

The Axiom Cloud™

Artificial Intelligence for Refrigeration Systems

NASRC “Shark Tank” Presentation

January 2020



Artificial Intelligence (AI) is transforming industries



MECHANICAL
Rotary phone



DIGITAL
Flip phone



INTELLIGENT
iPhone

Examples of AI reducing risk and saving money



Aviation

Airbus uses Runway Overrun Protection to alert pilots in real-time of unsafe landing approaches



Power generation

Google is using AI to improve the value of the wind energy by 20% over a baseline



Automotive

By 2025, AI is expected to provide \$173B in cost savings across the entire automotive OEM supply chain



Agriculture

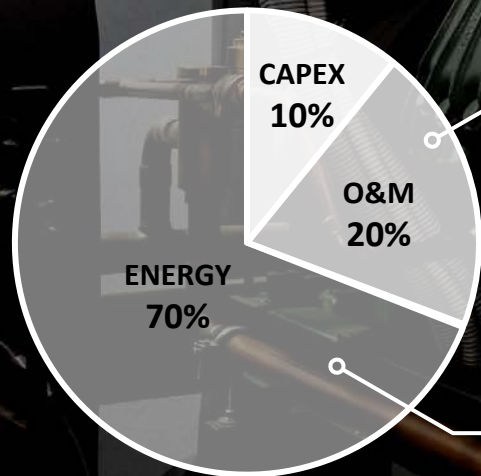
AI & data analysis are “giving the agricultural community a high-tech boost.” - NYTimes

Refrigeration is an excellent candidate for AI

Expensive to operate, critical to food safety, yet relatively untouched by modern software



20 Year Life-cycle Cost Of a Central Refrigeration System*



MAINTENANCE CHALLENGES

- Unplanned downtime
- Refrigerant leaks / compliance
- Technician shortage
- Too many alerts

ENERGY CHALLENGES

- Big energy consumer
- Increased electricity price volatility
- Changing utility programs / schedules
- Little visibility to impact on utility bills

*Typical grocery store in California; does not include display case costs

What can AI do for your refrigeration system?



Lower electric bills



Capture grid revenue



Decrease maintenance
spend



Reduce unplanned rack
outages



Save time on
repetitive tasks / alerts

Introducing the Axiom Cloud AI for Refrigeration Systems

HARDWARE
Onsite Gateway



SOFTWARE
Cloud-based AI
Engine

Quick deployments | Portfolio-wide applicability | <1yr payback



Rapidly deploy to your entire portfolio

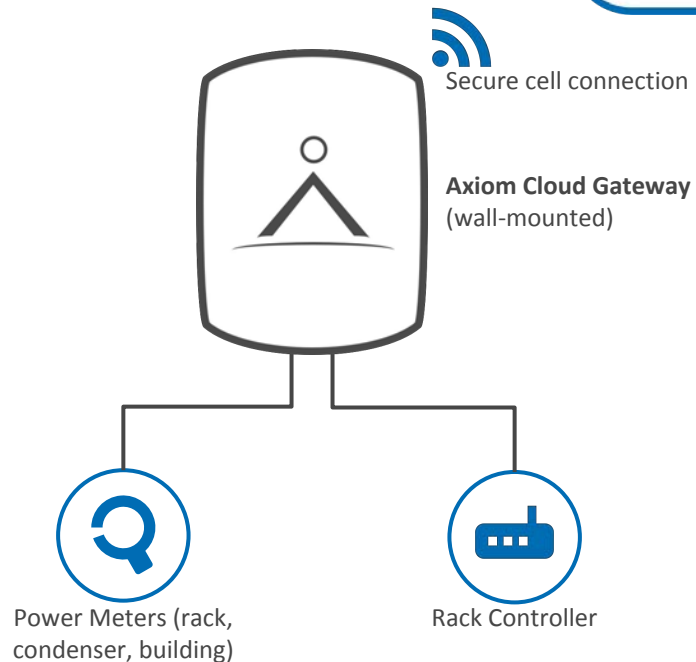
Installed & operational in 1 day

Minimal hardware

Retrofit or new sites

The services we offer

- Virtual Battery™
- Virtual Technician™

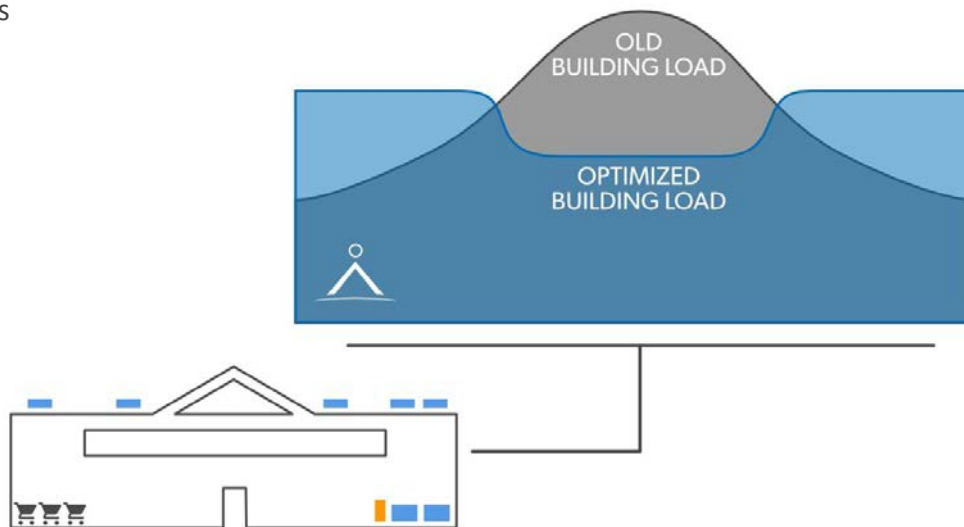


Virtual Battery

- Benefits of a battery without the expensive hardware
- Predictively pre-cool the low temp. refrigeration system
- Intelligently load shed the compressors and condensers

Results:

- Lower utility bills
- Generates demand response revenue
- Actively shape the buildings power curve
- Respond to changing utility programs

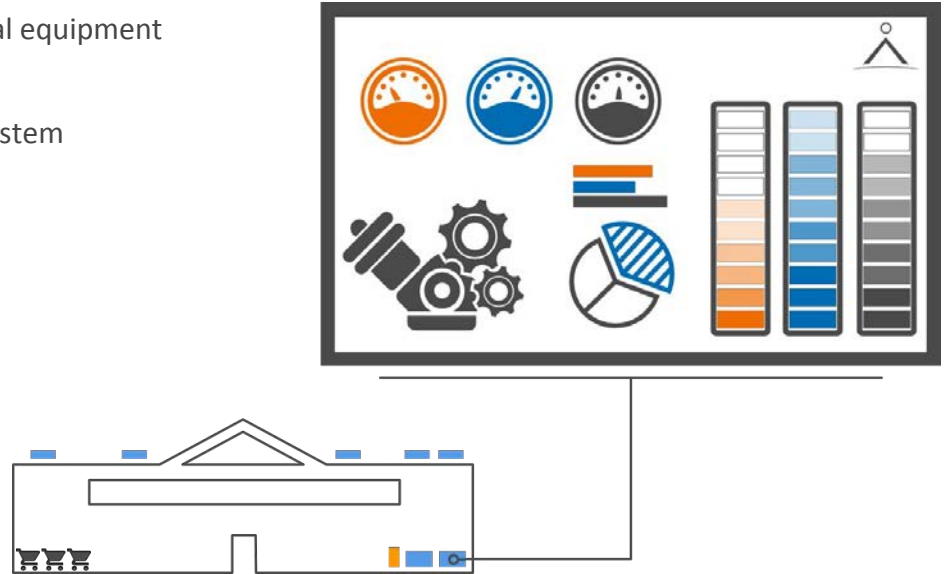


Virtual Technician

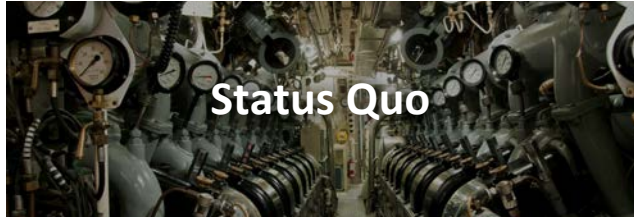
- Like having a technician with a data science degree looking over your system 24/7
- Predictive maintenance: identify and diagnose potential equipment failures before they occur
- Ongoing retrocommissioning: continuously optimize system efficiency to reduce energy consumption

Results:

- Decreased maintenance costs
- Reduced equipment outages
- Reduced refrigerant leak rates
- Increased system energy efficiency



Axiom will transform your refrigeration system



Electric Bills

Victim: accept as is

Ninja: actively manage

Grid Revenue

None

Generate thousands of \$ / year

Retrocommissioning

Manual, every 3+ years

Continuous, automated

Maintenance

React as needed

Predict, plan, prevent

Alerts

Ignore / react

Filter → auto-response

Performance Analysis

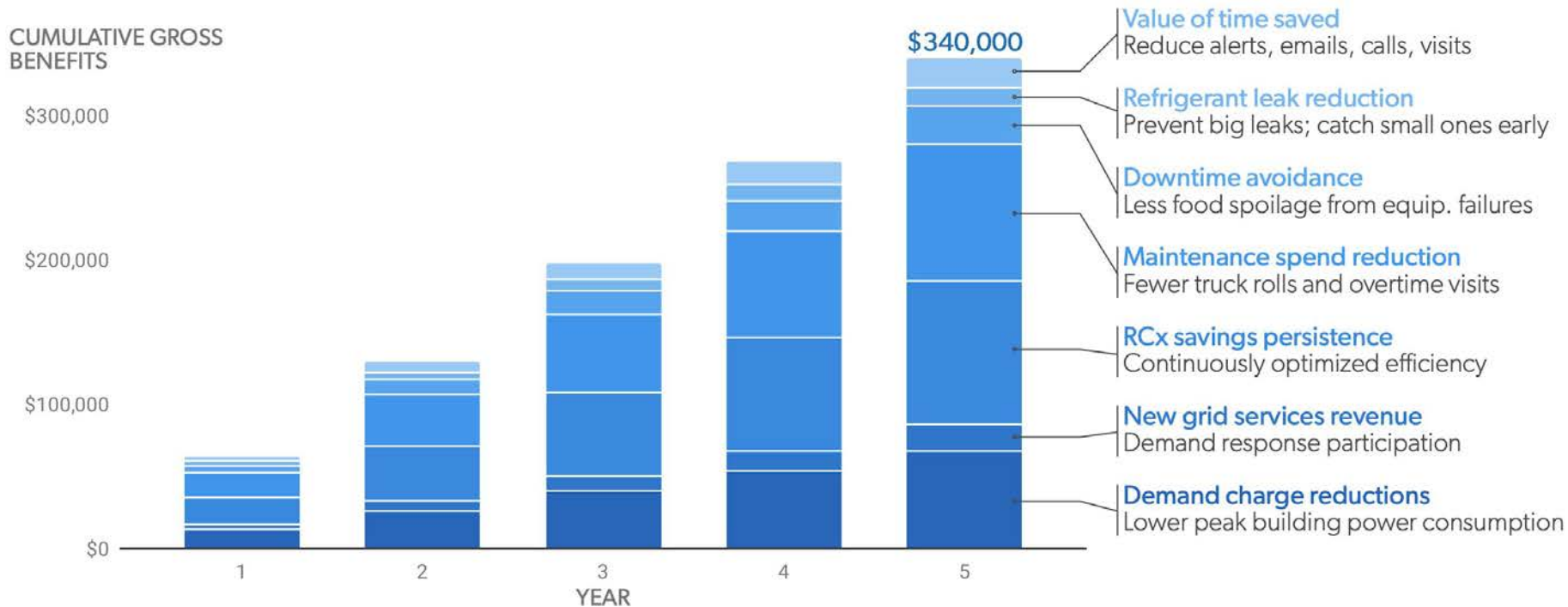
Extract, download, analyze

Autonomous with machine learning

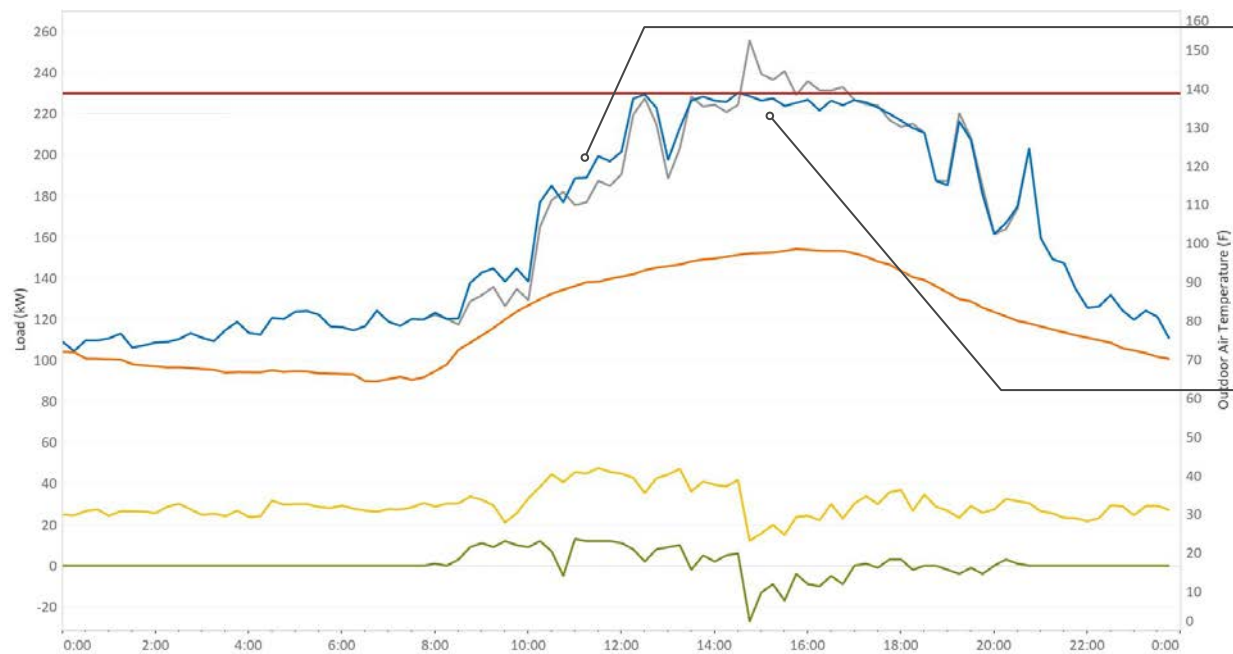


Value of the Axiom Cloud

Benefits for a typical Supermarket in California



Virtual Battery Example



Building Actual Power | Building Baseline Power | Refrigeration Power
Axiom Cloud Offset | OAT (°F) | Daily Building Target

Intelligent Precooling

- Lowers the temperature of the specified cases
- Increases the load on the refrigeration system
- Does not exceed system capacity or demand thresholds

Load Shedding

- Modulates compressors and EPRs to lower the building's load
- Case temperatures gradually come back up to setpoints

Results

- 28 kW peak demand reduction
- 55 kWh of flexible capacity
- \$1,322 total benefit for the month



Axiom Cloud delivering results (case studies)

AXIOM CLOUD™: AI FOR REFRIGERATION
Virtual Battery™ Case Study - Energy Bill Management

OPPORTUNITY
Customer was facing rising energy costs and needed a solution to manage their energy bill. Axiom Cloud's AI for Refrigeration Virtual Battery™ was implemented to optimize energy usage and reduce costs.

SOLUTION
Axiom Cloud's AI for Refrigeration Virtual Battery™ was implemented to optimize energy usage and reduce costs. The solution includes a cloud-based platform that monitors and controls refrigeration systems in real-time.

RESULTS
The solution resulted in a 15% reduction in energy costs and a 10% increase in system efficiency. The customer also achieved a 5% reduction in carbon footprint.

Customer: Westgrove, Raleigh, North Carolina, USA

Key Features:
• Cloud-based platform
• Real-time monitoring and control
• AI-driven optimization

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Virtual Battery
Energy Bill Management

AXIOM CLOUD™: AI FOR REFRIGERATION
Virtual Battery™ Case Study - Grid Services Event

OPPORTUNITY
Customer was facing a grid services event and needed a solution to manage their energy usage. Axiom Cloud's AI for Refrigeration Virtual Battery™ was implemented to optimize energy usage and reduce costs.

SOLUTION
Axiom Cloud's AI for Refrigeration Virtual Battery™ was implemented to optimize energy usage and reduce costs. The solution includes a cloud-based platform that monitors and controls refrigeration systems in real-time.

RESULTS
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Virtual Battery
Grid Services / Fleet DR

AXIOM CLOUD™: AI FOR REFRIGERATION
Virtual Technician™ Case Study - Retail Grocery - Compressor Floodback

OPPORTUNITY
Customer was facing a compressor floodback issue in their retail grocery store. Axiom Cloud's AI for Refrigeration Virtual Technician™ was implemented to detect and prevent the issue.

SOLUTION
Axiom Cloud's AI for Refrigeration Virtual Technician™ was implemented to detect and prevent the issue. The solution includes a cloud-based platform that monitors and controls refrigeration systems in real-time.

RESULTS
The solution resulted in a 15% reduction in energy costs and a 10% increase in system efficiency. The customer also achieved a 5% reduction in carbon footprint.

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Virtual Technician
Compressor Floodback

AXIOM CLOUD™: AI FOR REFRIGERATION
Virtual Technician™ Case Study - Condenser Fan Failure

OPPORTUNITY
Customer was facing a condenser fan failure issue in their retail grocery store. Axiom Cloud's AI for Refrigeration Virtual Technician™ was implemented to detect and prevent the issue.

SOLUTION
Axiom Cloud's AI for Refrigeration Virtual Technician™ was implemented to detect and prevent the issue. The solution includes a cloud-based platform that monitors and controls refrigeration systems in real-time.

RESULTS
The solution resulted in a 15% reduction in energy costs and a 10% increase in system efficiency. The customer also achieved a 5% reduction in carbon footprint.

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Virtual Technician
Condenser Fan Failure

AXIOM CLOUD™: AI FOR REFRIGERATION
Virtual Technician™ Case Study - Compressor Malfunction Detection

OPPORTUNITY
Customer was facing a compressor malfunction detection issue in their retail grocery store. Axiom Cloud's AI for Refrigeration Virtual Technician™ was implemented to detect and prevent the issue.

SOLUTION
Axiom Cloud's AI for Refrigeration Virtual Technician™ was implemented to detect and prevent the issue. The solution includes a cloud-based platform that monitors and controls refrigeration systems in real-time.

RESULTS
The solution resulted in a 15% reduction in energy costs and a 10% increase in system efficiency. The customer also achieved a 5% reduction in carbon footprint.

Customer: Westgrove, Raleigh, North Carolina, USA

Key Features:
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Virtual Technician
Compressor Failure



THANK YOU



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