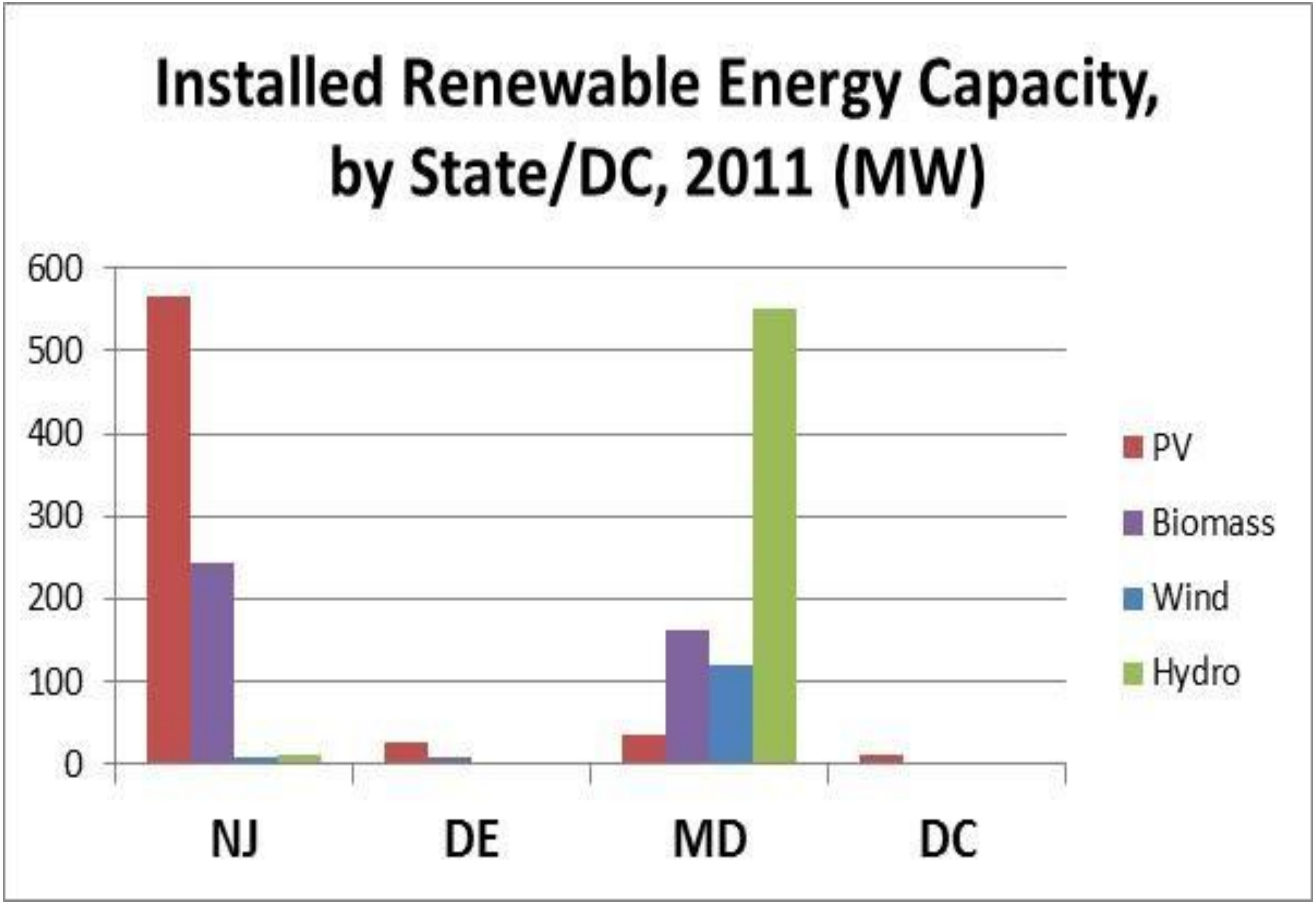
We will continue to empower customers through a smarter grid, create energy solutions for our business partners, protect our environment and deliver value to our shareholders.

- **CREATE ENERGY SOLUTIONS**
  BUILDING CUSTOM, CUTTING-EDGE SYSTEMS TO REDUCE ENERGY COSTS AND ADDRESS OPERATIONAL AND PERFORMANCE NEEDS OUTSIDE THE UTILITY ENVIRONMENT

State Renewable Portfolio Standard (RPS) in PHI Territory

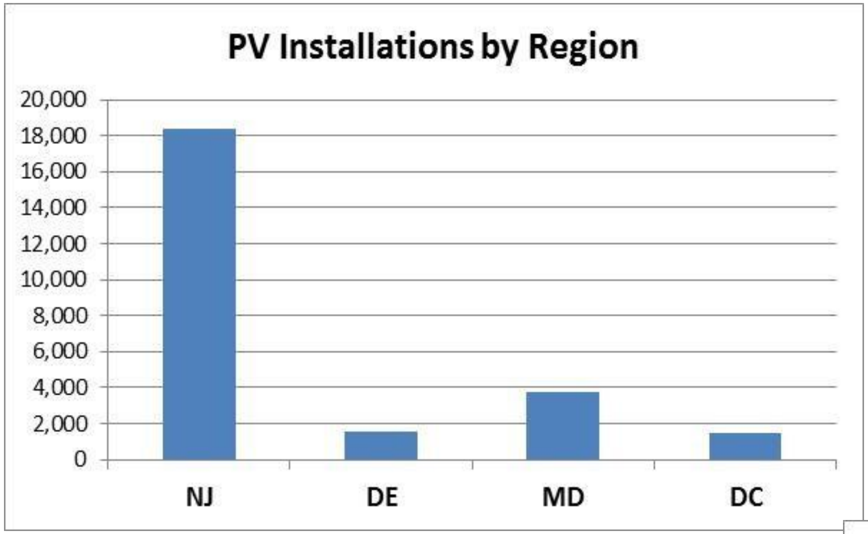
PHI Territory	RPS	Technology Minimum
New Jersey	20.38% (class I & II) by 2020/21	• PV: 4.1% by 2027/28 • Offshore wind: 1 100 MW
Delaware	25% by 2025/26	• PV: 3.5% by 2025/26
Maryland	20% by 2022	• PV: 2% by 2020 • Offshore wind TBD; 2.5% max beginning 2017
DC:	20% by 2020	• PV: 2.5% by 2023

Source: http://www.dsireusa.org/



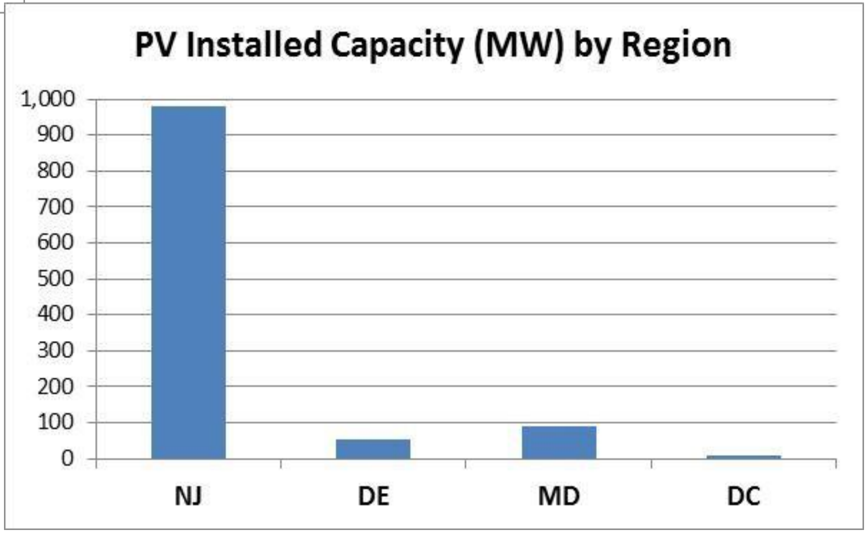
Note: Data for the graph gathered from
http://www.acore.org/files/pdfs/states

PV Installations by State/DC (Oct 2013)



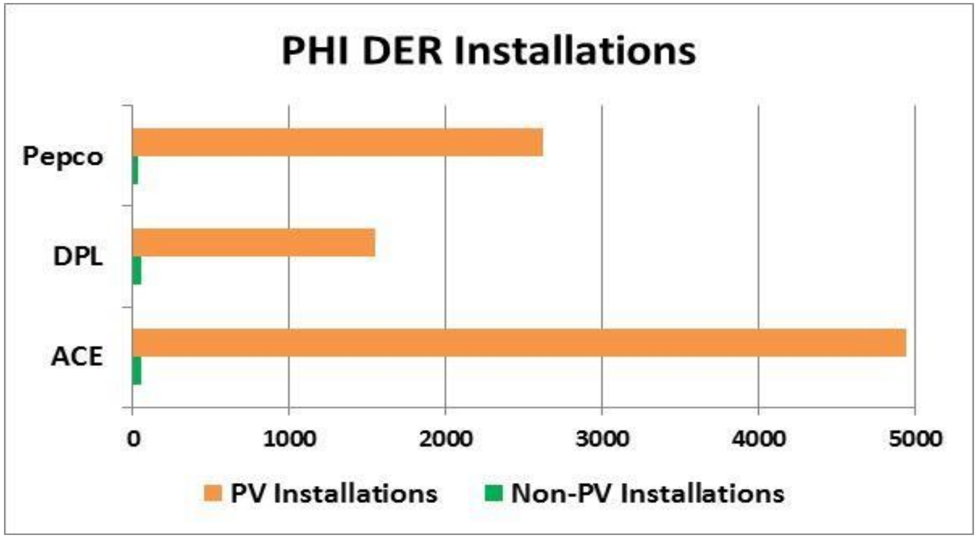
Fact: New Jersey is ranked third in the nation in PV installed capacity, first being California

Source: http://www.seia.org/research-resources/solar-industry-data



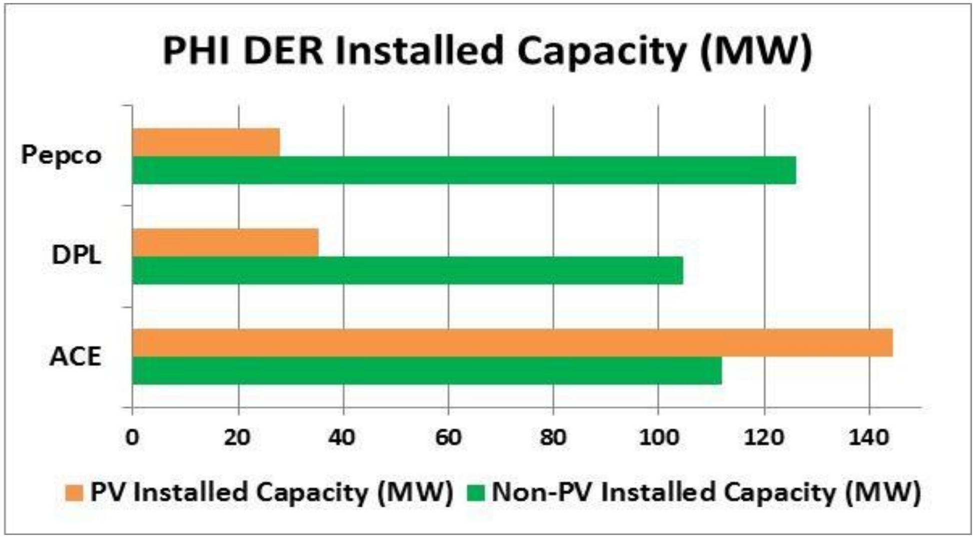
Note: Data for the graphs gathered from https://openpv.nrel.gov/search

PHI DER Installations and Capacity

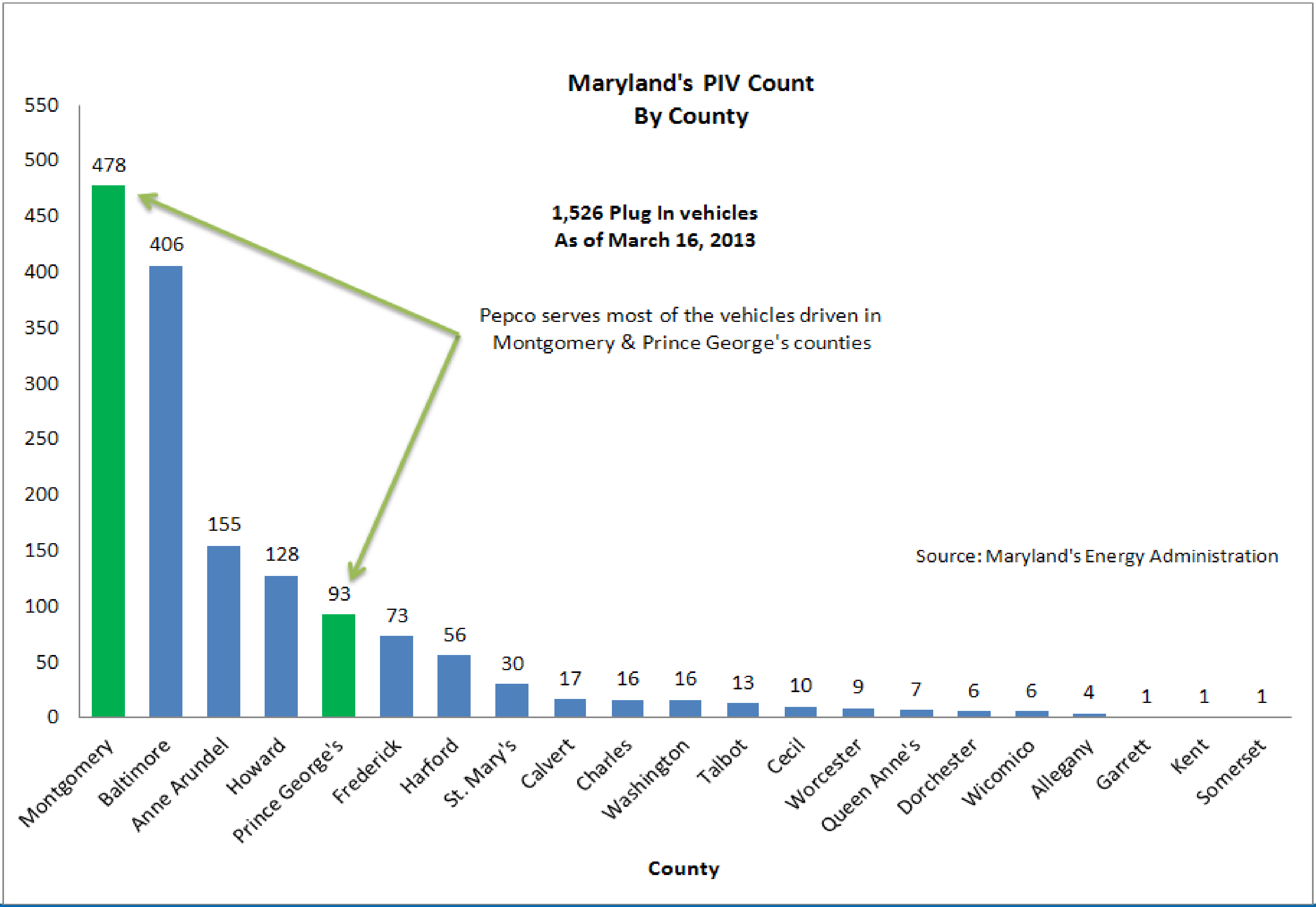


Fact: ACE is ranked 5th utility in the U.S. and 2nd in the Eastern region PV installed capacity (SEPA 2011)

Source: http://www.solarelectricpower.org/se pa-2011-utility-solar-rankings.aspx



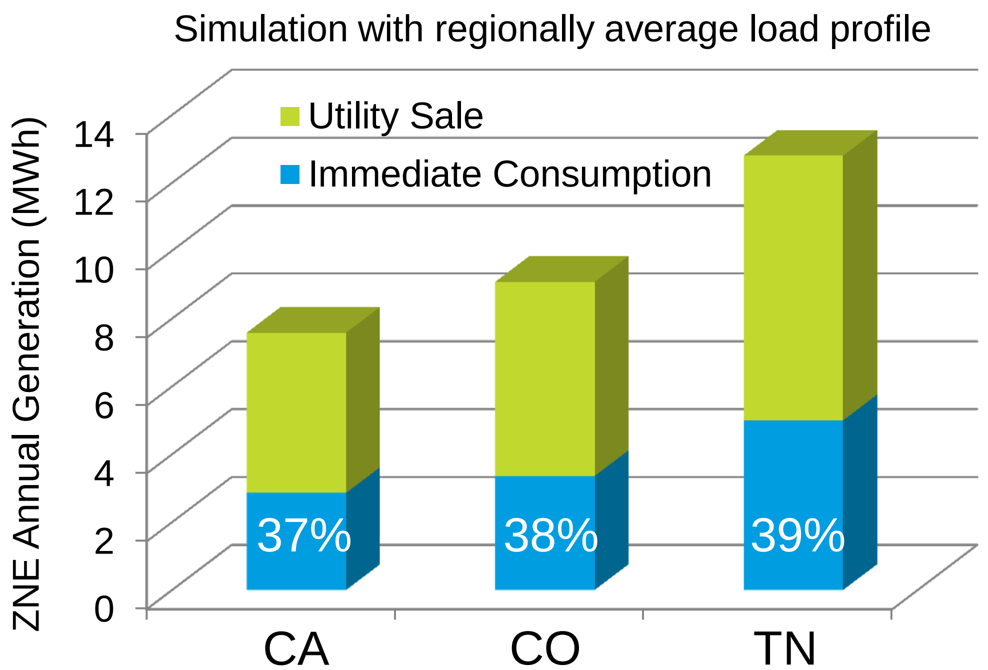
Plug-in-Vehicle Program - Maryland



Data on Electricity Consumption for ZNE Homes (with PV)

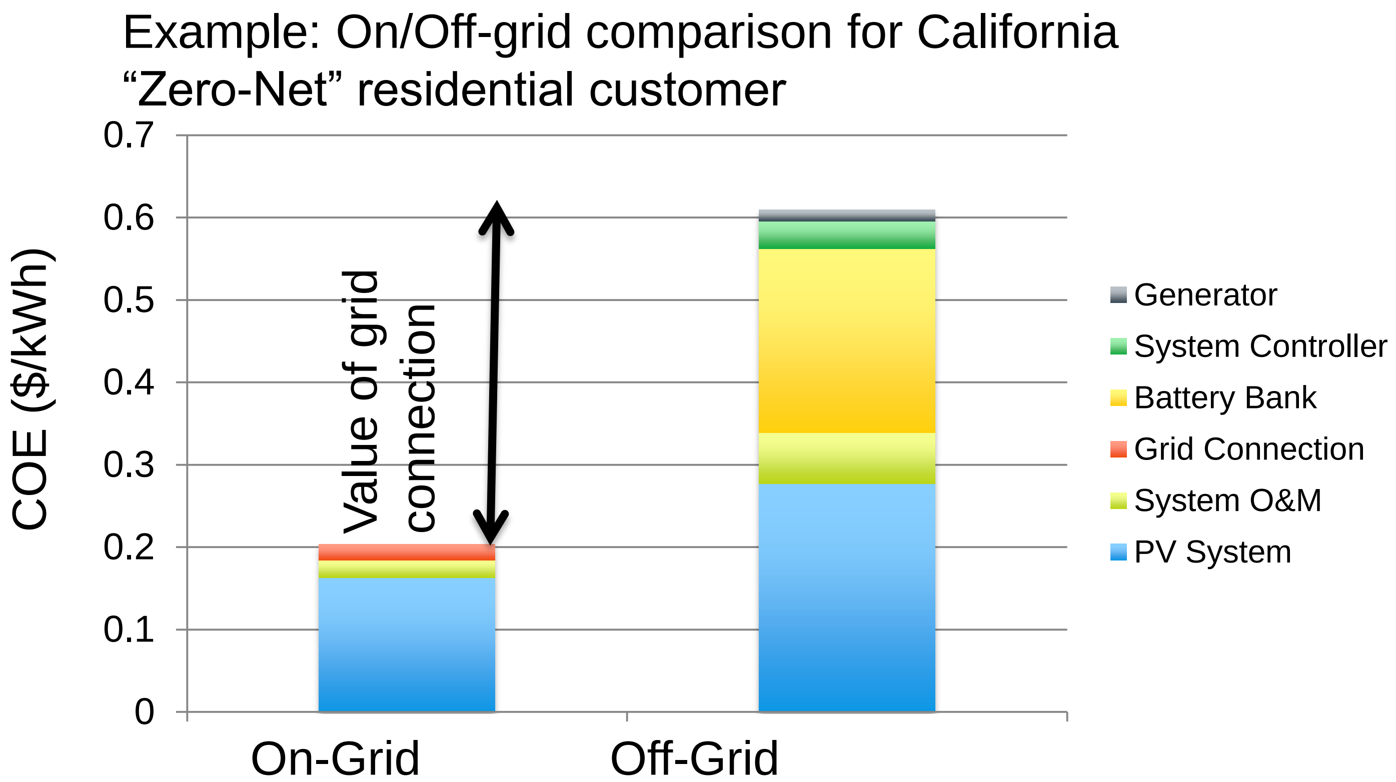
- Zero-net-energy (ZNE) is a measure of **annual** energy usage
- More than 60% of a ZNE home's PV energy pass through the utility connection

Utilization of Grid Connection by ZNE Homes



Source & Load Data: NREL

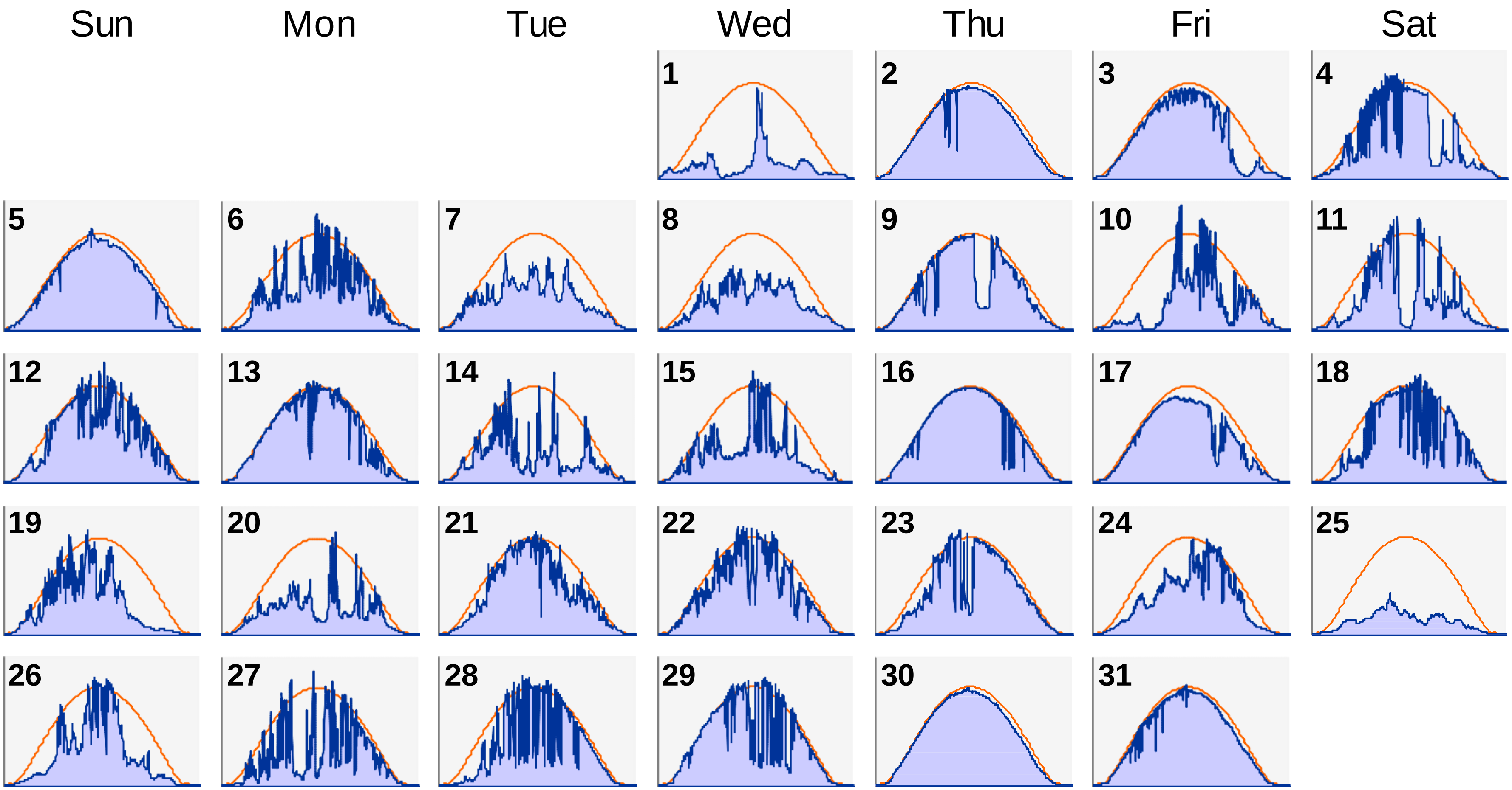
Modeling result for on and off grid costs….
Do customers understand what it costs to standalone?



1) *Net-energy-metered customer in PG&E service territory (Avg. Rate of $0.17/kWh)*
2) *Customer serves 100% of load from PV array (yearly-basis)*
3) *Analysis includes appropriate incentives (Federal ITC)*

Grid Delivers Balancing Resource

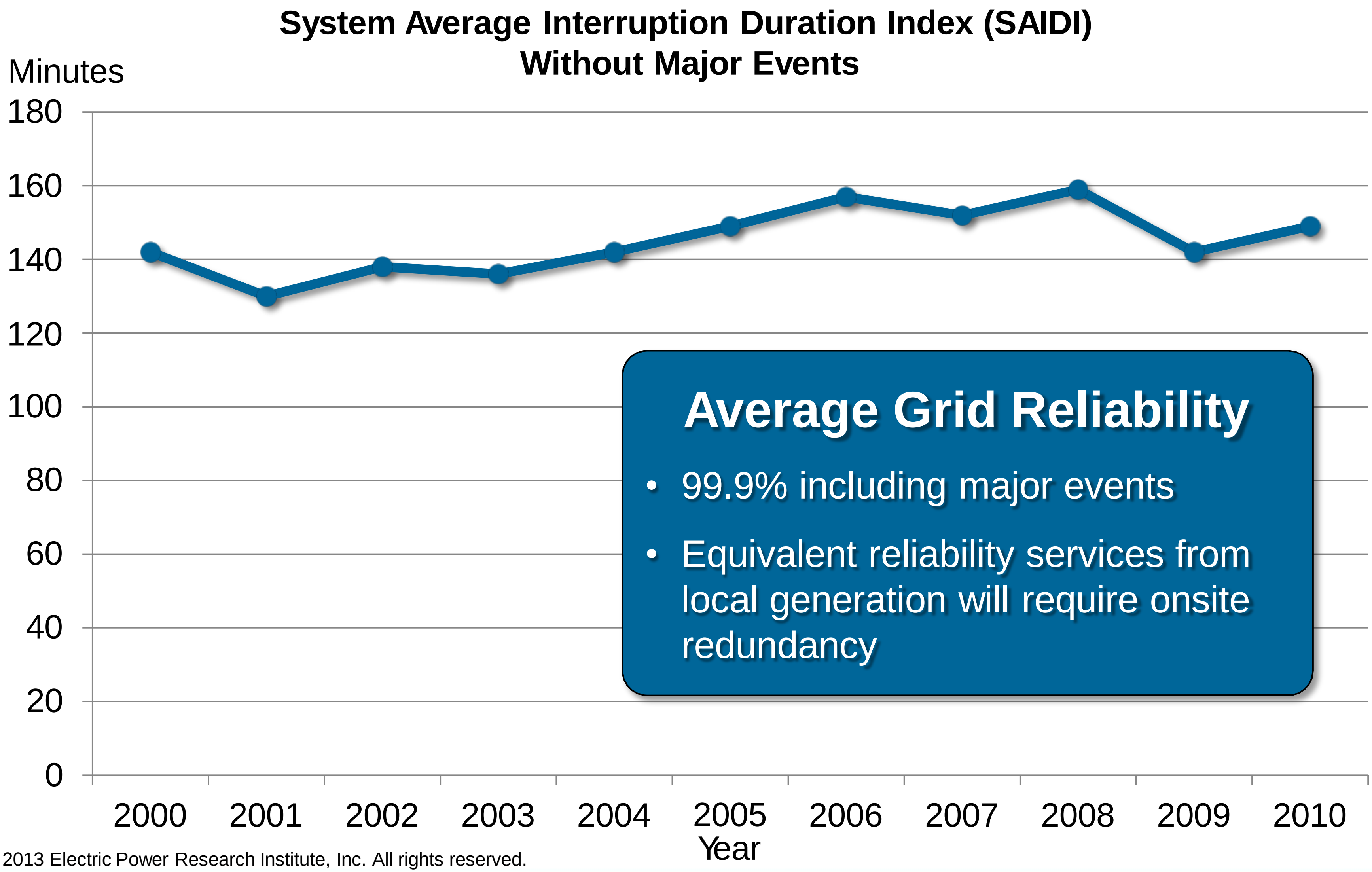
Solar resource calendar for August 2012 shows irradiance profiles in NJ



Blue area: measured irradiance

Orange line: calculated clear sky irradiance

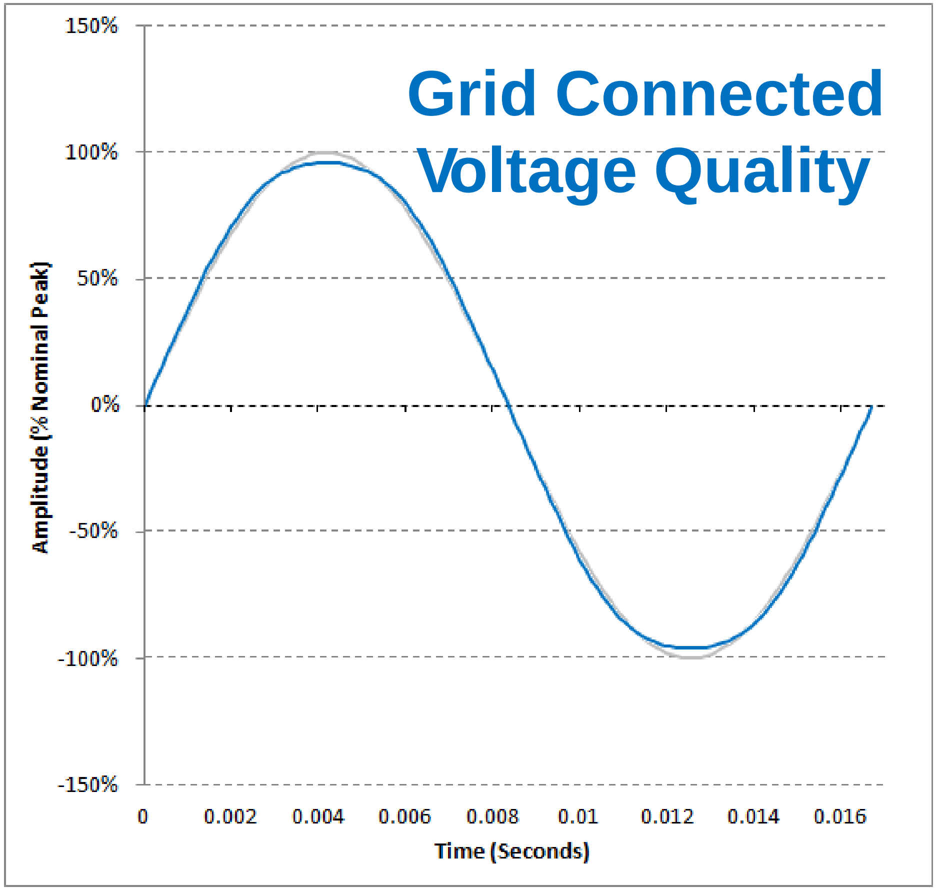
Grid Provides Reliability Service

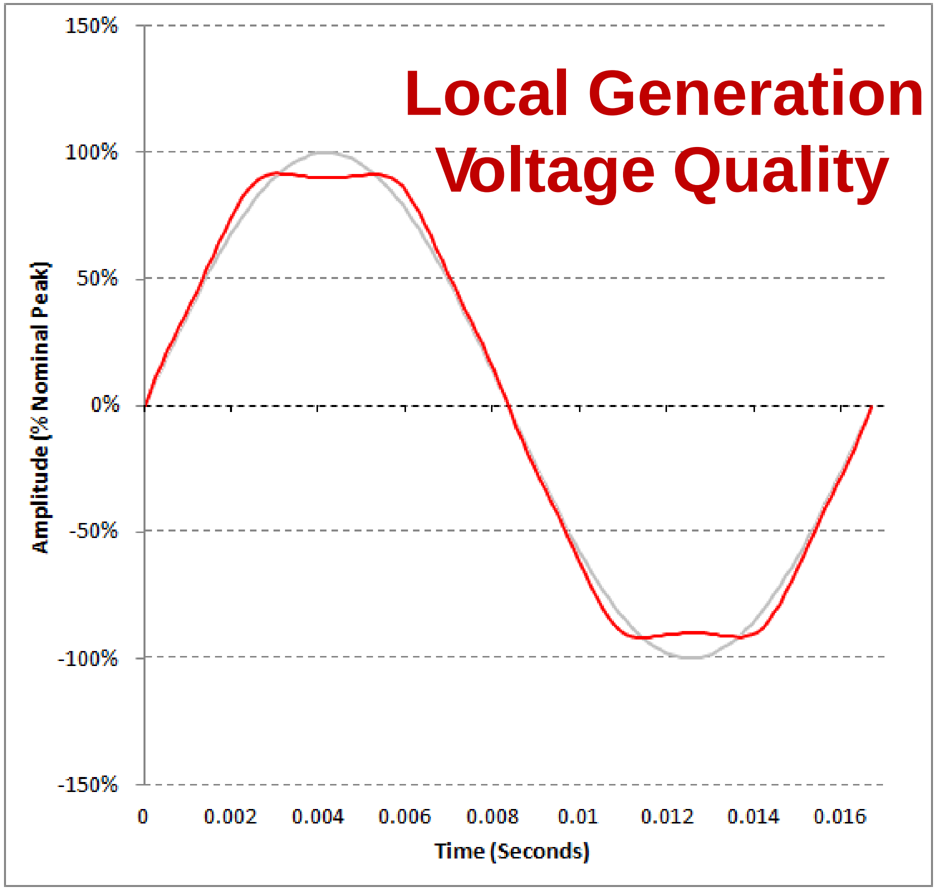


Average Grid Reliability

- 99.9% including major events
- Equivalent reliability services from local generation will require onsite redundancy

Grid Delivers Higher Quality Power

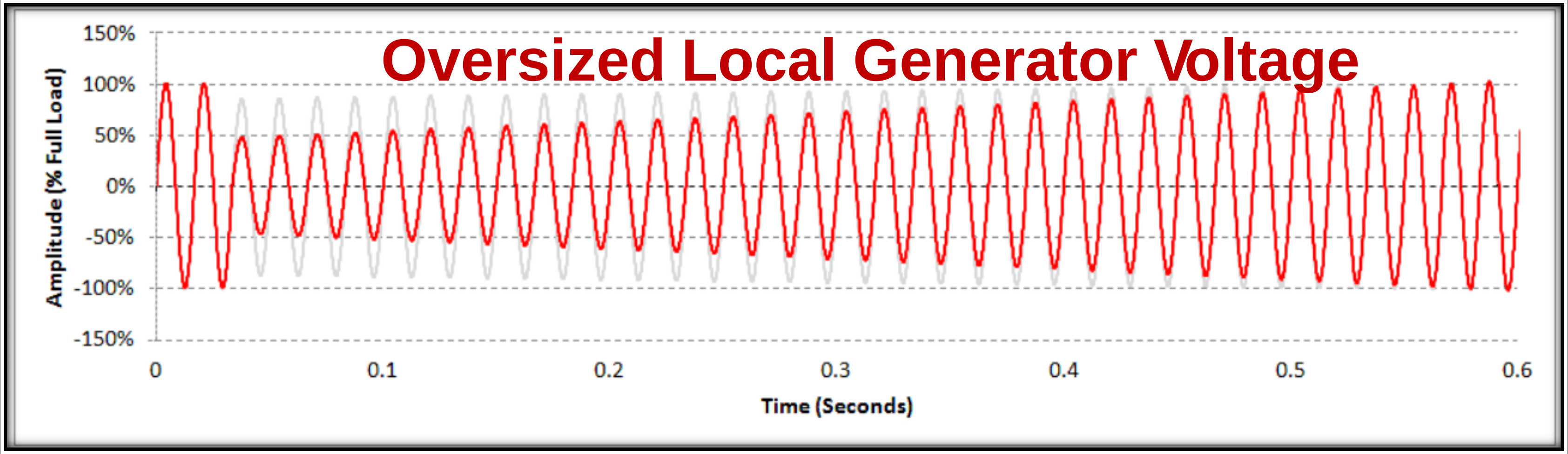


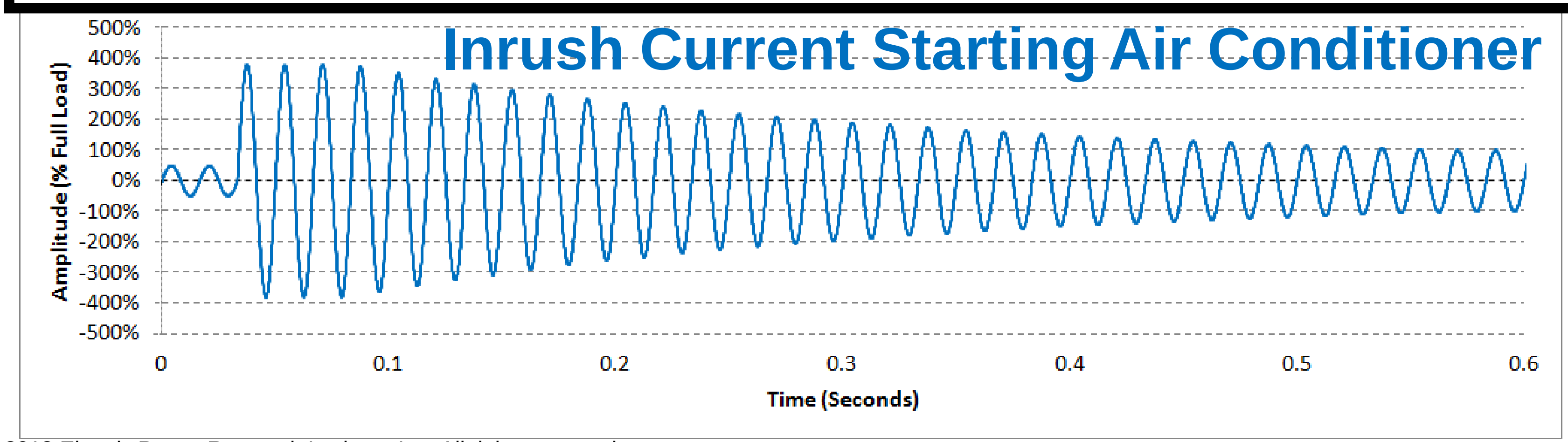


The grey line indicates the baseline for a sinusoidal wave with no harmonics

Grid Provides Start Up Service for Motors Loads

Grid Voltage to Support High Inrush Current





Value of Grid to Consumers: With Local Generation

Reliability	• Balancing and back-up resource • Cold-load pick-up following an interruption
Voltage Regulation	• Source to Start motor loads with high inrush current • Reactive power to maintain voltage within acceptable limit
Voltage Quality	• Higher power quality (less harmonics) to connected loads
Optimal Sizing	• Flexibility in sizing distributed generation irrespective to local load demand
Efficiency	• Operate local generation at an optimum power level for higher efficiency irrespective of load demand

Value of Grid Modernization to Enable High Penetration of Local Energy Resources

Reliability	• Reduce risk of grid instability due to sudden drop of large amount of local resources
Voltage Quality	• Enable better voltage regulation and flatter voltage profile
Resiliency	• Enabling consumers with local energy resources to be more resilient during power outages
Affordability	• Optimizing use of local and central resources • Higher utilization of grid assets • Incentive for local resources to provide grid services

Key Technologies for Grid Modernization

Smart Inverters	• Ability to provide additional functionalities such as voltage ride-through, frequency ride through, and volt and var support.
Distribution Management System	• Real time adaptive protection and control of distribution system and all connected local resources
Information and Communication Technology	• Robust telecommunication network • High speed data processing to enforce interconnection rules • Enhanced cyber security
Distributed Control Architecture	• Monitoring and control systems to communicate instructions to devices

Cost of Grid Modernization

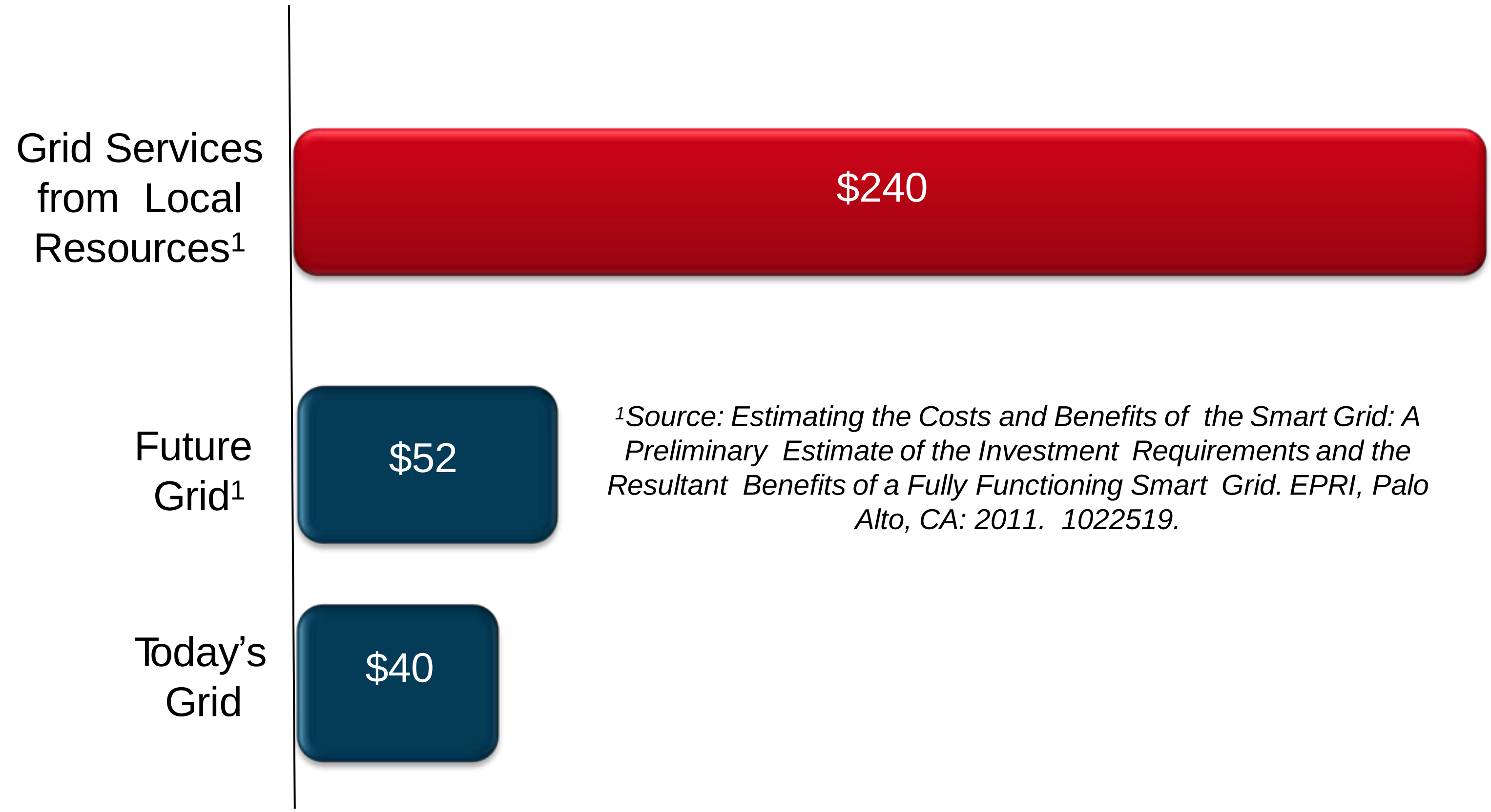
Reliability

Voltage Regulation

Voltage Quality

Optimal Sizing

Efficiency



[1]*Source: Estimating the Costs and Benefits of the Smart Grid: A Preliminary Estimate of the Investment Requirements and the Resultant Benefits of a Fully Functioning Smart Grid. EPRI, Palo Alto, CA: 2011. 1022519.*

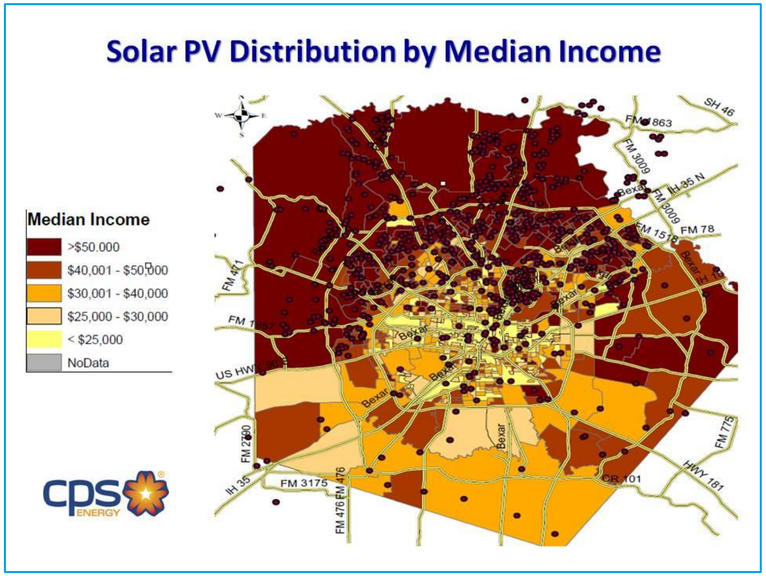
Grid Modernization Provides the Lowest Cost Approach for the Society

Non Technology Enablers for Grid Modernization

Interconnection Rules	Markets and Tariff Structure	Operation and Planning	Interoperability Standards
Enabling Local Resources to Provide Grid Support	Value non energy delivery related services from grid	New approaches to grid operations and system planning	Standard Language for Grid to Local Energy Resource Communication
Grid Visibility, Communication and Operational Flexibility of Local Resources	New Methods for measuring, creating, and capturing value	Least cost Distribution Design versus Design to Enable DG	Standard Set of Functions for Local Energy Resources to Provide Grid Support

Net Energy Metering: Core Challenges

- Cross Subsidization
  - Renters and urban dwellers have less access to DG
  - High income vs lower income disparity



PV systems in San Antonio largely installed by higher-income customers, leaving transmission and other costs to be borne by lower-income residents.

- Revenue erosion
  - DG customers offset their utility purchases – *reducing utility revenue but not utility costs*

Smart Inverters

Distribution Management System

Communications Technology

Distributed Control Architecture

Key Points to Consider

- The Grid does more than deliver electricity: it provides significant value to consumers with distributed generation
- Continued investments by utilities are necessary to enable increased penetration of DER
- Grid connectivity continues to be the least cost solution providing the public with reliable, high quality power
- Most interconnection rules are based on utility scale generation
- Rate structures need to be revisited to ensure an equitable distribution of the costs for the delivered service