Solar + Storage and Resiliency

ASHRAE/CBE Building Decarbonization Workshop

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Outline

- Decarbonizing Electricity
  - Let me count the ways
- Solar PV + Battery Energy Storage
  - Important Implementation Issues
- Load Shaping and Grid Harmonization
  - Why is this important?
- Resiliency
  - Practical Considerations

Carbon-free Site Energy Production Options

Solar PV

Pros

- Mature Technology
- Pricing and designs stable
- Longevity
- No (or few) moving parts
- Modeling tools and information

Cons

- Area required
- Price to performance
- Long payback times
- Requires maintenance

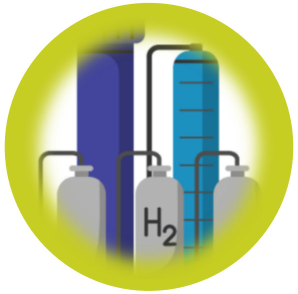
Solar Thermal

Pros

- Higher efficiency
- Less costly than other technologies
- Good Incentives available

Cons

- Moving parts, hard to maintain
- Longevity
- Few vendors and little expertise
- Difficult to finance



Fuel Cells

Pros

- Onsite baseload generation
- Most are co-generation: heat + electricity
- Relatively small footprint
- Incentives available

Cons

- Not carbon free – most use natural gas as a fuel
- Long term reliability?
- Financial viability of manufacturers
- Heat efficiency rarely meets design

100% Renewable Grid Energy

The easy way to go green?

+ Electrical Utilities

PG&E example

- Solar Choice (50% or 100% solar)
- Regional Renewable Choice (25%-100% of usage, direct contract with developer)

+ Community Choice Aggregators (CCAs or CCEs)

CleanPowerSF example

- Green (48% renewable, 40% hydro)
- SuperGreen (100% renewable)

+ CA State Mandates (SB 100)

- 50% renewable sources by 2026
- 60% by 2030
- 100% decarbonized electricity by 2045

Solar + Storage Practical Considerations

Project Financing

The Challenge

- Increasing energy requirements for new construction and major retrofits
- Construction dollars are (almost) always scarce
- Energy generation and storage can add 10% or more to project costs

A Solution – Third-Party Financing

- Removes energy system costs from project capital requirements
- Focus scarce capital on mission critical facilities
- Expert energy design, construction, procurement contracts

Solar + Storage Practical Considerations

Project Delivery

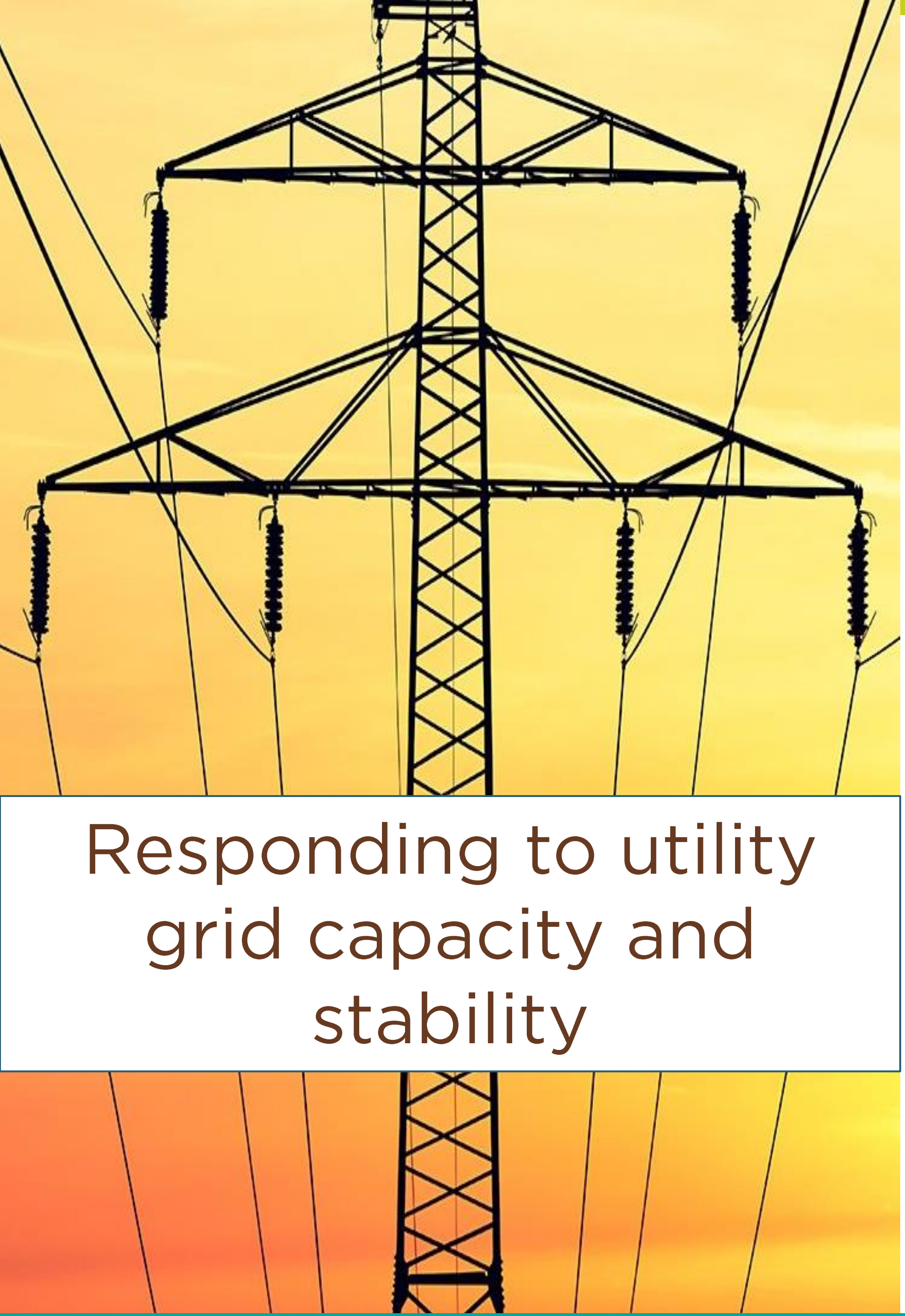
The Challenge

- Who designs the generation and storage systems?
- Complex systems – need to have solar and storage engineering experience
- Hard designs through EE firms often results in poor performing/expensive systems

Potential Solution – Design-Build

- **Energy firms** with expertise and procurement
- Expertise early in the design phase
- Separate competitive procurement
- Third-party financing options

Load Shaping and Grid Harmonization



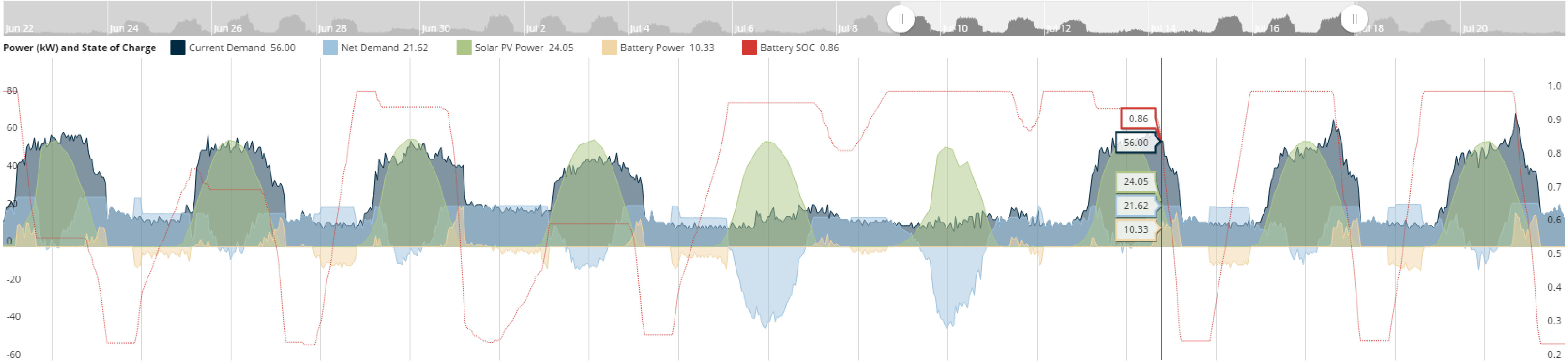
Responding to utility grid capacity and stability

- **Grid Harmonization**
  - LEED Points, GridOptimal Metrics
  - Title 24 TDV and local building codes
  - Utility signals
    - Tariffs (TOU pricing, Real-time Pricing)
    - Demand Response (DR)
    - Potential value streams
      - Resource Adequacy (RA)
      - Voltage and Frequency Regulation

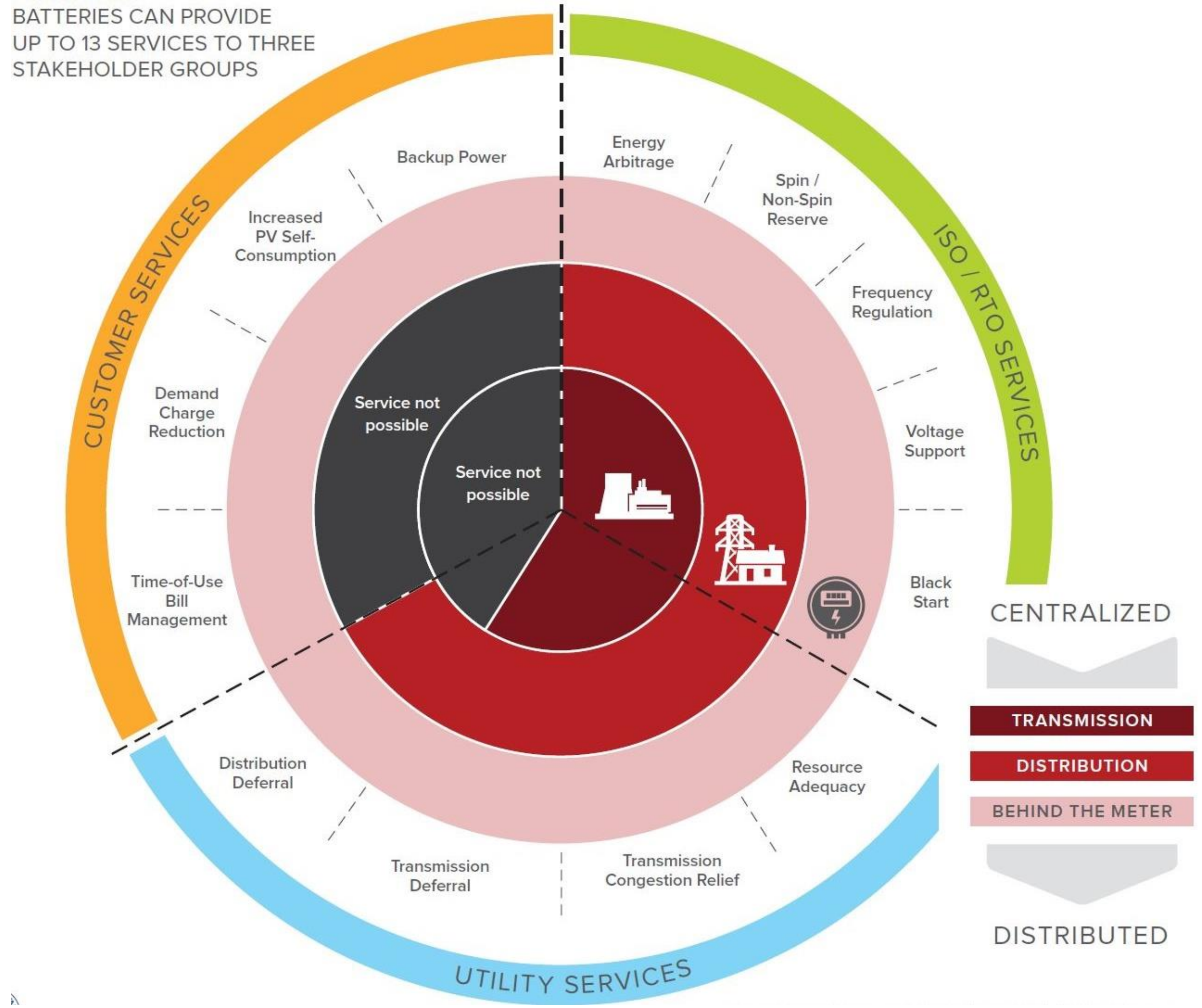
Load Shaping and Grid Harmonization

- Load Shaping
  - TOU Bill Management/arbitrage
  - Peak Shaving/Demand Charge Reduction
  - Renewables Firming/self consumption

Altering the customer's load profile as presented to the utility



BESS Services by Market Sector



Source: NREL

Resiliency

Practical Considerations

Resiliency adds time, complexity, and cost

Defining the needs

- What loads are critical?
- Duration of support?
- How will critical circuits be isolated?

Does not improve project financial performance (typically*)

- Critical capacity must be reserved
- Switchgear and load management equipment
- *Can offset costs of conventional backup

"an ability to recover from or adjust easily to adversity or change (e.g. grid outages)

Resiliency

Practical Considerations

+ Capturing Value of Resilience (VoR)
  - Offsetting costs of conventional backup generation
  - LEED, GridOptimal metrics
  - Direct Impacts
    - Offsetting energy costs
    - Asset preservation (food, equipment, brand)
    - Staff impacts/efficiency
    - Sales
  - Indirect Impacts
    - Losses to local businesses
    - Childcare
    - Critical medical services
    - Emergency shelter

Decision Framework

Weighing all costs, risks and benefits

Risks/Costs

1. Paying more for energy = <10% increase
2. Campus parking lot reconfiguration
3. Staff and consultant time
4. Underperformance of systems

Costs/Risks Doing Nothing

1. Carbon emissions/environmental impact
2. Reduction of SGIP storage incentives and federal ITC
3. NEM 2.0 replace by NEM 3.0, reducing value of solar
4. Dramatic increases in utility energy prices
5. Loss of potential energy cost savings

Benefits

1. Carbon Reduction/Environmental Stewardship
   - Agency and state environmental goals
2. Resiliency to Grid Outages
   - Preservation of critical functions
   - Emergency Services
   - Staff impacts/efficiency
3. Community Support
   - Emergency shelter
   - Critical medical services support
4. Take advantage today's strong SGIP and ITC incentives
5. Parking lot shading
6. Potential for STEM curriculum integration

THANK YOU

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