



Achieving Energy Savings with the Advanced Refrigeration Controls Pilot

Unlocking flexible, software-driven load reduction in one of the highest energy consuming sectors

Importance of Industrial Energy Savings

A photograph of an industrial facility, likely a power plant or refinery, featuring a complex network of large, silver-colored pipes and machinery. In the foreground, several large, blue-painted industrial motors or pumps are mounted on a concrete base. The background shows a large, multi-story industrial building with various structures and pipes extending upwards. The sky is blue with some white clouds.

Why Industrial Load Matters

- Energy use is 2-3 times more intense than commercial buildings
- Core processes drive the majority of industrial energy consumption

Gap in Existing Industrial Offerings

- Portfolios have historically focused on: **Lighting**
- Refrigeration is a big gap

Why Refrigeration

- One of the largest industrial energy loads
- Operates with inherent thermal flexibility
- Unique opportunity for energy efficiency and peak demand reduction

Closing the Industrial Refrigeration Energy Gap

Cold storage and food processing facilities operate continuously and are highly sensitive to temperature control — making traditional efficiency approaches challenging.

Three thermal energy storage (TES) strategies evaluated:

- Thermal Mass – Uses existing frozen product to act as storage medium
- Phase Change Material (PCM) – Adds specialized materials to increase on-site thermal storage capacity
- External Storage – Separate ice/brine tanks for load shifting thermal energy

Advanced refrigeration controls are required to unlock energy savings across all thermal energy storage



Thermal Mass + Advanced Controls



Phase Change Materials (PCM)



External Storage

Advanced Refrigeration Controls (ARC) System Overview

What it is

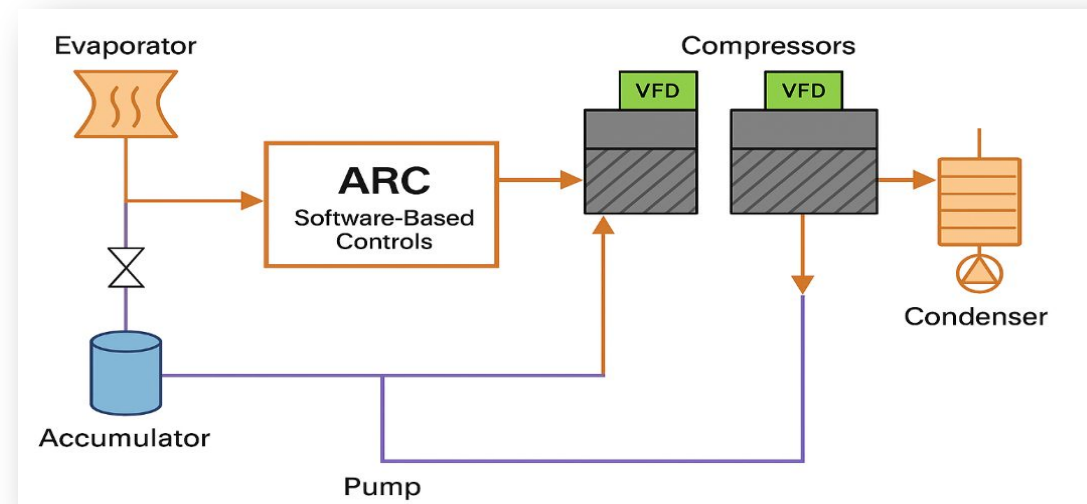
- Software-driven control system that overlays the existing refrigeration system to optimize compressor sequencing and system performance

How it works

- Interfaces with compressor controls (slide valve, VFDs, pressure sensors)
- Optimizes compressor sequencing, by prioritizing full load operation on the most efficacy compressors
- Overcools product during off-peak hours
- Reduces compressor load during peak
- Maintains safe temps using predictive control

Why this is effective

- No hardware changes needed
- Easy to deploy
- Reduces unnecessary compressor cycling, supporting longer equipment life
- Enables load shift and demand response cost-effectively



Implementation

1 Site Selection & Engagement

- Large cold storage site 700,000 sq ft was selected due to its large freezer footprint, high baseline energy use, and flexibility in temperature ranges
- Facility has two engine rooms, with over 3,100 tons of combined compressor capacity

3 Technology Integration

- Site underwent a site walk through, with a control point evaluation
- Once the control points were determined, the selected vendor installed the ARC platform, integrating with the existing compressors, VFD controlled condensers, and suction instrumentation

2 Commissioning & Optimization

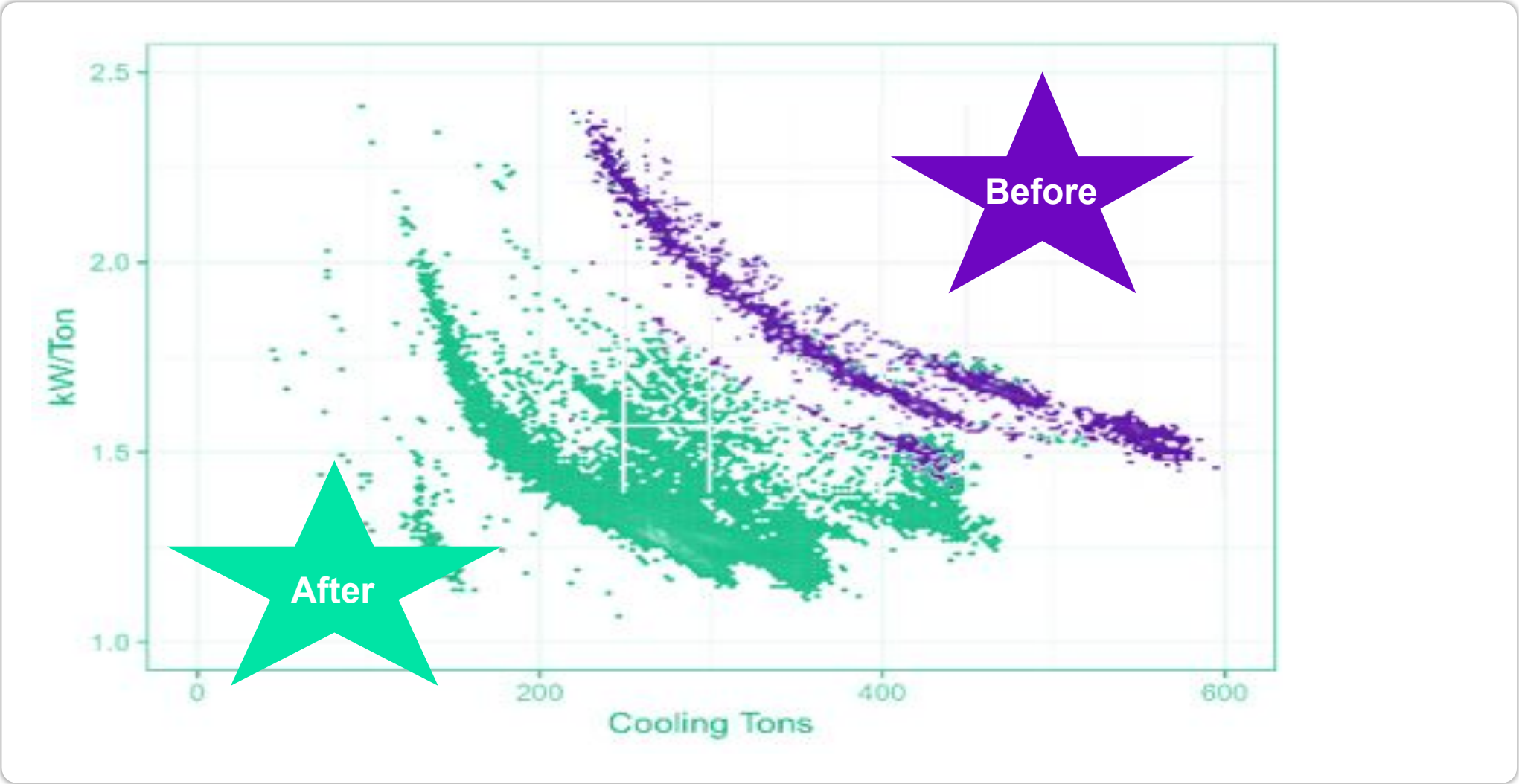
- Validated compressor operation and data using measurements from ARC platform , alongside load curves and remote connectivity
- Activated the demand stabilization application, allowing the ARC platform to reshape load profiles and communicate signals to control the compressor sequencing

4 Monitoring, M&V

- Post installation monitoring ran for one year
- Performance-based M&V model was created, to compare the pre- and post- ARC implementation

Refrigeration Efficiency Before and After ARC Optimization

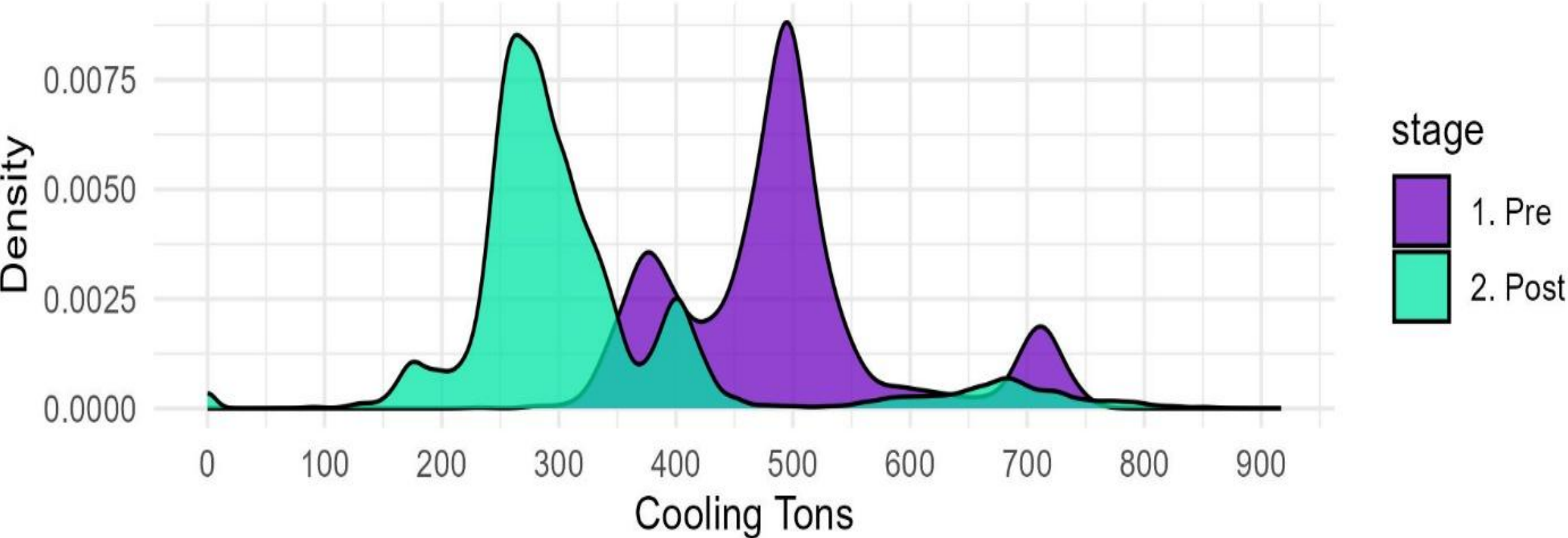
How much power the compressor uses



How much cooling the facility needs

Refrigeration Efficiency Before and After ARC Optimization

Cooling Tons: Pre- vs Post-Installation Density Plot



Results

Demonstrated Impact at Pilot Industrial Cold Storage Site

4.3 GWhr

Annual Energy Savings

22% Peak Reduction
Demand

\$270k

Annual Bill Savings



Equivalent to Powering
413 Homes Annually

Next Steps

Building off pilot success to scale potential energy savings across target refrigeration customers

Customer Expansion



Targeted Focus on customers meet the following:

- **Large Freezer Footprints**
- **Flexible temperature ranges**
- **Modern or retrofit-ready refrigeration Systems**

Technology Verification



- **Evaluation additional ARC technology Vendors**
- **Confirming scalability, interoperability, and performance consistency**