New Tools to Transform Energy Costs Into Revenue
An IFDA Webinar
Thursday, September 5, 2019
The Changing World of Power Purchasing

1. Competition has grown in retail energy, NOT the Monopoly of the past
2. More energy purchasing choices
3. Billing rate structures have changed
   - Time-of-use periods are longer
   - Demand is measured differently now
   - Transmission, Distribution, and Capacity charges also play a role

WHY THIS MATTERS
A kW now has greater $ value
More Customer Choices Are Available

What is driving these changes?
Challenges on the Power Grid

Growth in variable generation
2006-2016: Solar grew 48x and wind grew 4x faster than predicted

Major shifts in demand curves
Renewables, EVs, extreme weather

More decentralized energy
Variable, intermittent & growing 3-5x faster than central generation
Challenges in the Power Grid

Monthly Demand Variation

Seasonal Demand Variation

Solar Adoption Demand Variation – Duck Curve
Utilities are responding aggressively

**Increasing demand charges $/kW**
Peak power and Demand charges now represent 50-80% of utility bills in some regions

**Increasing time-of-use rates $/kWh**
A direct response to grid energy prices that fluctuate from negative to 20x the average price during peak hours (CAISO)

**Investing in energy storage**
Energy storage expected to grow 70x in US from today to 2025 (US Energy Storage Association)
Growth of Energy Storage

Worldwide deployment of new grid-connected energy storage will reach over 10 GW annually by 2025.
Energy Storage Basics for Cold Storage

Conventional Electrical Storage

Thermal Energy Storage (TES)

TES stores refrigeration output (cold) rather than electricity (electrons)
Thermal Energy Storage Applications

Residential & Commercial HVAC

Grocery Store Medium-Temperature

Commercial & Industrial Low-Temperature
TES – Permanent & Safe Thermal Mass

Phase Change Material: PCMs store and release energy as they transition between solid and liquid states

Natural Convection:
► PCM absorbs rising heat
► Releases cold that falls across the food

Latent Heat Absorption (vs Sensible Heat):
► 300x more heat capacity than frozen food
► 8x heat transfer rate of frozen food
TES - Intelligent Controls, Monitoring, Notifications

Flexible for Multiple Demand Management Strategies
- Target peak demand reduction
- Reduce consumption during high time-of-use pricing periods

Maximize Refrigeration Efficiencies
- More run time during cooler hours
- Run compressors at maximum designed efficiency
- Consolidate up to 85% of heat in refrigeration air flow
- No mechanical components that require more energy
- Heat is absorbed and it is removed faster using fewer kWh

Prioritize Temperature Requirements
- Algorithms prioritize temperature requirements
- More stable temperatures and slower temperature increases
- 3X longer temperature resiliency if power or equipment fails
Freezer Applications

- 1,000 to 200,000+ ft²
  (92 m² to 18,500 m²)

- -20° to 32° F
  (-28° to 0° C)
Energy Storage + Efficiency

No additional real estate
New visibility & actionable data
LCOE < 2¢ per kWh
Improved temperature stability
20+ year system life
No additional energy required
Easy retrofit installation
Back-Up Resiliency

Zero maintenance
No roundtrip loss
93,000 Ft² Warehouse Customer (8,600 m²)

Flywheeling on TES

13-Hour Daily Peak Period, Six Days per Week

- 43% Lower net consumption (kWh)
- 29% Lower peak demand (kW)
- 50% More stable temperatures
Utility-Sponsored TES Cold Storage Programs

- 8 installations
  - Largest foodservice distributor (Sysco)
  - Largest cold storage 3PL (Americold)
  - Food processors
  - Greater Boston Food Bank

- Average facility ~50,000 ft²
- Largest Facility 157,000 ft²

This is one of many utility programs around the country
Expansion of Demand Management Programs

MONETIZATION STRATEGIES
Cost Avoidance & Revenue Generation

- Permanent Load Shed
- Targeted Load Shed
- Demand Response
- Energy Efficiency
- Solar Plus Storage
- Capacity Programs
# Example of Value Stacking in Multiple Programs

<table>
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<th>Year</th>
<th>Curtail (kW)</th>
<th>ICAP</th>
<th>TES</th>
<th>Daily Dispatch</th>
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Think More Broadly About Energy Purchases

- Aggregate load across multiple sites in a region
- **Fixed price** (low-customer risk, higher price premium)
- **Index pricing** (higher managed risk, lower pricing premium)
- **Capacity and transmission passthrough** (higher managed risk, lower pricing premium)
- Retail energy supply exchanges
- Value stack in multiple Demand Management programs
Manage Your Risk with a Physical Asset

- Power providers charge risk premiums for fixed price power
- Manage the calculated risk with TES and lower your pricing
- Leverage a physical asset behind-the-meter in your facility
- Don’t use your customer’s food as a battery
- Purchase energy at lower costs

Utility funding & demand management programs need to be part of your energy strategy
Questions?

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