SunShot
U.S. Department of Energy

SHINES Program Review 2017

Austin SHINES Project

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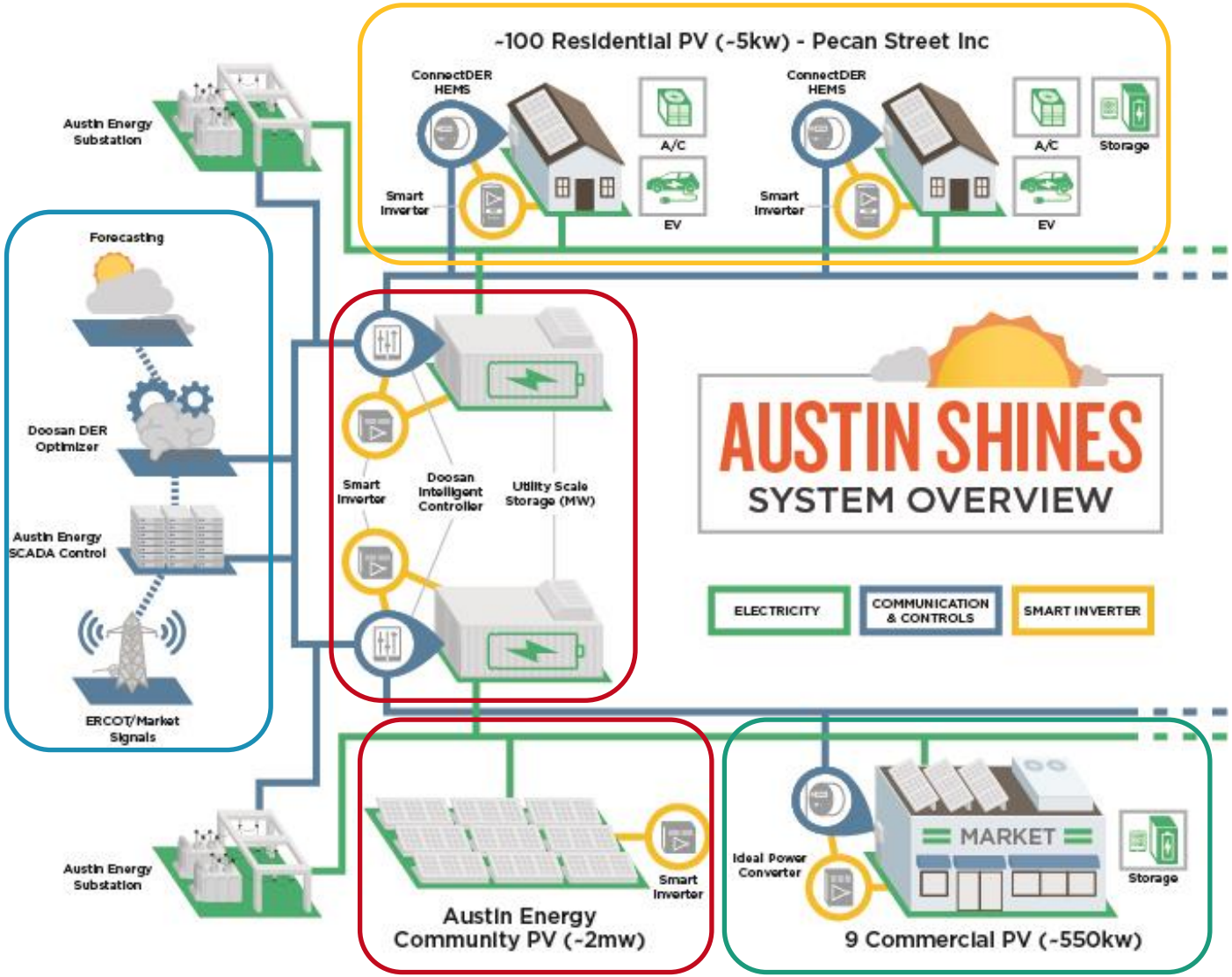
Objectives/Agenda

- Austin SHINES project overview and status
- Budget Period 1 highlights
  - Control platform conceptual design
  - Economic modeling framework
  - Communications and monitoring
- Next steps
  - Remainder of Budget Period 1
  - Budget Periods 2 and 3
- Austin SHINES impact

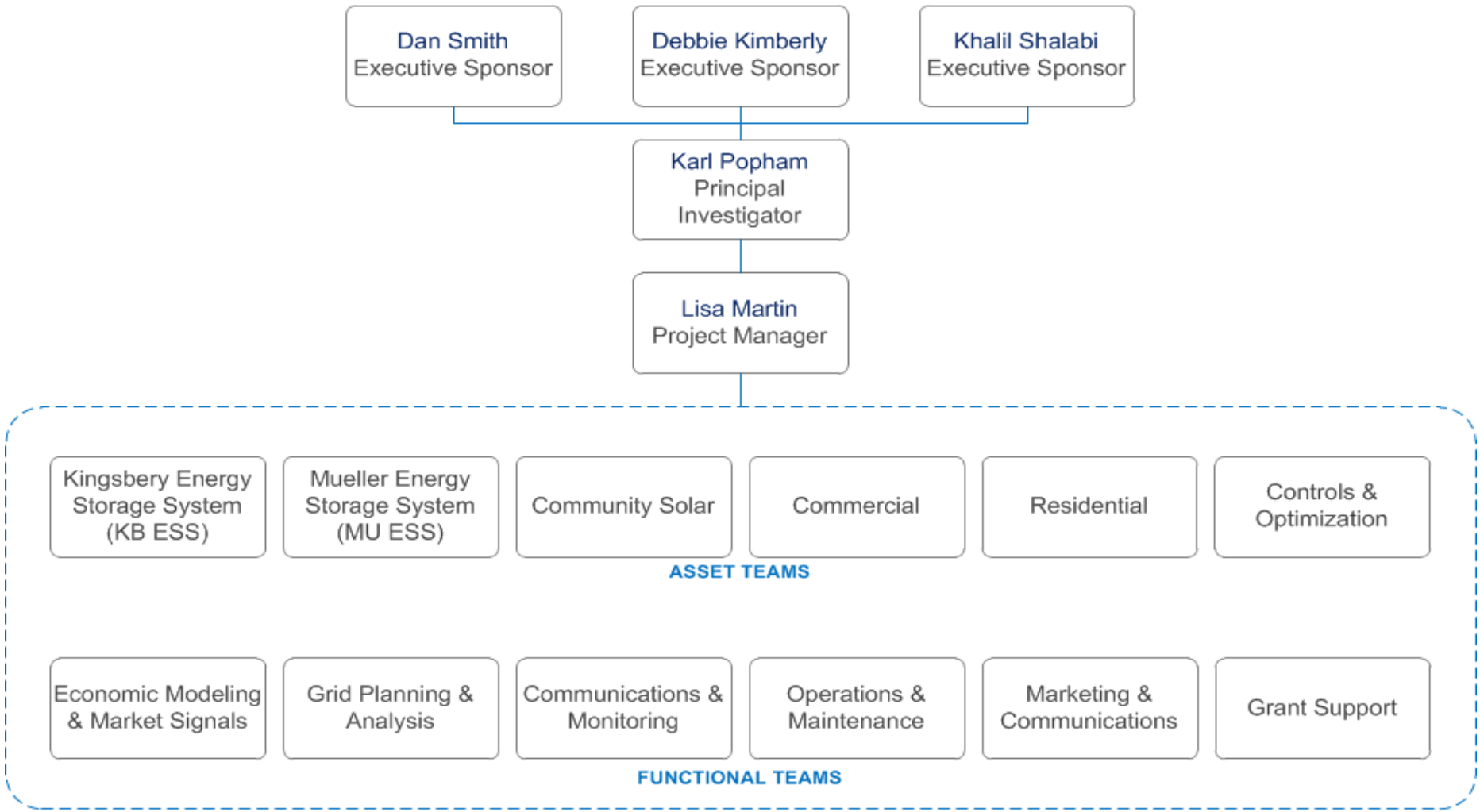
Austin SHINES Conceptual Overview



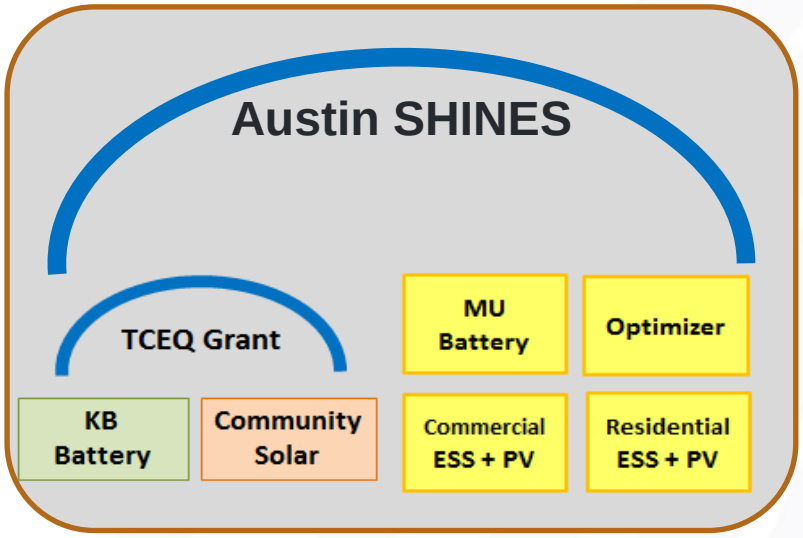
- Utility Scale Energy Storage + PV
- Commercial Energy Storage + PV
- Residential Energy Storage + PV
- DER Management Platform

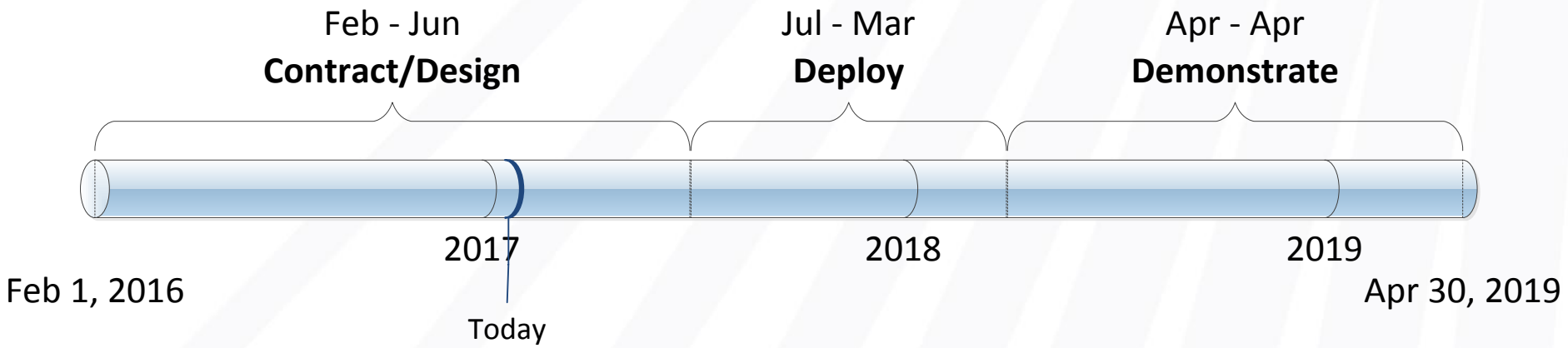
Illustrative

Austin SHINES Project Org Chart



Project Structure and Timeline





39-month project with phases

Key Benefits of the Austin SHINES Project

- Distributed Energy Resource (DER) management platform based on **open standards** to drive interoperability and lower costs
- Enables **diverse strategies/business models** for both utility and customer owned resources; to include direct utility control, third-party, and autonomous resource management of DERs
- Studies **Distributed Energy Resource (DER) value** for the utility and the customer
- Employs a **modular approach** allowing utilities across the country to adopt the scale and use-cases right for them
- Includes affordability targets and captures holistic benefits via **System Levelized Cost of Energy metrics**

Budget Period 1 Highlights

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1. DERO Conceptual Design
2. System LCOE to Serve Load
3. Communications & Monitoring

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DER Control System

Austin SHINES includes **multiple levels of control** to achieve DER optimization

DERO

- Provides bulk power system (BPS) control
- Used to deploy DERs to meet overall goals for grid
- Connects directly into ADMS; inputs include market signals, forecasts, grid data

DER Optimizer

DG-CM

- Provides control at the distribution circuit level
- Allocates commands from DERO across available circuit-connected assets
- Used in select applications such as voltage support

Circuit Manager

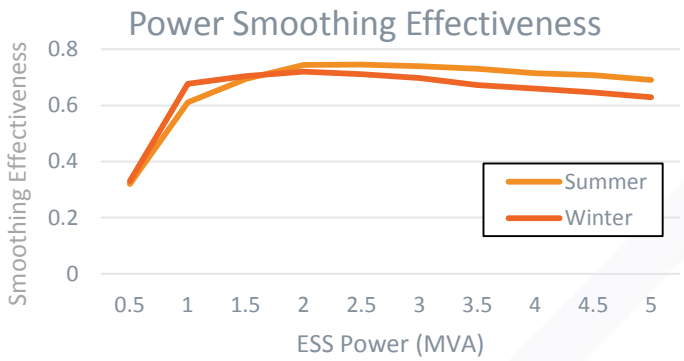
DG-IC

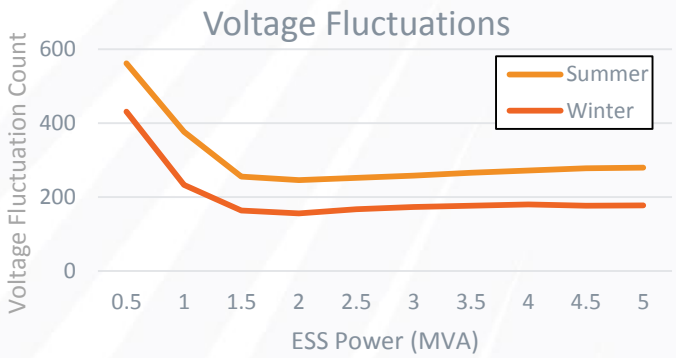
- Provides local control for a single energy storage site
- Applies to grid-scale energy storage systems
- Tries to make as many decisions as it can locally

Intelligent Controller

Utility-Scale ESS Sizing Analysis and Controls Design

LOCAL





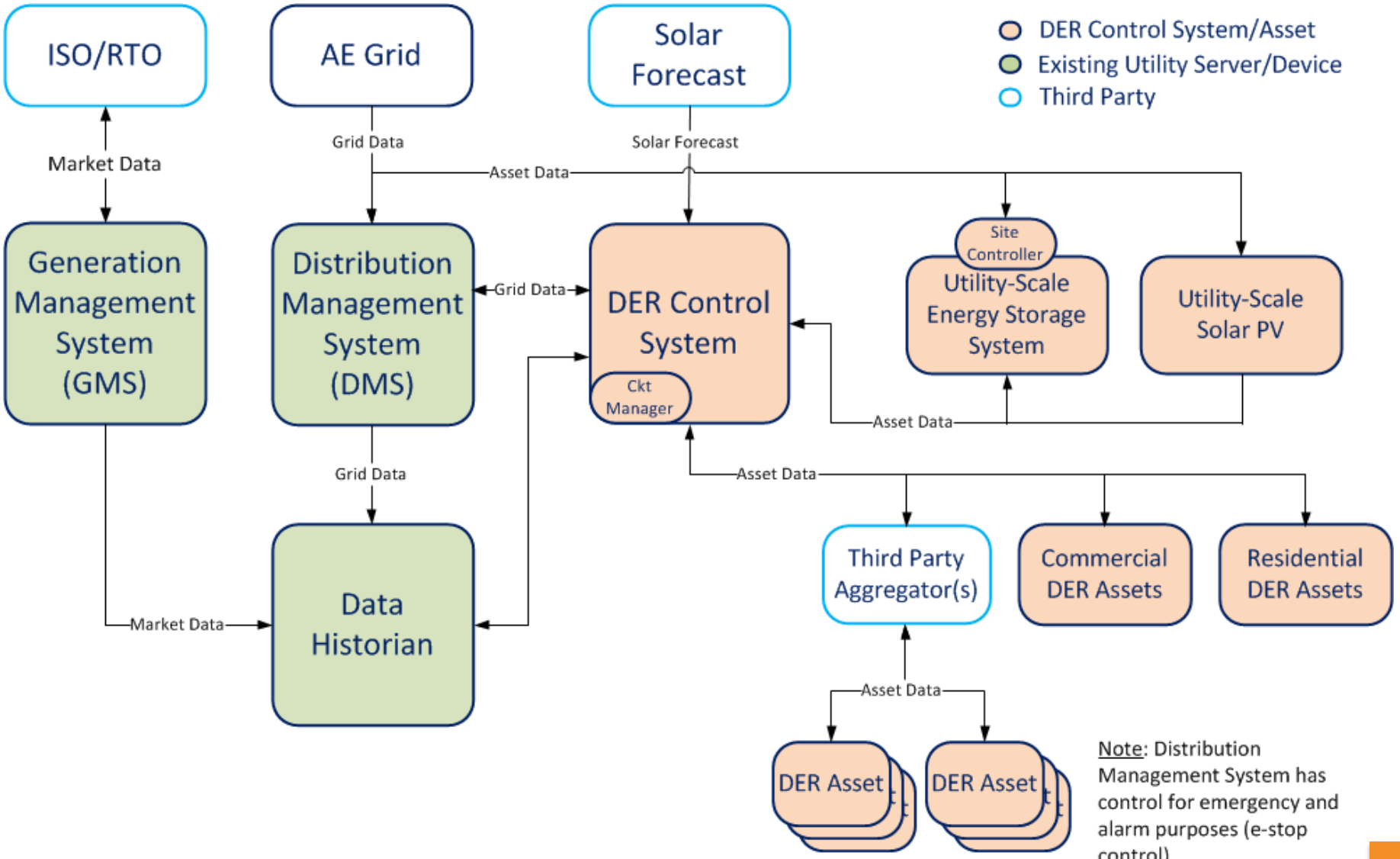
BULK

Use Case	Optimal Range	Use Case Priority
AS Revenue: Summer	2.5-3.5 MWh	Medium
AS Revenue: Winter	2.0-2.5 MWh	Medium
Energy Arbitrage Revenue: Summer	2.0 MWh	Low
Energy Arbitrage Revenue: Winter	2.0-2.5 MWh	Low

Mueller ESS: 1.5MW / 2.5MWh

Kingsbery ESS: 1.5MW / 3.0MWh

Conceptual Architecture



Potential Control System Applications

The Austin SHINES team considered 19 applications during conceptual design of the DER Control System

Application List

Transmission

1) Transmission Constraint Avoidance
2) Peak Loss Avoidance
3) VAR Support for Transmission

Distribution

4) **Congestion Management**
5) **Voltage Support**
6) Power Factor Correction
7) Loss Avoidance
8) Harmonics

Customer

9) Back-up Power (Islanding)
10) **Demand Charge Reduction**
11) Time of Use

Market

12) **Peak Load Reduction**
13) **Energy Arbitrage**
14) **LMP Opportunities**

Ancillary Services

15) Regulation Up/Down
16) Fast Frequency Response
17) Emergency Response Service

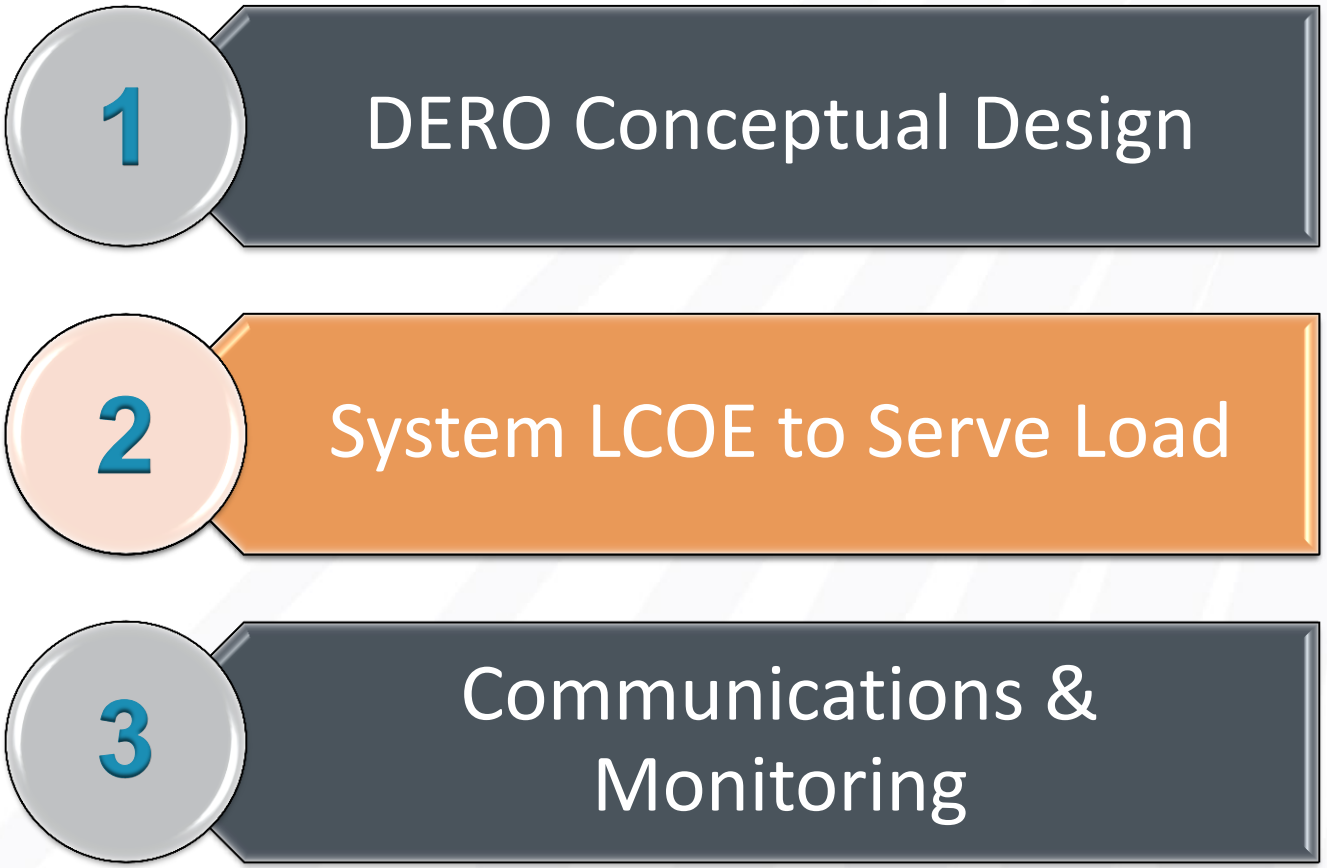
Renewable

18) Solar Variance
19) Wind Variance

Prioritization

- SHINES Goals
- Team Feedback
- Value
- Variety
- Practicality

Budget Period 1 Highlights



A Different Perspective on LCOE

$$\text{LCOE} = \frac{\$_{\text{capital}} + \$_{\text{O\&M}}}{\text{kWh}_{\text{generated}}}$$

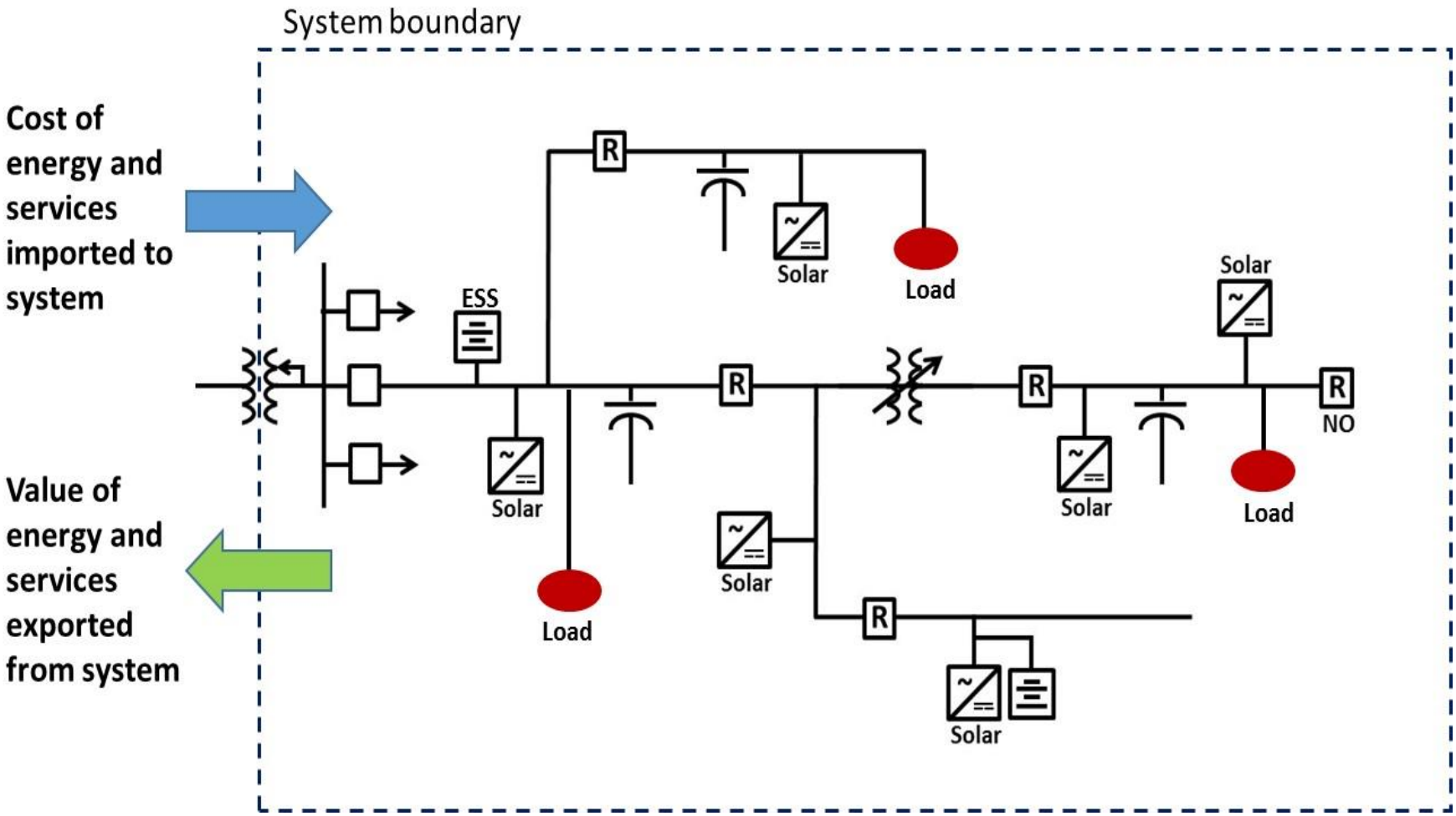
LCOE

- Generation in isolation
- Quick and straight-forward calculation

System LCOE

- All system costs computed for investment / operational scenarios
- Requires calculation of complex interactions

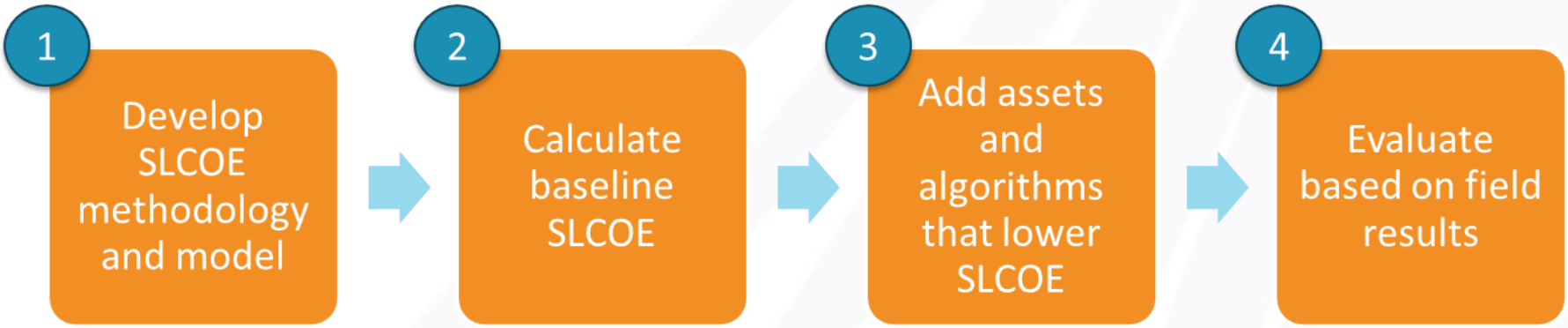
System LCOE Boundary



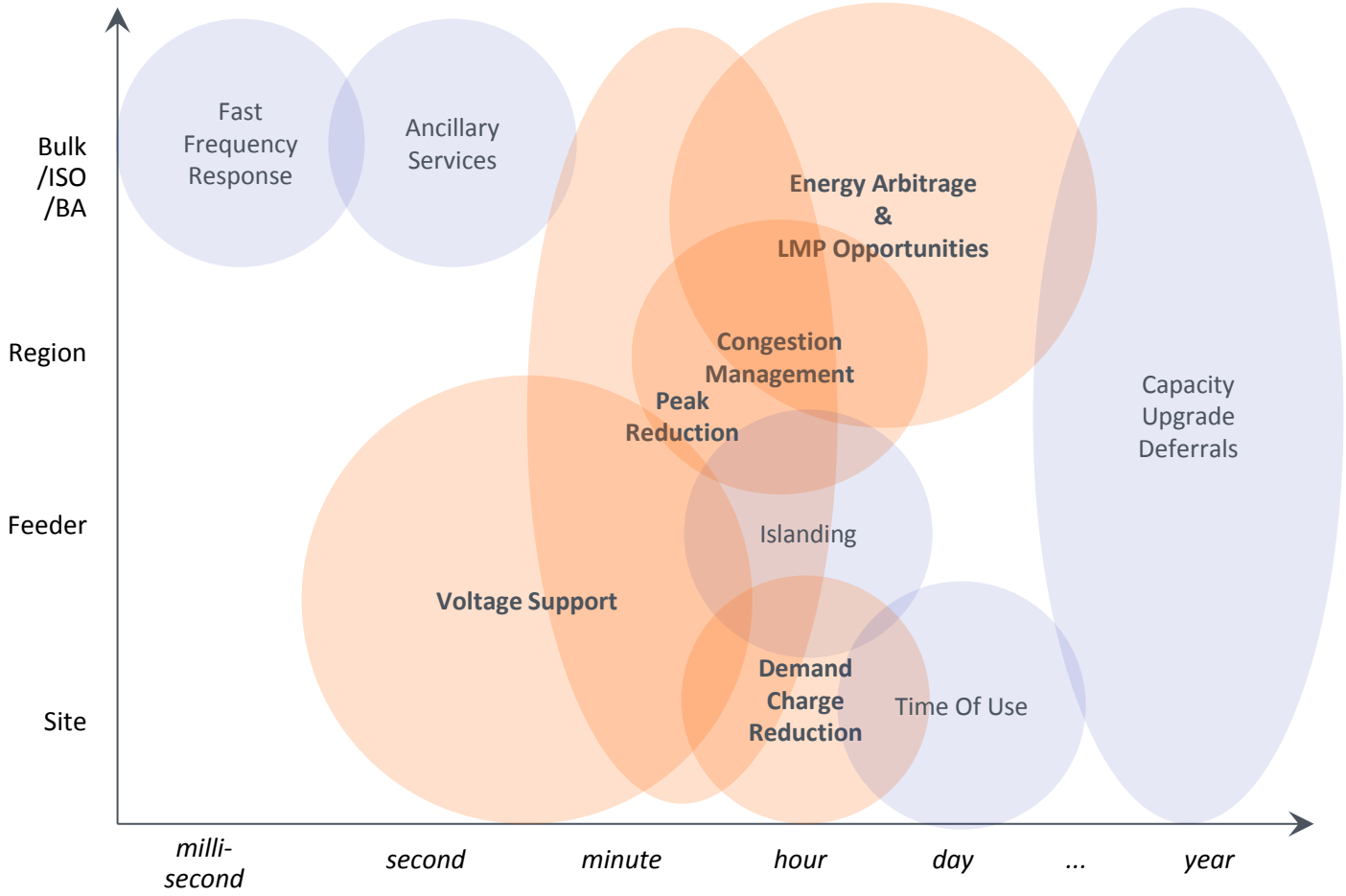
System LCOE Equation

$$\textit{System LCOE to Serve Load} = \frac{\left[\text{Capital cost of all equipment within system}\right] + \left[\text{Operating costs of all equipment within system}\right] + \left[\text{Cost of energy and services imported to system}\right] - \left[\text{Value of energy and services exported from system}\right]}{\left[\text{All load served within the system (kWh)}\right]}$$

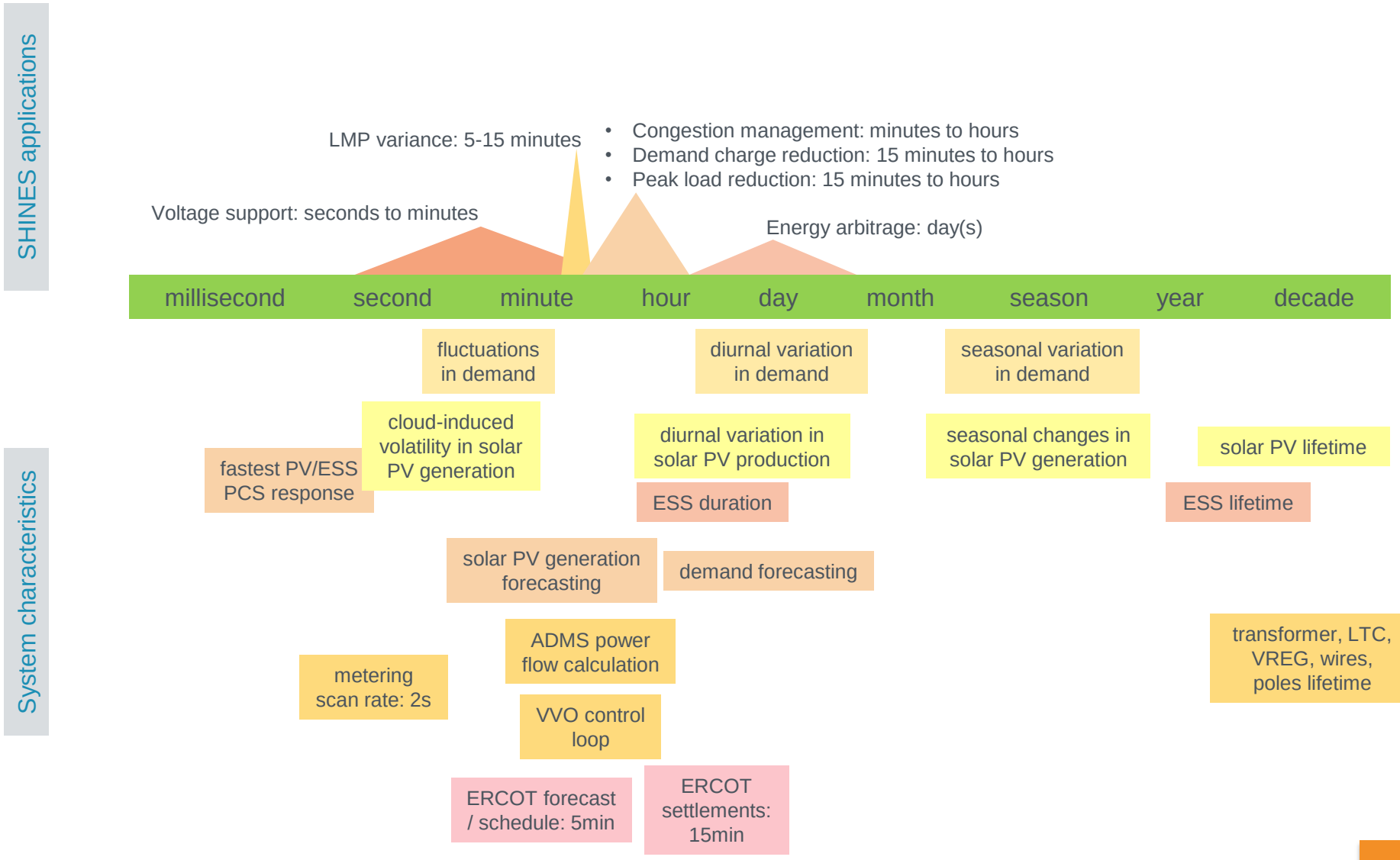
System LCOE Task Breakdown



Value Creation Mechanisms



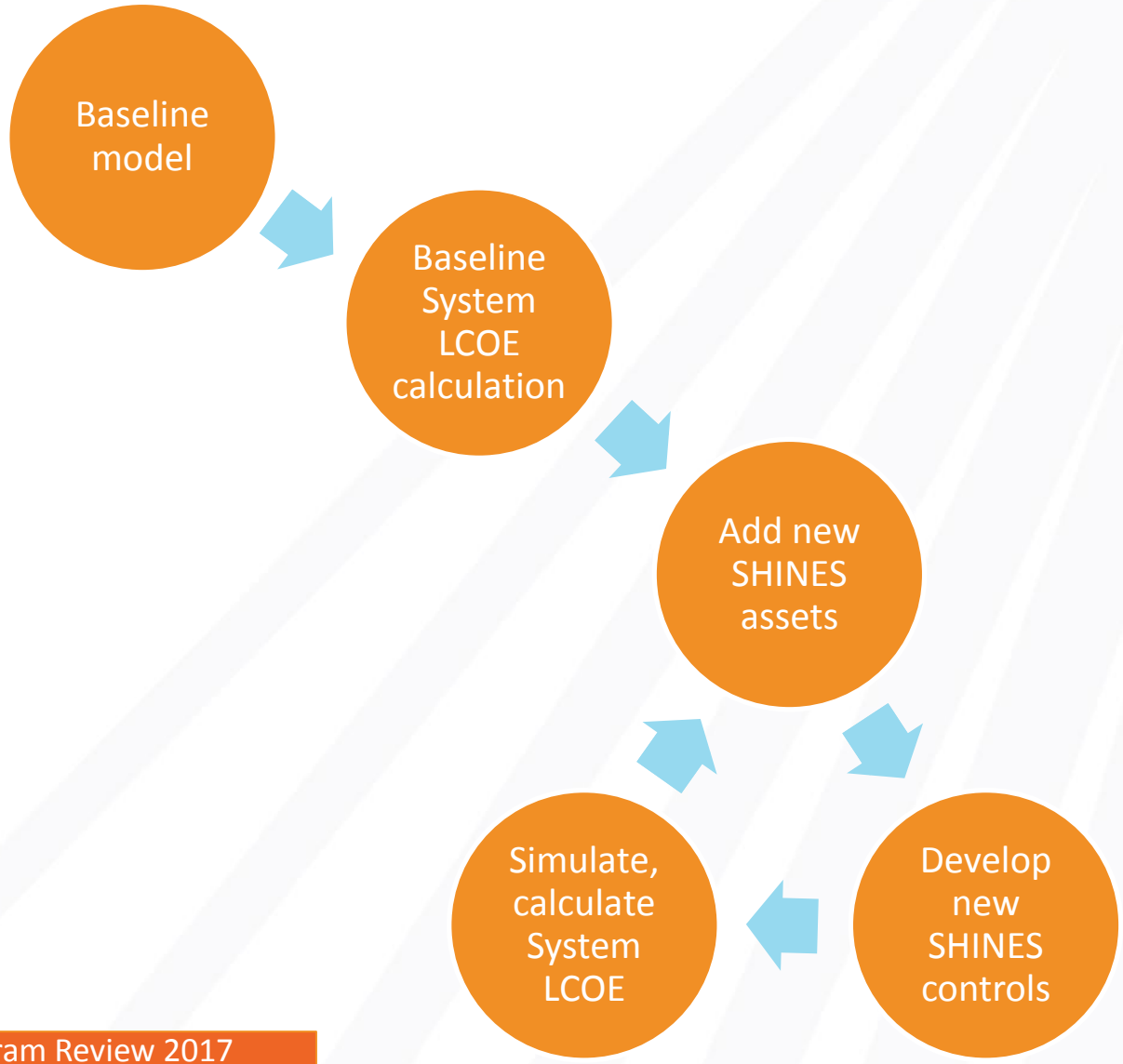
Timescales for Austin SHINES Controls



System LCOE Modeling Requirements

- Time dependency → need a **time-series** modeling tool
- Coordinated voltage control and congestion management → need a **power flow solver**
- The solution: GridLAB-D™, a power system simulation and analysis tool
  - Developed by the DOE at Pacific Northwest National Laboratory (PNNL) with support from Office of Electricity
  - Strongest at the nexus of electrical and economic interactions
  - Flexible environment enables detailed study of controls design and configuration

Modeling and Simulation Process



Budget Period 1 Highlights

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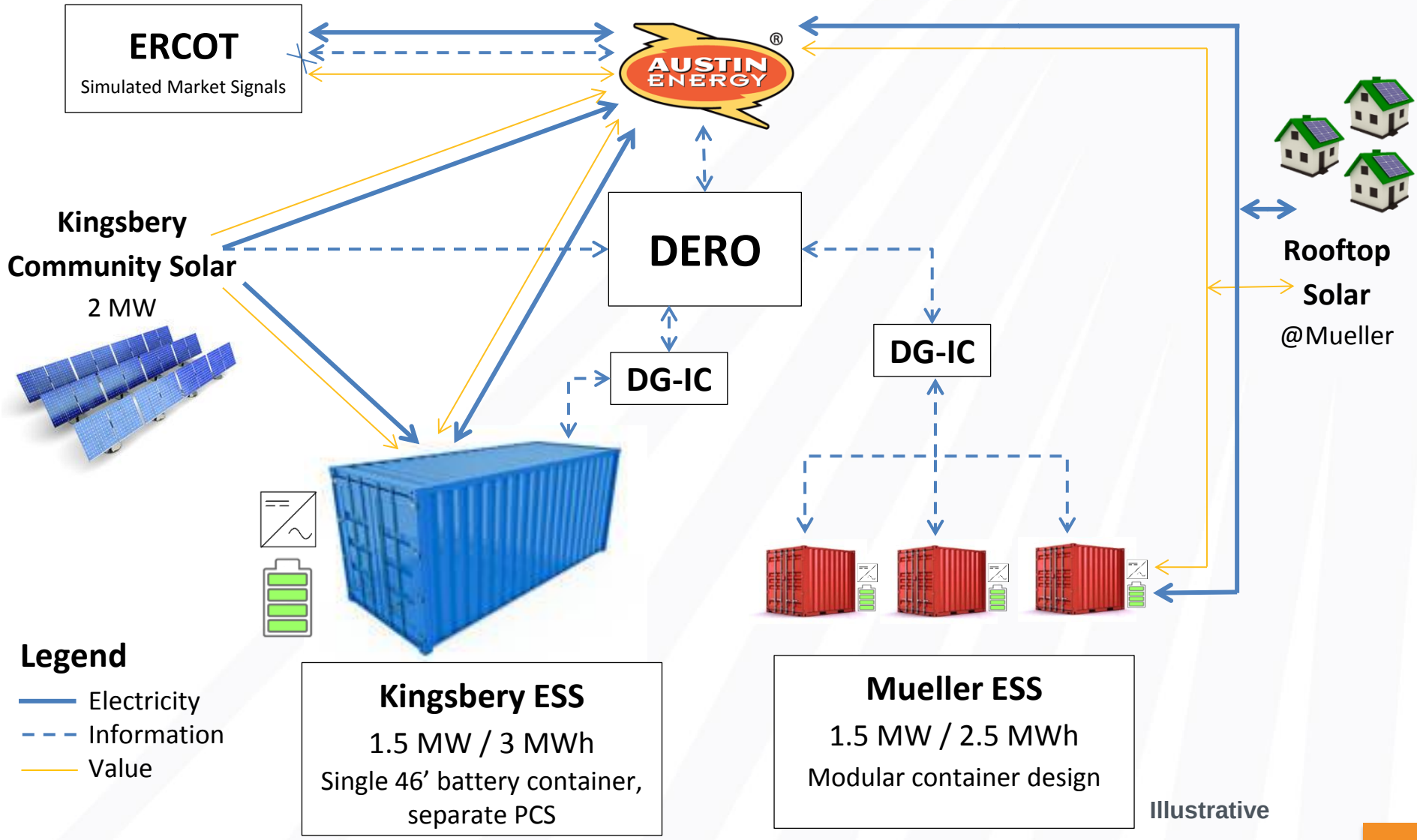
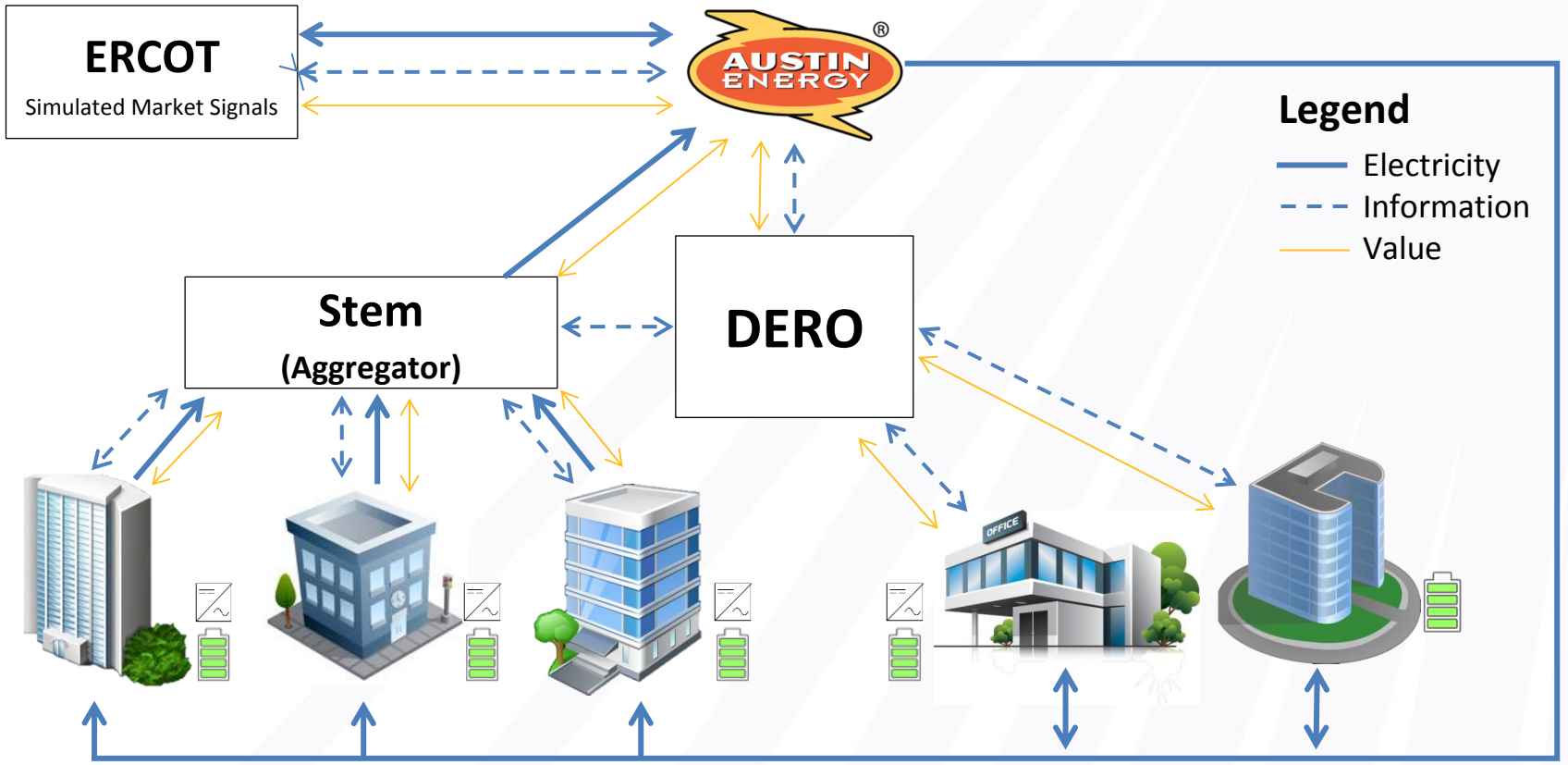
Utility-Scale Components



Commercial Components



3rd Party Aggregator Sites

4x – 30kW

1x – 125kW

Dispatch Priority: Customer value propositions

Direct Utility Control Sites

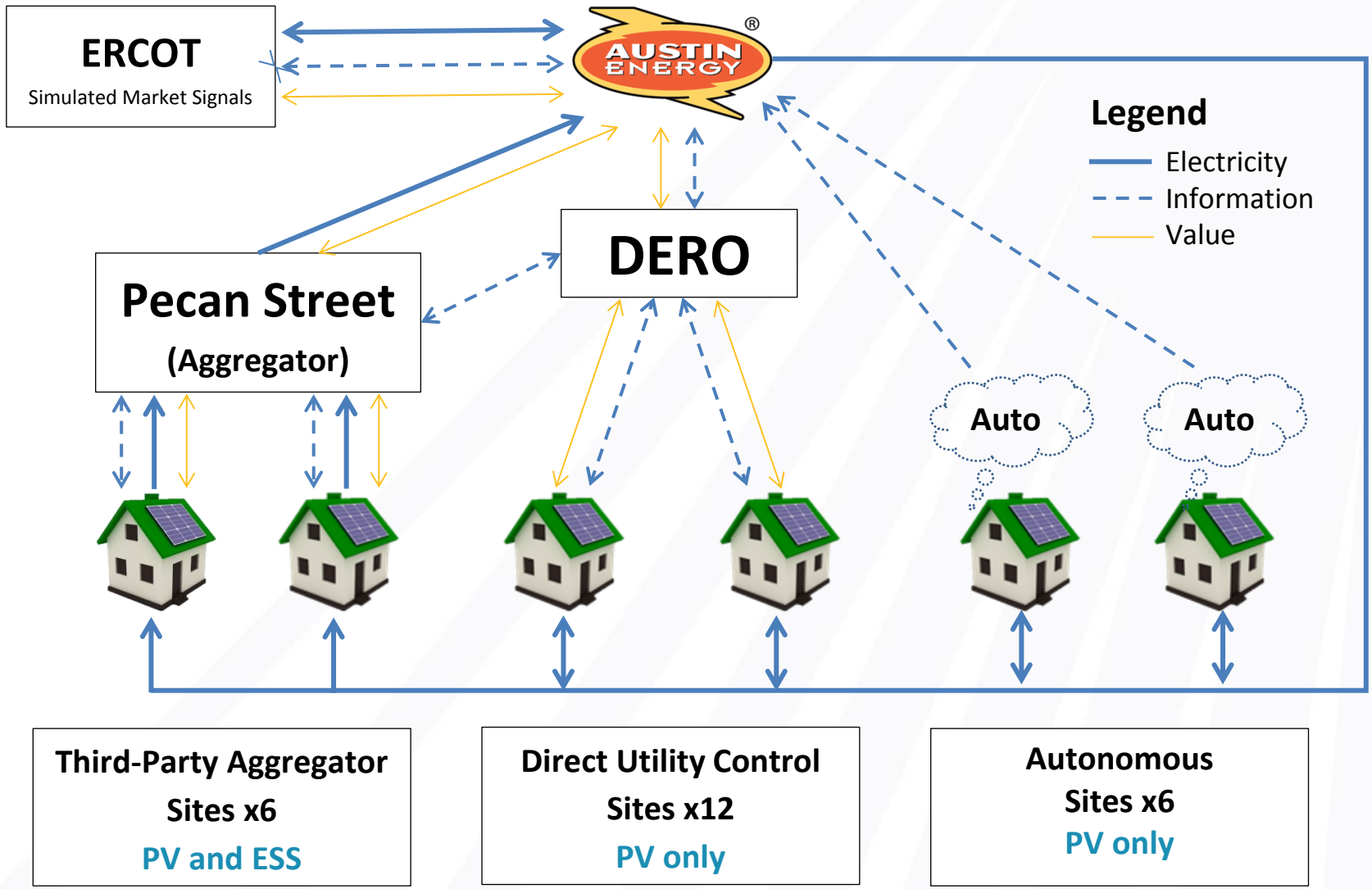
1x – 30kW

1x – 125kW

Dispatch Priority: Utility reliability needs

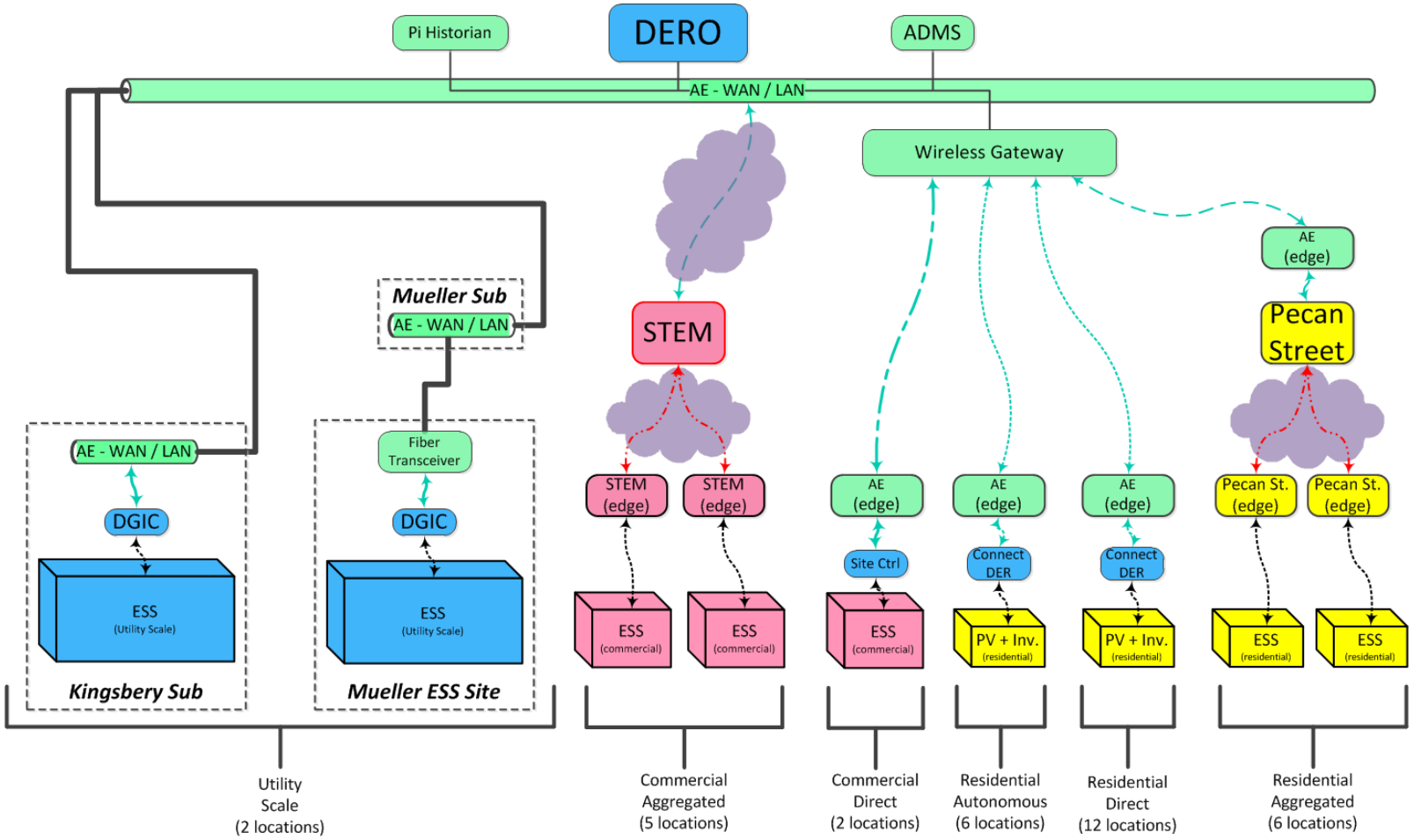
Illustrative

Residential Components



Illustrative

Communications Connectivity



Illustrative

Next Steps &
Austin SHINES Impact

Next Steps

Remainder of BP1

- Detailed design documentation
- Commercial & Residential participant selection
- Lab testing
- Permitting
- Econ modeling
  - Calcs for System LCOE “as designed”

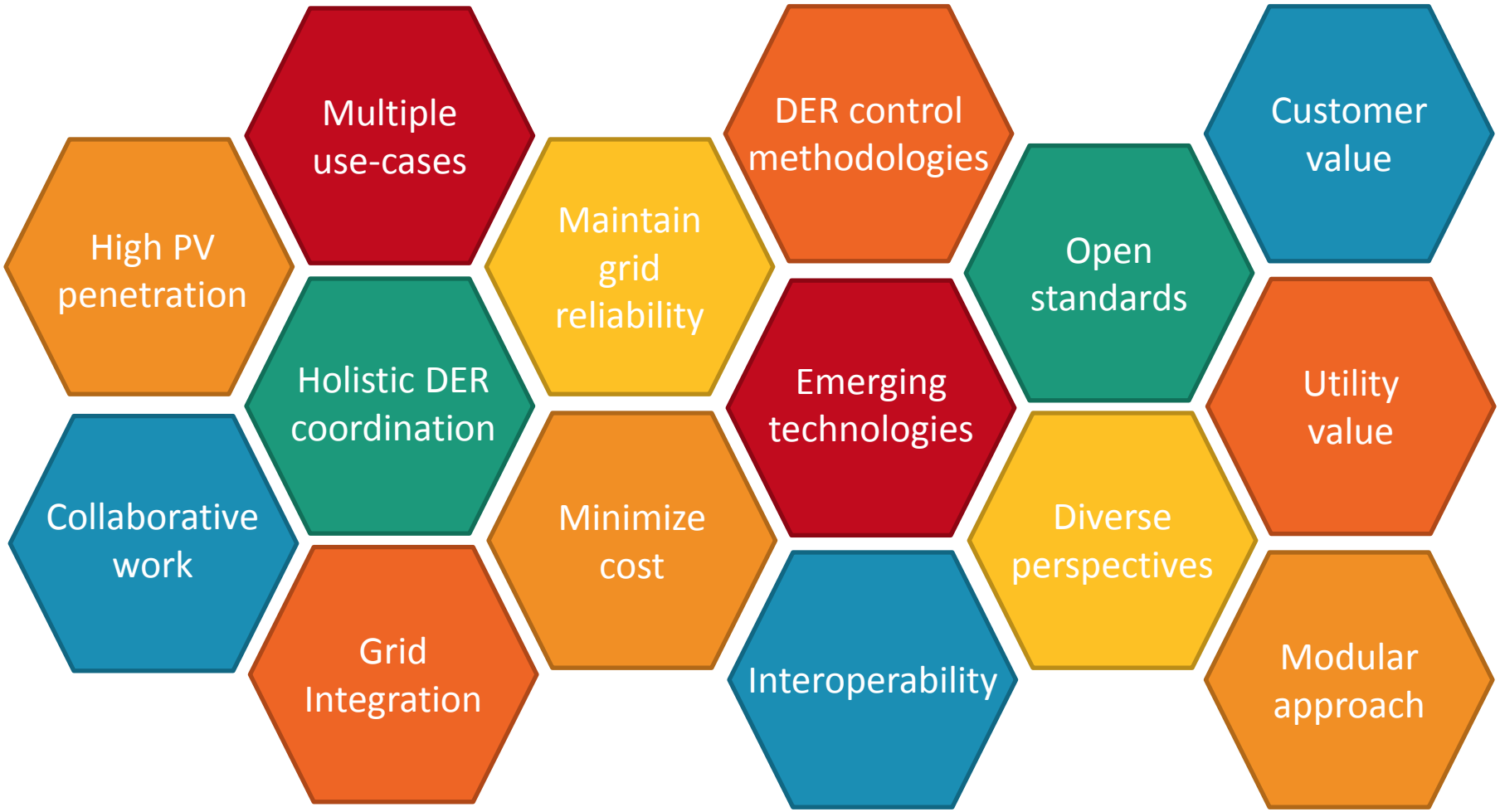
BP2

- Deploy all SHINES assets
- Site acceptance testing
- Econ modeling
  - Calcs for System LCOE “as deployed”

BP3

- Demonstration year
- Performance analysis
- Econ modeling
  - Calcs for System LCOE “as demonstrated”
- Final deliverables

Austin SHINES Impact



Questions?

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AUSTIN SHINES

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