

APRIL 30
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2025



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U.S. DEPARTMENT
of **ENERGY**



Lessons From the Field: Best Practices for Advanced Rooftop Unit Controls

May 1, 2025

2:30 – 3:30 pm ET

Moderator: Jeff Wanner
Pacific Northwest National Laboratory

Agenda

1 Welcome and Introductions

2 Kimco Realty

3 Sheetz, Inc.

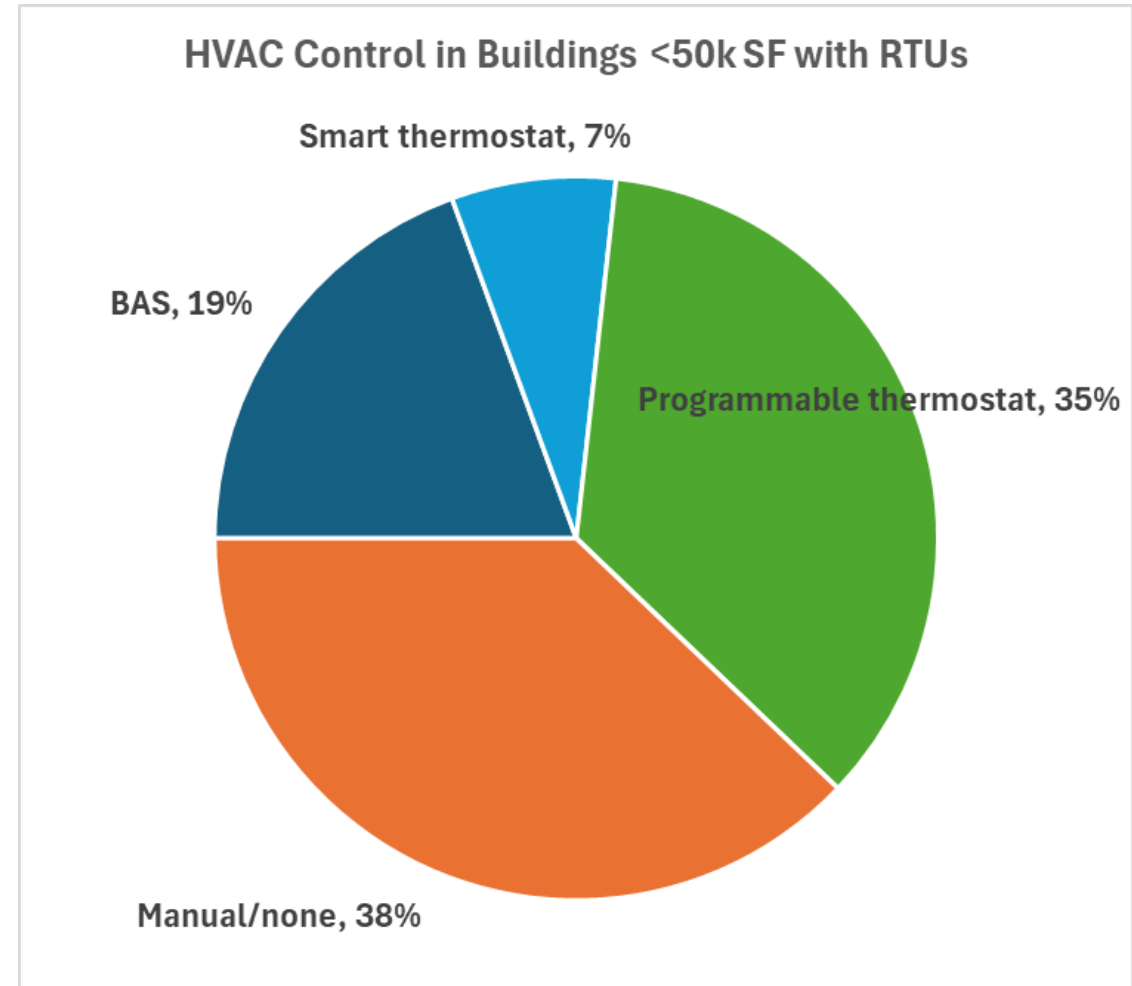
4 Closing and Q&A

HVAC Controls in Medium / Small Commercial Buildings

- 94% of commercial buildings are <50k SF
- RTUs serve ~60% of commercial floor space and account for 150 TWh of annual electrical usage, corresponding to 20% of total commercial building energy use.
- 73% use simple (programmable tstat) or manual HVAC control
- 1.9 million buildings with energy savings potential from better controls
 - Existing technology that can save 20 – 50% of HVAC energy

Multi-lab Observational Research to

Improve understanding of barriers associated with deployment of advanced RTU controls in small/medium commercial buildings.



Efforts to Support Successful Adoption

Barriers from Stakeholder Discussions

Owners

- Are unclear about the value of controls upgrades.
- Not confident that savings justify investment cost.
- Discouraged by complexity of incentive programs.

Installers

- Incentive programs require upfront expenditures to cover costs.
- Lack of familiarity with the technology.
- Small job scope, yet logistically complex to integrate new controls with existing equipment.

Installers



Update workforce training, best practices

Building Owners



Elevate concerns and motivations for installation

Occupants/Tenants



Address small commercial energy efficiency challenges

Property Managers



Establish maintenance practices and new lease structures

Technology Vendors



Improve product offerings and documentation

IT Professionals



Identify appropriate approach for networked tech solutions

Nathan Mitten

Kimco Realty

Kimco Realty – Background

- Own and manage diverse portfolio of retail shopping centers across the U.S. and Puerto Rico
- 101M SF of leased across 568 properties
- Founded over 65 yrs ago, public REIT on NYSE since 1991
- Focused on strategic growth in core metropolitan areas with long history of leadership in corporate responsibility and sustainability

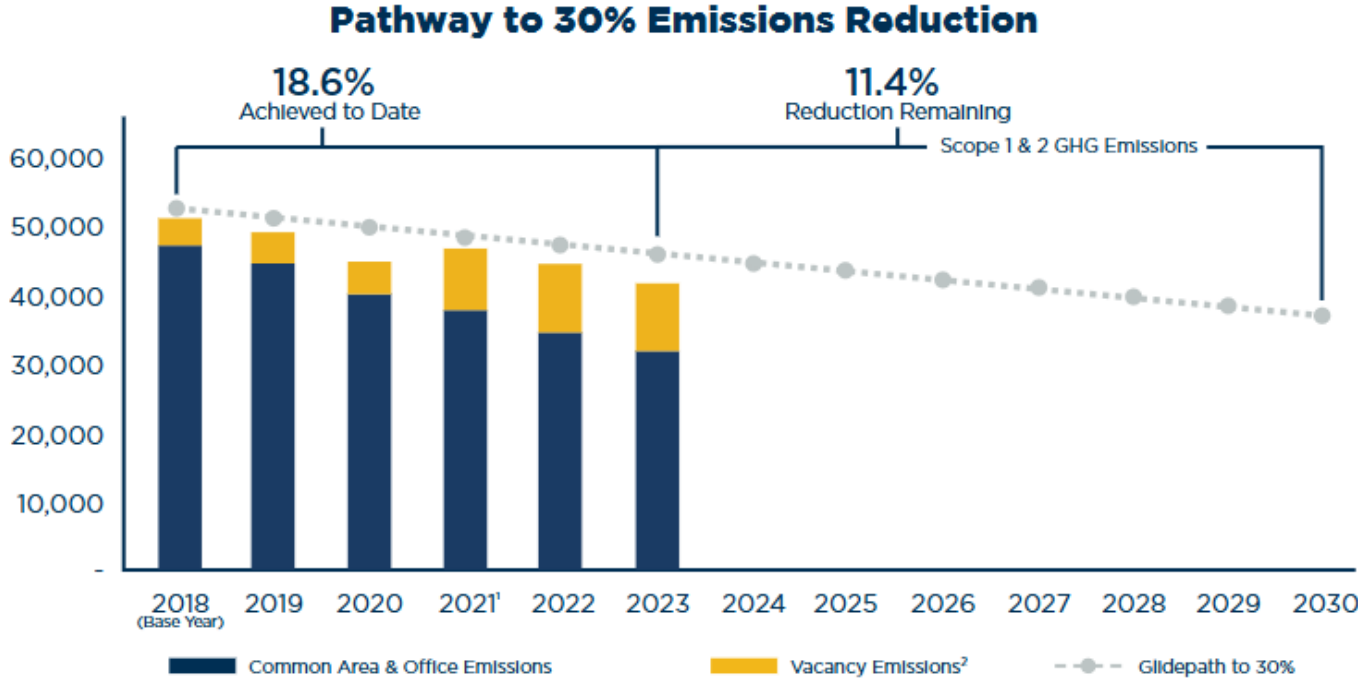


Anchor (10K+ SQFT)

Small Shop (<10K SQFT) **Top 50 Small Shop Tenants** ranked by Pro-rata ABR% are all National

Kimco Realty – Energy and Water Savings in the Exterior

- Outdoor LED lighting retrofit program (~500 completed, ~25-50% savings)
- Parking lot wireless dimming controls (~260 completed, ~15% additional savings)
- Rooftop solar (19 sites w/ 9 in progress)
- Smart irrigation controllers (~209 sites completed)



Kimco Realty – Challenges for Interior ECMs

- Triple-net lease creates split incentive - landlord pays for improvements, but tenants pay for utilities
- Changing the lease is complex and only renegotiated every 5-10 yrs
- Tenant spaces vary significantly across:
 - Use types
 - Construction types and building age
 - Applicable codes/requirements
 - Operational sophistication



Kimco Realty – Challenges for Interior ECMs

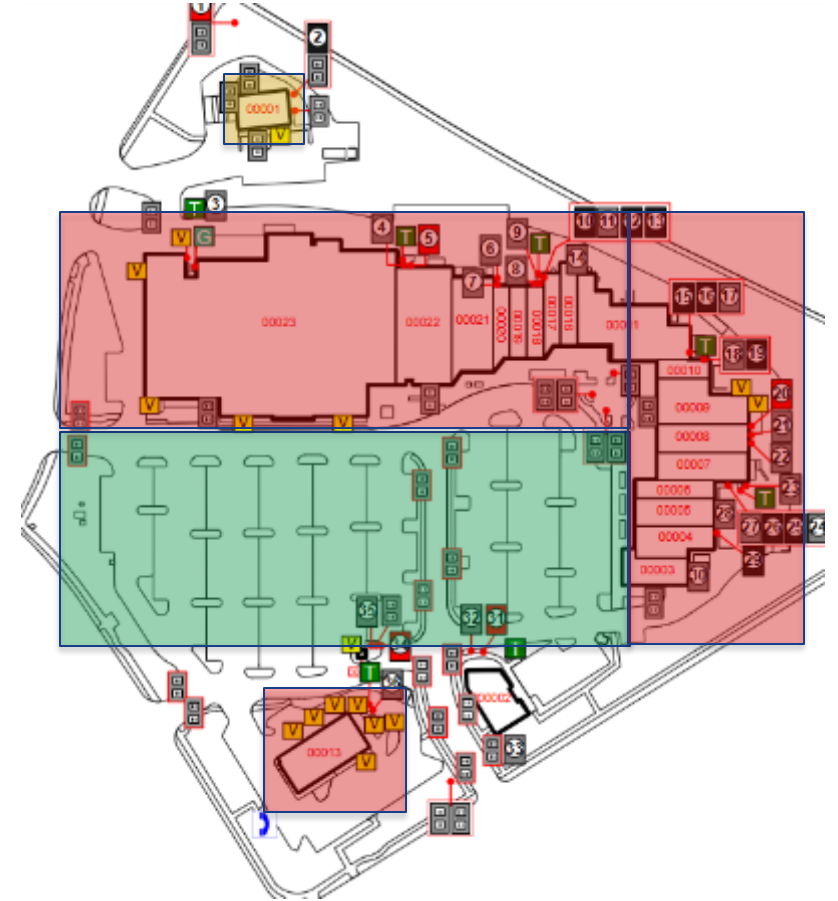
- Utility configuration:
 - Common area or “house” meter – landlord pays and bills to tenants based on their SF
 - Vacancy meter – landlord pays direct (temporarily)
 - Tenant meter – tenant pays direct
- Landlords avoid risk of disrupting tenant operations
- Intermittent vacancy reduces time to recoup investment
- Each space must be upgraded and operated independently, limiting economy of scale / shared infrastructure
- Small spaces- each with a small energy load- generally leading to lower ROI



Kimco Realty – Challenges for Interior ECMs

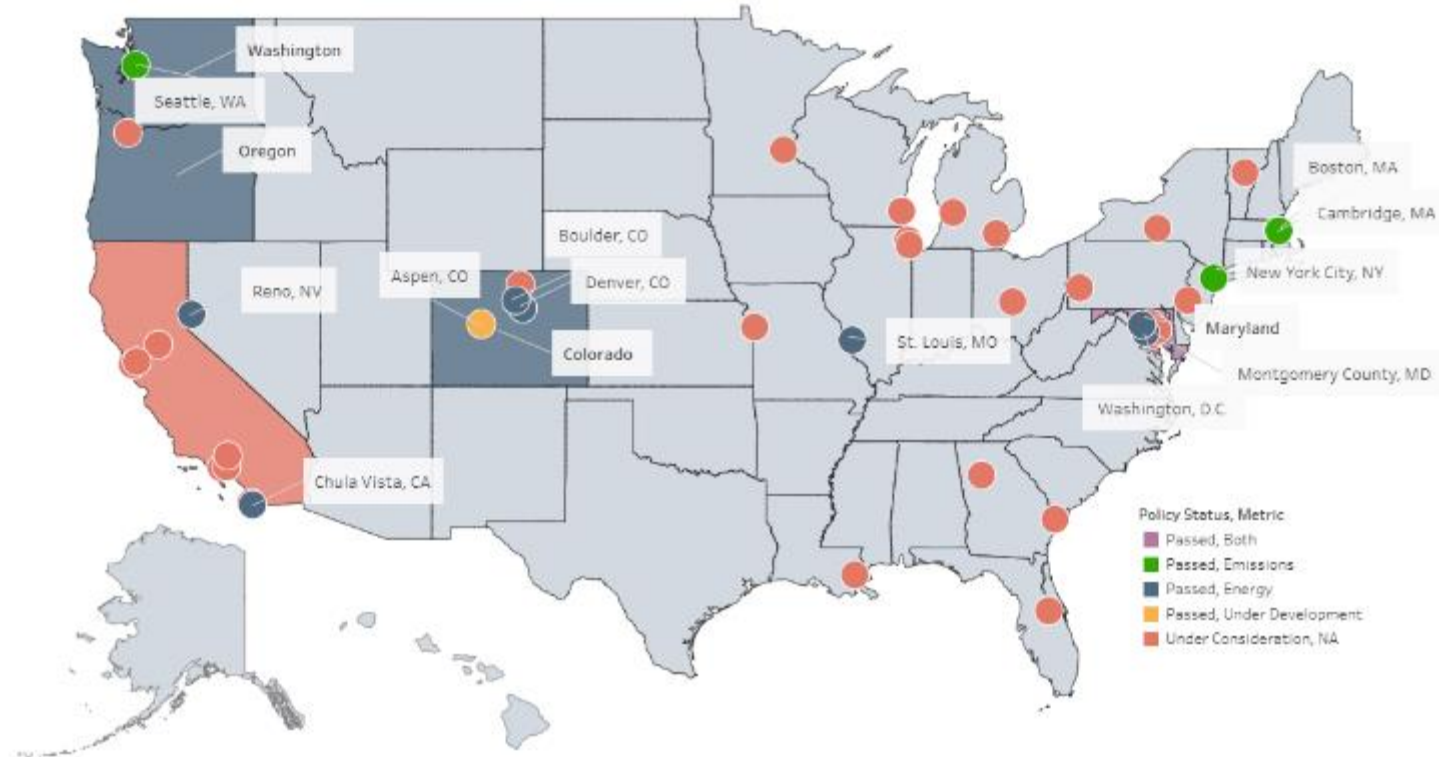
In Summary:

- Exterior or “common area”: no split incentive, long horizon, represents a nominal portion of energy load
- Vacancy interiors: no split incentive, short horizon, represents even small portion of energy load
- Tenant interiors: split incentive, complicated, low ROI, represents most of the energy load



Kimco Realty – New Drivers for Interior Energy Improvements

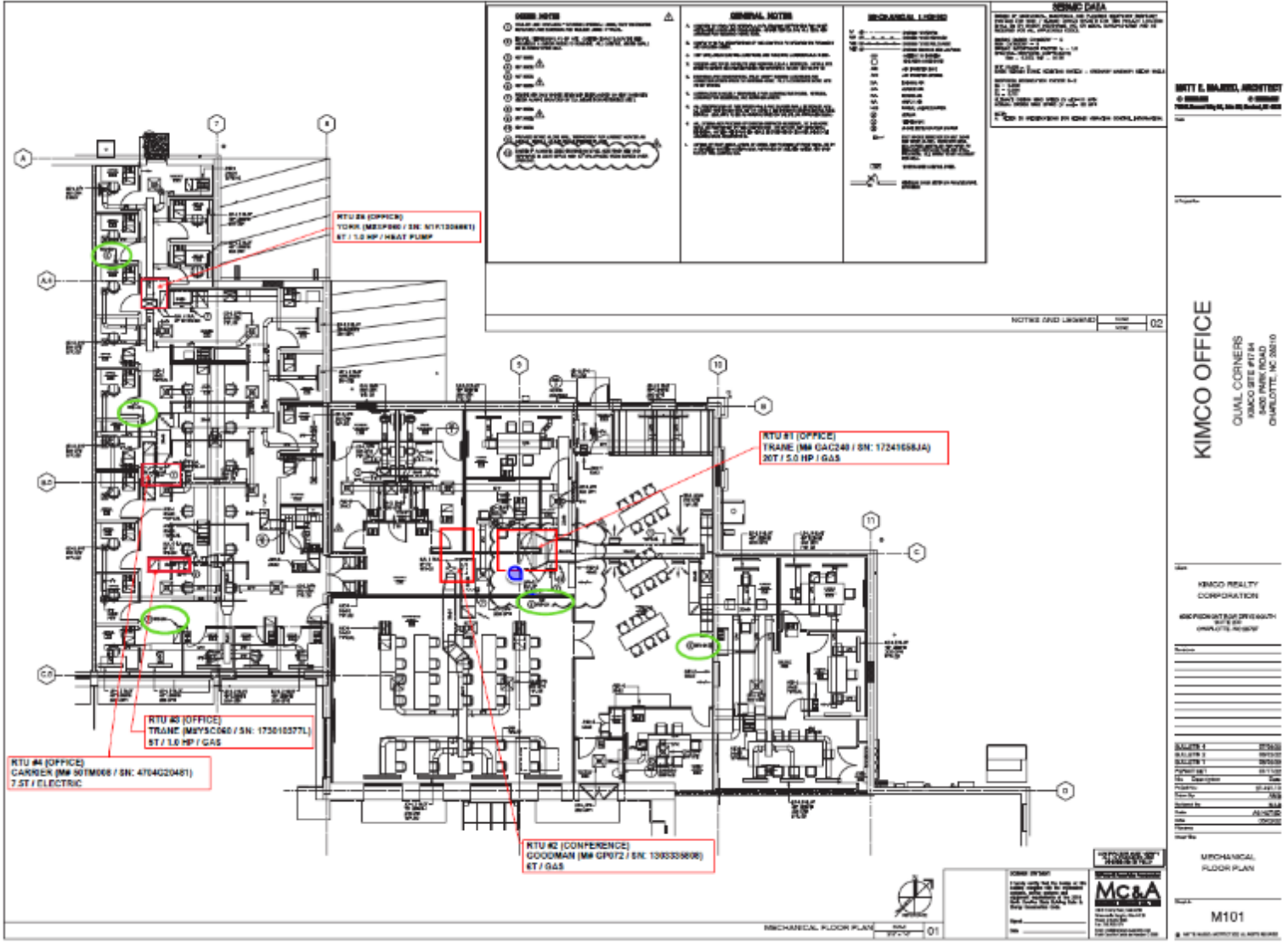
- Building Performance Standards (BPS)
 - Risk of financial impact
 - Risk of public relations impact
- Public carbon reduction target for Scope 3 emissions
- Benchmarking data helps identify and prioritize bad performers
- “Green” lease advancements
- Potential revenue from new business model
- Technology improvements



Kimco Realty – RTU Controls Pilot Project Background

- Goal: Kimco is focused on developing a repeatable and cost-effective package of ECMs for small-to-medium retail stores
- Partnership: we previously worked with PNNL on a lighting research project to help identify installation barriers for advanced lighting systems and controls. Same team presented the opportunity for a similar research project on smart thermostats.
- Location / Manufacturers: at a regional Kimco office in Charlotte NC we tested five different OEM products on each of the five existing RTUs.
 - Two legacy HVAC manufacturers
 - Two IoT controls manufacturers with energy management software
 - One security company adding commercial HVAC control to business service package

Kimco Realty – RTU Controls Pilot Project Floor Plan



Kimco Realty – RTU Controls Pilot Project Objective

Evaluate various commercial wireless thermostats to further understand:

- Installation process
- Setup and handoff process
- Comfort benefits
- Energy savings (ROI)
- Operational efficiency
- Maintenance and fault detection benefits



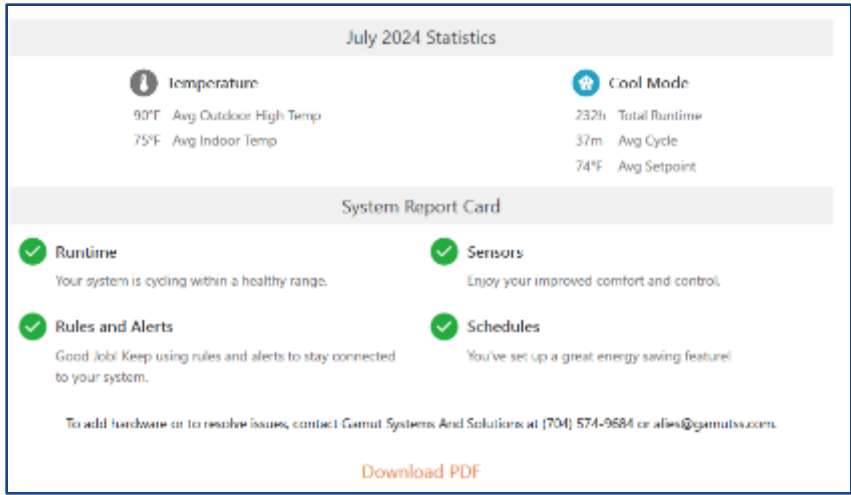
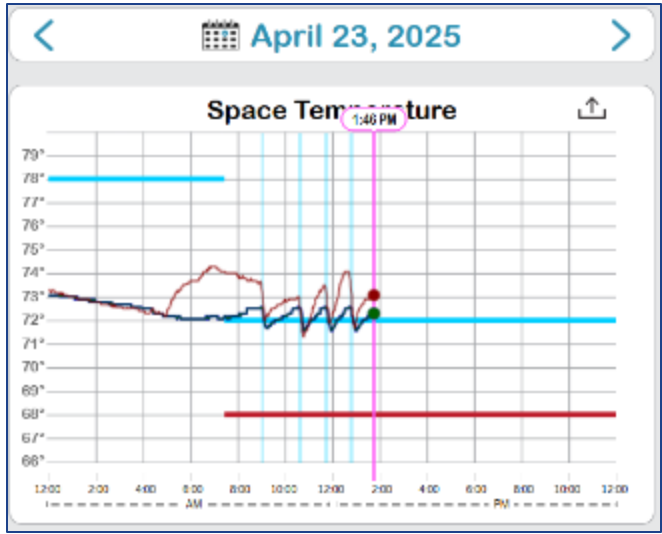
Kimco Realty – Findings During RTU Controls Installation

- Systems required combination of legacy HVAC skills with networking/technology acumen
- Contractor familiarity with components and networking varied widely
- Software setup and hand-off process varies / some more intuitive than others for new users
- Introduction of various wireless technologies makes installation faster and less expensive but can lead to reliability issues
- Other factors/findings:
 - Independent wifi network with cellular backhaul had to be set up for cyber security purposes
 - One RTU failed and was replaced during the pilot period / one brand new T-stat came with a bad relay
 - Air distribution issues became more apparent during pilot period so full Test & Balance was completed along with adjustments for Outside Air on each unit



Kimco Realty – Benefits Realized from RTU Controls

- Energy Savings: consistent schedules and setpoints reduced energy use
- Comfort: recent survey showed the majority of occupants were “mostly comfortable”
- Operational Efficiency: setpoints were easily adjusted remotely and tweaked regularly to optimize both comfort and energy. Trips by offsite management and technicians were reduced.
- Maintenance and fault detection: basic health reports received by email along with text alerts
- Expandability: Mesh network platform now in place to build upon for additional devices

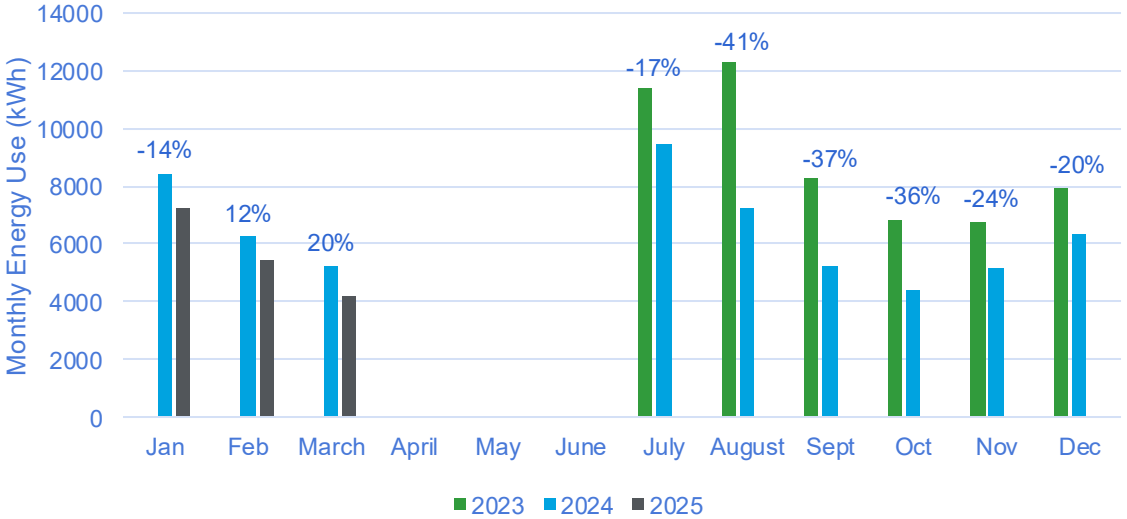


Kimco Realty – Energy Results from RTU Controls Pilot

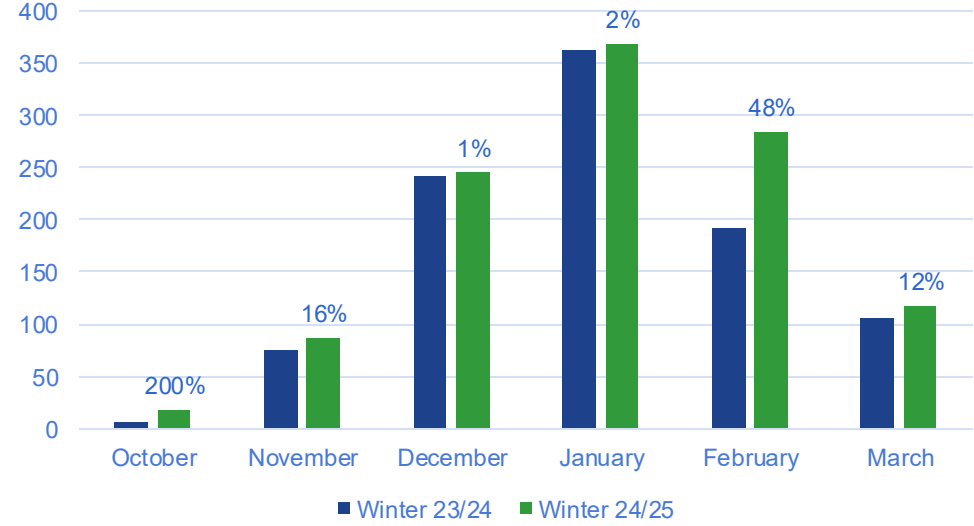
Energy Savings

- 25% electric reduction (over 9 months)
- 14% gas increase (over 9 months)
 - 7.3% increase in heating degree days over this same time period results in ~7% adjusted increase
 - Outside air rates for changed for entire office in February (driving higher OA heating load)

QC Office Electric (kWh) by Month



QC Office Gas by Month (Therms)



Kimco Realty – RTU Controls Decisions for Portfolio

Factors in Selection for Pilot Expansion

- Well-documented installation process for technicians with remote tech support
- Simple & user-friendly but includes enterprise capabilities for portfolio management
- Incorporated cellular connectivity within the T-stat (which also serves as hub for additional devices)
- National dealer/support network
- Reasonable cost (\$300-500 per RTU depending on features)
- Expandable features for security and business intelligence benefits
- Dedicated in-house engineering and development team adding new capabilities




INTRUSION


VIDEO


ACCESS


MULTI-LOCATION


INSIGHTS


MOBILE APP


CONNECTED FLEET

Kimco Realty – Next Steps

- Expand pilot testing in Southeast to 4-6 vacancy units and 1-2 gross leased areas
- Test additional capabilities
 - OA monitoring with damper control (DCV)
 - Hot water heater control
 - Exhaust monitoring and control
 - Electric submetering
- Better understand business case
 - Representative energy savings
 - Utility rebates
 - BPS compliance / fine avoidance
 - Benefits to equipment useful life and maintenance practices
- Develop new lease model

Devin Messerschmidt & Levi Love

Sheetz, Inc.



BMS Data Utilization

Sheetz, Inc.

Devin Messerschmidt

Levi Love



Sheetz, Inc.

- Proudly Serving Customers in PA, OH, MD, WV, VA, MI, and NC.
- To provide customers with fast and friendly service and quality products in clean and convenient locations.

Building Management System

- **Devices**

- **Controlled**
 - HVAC
 - Exterior Lighting
 - Economizers
- **Monitored**
 - Refrigeration
 - Energy Usage
 - HVAC Information

- **Benefits**

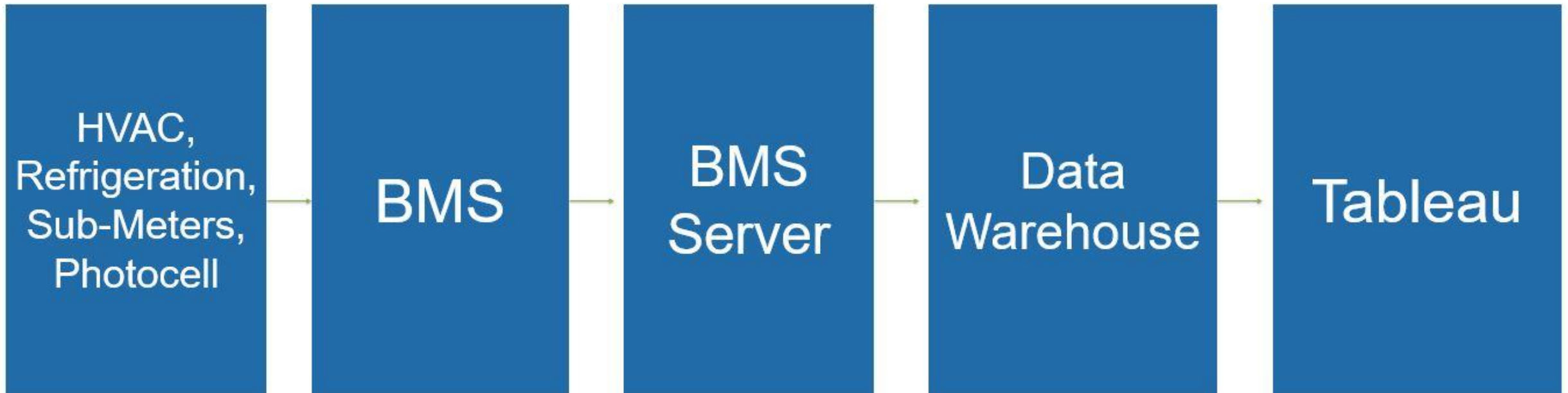
- Average 10% Energy Savings per site
- Access to equipment specific data and energy data
- 80% of HVAC calls come from the system
- Advanced auditing capabilities
- Global set point changes

Lessons Learned

- Automate as many tickets as possible after identifying root cause
- Create a plan for incorporating new equipment
- Group locations into similar buckets for comparison
- Ensure robust data flow from the start
- Identify low hanging fruit to build case for further exploration
- Collaboration between multiple departments to ensure optimization of system and buildings.

Data Flow

- BMS Speaks BACNET
- Export is used to send data to internal warehouse



RTU Temperature Rise

store_num..	State	Device	RTU_Type	HeatType	Maint_Area	Media..	Media..	Media..
208	VA	Sales RTU-1	Lennox	Gas Heat	1	2.00		66.00
392	PA	Sales RTU-1	York	Gas Heat	2	5.00	15.30	67.00
297	PA	Workroom RTU..	Lennox	Gas Heat	2	7.60	71.50	67.00
166	PA	Seating RTU-3	York	Gas Heat	4	15.10	34.70	67.00
534	NC	Sales RTU-1	Lennox	Gas Heat	6	32.10		67.00
445	PA	Kitchen RTU-2	Lennox	Electric Heat	4	3.70	28.20	68.00
99	PA	Sales RTU-1	Lennox	Gas Heat	4	4.90	7.50	68.00
31	PA	Sales RTU-1	Lennox	Electric Heat	4	7.90	17.50	68.00
325	VA	Sales RTU-3	York	Gas Heat	3	8.20	15.70	68.00
382	PA	Seating RTU-3	Lennox	Electric Heat	4	9.20	31.10	68.00
443	WV	Sales RTU-1	Lennox	Electric Heat	3	9.20	24.60	68.00
61	PA	Seating RTU-3	York	Electric Heat	4	9.60	28.10	68.00
204	PA	Kitchen RTU-2	York	Gas Heat	4	9.60	17.60	68.00
425	WV	Sales RTU-1	Lennox	Electric Heat	1	9.80	26.50	68.00
430	PA	Sales RTU-1	Lennox	Electric Heat	1	9.90	23.70	68.00
152	PA	Sales RTU-1	Lennox	Gas Heat	4	10.00	33.30	68.00
257	PA	Sales RTU-1	Lennox	Gas Heat	2	10.20		68.00
114	PA	Kitchen RTU-2	Lennox	Gas Heat	4	10.60		68.00
166	PA	Kitchen RTU-2	Lennox	Electric Heat	4	10.70	21.50	68.00
169	PA	Workroom RTU..	Lennox	Electric Heat	1	11.60	29.80	68.00
446	WV	Sales RTU-1	Lennox	Electric Heat	4	11.70	17.00	68.00
137	WV	Sales RTU-1	Lennox	Electric Heat	1	11.80	24.30	68.00
221	VA	Sales RTU-3	Lennox	Gas Heat	1	12.00		68.00
285	VA	Workroom RTU..	York	Gas Heat	3	12.30	20.10	68.00
424	WV	Kitchen RTU-2	Lennox	Electric Heat	4	12.60	32.90	68.00
420	PA	Sales RTU-1	Lennox	Electric Heat	1	12.70	24.80	68.00
221	VA	Checkstand RT..	Lennox	Gas Heat	1	12.90		68.00
169	PA	Sales RTU-1	Lennox	Electric Heat	1	13.50		68.00
462	PA	Seating RTU-3	York	Electric Heat	2	13.70	31.40	68.00
431	OH	Sales RTU-1	Lennox	Electric Heat	5	14.10	26.50	68.00
439	PA	Seating RTU-3	York	Electric Heat	4	14.50	28.10	68.00
166	PA	Sales RTU-1	Lennox	Electric Heat	4	15.00	32.70	68.00
15	PA	Sales RTU-1	Lennox	Gas Heat	1	15.10	5.90	68.00
382	PA	Sales RTU-1	Lennox	Electric Heat	4	15.40	39.00	68.00
84	PA	Kitchen RTU-2	Lennox	Electric Heat	4	15.50	39.40	68.00
27	PA	Seating RTU-3	York	Gas Heat	1	15.50	26.40	68.00
34	PA	Seating RTU-3	York	Electric Heat	1	15.70		68.00
307	VA	Sales RTU-1	York	Electric Heat	3	15.90		68.00
132	MD	Sales RTU-1	Lennox	Electric Heat	2	16.20	32.50	68.00
256	PA	Seating AHU-2	Lennox	Electric Heat	2	16.70	21.10	68.00
260	PA	Sales RTU-1	Lennox	Electric Heat	2	16.70	26.00	68.00

Store Temperature Rise

store_num..	device	RTU_Type	HeatType	Median Stage 1..	Median Stage 2..	Stage 1 %
445	Kitchen RTU-2	Lennox	Electric Heat	3.70	28.20	0.72
	Sales RTU-1	Lennox	Electric Heat	12.30	26.90	0.85
	Seating Area RTU-3	York	Gas Heat	12.00		

SD Calls

Store #	SD Call	Open Da..	Closed Date	Details	
00445	13358509	3/12/2025 12:14:01 PM	3/12/2025 12:55:17 PM	Install fuse block into RTU 1	
	13276793	2/12/2025 5:44:54 AM	2/18/2025 1:22:00 PM	RTU 2 needs a new fuse block for the stage 1 heating section. current one is undersized.	
	13227386	1/25/2025 11:18:55 AM	1/31/2025 1:56:44 PM	RTU 1 (by ladder) needs a new belt tensioner	
	13205397	1/17/2025 12:53:19 PM	1/25/2025 11:18:31 AM	RTU-2 stage 1 heat not engaging again. recent ticket for same issue reported blown fuses.	
	13134084	12/23/2024 2:51:50 PM	12/27/2024 10:56:18 AM	RTU-2 check heating circuit on stage 1 and verify output. showing minimal temperature rise. stage 2 looks ok.	
	12767524	8/30/2024 4:36:55 PM	8/30/2024 7:40:26 PM	Kitchen RTU-2/ ZTMP_HI This zone is consistently too hot, even though the Cooling System is ok. at 08/30/2024 1:25:25	

Audits

date	Incidents	AUDIT_ERROR	notes
2/3/2025	Sent to Josh	RTU-2: 1 stage of heating gets about 3 degree rise, have opened..	Area 4 check power monit..
1/13/2025	13205397	RTU-2: 1 stage of heating does nothing, previous ticket we open..	Null
12/23/2024	13134084	RTU-2: 1 stage of heating not doing much, getting maybe 3 degr..	Null

Analytics

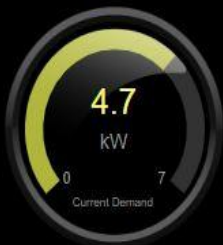
Power Monitoring

Main Power



Today 1295 kWh
Month to Date 26306 kWh

RTU-1



Today 68 kWh
Month to Date 1088 kWh

RTU-2



Today 122 kWh
Month to Date 1412 kWh

RTU-3



Today 80 kWh
Month to Date 1518 kWh

83.0 °F
36 %rh

Sales RTU-1

FDD Alarm

Critical 2
Comfort 0
Maint 0
Energy 0



Monthly Runtime

Clg Stg 1 179 hours
Clg Stg 2 4 hours

59.6 °F



IMC

Disch Temp 0.0 °F
Clg Status 0 %
Htg Status 0 %
Fan Status 0 %
Alarm Code
Unit Status Off

Zone Humidity 47.0 %rh
Zone CO2 72 ppm
Zone Dewpt 46.7 °F



Effective Cool Sept 68.0 °F
Effective Heat Sept 64.0 °F



Future Plans

- Peak Load Management
- Nighttime set-backs
- Equipment degradation analysis
- Improved electric sub-metering
- AI controlled HVAC
- Continued auditing
- Water Meters

Q & A

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