



 OCTOBER 8 & 9  DOWNEY, CA

ET Summit Fall 2018

COMMERCIAL + RESIDENTIAL BUILDINGS

Learn the Storage Quickstep: Shape, Shift, Shed, and Shimmy to Fix the Duck!

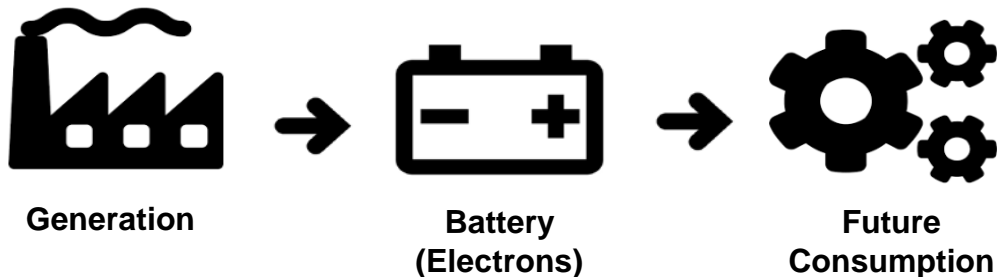
C&I Load Flexibility with Thermal Energy Storage (TES)

Collin Coker
Vice President, Sales and Marketing
Viking Cold Solutions



Energy Storage Processes

Conventional Electrical Storage



Thermal Energy Storage (TES)



- TES stores energy in the form of **cold** vs electrons
- Less than 50% cost and 4X the discharge time of lithium ion
- 20-year life, environmentally-friendly, more efficient

Low-Temperature TES Applications

Keeping food frozen requires an enormous amount of energy.

Energy Usage

OF THE GLOBAL COLD CHAIN

1ST HIGHEST DEMAND
of ANY industrial category per ft³

3RD HIGHEST CONSUMING
utility category



TES leverages green technology to reduce energy usage by 25% or more while better protecting the food.

US Cold Storage Industry Opportunity

Commercial & Industrial

2,300

Warehouses



920 MW

of Potential Storage

Grocery & Supermarket

40,000

Supermarkets



2,000 MW

of Potential Storage

Restaurant & Fast Food

620,000

Restaurants



3,100 MW

of Potential Storage

US Storage Market for TES:

Over

6,000 MW

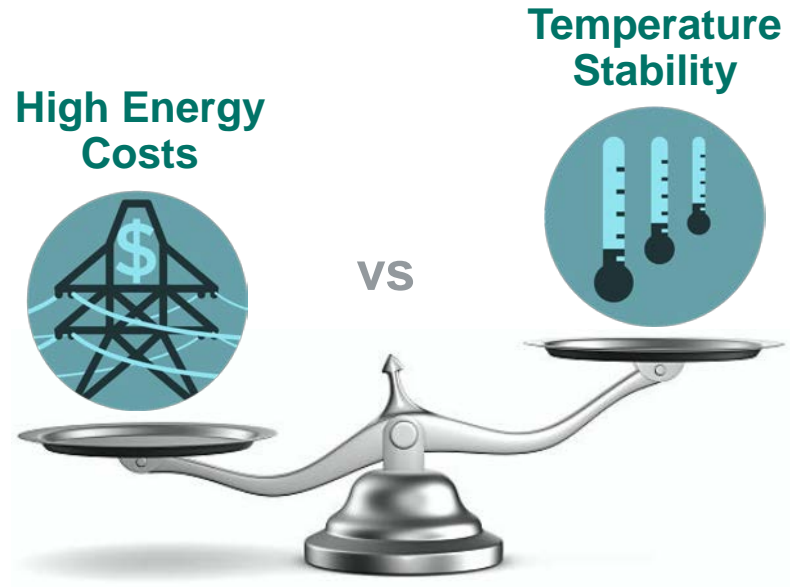
Equivalent Cost of Batteries:

\$6 Billion

Cold Storage's Biggest Challenge

Variable Utility Pricing

- Time-of-Use
- Peak Periods
- Peak Demand Charges
- Global Adjustment Charges (Canada)



Importance of Temperature Stability

- **ALL** frozen foods contain small amounts of unfrozen water
- **ANY** increase in temperature results in an increase in the amount of unfrozen water
- A subsequent decrease in temperature causes unfrozen water to return to solid state (ice), but with larger ice crystals.
- Larger ice crystals cause damage to product structure and loss of shelf-life



Thermal Energy Storage Systems



TES Modules

- Filled with proprietary Phase Change Material (PCM)
- Individually sealed, non-circulating HDPE cells
- PCM formulated for standard cold storage temperatures
- Freezer temperature ranges from -18° F to 32° F



Intelligent Controls

- Proprietary algorithms minimize equipment runtime and energy consumption within required temperatures
- Flexibility for load shed, efficiency, and demand response
- Multiple sensors & energy submeters
- Integrate with existing controls or as a subsystem



24/7 Cloud-Based Monitoring & Notification

- Measures temperatures, equipment run time, and energy use
- Real-time monitoring & notifications via email, call, text
- Energy efficiency reports and recommendations
- Optimizes operations and enables predictive maintenance

Case Study: TES in Industrial Warehouse

Description

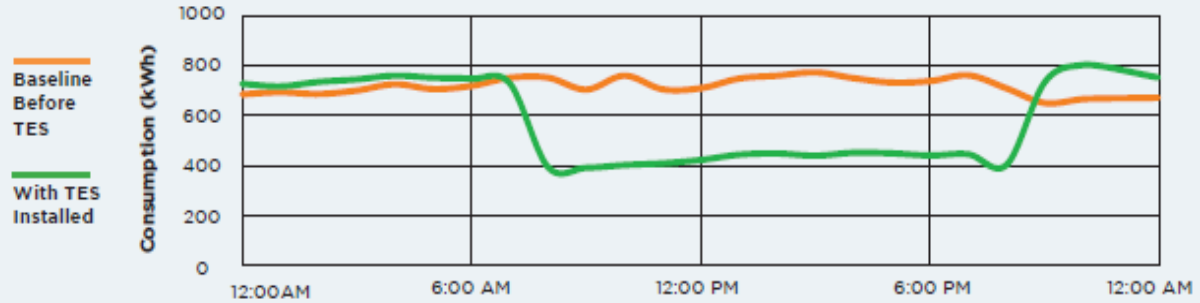
- Frozen food warehouse in Richmond, CA
- 93,000 square feet
- Central ammonia refrigeration system
- Utility provider: PG&E
- Partial Peak or Peak pricing for 13 hours (8:30 am to 9:30 pm) every weekday of the year
- Peak period consumption and demand charges nearly 50% of annual energy costs



Case Study Results



DAILY WEEKDAY CONSUMPTION



**FREEZER ENERGY
CONSUMPTION**

reduced

35%



**PEAK PERIOD
CONSUMPTION**

reduced

43%



**PEAK PERIOD
DEMAND**

reduced

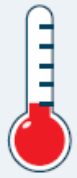
29%



50%

More Stable

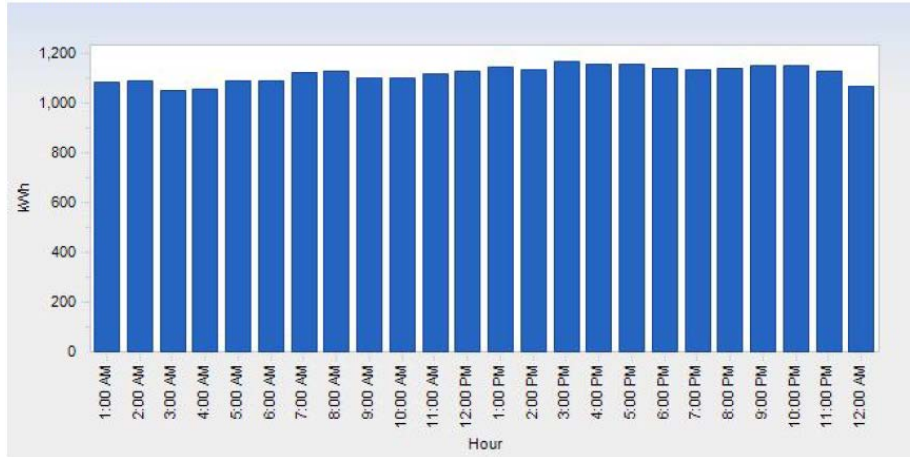
TEMPERATURES



Post Study Load Profile

Before TES - June 2017

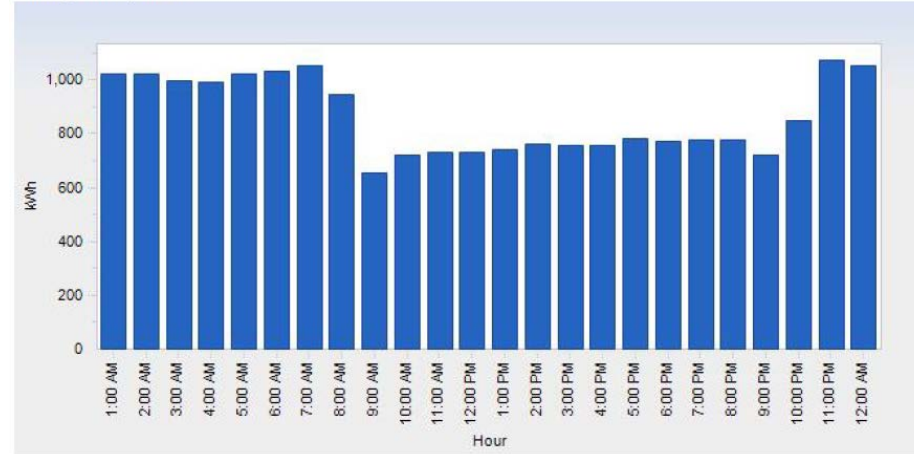
Average Hourly Profile



- Max Demand (kW): 1,316 (4:30 PM)
- Average Demand (kW): 1,118
- Minimum Demand (kW): 783

After TES - June 2018

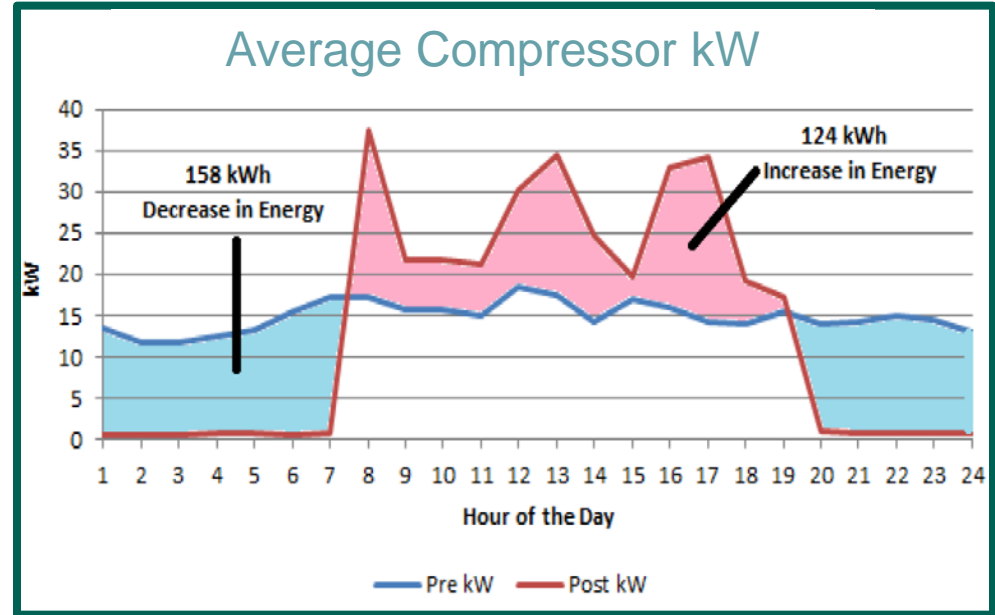
Average Hourly Profile



- Max Demand (kW): 1,241 (10:30 PM)
- Average Demand (kW): 864
- Minimum Demand (kW): 403

ETCC Study: Solar Energy Storage + Shift

- Utility sponsored by SDG&E
- Third-party engineering firm M&V study
- Sand Diego Food Bank's cold storage warehouse
- Eliminated facility's solar shift or "duck curve" contribution



**95% Overnight
Grid Reduction**

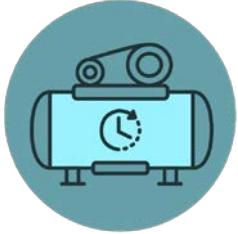
**39% Annualized
Refrigeration Savings**

TES Customer Benefits



Reduce Energy Costs Up to 50%

- Shift Load up to 13 Hours to Avoid Peak Period Pricing
- Reduce Net Consumption Through Efficiencies
- Lower Pricing Through Demand Reduction
- Increases Return on Renewable Energy



Extend Refrigeration Equipment Life

- Reduce Cycling & Overall Mechanical Run Time
- 24/7 Monitoring & Notification of Equipment Status
- Reduce Existing Maintenance Costs
- No Additional Maintenance Required for TES



Protect Temperature Stability

- Absorbs 85% of Heat Infiltration
- Reduces Temperature Fluctuations by Half
- 3X Longer Thermal Back-Up Protection
- 24/7 Remote Monitoring & Notification Service

TES Utility Benefits



Behind-the-Meter Storage

- DER opportunity for aggregation
- Benefits resemble Front-of-the-Meter



Shift More Commercial Load for Longer

- Shift up to 500kW or more per facility for 13 hours
- Hundreds of thousands of facilities in US



Efficiently Store Renewable Energy

- Store energy any time of day
- No round-trip losses



Flatten Renewable Variability & the “Duck Curve”

- Release energy any time of day
- Delay commercial solar customers’ re-entry to the grid

Questions?

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