

SolarCity Perspective: DER Market Integration

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Agenda

SolarCity Overview

SolarCity's Experience with DERs

Suggested DER Market Principles

Our Vision

Transform the way energy is delivered in the 21st century through cleaner, more affordable distributed solar energy



SolarCity Overview

- **The national leader in clean energy services**
 - Install 1 in 3 solar power systems
 - 190,000+ customers
 - 1.1+ GW deployed
 - Serving 17 states nationwide
- **9,000+ Employees**



U.S. AIR FORCE



Bayer HealthCare



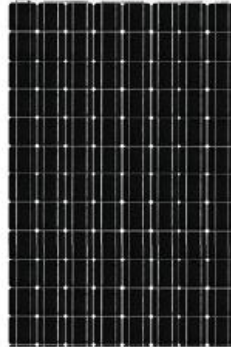
Intel



Technology Portfolio

Solar Modules

- High efficiency / low cost
- Triex tunneling junction cell design with a goal of 24% efficiency



Mounting hardware and Balance of System

- Faster installation, lower cycle time
- Superior aesthetics



Software

- System design automation
- Energy production forecasting
- Logistics and resource management
- Utility rate tariff database
- Energy usage evaluations
- Customer account management
- Customer applications



Grid Control Systems

- Real time energy monitoring
- Fleet control of solar systems for management of voltage, power quality, and remote diagnostics
- Peak load and solar intermittency management through integrated battery packs



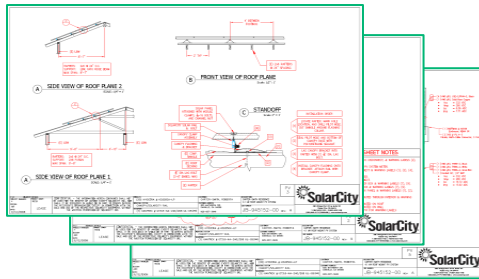
The SolarCity Advantage: Built to Scale



SOLARBID™

Lowers customer acquisition costs
Energy analysis and proposal generation

- Solar production model
- Utility rate database
- Accurately predicts savings



SOLARWORKS™

Enables massive throughput and lowers overhead expenses
Massively scalable project management

- Project Management
- Permitting
- Engineering
- Supply Chain
- Quality Assurance

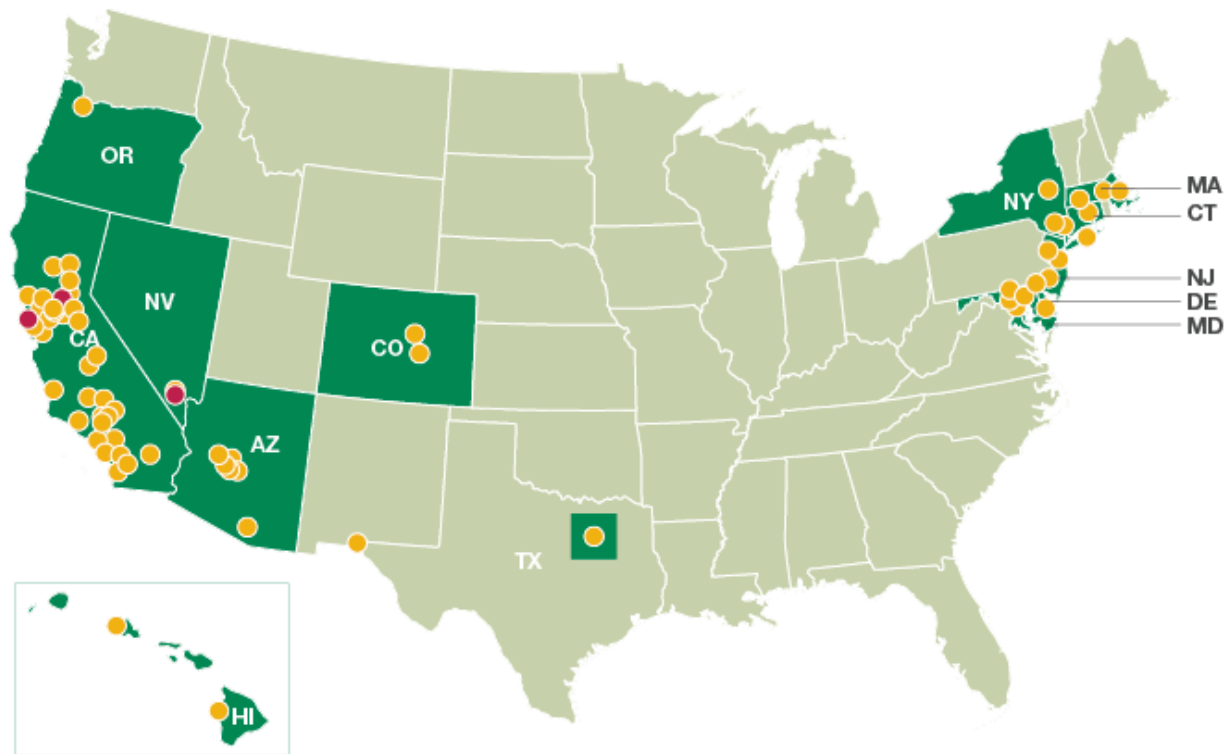


POWERGUIDE™

Ensures system production and continued customer engagement
Continual customer conversation

- Customer portal shows real-time production and integrates with social media platforms
- Platform to upsell additional services
- Monitors energy usage and solar production in real time
- Integrated with field service and billing

Locations & Regional Operations Centers



● Headquarters

● Regional Operations Centers

San Mateo, CA
Granite Bay, CA
Las Vegas, NV

Deer Valley, AZ
Dewey, AZ
Gilbert, AZ
Glendale, AZ
Mesa, AZ
Phoenix, AZ
Tucson, AZ (2)
Atwater Village, CA
Bakersfield, CA
Berkeley, CA

Camarillo, CA
Chatsworth, CA
Chico, CA
Hawthorne, CA
Escondido, CA
Foster City, CA
Fresno, CA
Lancaster, CA
Livermore, CA
Martinez, CA

Merced, CA
Milpitas, CA
Modesto, CA
Morgan Hill, CA
Murrieta, CA
Palm Springs, CA
Petaluma, CA
Rancho Cordova, CA
Riverside, CA
Sacramento, CA

San Diego, CA
San Luis Obispo, CA
Santa Ana, CA
San Francisco, CA
Stockton, CA
Ventura, CA
Victorville, CA
Visalia, CA
Yuba City, CA
Denver, CO

Parker, CO
Rocky Hill, CT
Newark, DE
Seaford, DE
Kona, HI
Mililani, HI
Springfield, MA
Marlborough, MA
Pembroke, MA
Wilmington, MA

Beltsville, MD
Clarksburg, MD
Baltimore County, MD
White Plains, MD
Blackwood, NJ
Cranbury, NJ
Henderson, NV
North Las Vegas, NV
Albany, NY
Elmsford, NY

Long Island, NY (2)
Orange County, NY
Portland, OR
Dallas, TX
El Paso, TX

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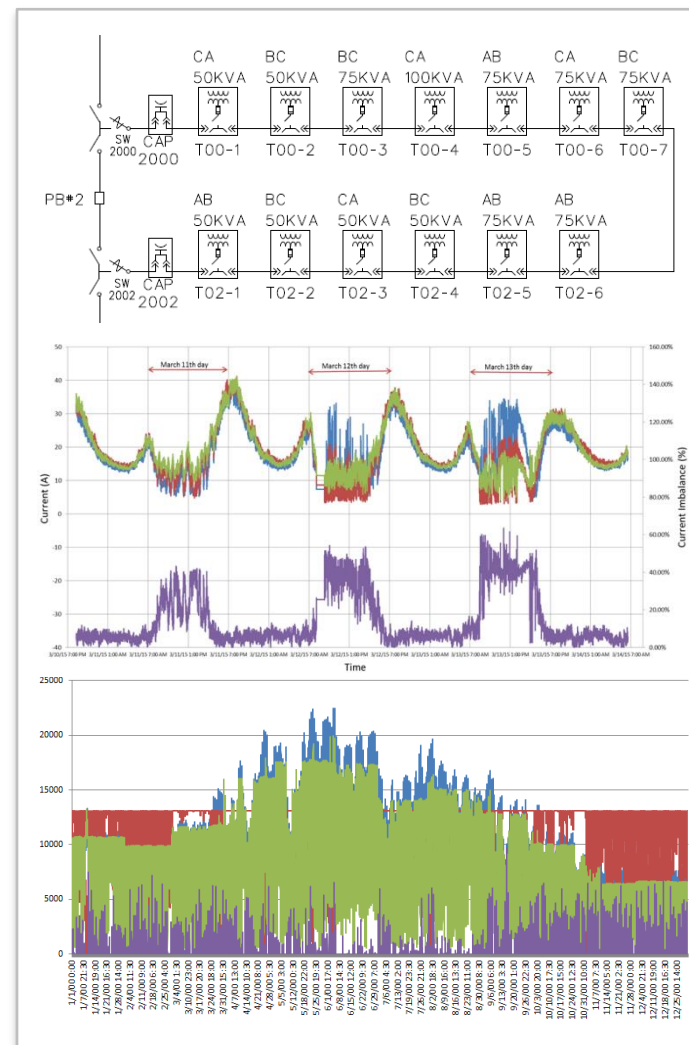
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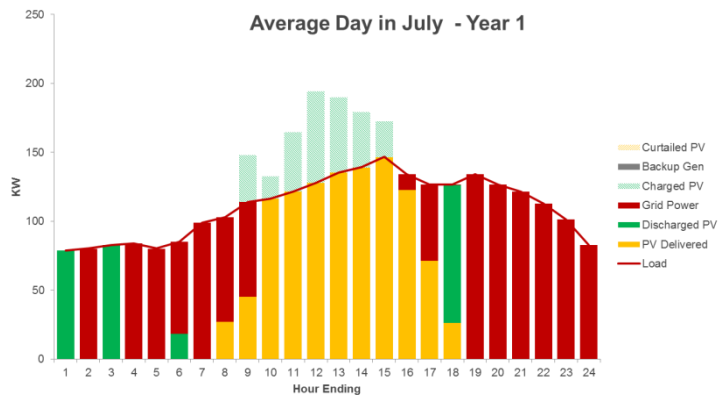
Grid Engineering Solutions

- **Dedicated grid engineering team**
 - Complex grid engineering and design, focused on distributed energy resource utilization
- **Collaborative design with utilities, coops, municipalities and campuses**
 - Deploy cutting-edge distributed solutions to meet energy and reliability goals
 - Leverage existing grid infrastructure and energy delivery portfolio
 - Design solutions to leverage distributed energy resources to support grid operational needs
- **Expertise**
 - Power systems engineering
 - Distribution grid planning and modeling
 - Asset optimization and aggregated fleet control
 - Optimized economic resource dispatch
 - Microgrid solution design

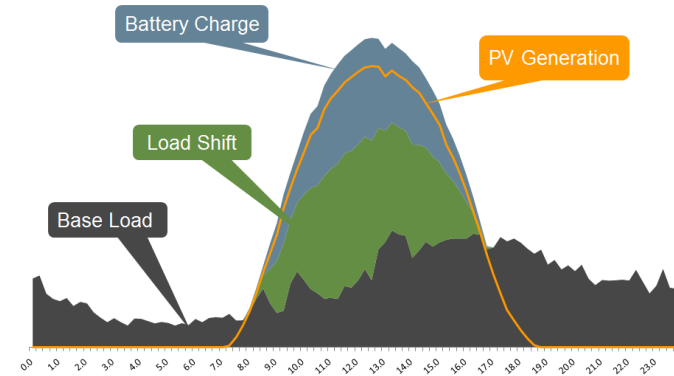


Grid Engineering Capabilities

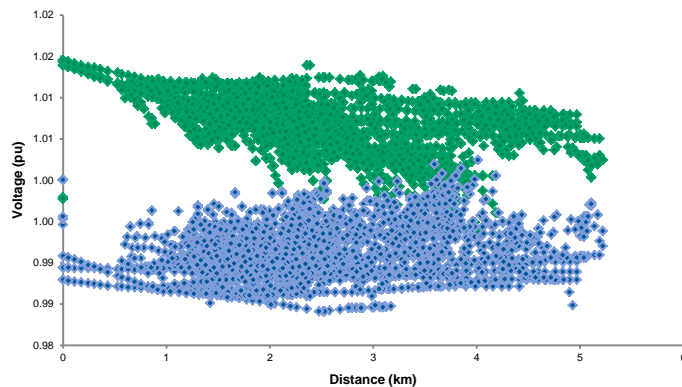
Microgrid Design



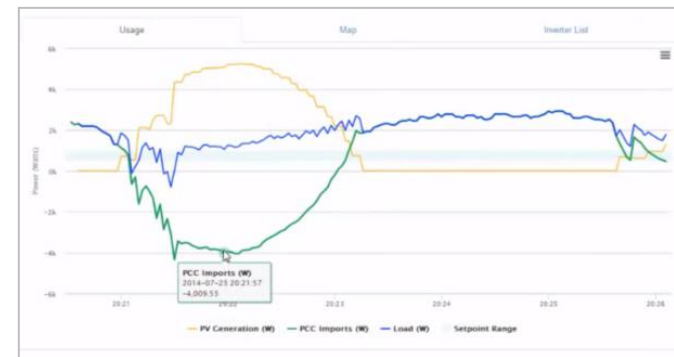
DER Aggregation



Volt/VAR Optimization



Reverse Power Management

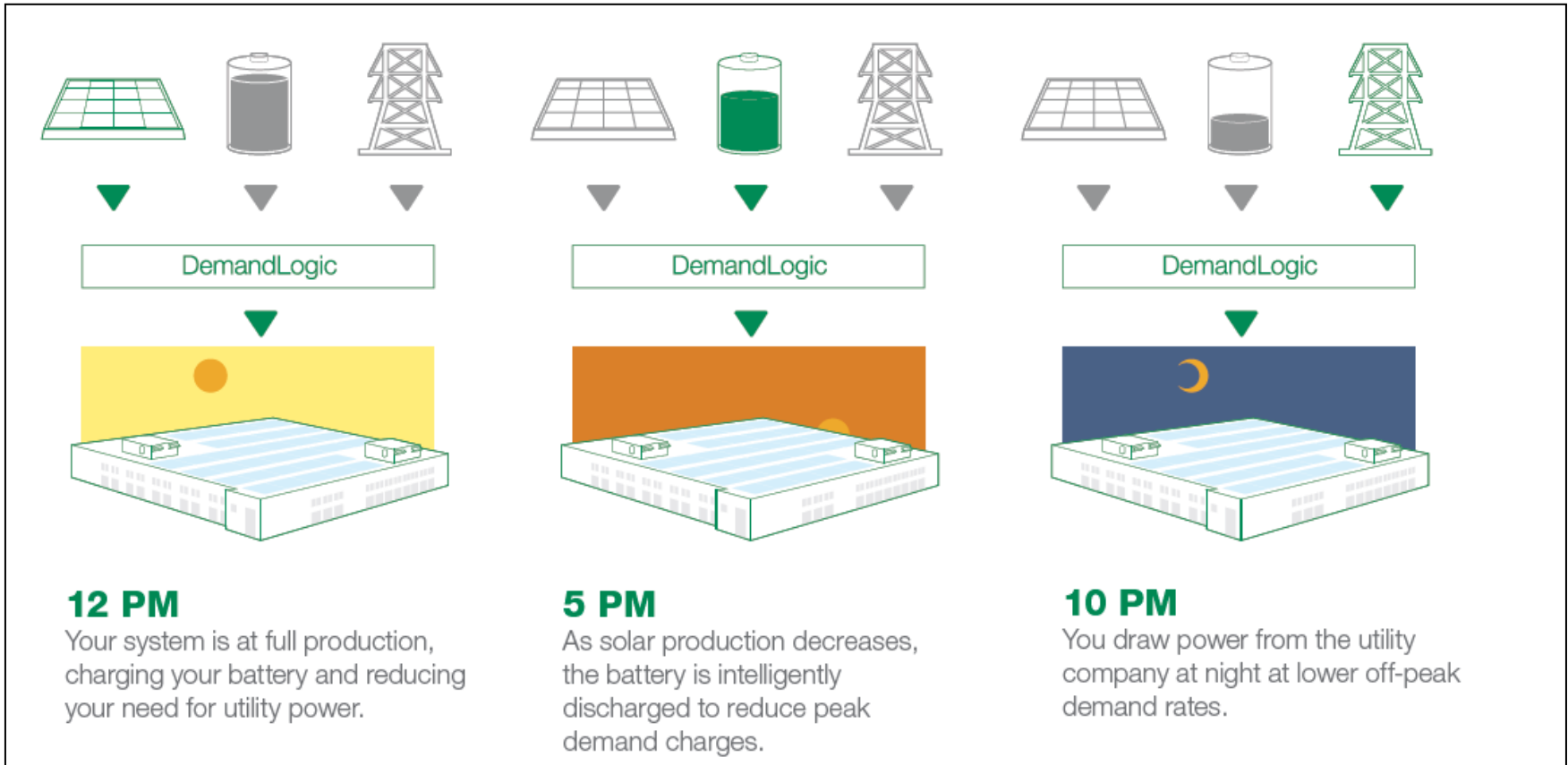


DemandLogic: PV + Battery Solution

Battery system installed in conjunction with new solar PV system

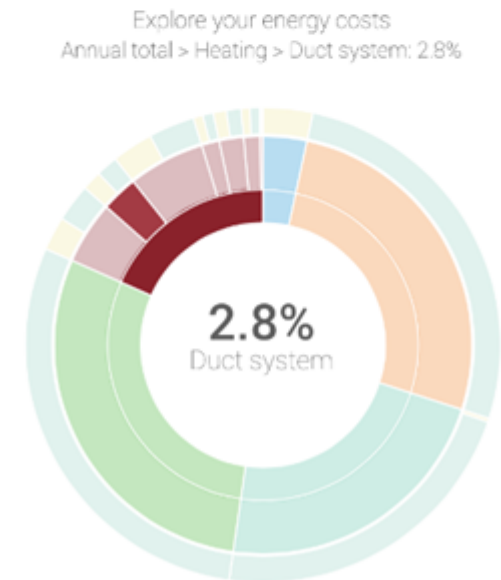
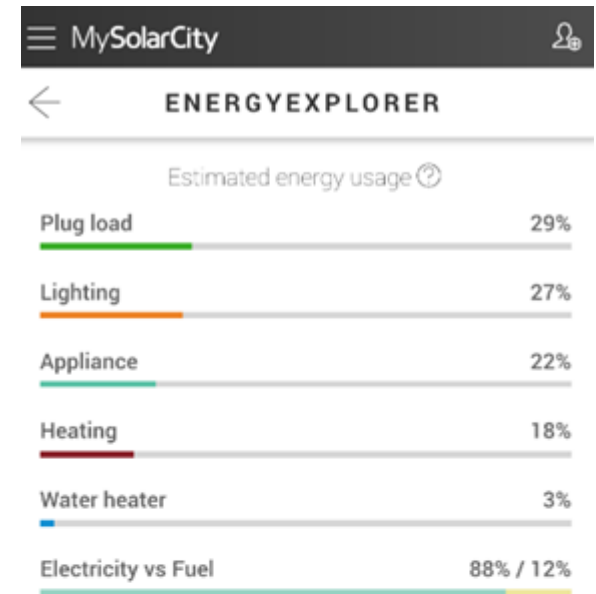
SolarCity finances the combined system at no upfront cost to customer

Customer saves on both energy (\$ / kWh) and demand (\$ / kW)

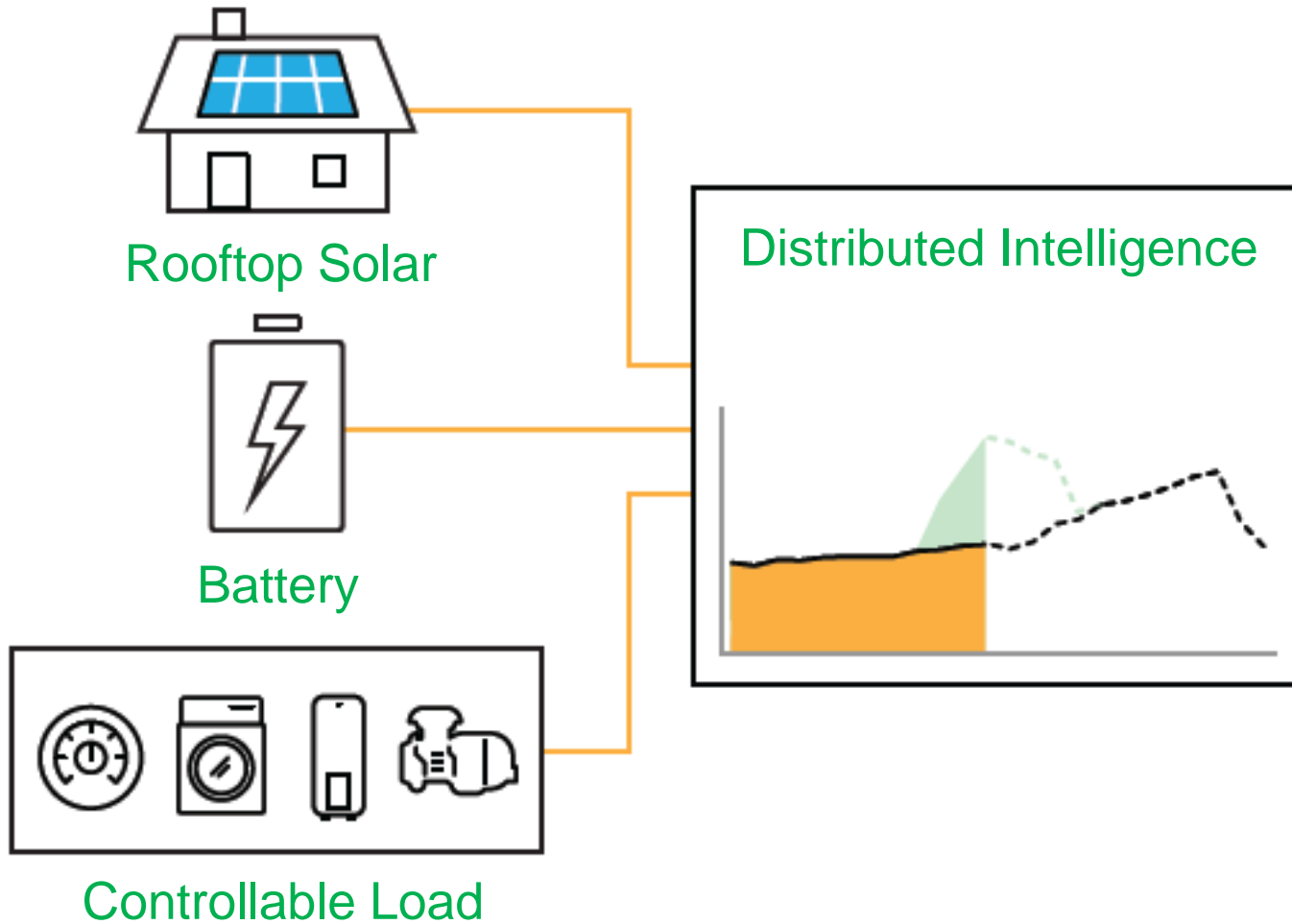


Load Management

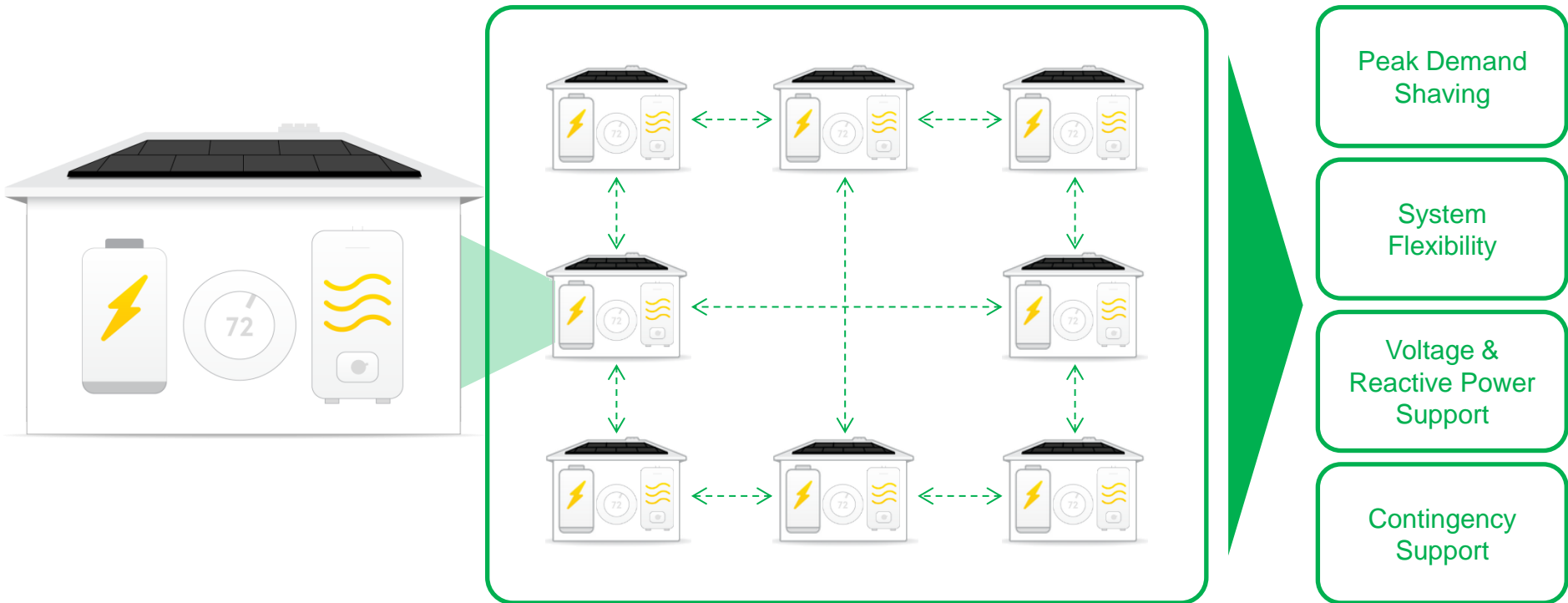
- We are transitioning our focus from Energy Efficiency to Load management and behavior modification
- Massive investments are being made in customer data access



Whole-Home Energy Optimization



DER Aggregation



A diverse portfolio assets across SolarCity homes can be aggregated into a single 'resource' capable of providing a variety of grid services.

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Overall DER Market Principles

- Delineate policy decisions from technical barriers
 - Craft policy frameworks to incent appropriate actions of DERs in the market
 - Address technical concerns after broad market design
 - Focus on the end-state ten years from now – expect significant market innovation
- Plan for multi-use DERs in the market
 - Product, technological, and data requirements of DERs must be structured with an expectation of multi-use DERs
 - DERs can – and should be – providing value to end-use customer, distribution system (operational services and infrastructure deferral), and wholesale market

Overall DER Market Principles Continued

- Market Design for DERs should be Technology-Neutral
 - Heterogeneous technology mix behind a DER aggregation should not matter if aggregation provides agreed upon product
 - PV + Storage + Load Control aggregations reduce market risk for participants

Plan for the possibility of large-scale DER deployment given rapid evolution of DER economics

Other DER Considerations (1/3)

- Use performance-based requirements at the aggregation level unless specific need at device level
 - “DER aggregations must be capable of 60 days storage of kWh data”
- Allow for different aggregation options (and settlement points) to give market providers commercial flexibility
 - A DER aggregation across a larger geographical regions could offer simpler grid products (e.g. energy)
 - Easy entry point for DER aggregators
 - More complicated grid products (e.g. regulation) may need to be aggregated within single LMP
 - More difficult to group customers into aggregation

Other DER Considerations Continued (2/3)

- Require only the relevant data needed for the market product offered by the DER aggregation
 - “DERs must be capable of 60 days storage of kVARh if offering reactive power as a market product.”
- Design data requirements with expectations of technological innovation
 - Base requirements on generalized industry standards
 - “Calibration requirements should be consistent with the industry standard ANSI C12.20 accuracy interval meters”
 - Expect inventive data, metering, and validation solutions
 - For example, it may be more economical and technically feasible to measure load at the utility-owned meter while measuring generation through a separate DER-owned revenue grade meter

Other DER Considerations Continued (3/3)

- Consider economic and engineering realities of end-use customer interconnections vs. traditional interconnections
 - “DER devices must match the appropriate phase of service (e.g. single phase or split phase) at the point of interconnection”
- Data validation should be considered in the context of use cases and technology
 - For example, solar PV + storage systems are likely to share an inverter to minimize system costs with one point of alternating current (AC) output, requiring innovative solutions to calculate the share of AC power coming from each device

SolarCity

Thank you.