ted

AI Optimization
for Energy Savings & Demand Reduction in Refrigeration Systems

Technology Early Deployment
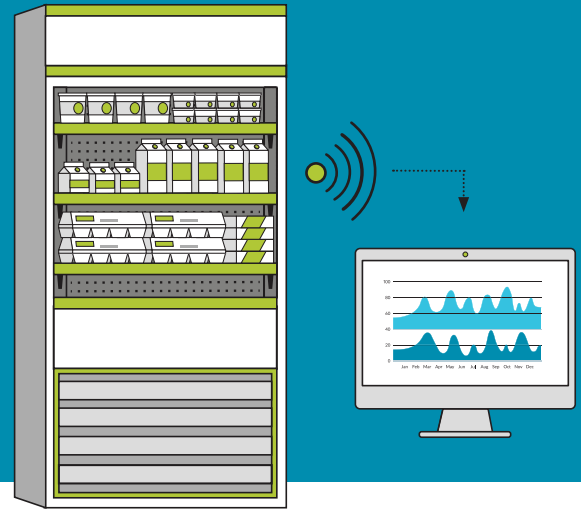
Grid Fruit

Grid Fruit utilizes artificial intelligence (AI) designed to enhance refrigeration control in convenience stores, supermarkets, and wholesale warehouses, resulting in lower energy use and reduced electricity demand. Their approach utilizes existing refrigeration data streams and utility electricity pricing to optimize operations on a monthly basis, using a Software-as-a-Service subscription model. Grid Fruit is currently expanding their energy management platform to coordinate refrigeration control with other store loads such as HVAC, lighting, rooftop solar, and EV charging.
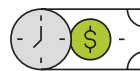
TECHNOLOGY BENEFITS
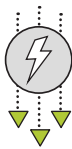
REDUCE DEMAND through optimized operations.

DECREASE GHG EMISSIONS by utilizing more renewables.

REDUCE ENERGY COSTS by aligning usage with TOU pricing.

SCALE SAVINGS through chain-based customer acquisition.

Disclaimer: Grid Fruit's AI Technology was chosen for TED because it supports **California's clean energy goals** of increased energy efficiency, reduced GHG emissions, energy storage capacity and demand flexibility. This document does not constitute or imply endorsement, recommendation, or favoring by EPRI or SCE of the product or company described herein. This publication is funded and administered by Southern California Edison's Emerging Technologies Program.
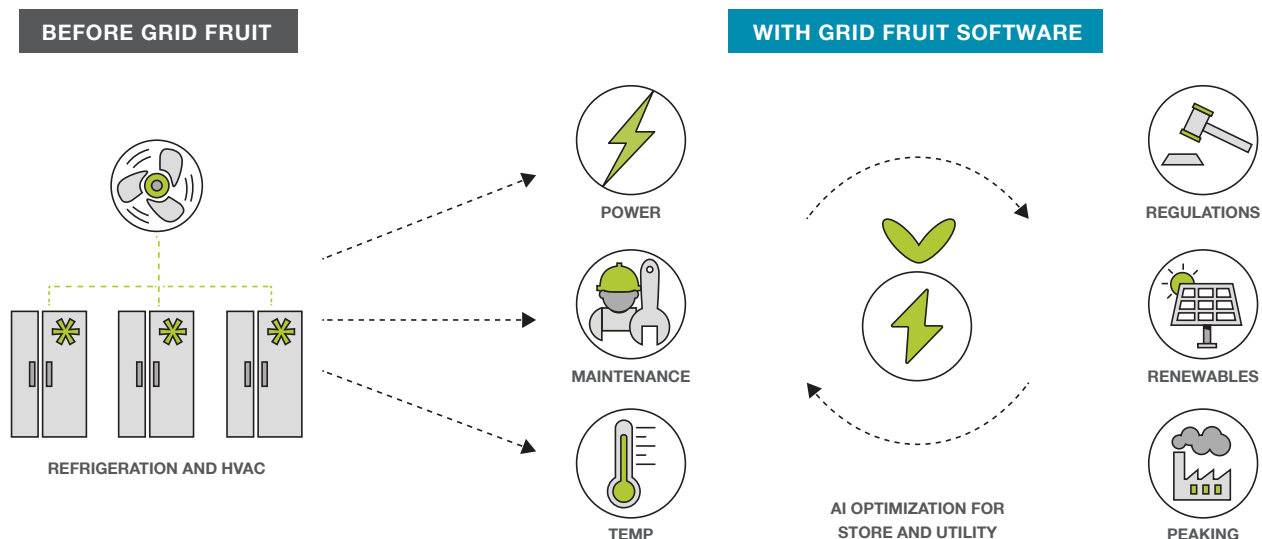
Watch a video
youtu.be/aDlTRN7975A

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Grid Fruit artificial intelligence optimizing software

BEFORE GRID FRUIT

REFRIGERATION AND HVAC

WITH GRID FRUIT SOFTWARE

POWER

MAINTENANCE

TEMP

AI OPTIMIZATION FOR
STORE AND UTILITY

REGULATIONS

RENEWABLES

PEAKING

Grid Fruit builds digital twins* based on physics and existing data to model the building envelope and energy-intense equipment at the site, including refrigeration, lighting, and HVAC. These models guide the implementation of refrigeration control strategies, protecting food quality while optimizing for cost savings and peak demand reduction, among other potential objectives. The primary strategy for cost and demand savings that has been demonstrated to-date is timing of refrigeration defrost cycles, which does not affect food quality or jeopardize food inventory. The AI-based optimization is performed using existing data from the refrigeration system, building energy consumption, local weather, and utility rate structures.

*Digital twins are digital models/simulations that were used to identify the savings opportunities.

ESTIMATED TECHNOLOGY POTENTIAL

4%-15%
REDUCTION
in peak demand per store.

up to
20%
REDUCTION
in refrigeration demand per store.

5%-15%
REDUCTION
in on-peak demand per store.

up to
15%
REDUCTION
in GHG emissions per store.

5%
ENERGY SAVINGS
per store.

5%-15%
ENERGY COST SAVINGS
per store.

TARGET CUSTOMERS

✓ Existing convenience stores, supermarkets, wholesale stores.

✓ Packing, shipping & distribution warehouses.

✓ Utilities.

HARDWARE COMPATIBILITY

✓ Capable of leveraging existing hardware sensors and data streams.

SOFTWARE FEATURES

ENERGY USE OPTIMIZATION

PERCENTAGE-BASED COST SAVINGS

DEMAND REDUCTION

DATA INTEGRATION

UTILITY REBATE APPLICATION

PORTFOLIO SCALE

TOU RATE OPTIMIZATION

California's decarbonization challenge

California's executive order B-55-18 mandates that the state achieve carbon neutrality by 2045. Additional legislation supports this goal through multiple strategies that include double energy savings by 2030 (SB 350), increased demand flexibility (19-OIR-01), advanced energy storage and 100 percent of all retail electricity from renewable energy (SB 100). Applying these strategies to new construction and upgrades to existing buildings provides a path to achieving carbon neutrality but also comes with a new set of challenges:

1.

New technologies for buildings

must support desired outcomes for CA.

2.

Testing, compliance & standards

including utility participation and enabled workforce.

3.

Establishing trust

that replacement of old systems will meet/exceed performance expectations.

GRID FRUIT SUPPORTS CALIFORNIA'S DECARBONIZATION GOALS

ENERGY, GHG, & DEMAND
reduction.

SCALABLE SAAS SOLUTION
to optimize refrigeration systems.

AI OPTIMIZATION OF OPERATIONS
to increase demand flexibility.

Addressing market barriers and opportunities for deployment in commercial buildings

Refrigeration systems across convenience stores, supermarkets, and wholesale warehouses present real potential for energy savings, demand reduction, reduced GHG emissions and cost savings for customers. Grid Fruit is piloting in California to identify potential deployment opportunities and barriers.

MARKET SIZE

- ✓ Beach-head: **100 stores.**
- ✓ Serviceable available market: **7000 stores.**
- ✓ Total addressable market: **$24B/year** US Market.

CURRENT STRATEGY

- ✓ Low-cost chain-based customer acquisition.
- ✓ Tech & UI build-up for scalability.

LEVERAGE POINTS

- ✓ DOE SBIR and other funding.
- ✓ EPRI Collaboration.

FUTURE STRATEGY / COMPANY GOALS

- ✓ Additional features that integrate additional store loads such as HVAC, lighting, rooftop solar, and EV charging.
- ✓ Build relationships for additional customer acquisition.
- ✓ OEM Licensing.
- ✓ Tech & UI build-up for scalability.
- ✓ Expansion to Supermarkets, Discount Stores, Wholesal.
- ✓ Multi-supermarket pilot.
- ✓ Additional hiring.
- ✓ Scaling through US & Europe.

Market readiness

8
TECHNOLOGY
READINESS LEVEL
SCORE

> Software has been demonstrated on multiple sites.

> Additional features for other store loads such as HVAC, lighting, rooftop solar, and EV charging not yet ready.

1-2
YEARS
TO MARKET

> Multi-scale supermarket pilot demonstrations, tech and UI build-up, and hiring needed.

> **2024-2025**
Expected to scale in the US by 2024 and Europe by 2025.

8
MANUFACTURER
READINESS
LEVEL SCORE

> Software has been deployed to multiple sites, but additional tech and UI has to be built for scale-up.

6
KEY
OUTCOMES

> **PEAK DEMAND**
4%-15% reduction.

> **REFRIGERATION DEMAND**
Up to 20% reduction.

> **ON-PEAK DEMAND**
5%-15% reduction.

> **GHG EMISSIONS**
Up to 15% reduction.

> **ENERGY SAVINGS**
5% per store.

> **ENERGY COSTS**
5%-15% reduction.

Supporting utility goals for decarbonization

Grid Fruit AI Software supports utility goals through C&S alignment, meeting 2020 Load Management Rulemaking (19-OIR-01) for increased demand flexibility. Per-store performance data show the software reduces energy consumption by ~5%, reduces GHG emissions by up to 15%, reduces monthly peak demand by 4% -15% and reduces utility on-peak demand by 5% - 15%. It is estimated that up to 20% of refrigeration demand can also be reduced.

Case study

Grid Fruit's AI optimization software was deployed across 27 retail chain stores in Southern California Edison's service territory

Energy savings associated with time-of-use pricing and annual demand charges

	ANNUAL TIME-OF-USE CHARGE	ANNUAL DEMAND CHARGE	STORE BENEFITS ANNUAL ELECTRICITY CHARGE
Cost of present operations (USD)	$9.23M	$5.46M	$14.69M ($544K/store)
Cost of optimal operations (USD)	$9.16M	$4.89M	$14.04M ($520K/store)
Reduction (USD) **Present > Optimal**	$70K	$570K	$643K ($24K/store)
Reduction (%) **Present > optimal**	0.8%	10.5%	4.4%

Monthly peak demand reduction
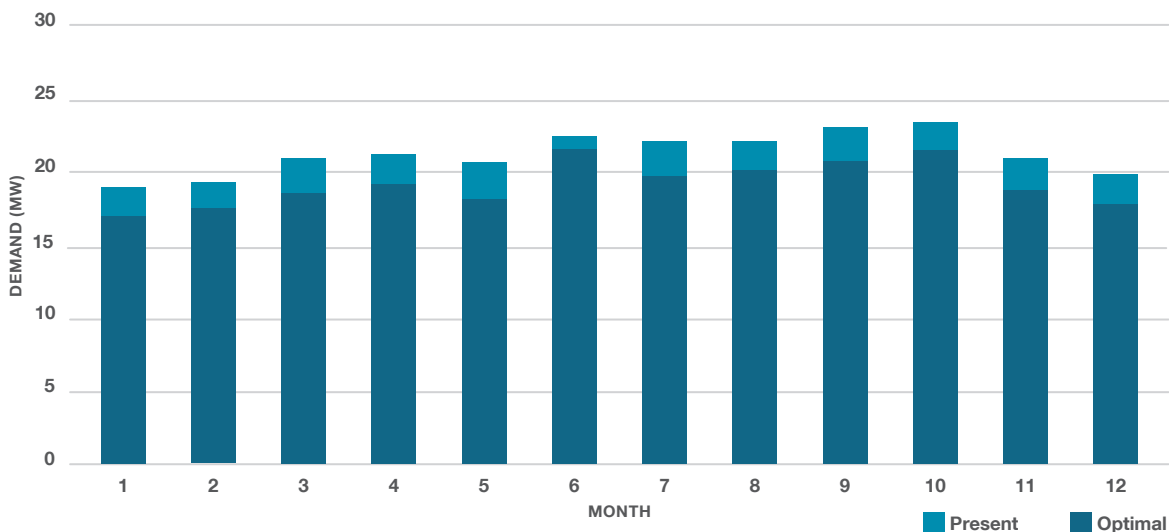
Grid Fruit Roadmap

PRODUCT READINESS LEVELS

TECHNOLOGY READINESS LEVEL (TRL)
Score: 8
Software has been demonstrated on multiple sites.

MANUFACTURER READINESS LEVEL (MRL)
Score: 8
Software has been deployed to multiple sites, but additional tech and UI must be built for scale-up.

TIME TO COMMERCIALIZATION
Years: 1-2
Multi-scale supermarket pilot demonstrations, tech and UI build-up, and hiring needed. Expected to scale the US by 2024 and Europe by 2025.

POTENTIAL INDUSTRY IMPACT
Rating: Transformational Energy Savings, Energy Storage and Demand Flexibility for refrigeration systems.

CURRENT STATUS AND ACTIVITIES

FUNDING
Output: DOE, SBIR, TVA/ORNL, Utility Rebates for Stores, Innovation Works.

2015-2017 CMU GRANTS AND PATENTS
Output: Patents Pending

PILOTS AND TEST BEDS
Output: 2017 NSF I-Corps Store Pilot, 2018-2019 PGH Testbed, 2020 SCE Utility Paid Pilot.

SELECTED FOR ORNL INNOVATION CROSSROADS COHORT 2019-2021
Output: Modeling and design feature optimization. Learning-Based Monitoring and Control for Optimizing Commercial Refrigeration Operations.

KNOWLEDGE INDEXES

TECHNICAL PERFORMANCE
Medium

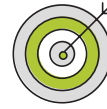**MARKET KNOWLEDGE**
Medium

PROGRAM INTERVENTION
Medium

UTILITY VALUE
- Meets 2020 19-OIR-01 for increased demand flexibility
- Reduces monthly peak demand by 4% - 15% and utility on-peak demand by 5% - 15% per store.

UTILITY TRAJECTORY PATH
- EE Operations (Energy Efficiency)
- DSM Operation & Technical Support (Op Efficiency)

COMPANY GOALS

EXPANSION
Supermarkets, Discount Stores, Wholesale Outlets
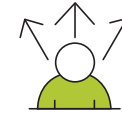
ADDITIONAL FEATURES
Store loads such as HVAC, lighting, rooftop solar, and EV charging.

GENERAL GOALS
- Build relationships for additional customer acquisition
- Additional hiring
- Tech & UI Buildout
- Pilot execution
- Scaling through US & Europe

CERTIFICATIONS
Seeking certification from OpenADR for scalability.

KEY STAKEHOLDERS

ELECTRIC UTILITIES
Host field sites, market electricity rates, TOU schedules.

EPRI
Testing and/or grant collaborator for measurement & verification projects.

SUPERMARKET/CONVENIENCE STORE/ETC. CHAIN OPERATORS
Site Access

REFRIGERATION SYSTEM OPERATORS
- Data acquisition
- Small Commercial Building advocates/customers.

UTILITY'S DESIRED OUTCOME

DEMONSTRATION PROJECTS
- Validate technology use case and saving potentials.
- Achieve kWh, kW, and GHG reduction goals.

PATH TO ADOPTION
- Reliable commercial partners and customer adoption channels.
- Commercially available to end users.
- Pathway into Utility Programs (Non-wires alternatives; DER; Energy Efficiency as a Service.

MEET CA GOALS
- Meet zero net carbon emission goals with minimal impact to ratepayers.
- Increase grid reliability.