The Right Combination: Solar, Storage, and Demand Response

- Feb. 25, 2021:
  - DOE/SI will present an overview of SETO systems integration challenges and vision
  - Fraunhofer will discuss their centralized scheduling solution to optimize utility-scale PV generation, storage, DR around commercial and industrial flexible loads, and granular load forecasting
  - Extensible Energy will present their building energy management solution around optimized on-site solar, storage and flexible loads
- Feb. 26, 2021:
  - SI Technology Manager for Austin Energy's SHINES project will discuss their distributed energy resource management platform that can adapt to any region and market structure
  - EPRI team will present their work with five utilities to create technology that integrates storage and load management with PV generation on the grid
  - Hawaiian Electric team will present their demonstration of the system-level benefits of greater utility visibility and control of the distribution system

U.S. DEPARTMENT OF ENERGY | Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

SOLAR ENERGY TECHNOLOGIES OFFICE

Austin Sustainable and Holistic INtegration of Energy Storage and Solar PV (Austin SHINES)

Panel Presentation for SETO SI: The Right Combination: Solar, Storage, and Demand Response

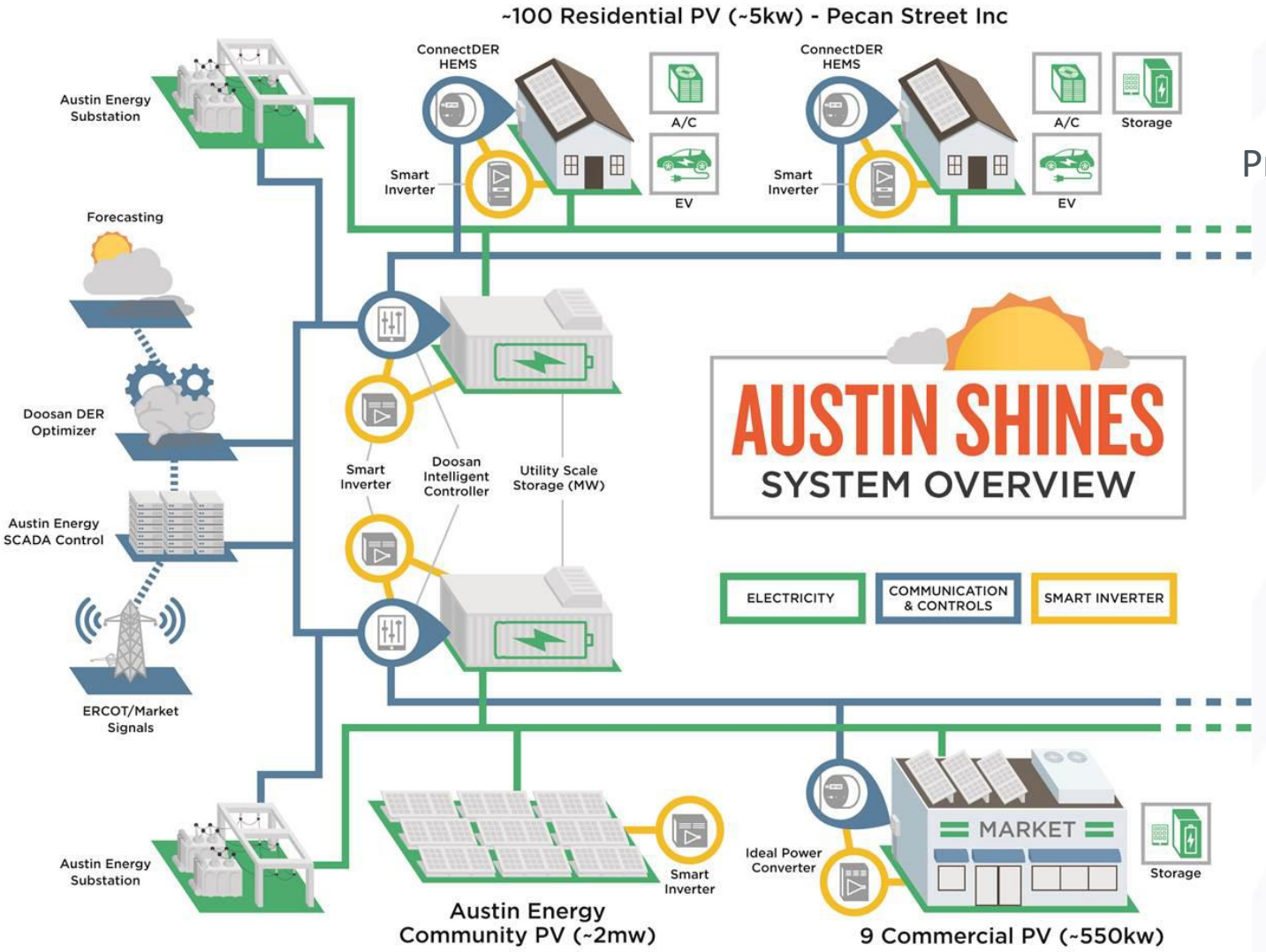
February 26, 2021

Jeremiah Miller, DOE Technology Manager overseeing Austin SHINES

Disclaimers

- The presentation and associated discussion are my personal thoughts and ideas.
- These views are not represented as those of the U.S. Government or DOE.
- They are likewise not represented as those of Austin SHINES, or Austin Energy, or the City of Austin.
- Personal thoughts and ideas only from being the DOE Technology Manager overseeing the Austin SHINES project!

Austin SHINES Conceptual Overview



Project Website:

https://austinenergy.com/ae/green-power/austin-shines/austin-shines-innovations-energy-storage

Project Videos:

https://youtu.be/ijj6-ua-8bs

https://youtu.be/P_d0x8uG6kE

AUSTIN SHINES

UTILITY SCALE

2.5 MW Community Solar Farm

1.5 MW / 3 MWh Li-Ion Battery Storage

1.5 MW / 2.5 MWh Li-Ion Battery Storage

COMMERCIAL SCALE

Aggregated storage installations at three sites:

One 18 kW / 36 kWh Li-Ion Battery Storage installation

Two 72 kW / 144 kWh Li-Ion Battery Storage installations

All sites have existing solar (300+ kW)

RESIDENTIAL SCALE

Aggregated storage installations at six homes (10 kWh each)

Each with existing rooftop solar

Utility-Controlled Solar via Smart Inverters at twelve homes

Autonomously Controlled Smart Inverters at six homes

DER MANAGEMENT SYSTEM

Fleet-wide controller at T&D control center & energy market desk

Circuit manager for certain applications like voltage control

Site-level controller or aggregator for each installation

Inputs include grid data, market data and forecasts

Grid Scale Installations

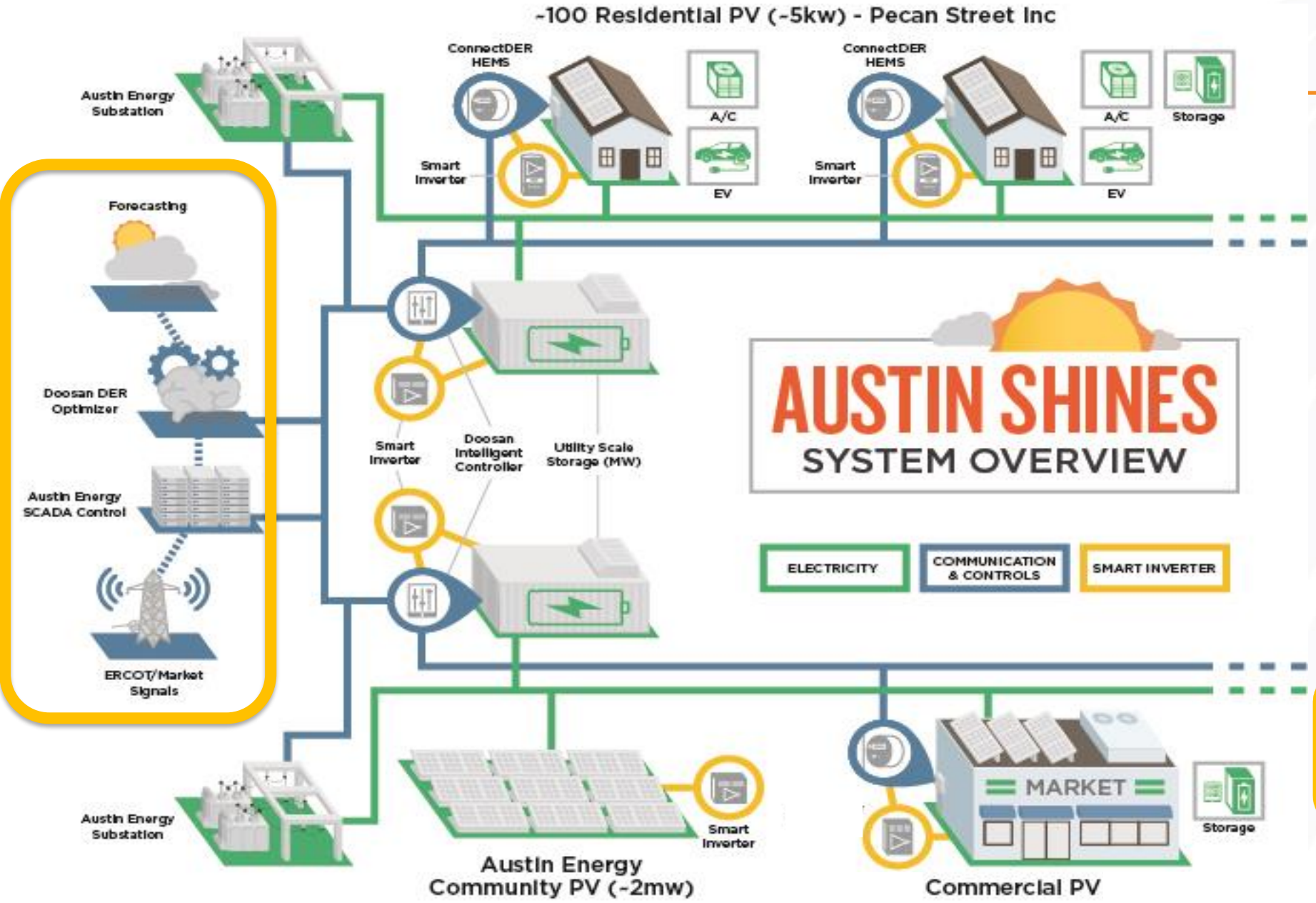
Commercial & Residential Installations

Key SHINES Technology Principles

1. Holistic consideration of all resources
   - Regardless of type, age, ownership, side of meter
2. Digital and distributed decision-making
3. Open-standards are critical for scalability
4. Blended and complimentary technical and economic objectives

5. Key principle:

Energy storage must be considered holistically within the full utility environment



Utility Scale Energy Storage + PV

Commercial Energy Storage + PV

Residential Energy Storage + PV

DER Management System

Energy Storage and DER Integration Solutions

DESIGN

- System site, size, and chemistry modeling
- Control applications development and optimization
- Economic feasibility analysis

CONTROL SOFTWARE

For the fleet:

Doosan GridTech Distributed Energy Resource Optimizer™ (DG-DERO™)

For each asset:

Doosan GridTech Intelligent Controller™ (DG-IC™)

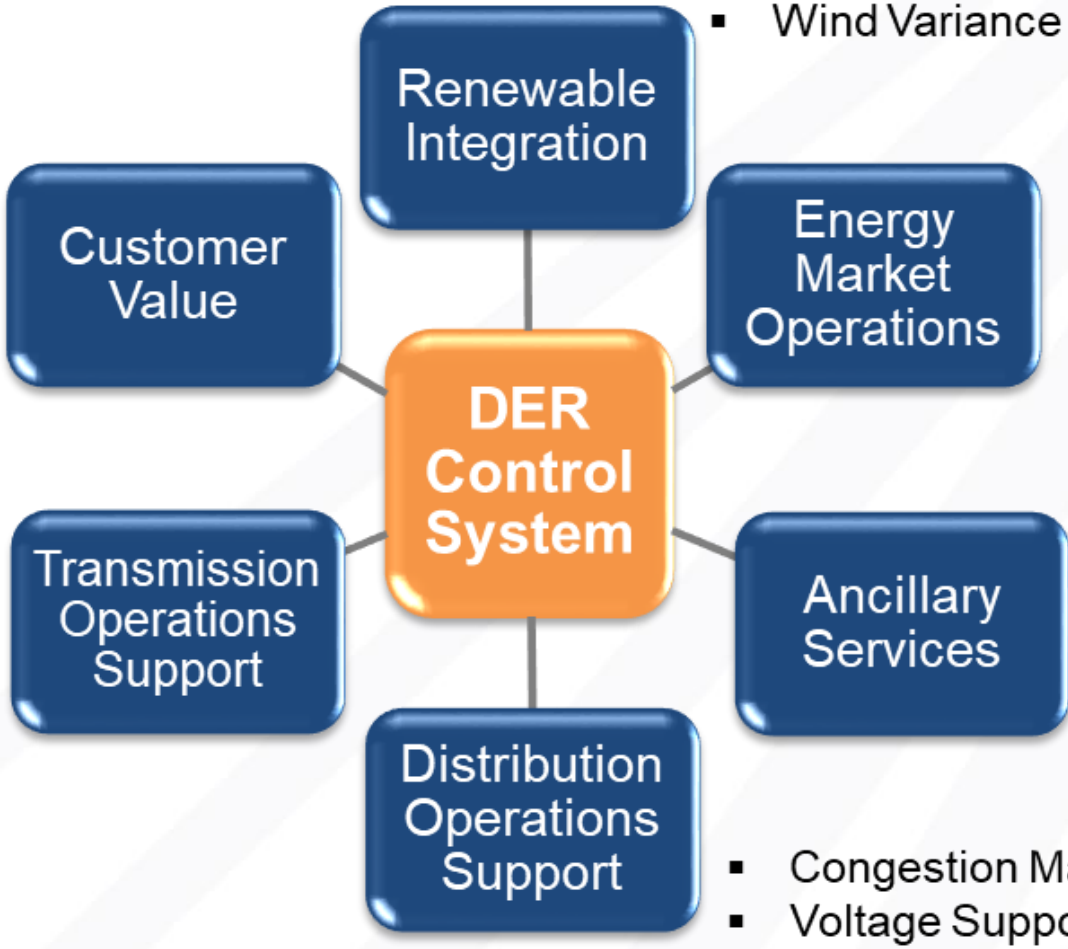
DEPLOYMENT

- Turnkey/ Engineering, Procurement, and Construction (EPC)
- Systems Integration
- Maintenance and support

DOOSAN

Doosan GridTech™

DER Value Propositions



- Solar Variance
- Wind Variance

- Demand Charge Reduction
- Back-up Power
- Time of Use

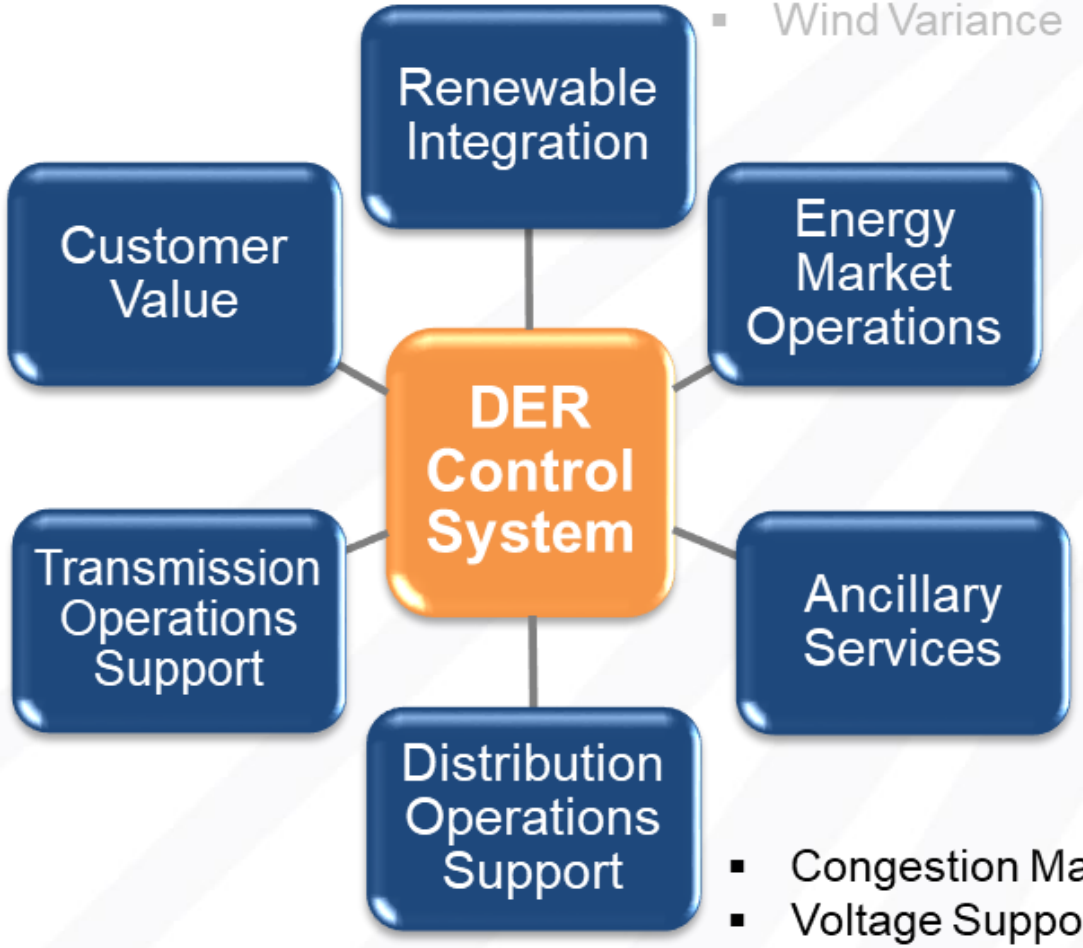
- Peak Load Reduction (4-CP)
- Day-Ahead Energy Arbitrage
- Real-Time Price Dispatch

- Voltage Support for Transmission
- Peak Loss Avoidance
- Transmission Constraint Avoidance

- Fast Frequency Response
- Emergency Response Service
- Regulation Up/Down

- Congestion Management
- Voltage Support
- Harmonics
- Loss Avoidance
- Power Factor Correction

DERO Applications



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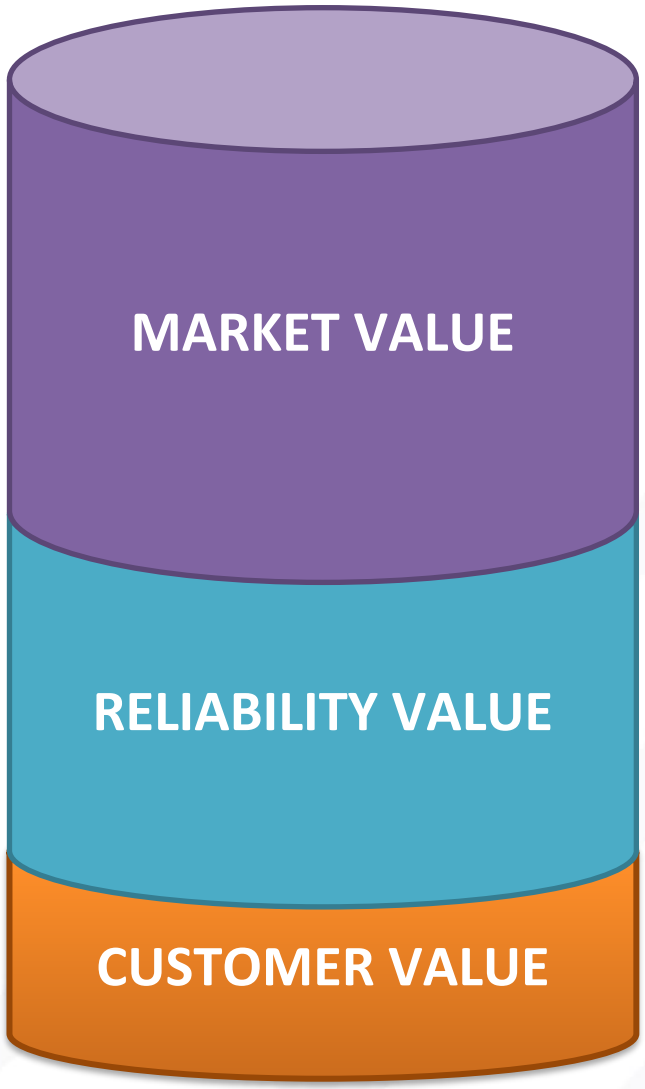
DER Value Stacking

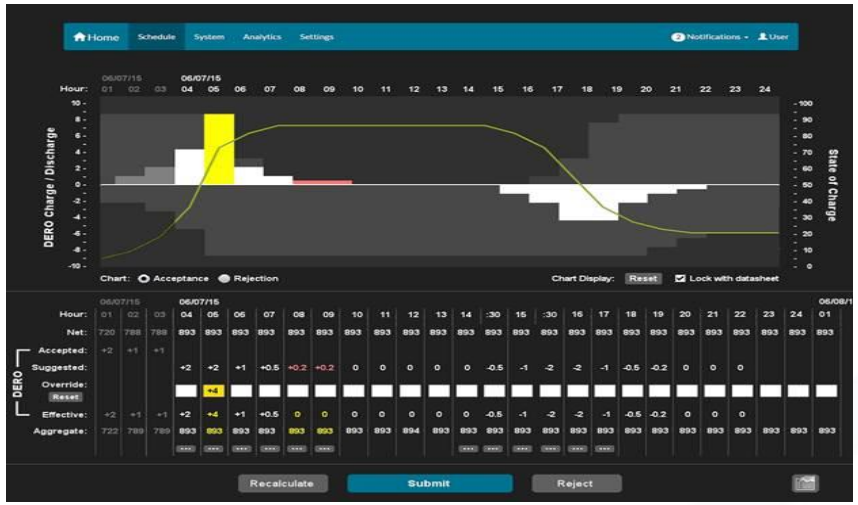


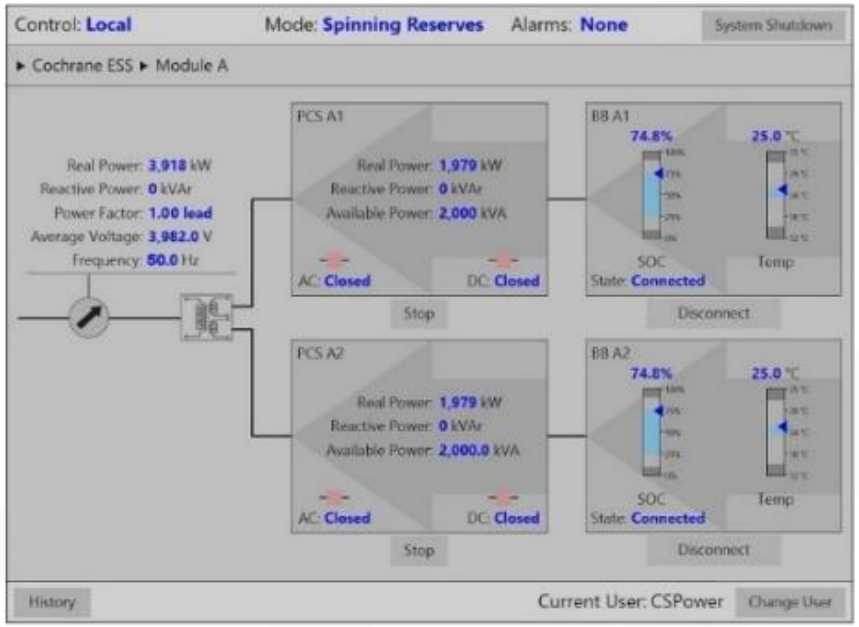
	Application	Benefit
MARKET	Utility Peak Load Reduction	Lower TCOS obligation
MARKET	Day-Ahead Energy Arbitrage	Price differences create economic value
MARKET	Real-Time Price Dispatch	Economic value from real-time price spikes
RELIABILITY	Voltage Support	Reduce losses and increase PV generation
RELIABILITY	Distribution Congestion Management	Increase local grid reliability
CUST	Demand Charge Reduction	Customer and system benefit

SHINES Assets and DERO Application Matrix

	DERO Application (application benefit)	Kingsbery ESS (grid-scale)	Mueller ESS (grid-scale)	Agg ESS (commercial)	Agg. ESS (residential)	Solar PV (residential)
MARKET	Utility Peak Load Reduction (Lower transmission cost obligation)			☀	☀	
MARKET	Day-Ahead Energy Arbitrage (Realize economic value through price differential)	☀	☀	☀	☀	
MARKET	Real-Time Price Dispatch (Realize economic value from real-time price spikes)	☀	☀	☀	☀	
RELIABILITY	Voltage Support (Reduce losses and increase solar generation)	☀	☀		☀	☀
RELIABILITY	Distribution Congestion Management (Increase local grid reliability)	☀	☀		☀	
CUST	Demand Charge Reduction (Lower customer bills and realize system benefit)			☀		

Layered Intelligence Example: at ESS and in Ops Center





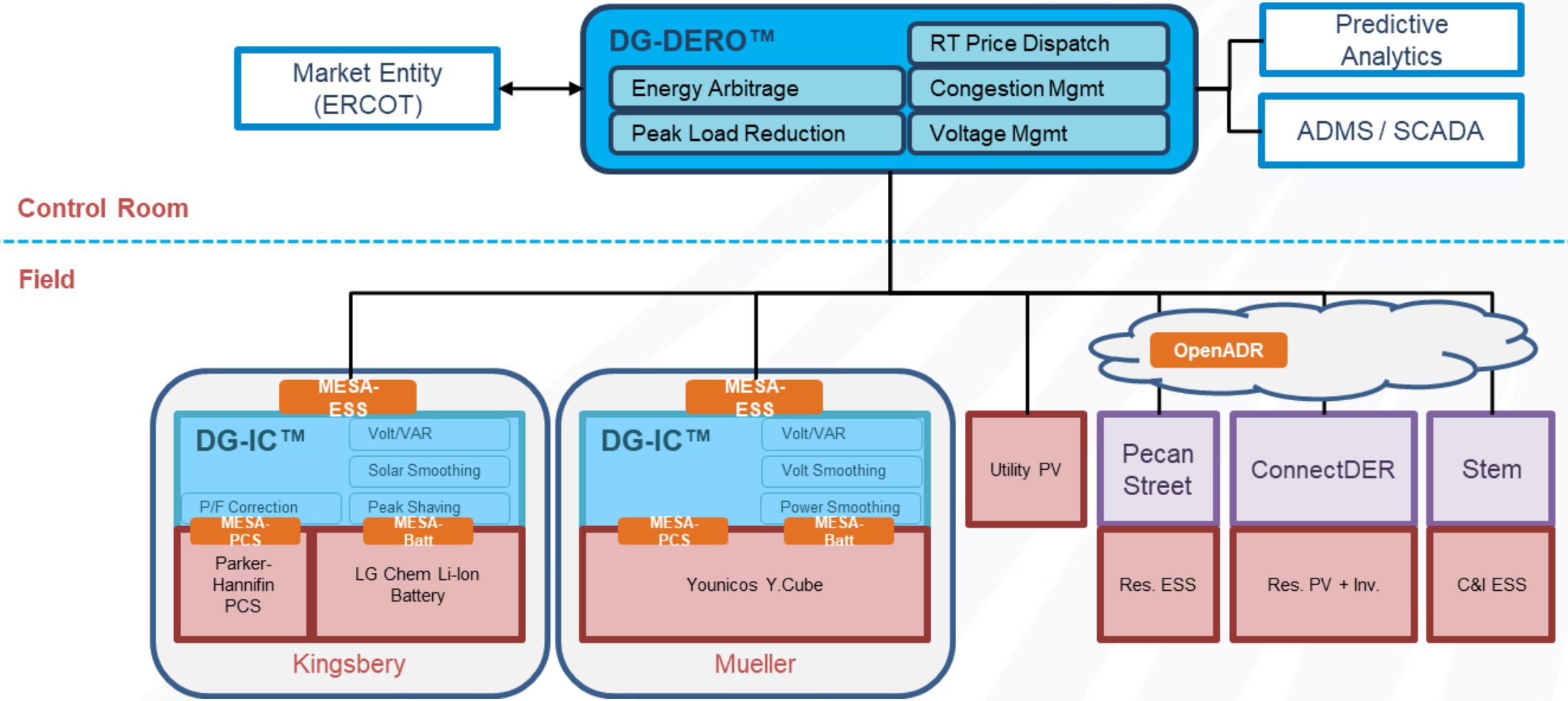
Distributed Energy Resource Optimizer (DERO™)

- One per fleet, located in Control Center
- Interacts with operational and market-based platforms
- Executes and optimizes multiple fleet level ESS applications

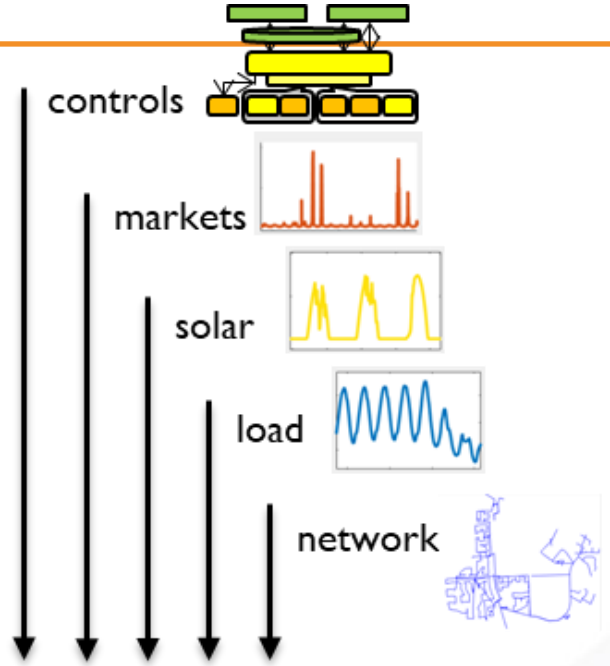
Intelligent Controller (DG-IC™)

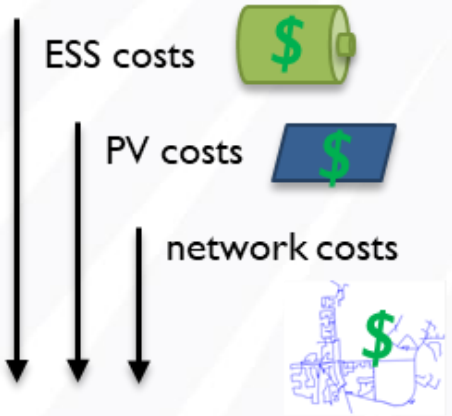
- One per ESS, located at ESS site
- Executes local, autonomous operating modes based on local sensors
- Provides standard MESA interface to all ESS's regardless of battery type/manufacturer

Optimized Autonomous + Local + Centralized logic



Framework for modeling and SLCOE calculations





GridLAB-D™

- Circuit analysis
- Controls
  - Tradeoffs between bulk and local applications

MATLAB

- Data processing
- Key performance indicators
- Visualization

Excel

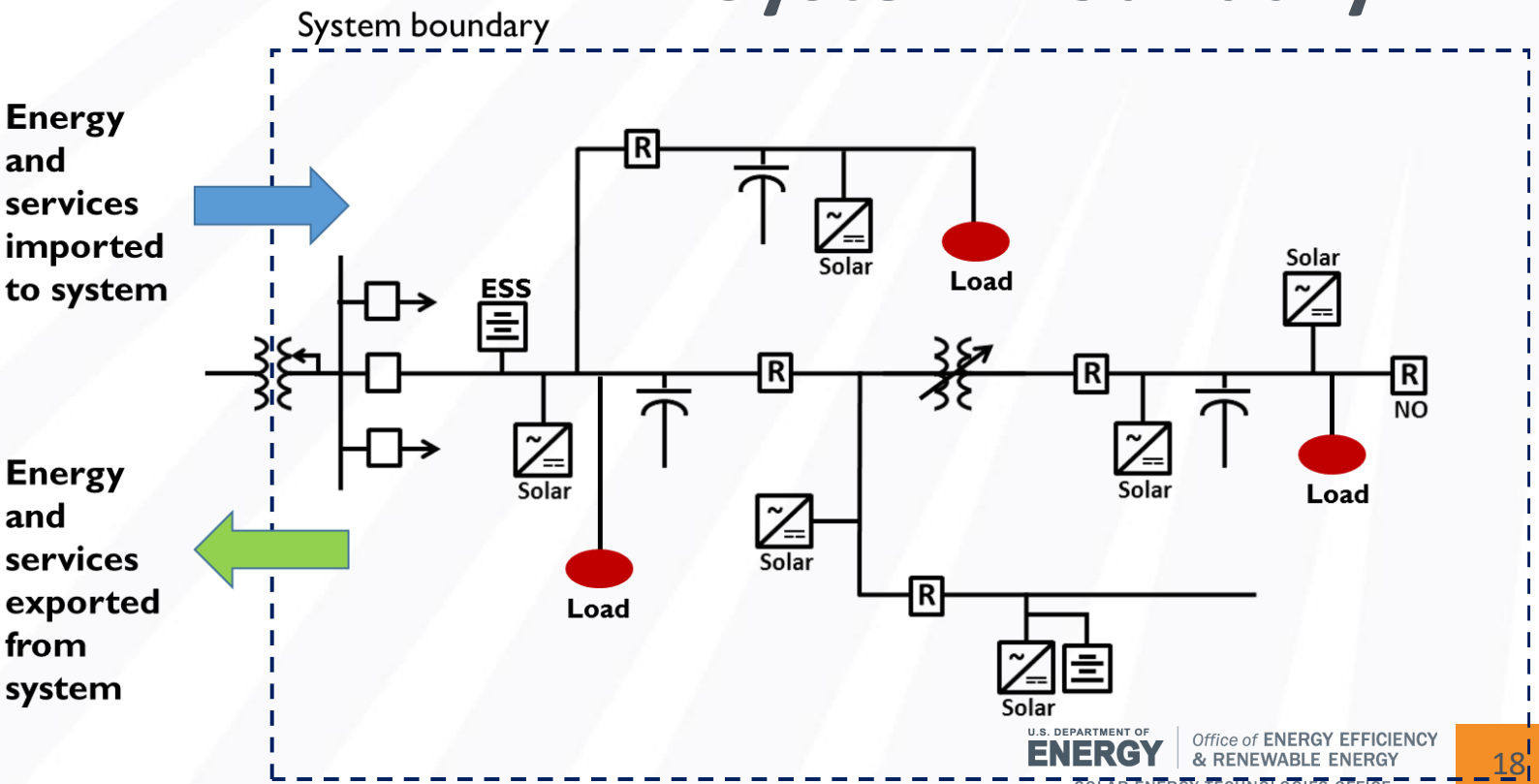
- Economic calculations
- Synthesis and comparisons

Measuring Holistic Value of DER Controls

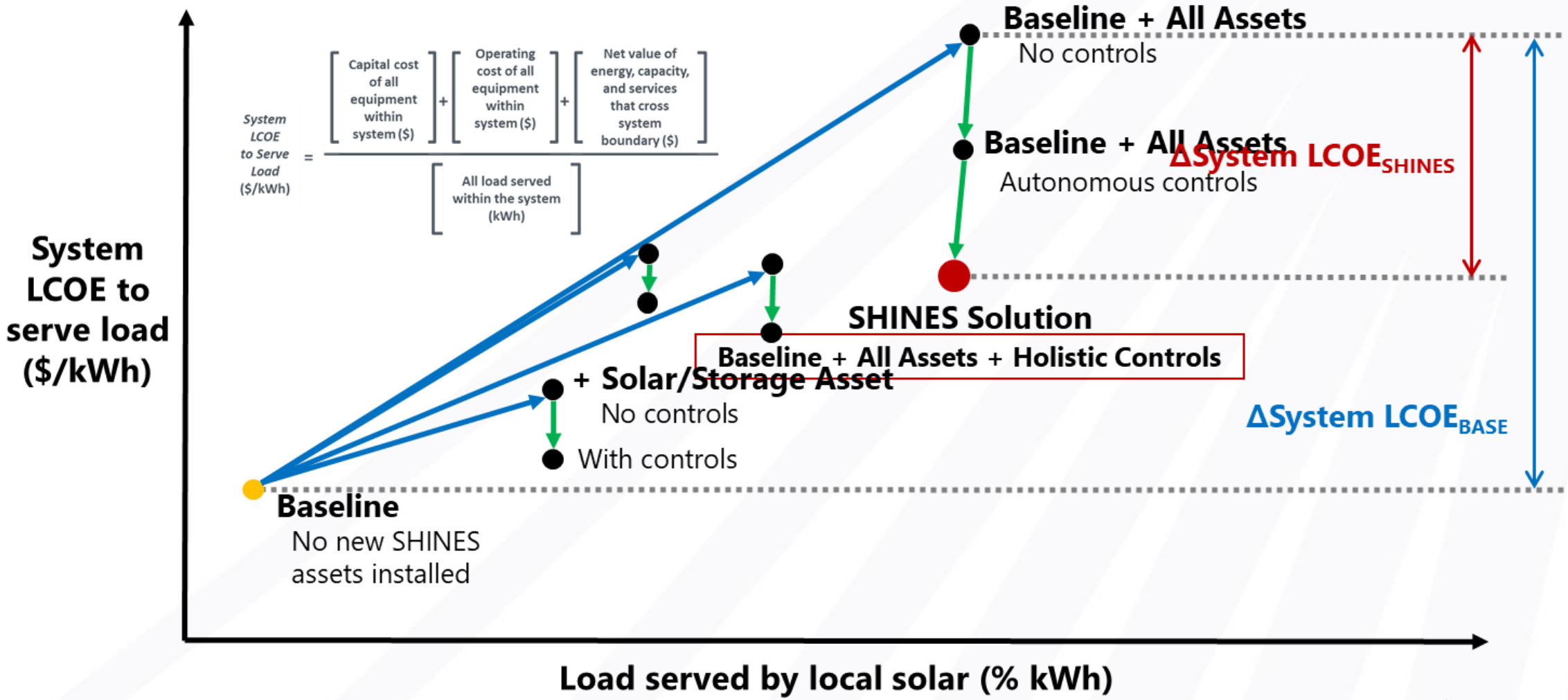
$$\textit{System LCOE to Serve Load (\$/kWh)} = \frac{\left[\text{Capital cost of all equipment within system (\$)}\right] + \left[\text{Operating cost of all equipment within system (\$)}\right] + \left[\text{Net value of energy, capacity, and services that cross system boundary (\$)}\right]}{\left[\text{All load served within the system (kWh)}\right]}$$

System LCOE

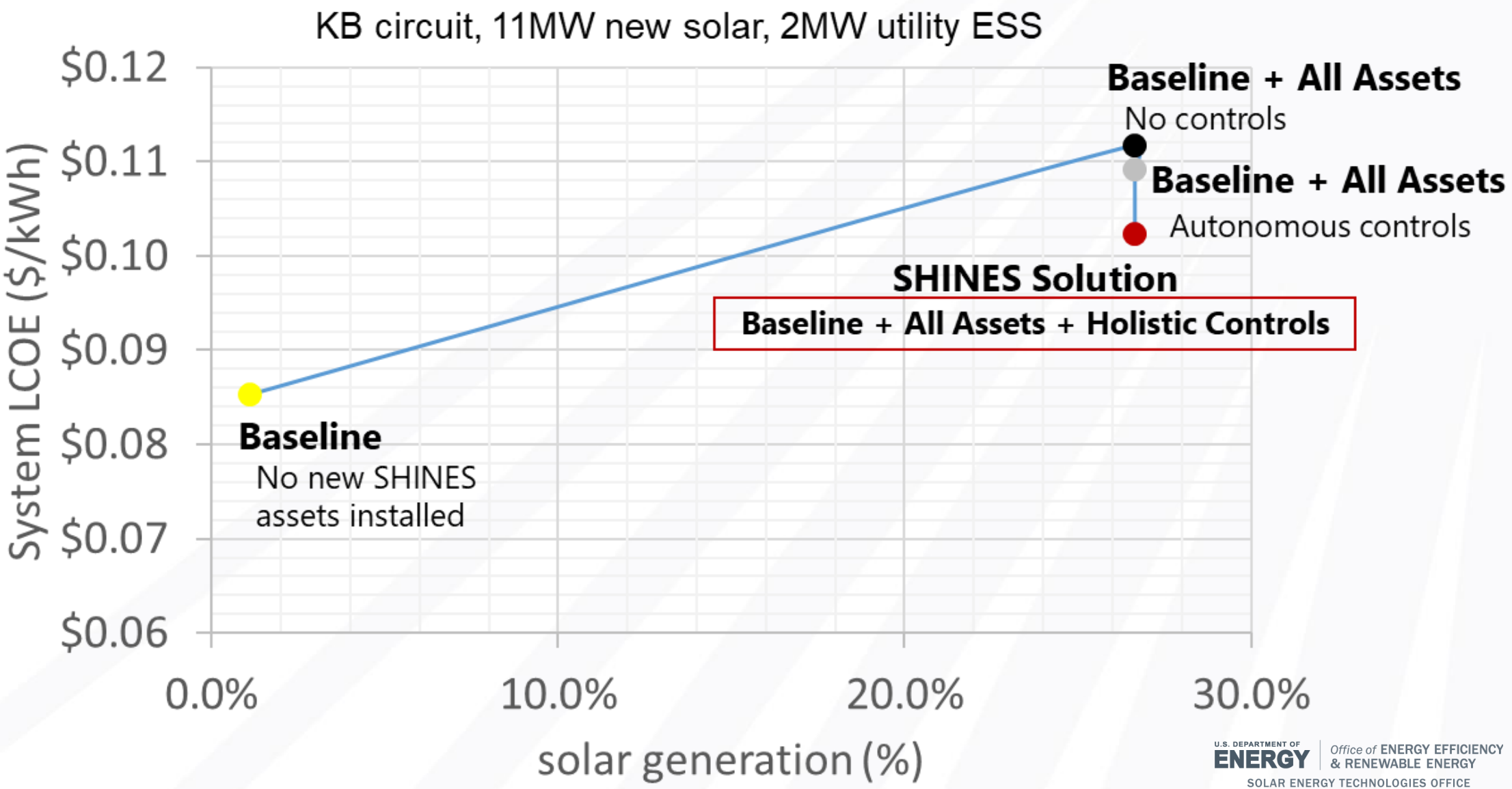
System Boundary



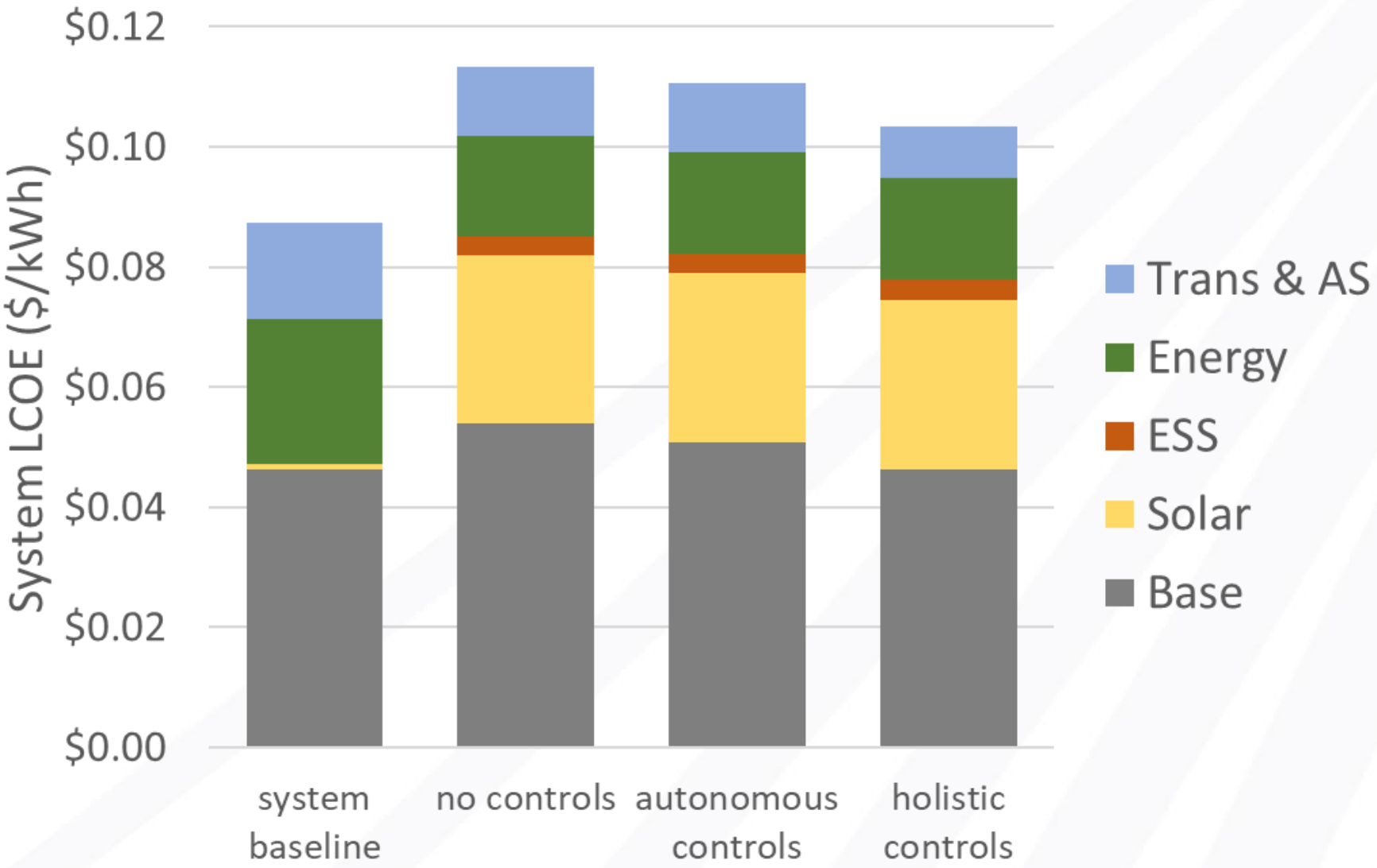
Calculating System LCOE



SHINES solution designed by minimizing System LCOE



Break out System LCOE by category of cost



Questions?

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