Energy Conservation Strategies

Demand Control, Refrigeration Optimization & Metering Impact for a 10,000 kW Wisconsin CPG Facility

WPS Schedule CP2 · 2026 Rate Year · 61.3M kWh Annual Consumption



Facility Energy Profile & Refrigeration Load

WPS Schedule CP2 · Large Commercial & Industrial · Wisconsin

10,000 kW

PEAK DEMAND

WPS Cp Large Commercial & Industrial rate

61.3M kWh

ANNUAL ENERGY CONSUMPTION

~70% load factor, 8,760 hrs/yr

60–70%

REFRIGERATION SHARE

Compressors, condensers, evaporators, glycol loops

$5.2M+

EST. ANNUAL ELECTRIC COST

Demand + energy charges at secondary metering rates

Refrigeration systems dominate the load profile — compressor staging, condenser fan control, and defrost scheduling are the highest-impact levers for demand reduction.

OPTIMIZATION PLAYBOOK

Demand Control & Refrigeration Optimization Strategies

VFDs on Compressors & Condensers

Variable-frequency drives reduce compressor and condenser fan energy 20–35% by matching motor speed to real-time load rather than cycling on/off.

Load Staggering & Sequencing

Offset startup of large compressors, defrost cycles, and process loads to shave 500–1,500 kW off coincident peak demand during WPS on-peak windows (7 AM–11 PM summer).

Floating Head Pressure Control

Lower condensing pressure when ambient temps allow — each 1°F reduction in condensing temp saves ~1.5% compressor energy. Wisconsin winters offer 5+ months of free subcooling.

Thermal Energy Storage (TES)

Build ice or chilled-water storage during off-peak hours ($0.03678/kWh primary) and discharge during on-peak ($0.06253/kWh) — shift load and cut peak demand charges.

Real-Time Energy Management System

Deploy EMS with demand limiting and load-shed algorithms. Trigger automated curtailment when demand approaches 15-minute interval peak — protect against ratchet clause (trailing 11-month max).

Condenser & Evaporator Maintenance

Clean condensers, replace degraded evaporator fans, and maintain proper refrigerant charge. Fouled condensers increase head pressure 10–15%, raising compressor energy proportionally.

$ Financial Impact: Primary vs. Secondary Metering

WPS Schedule Cp · 10,000 kW facility · 70% load factor · 61.3M kWh/yr

CURRENT

Secondary Metering

Customer Demand	$2.291/kW → $22,910/mo
Summer Peak Demand	$24.018/kW → $240,180/mo
Winter Peak Demand	$13.343/kW → $133,430/mo
On-Peak Energy	$0.06442/kWh
Off-Peak Energy	$0.03789/kWh
Daily Customer Charge	$21.86

PROPOSED

Primary Metering

Customer Demand	$1.926/kW → $19,260/mo–$3,650	-$3,650
Summer Peak Demand	$23.483/kW → $234,830/mo–$5,350	-$5,350
Winter Peak Demand	$13.046/kW → $130,460/mo–$2,970	-$2,970
On-Peak Energy	$0.06253/kWh–2.9%	-2.9%
Off-Peak Energy	$0.03678/kWh–2.9%	-2.9%
Daily Customer Charge	$25.51+$3.65	+$3.65

~$184,000/yr estimated annual savings by switching to primary metering

Payback on switchgear & transformer investment: **1–3 years**. Combined with demand control strategies, total savings potential exceeds **$400K annually**.

Annual Cost Summary — CP2

WPS Schedule CP2 · 2026 Rate Year · 61.3M kWh Annual Consumption

> *"Refrigeration systems dominate the load profile — compressor staging, condenser fan control, and defrost scheduling are the highest-impact levers for demand reduction."*
> *"Source: WPS Schedule Cp, Eff. 01-01-2026, PSCW Order 6690-UR-128 – based on CP2 rate class"*

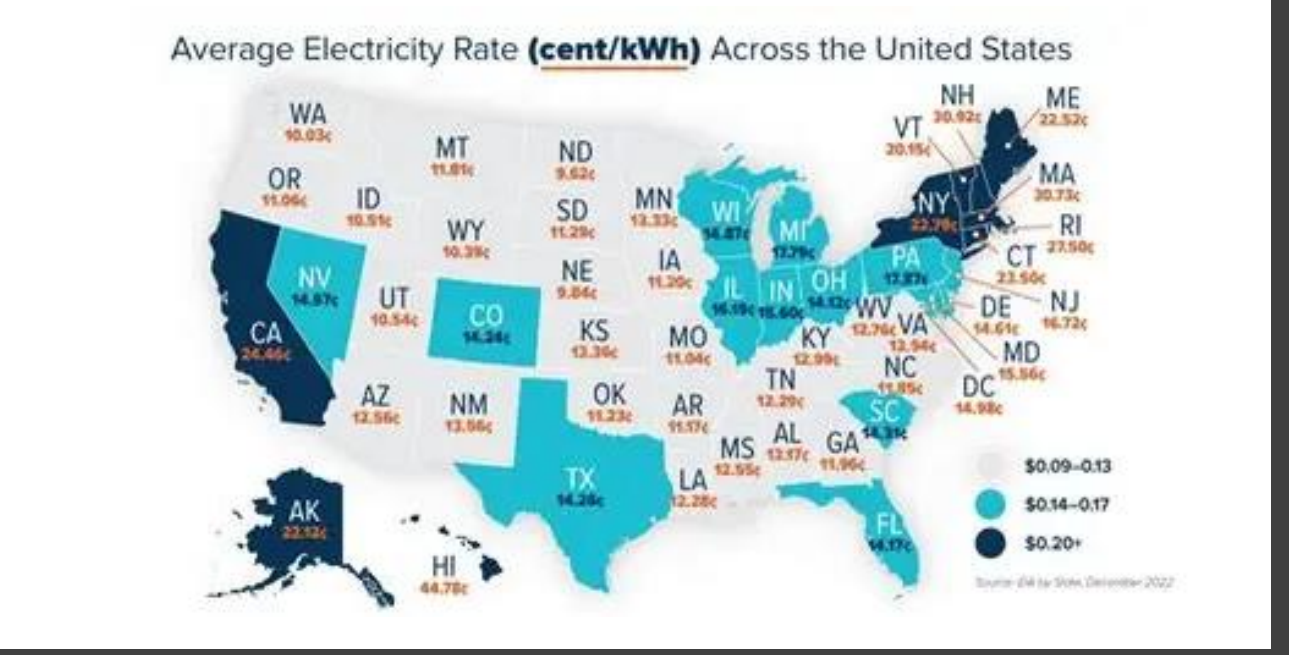
COMPONENT	AMOUNT (USD)
Energy (on + off)	$2,885,684
Demand charges (summer + winter + customer demand)	$1,771,296
Daily customer charge	$9,311
Estimated annual total	**$4,666,291**

Estimated annual total: $4.67M / year

- **Demand charges dominate** demand + customer demand ≈ 38% of total; energy ≈ 62%.
- **Ratchet risk:** a single 15-minute peak above 8,000 kW can raise monthly summer demand and trigger an 11-month ratchet, increasing bills for months.
- **Actionable levers:** demand control, VFDs, TES, and EMS can reduce peaks and protect against ratchet exposure.

Assumptions: 61.3M kWh/yr; 40% on-peak / 60% off-peak; 8,000 kW coincident demand; CP2 unit rates per WPS Schedule Cp (Eff. 01-01-2026).


LET’S TALK ENERGY COSTS!





US UTILITIES REQUESTED $31B IN RATE HIKES IN 2025 ALONE

NATIONAL AVERAGE AROUND ~9%

- Washington, D.C. → ~+30%
- Virginia → ~+26%
- Pennsylvania → ~+19–21%
- Maryland → ~+20%
- Indiana, Illinois, New Jersey → 15%+
  - PSEG NJ ELECTRIC 30%
- Maine → ~+17.6%

GAS PRICE SWINGS~56% from 2024 to 2025

WATER PRICES: +24% increase over last 5 years

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Manufacturing Utility Cost Reduction

Reduce total utility spend **10–25%** using proven, low-risk operational improvements—without disrupting production or requiring major capital investment.

Initiative Area	Typical Savings	Investment Level	Payback Period
Demand Management	5–15%	Low	Immediate–6 mo
Compressed Air Optimization	10–20%	Low–Medium	<12 months
Preventive HVAC Maintenance	5–10%	Low	Immediate
Motor & VFD Optimization	10–30%	Medium	12–24 months
Chilled Water Optimization	10–20%	Low–Medium	<12 months
Utility Bill Optimization	3–10%	Very Low	Immediate

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Manufacturing Utility Cost Reduction

Reduce total ut ithout
disrupting prod

EMIS and Optimization AI Platform



Initiative Area			ck Period
Demand Manag			diate–6 mo
Compressed Ai Optimization			onths
Preventive HVA Maintenance			diate
Motor & VFD Optimization			months
Chilled Water Optimization			onths
Utility Bill Optimization	3–10%	Very Low	Immediate

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IoT/AI About Knowledge, Visibility, and Going to Action!

Saving Upwards of 27%*...

"...**new urgency due to factors**

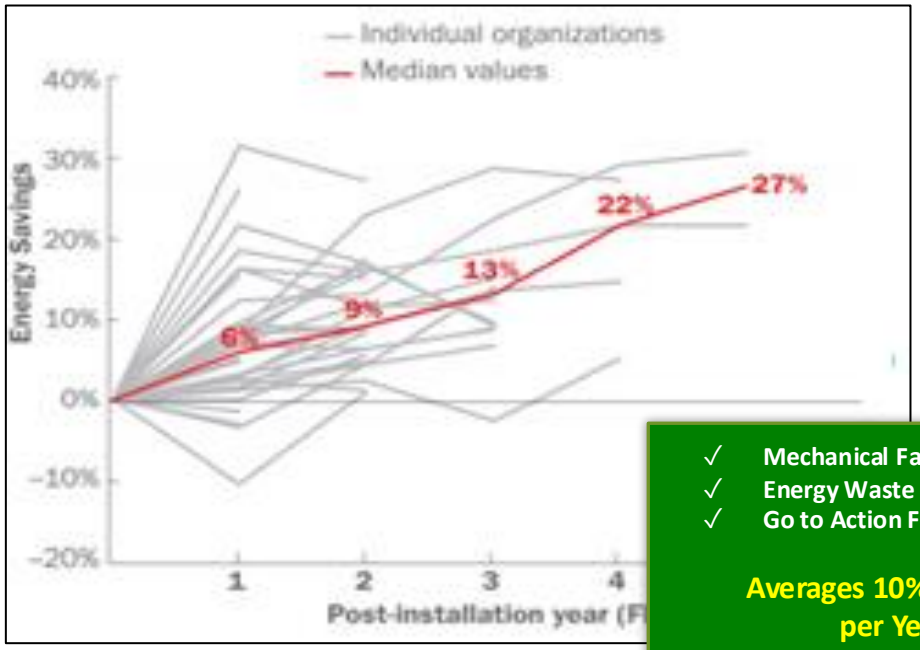
... higher reliability and integrated systems
... energy conservation
... new carbon emission goals
... safety and compliance

... leverage the new technologies

... IoT. big data, cloud computing
... AI and Machine Learning
... artificial intelligence

... benefits of

... saving energy cost
... reducing operational expenditures
... increasing occupancy comfort
... meeting regulations and compliance
... sustainability goals



- ✓ Mechanical Fault Detection
- ✓ Energy Waste Identification
- ✓ Go to Action Faster

Averages 10% to 20% per Year

Proving the Business Case for Analytics: Final Outcomes on Costs, Savings and Industry Trends from the Smart Energy Analytics Campaign
Hannah Kramer, Eliot Crowe, and Jessica Granderson
Lawrence Berkeley National Laboratory
October 28, 2020

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25% of Electric Costs Is YOUR Chilled Water Plant



Continuous M&V and ROI

Chilled Water System Fault Detection

- Non-functioning or Non-existing Temperature Resets
- Compressor Short Cycling
- Chiller Approach Temperatures
- Pump Control Optimization – On/Off/Runtime
- Loop Pressure Analysis
- Economizer Control
- Downstream Demand Detection (AHUs/RTUs)
- Cooling Tower Fan Controls
- Energy Waste Analysis

Advanced Machine Learning Optimization

- Dynamic Condenser Water Temperature Reset Algorithm
- Dynamic Condenser Water Flow Reset Algorithm
- Chiller Sequencing Strategy
- Chiller Stage Up & Down Demand Setpoints
- Dynamic Chiller Load Balancing Algorithm

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AI/ML FDD Systems Focused on Cost Reduction and Reliability



HVAC Ventilation and Cooling/Heat Control

15% to 20% Cost Reduction*

Advanced Fault Detection and Diagnostics (MBCx)

AHUs, RTUs, MAU, Heat Recovery

In Control Terminal Devices with Advanced ML Analytics



Chilled Water System and Boiler Plants

10% to 20% Cost Reduction*

>25% of Utility Consumption

Chillers, Boilers, Towers, Loops

Patented Machine Learning Optimization Analytics



Product/Process Environment Control

10% to 20% Cost Reduction*

Safety and Compliance

OR, ICU, Labs, Clean Rooms and Pharmacy

Advanced Air Optimization



Energy, Utilities, and GHG Monitoring

6% to 8% Cost Reduction*

Energy Consumption/Demand

Carbon and Gas Analysis

Equipment Energy Waste

Billing and Cost Analysis

Energy to Care and Utility Incentives

IoT/AI Advanced Visualization and Analytic Platform – FCX VOICE

***Average Realized Savings with FCX Analytics (Custom Analytics Available)**

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QUESTIONS

DISCUSSION

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