



# Are You Forgetting About Your Rooftop Units? Efficiency for Packaged HVAC

Better Buildings Summit  
May 2016

# Introductions



**Jim McClendon,**  
Walmart Stores Inc.



**Melissa Green,**  
Starbucks Coffee  
Company



**Marta Schantz,**  
Waypoint Building  
Group

# Why Rooftop Units (RTUs)?

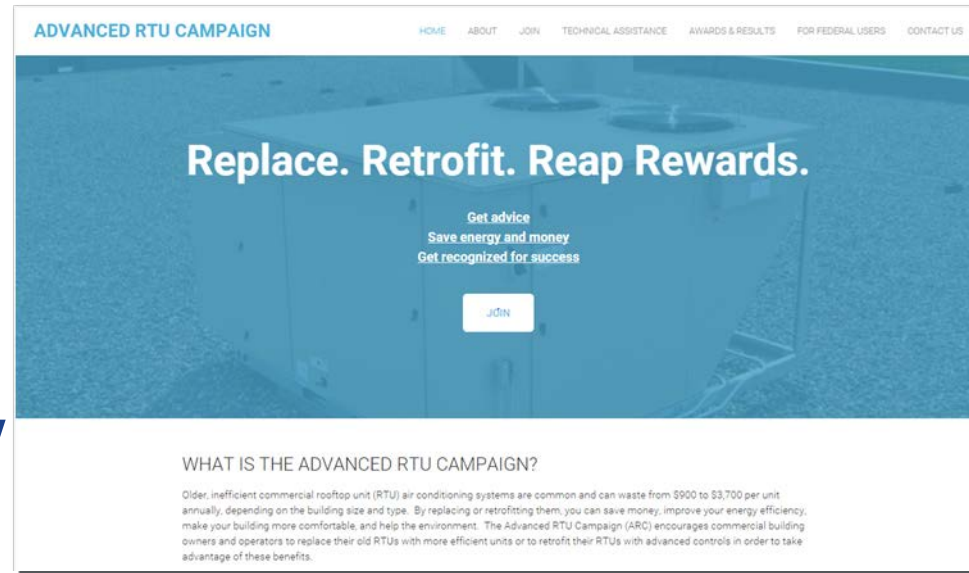
- RTUs cool 60% of commercial building floor space nationwide
- State of the art RTUs are up to 50% more efficient than RTUs available ten years before
- RTUs can last up to 15-20 years depending on climate conditions, but lose ~1% efficiency annually



# What is the Advanced RTU Campaign?

## National Campaign to promote high-efficiency RTU solutions

- High-efficiency RTU replacements and new installations
- Advanced control retrofits
- Quality Installation and Quality Maintenance



[www.advancedRTU.org](http://www.advancedRTU.org)





# What are RTU Retrofit Controls?

## Common Features

Integrated Economizer Control



Outdoor Air (OA) in OA Damper

Demand Controlled Ventilation



Variable Speed Fan Control

Condenser Exhaust



Return Air (RA)

DX Evaporator Coils

Supply Air (SA)

DX Condenser Coil

Outdoor Air into Condenser

## Other Potential Features

- FDD and Remote Monitoring
- Variable Speed Condenser Fan Control
- Compressor control

Credit: Ian Doebber

# 2015 Advanced RTU Campaign Leaders



**GIANT  
TIGER**



**Walmart**



SOUTHERN CALIFORNIA  
**EDISON**

An *EDISON INTERNATIONAL*® Company



**TARGET**

# Newest Resources

## Business Case for Proactive RTU Replacement

## Retail Lease Language for Efficient RTUs

## Efficiency Vermont RTU Replacement Case Study

**Superstore Example: Early Retirement of 5 RTUs**  
Weigh the Costs and Benefits

Category	Item	Value	
Up-Front Costs	Capital		
	Design and Analysis	\$5,000/week	
	Installation & Building	\$20,000	
	Operative Costs	\$1,440,000	
	Financing Options	\$200,000	
Variable Ongoing	CM&M	\$12,500	
	Tax Depreciation	\$1,750	
Benefits	Energy Savings	\$20,427	
	Additional Clean Savings	\$4,250	
Qualitative Benefits	LEED Credits and Certifications	\$2,000	
	Sustainability Values		
<b>Financial Metrics</b>			
ROI Energy and Other Costs	52%	NPV	\$5,020
Payback Period	3.3 Years	IRR Energy and Other Costs	14%

**4.3 Conclusion**  
After calculating the financial return metrics for a proactive and early retirement RTU replacement, the Superstore manager can decide to replace the building's RTU based on the best available data and strong financial analysis. The financial metrics for Superstore show that replacement based on energy savings alone generated by the investment are not favorable for an RTU upgrade at the time. However, the business case for replacement is quite strong with the additional benefits of avoided RTU failure and improved IAQ as summarized in Figure 2. To understand these financial metrics in the context of Superstore's business, the manager can compare these metrics against similar financial metrics for other capital improvement projects. If the returns for the RTU project are greater than the projected returns for other available projects, the case for RTU replacement will be especially compelling. The analysis completed for this example was simplified in that the costs were assumed constant over the analysis period and the analysis period was limited to 5 years. It is likely that there will be an increase in energy and maintenance costs over 8 years, which would show an improved financial analysis for proactive replacement. A longer analysis period would show an increased value to the building owner and could include a simple extension of the analysis period or could include RTU replacements at the end of 5 years. In either scenario, the value to the building should increase showing higher values for NPV and IRR.

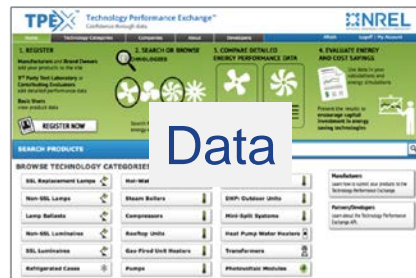
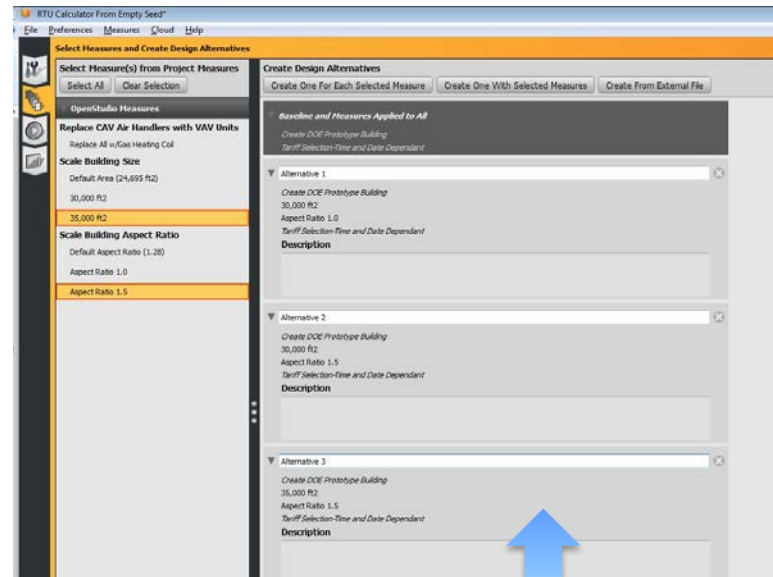


### ROOFTOP UNIT PROJECT HIGHLIGHTS

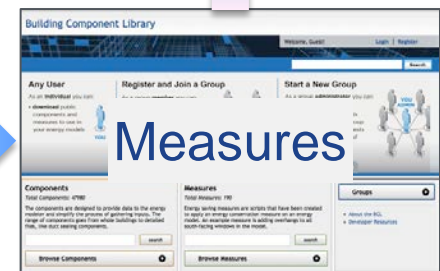
Peak electricity demand reduction	163 kW
Annual electricity savings	575,000 kWh/year
Annual gas savings	940 MCF/year
Annual utility cost savings	\$93,000
Payback	3.8 years with incentives 5.9 years without incentives

# Upcoming: RTU Calculator

- Simple to use
- Harness the data and power of EnergyPlus and OpenStudio
- Steps:
  - ✓ Select a building type
  - ✓ Select a location
  - ✓ Select design alternatives: RTU efficiencies and sizes, lighting, envelope, etc
  - ✓ Run
  - ✓ Review energy and economic results



Data



Measures



Jim McClendon  
Walmart Stores Inc.

# Energy Efficiency thru RTU Advancements

Jim McClendon  
Walmart Design

11 May 2016



# On April 15, 2013 we announced two new corporate energy goals for 2020

Walmart is on the path to being supplied by 100% renewable energy.

We will take a two tiered approach by both increasing renewable energy usage and increasing energy efficiency with the following commitments:

## Commitment 1: scale renewables



### Public Goal

Drive the production or procurement of 7 billion kWh of renewable energy globally by December 31, 2020—an increase of over 600% versus 2010

## Commitment 2: accelerate efficiency



### Public Goal

By December 31, 2020, reduce the kwh/sq.ft. energy intensity required to power our buildings around the world by 20% versus 2010

# Formats & Footprint



Brazil



US



Mexico



China

**Quick Stats:**  
**71 Banners**  
**>1 Billion SF**  
**>200 Million Cust/Wk**  
**>2 Million Associates**  
**>10,000 Stores/Clubs**  
**27 Countries**

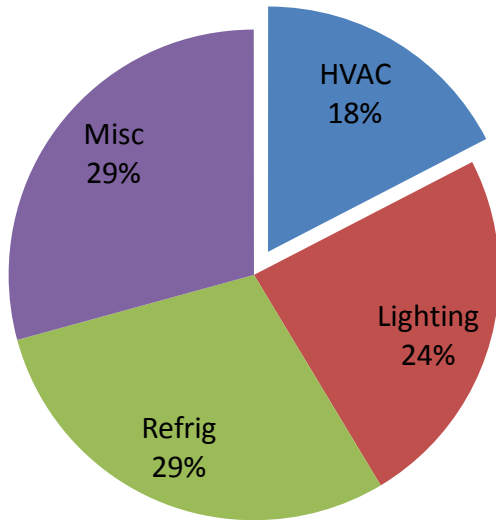


UK

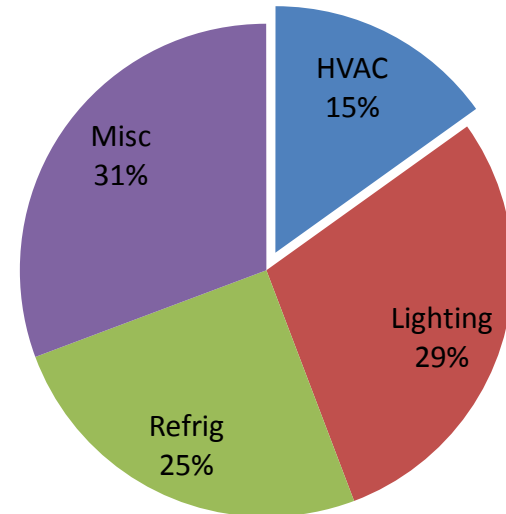


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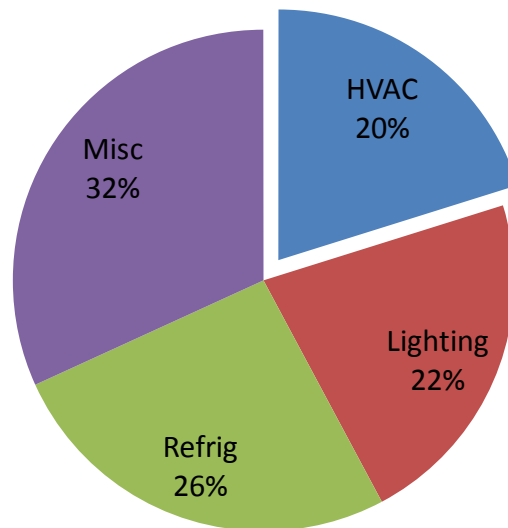




**Legacy Fleet**



**New Store**



**New Store w/LED**

# Portfolio at a Glance

## Inputs

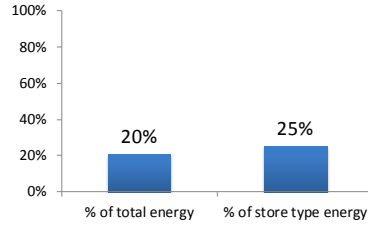
Select a store type and a climate zone from the drop-down menus above. Select "\*" to include all of the categories in the analysis.

Select a store type

Select a climate type

## Quick Facts

Percent of portfolio-wide energy use

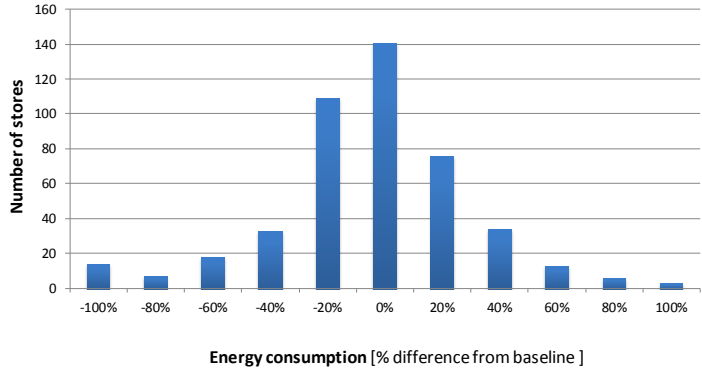


This tab allows stores to be filtered by store type and by climate zone to show store performance and electricity end use break down for stores meeting a specific set of criteria. It also generates a list of outlier stores ranked worst to best that should be examined more closely. For store-level details, select a store from the drop down menu and click the button in the lower right corner of this dashboard.

A dynamic, filterable data table is provided on the "data table" tab. This allows for the portfolio to be filtered by a number of different criteria, including store type, climate zone, prototype, protogroup, performance relative to baseline, and total energy consumption, location, and area.

## Store Performance Histogram

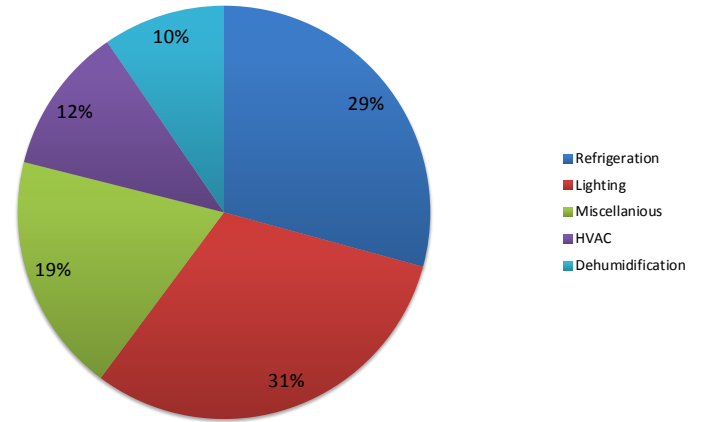
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Click the up and down arrows on the sliding bar below to change the bin sizes in the histogram.

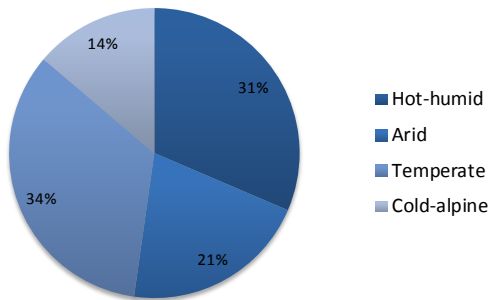


## Electricity End Use Breakdown

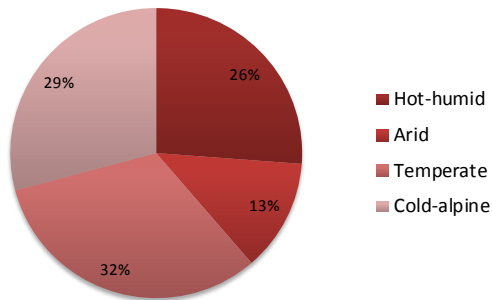


## Energy Use by Climate Type

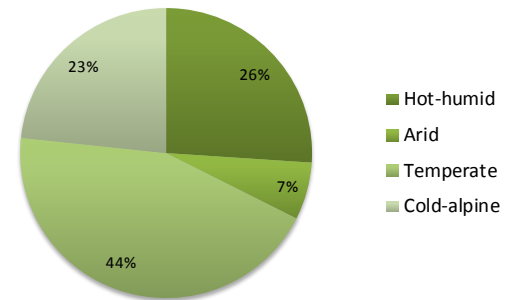
### Neighborhood Market



### Sams Club



### Supercenter



# Portfolio at a Glance

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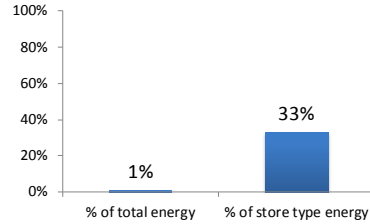
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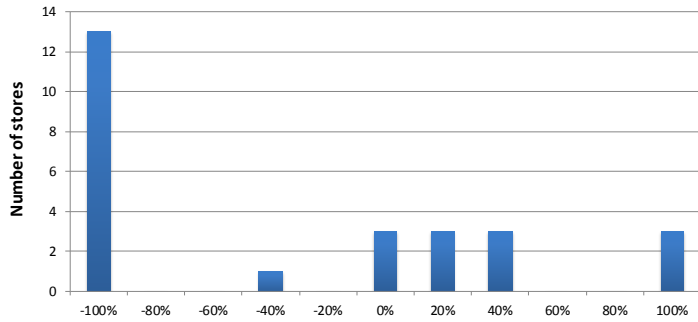


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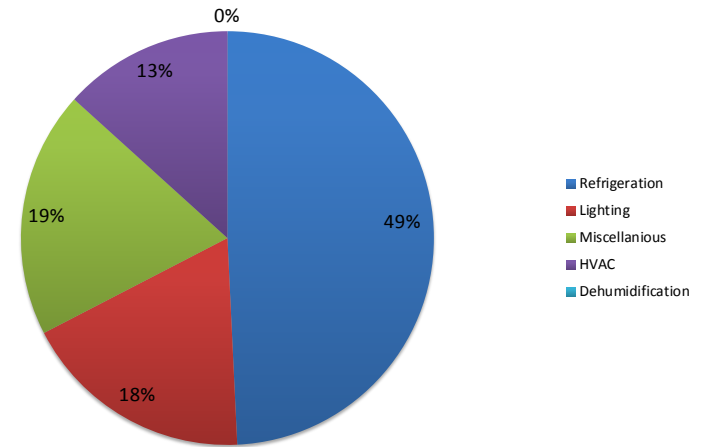
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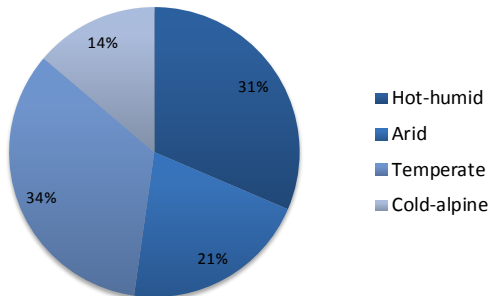


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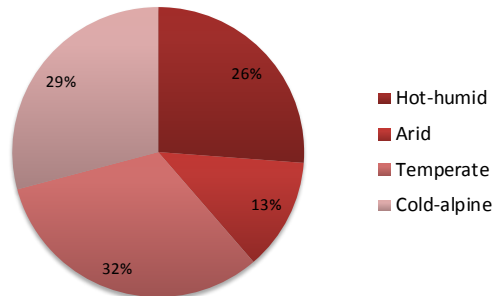


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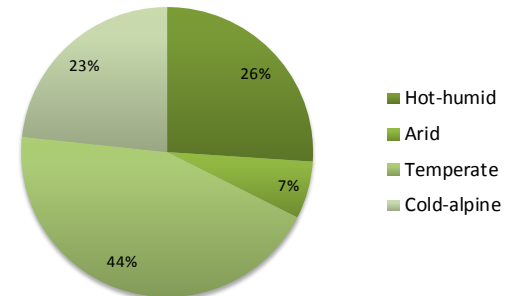
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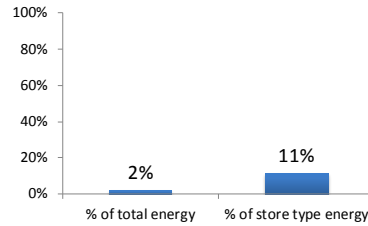
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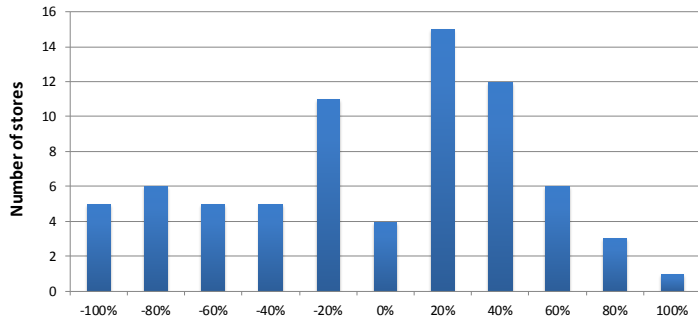


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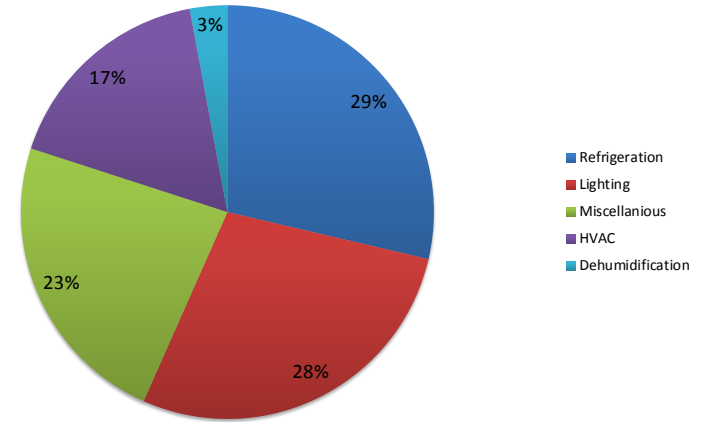
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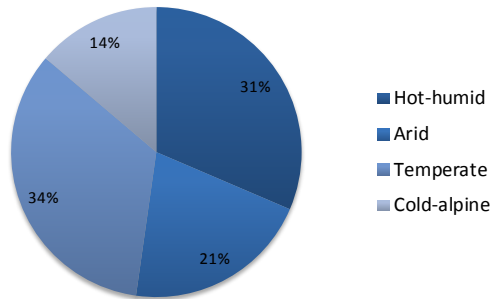


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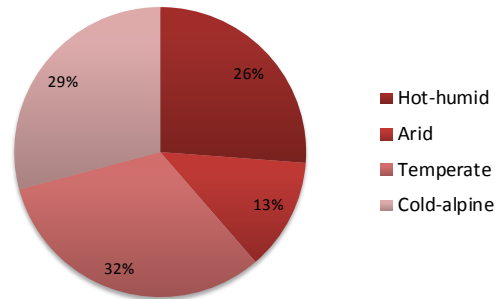


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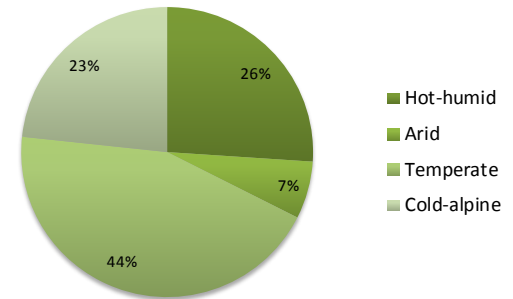
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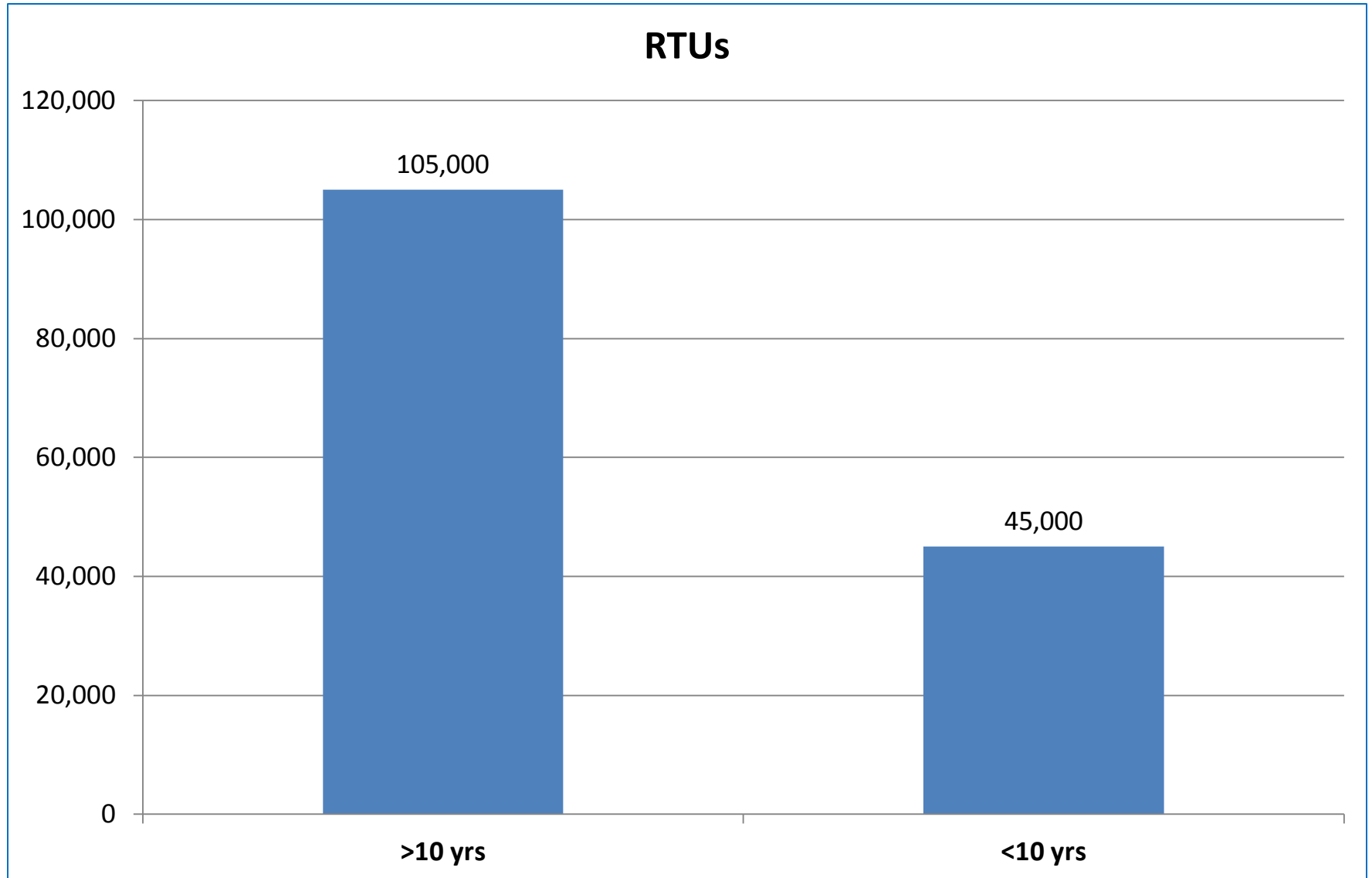
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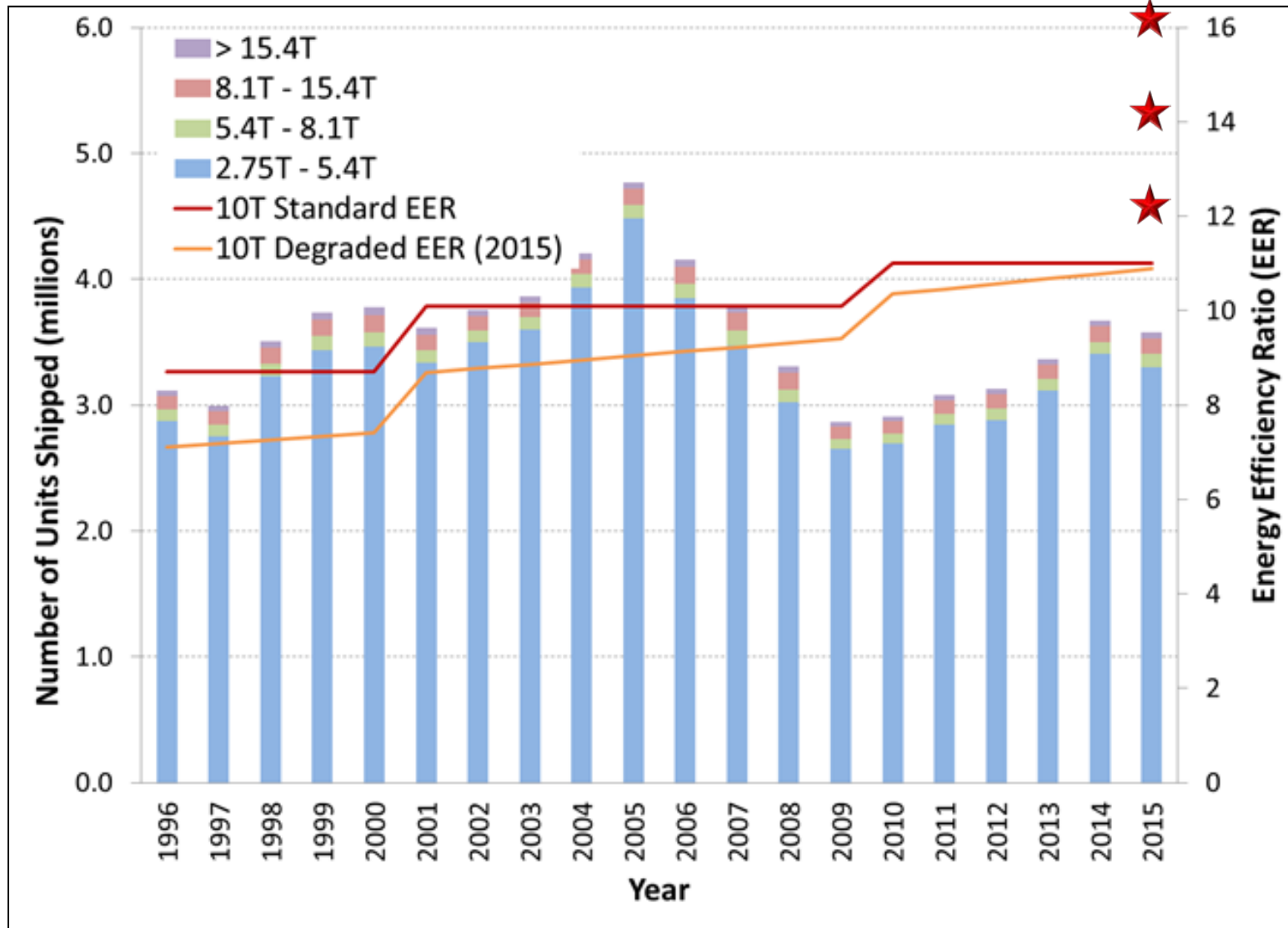
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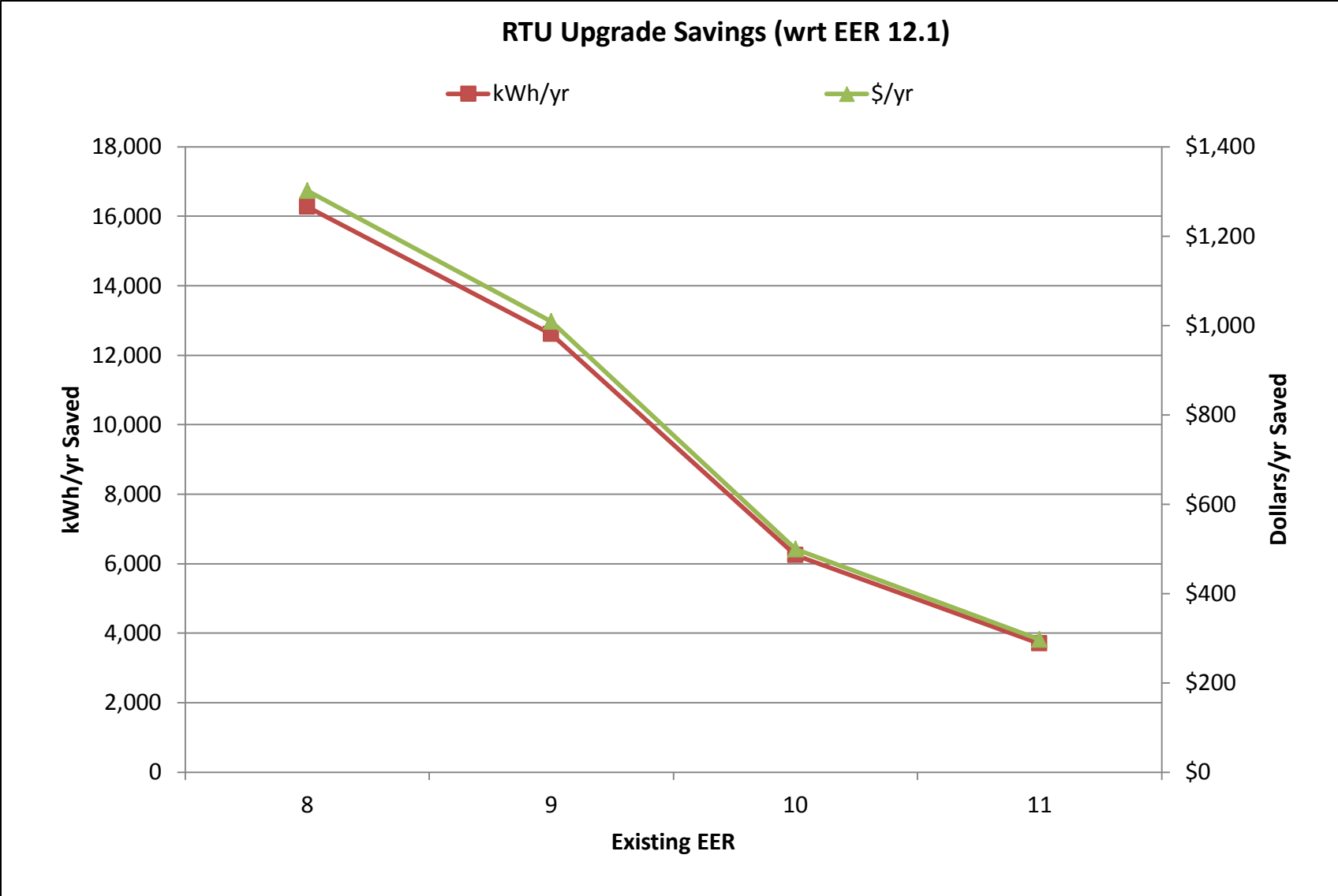
# Footprint Opportunities



# RTU Efficiency Improvements vs Volume



# Approximate RTU Upgrade Savings per Year – Nominal 10 Ton RTU (Source PNNL)



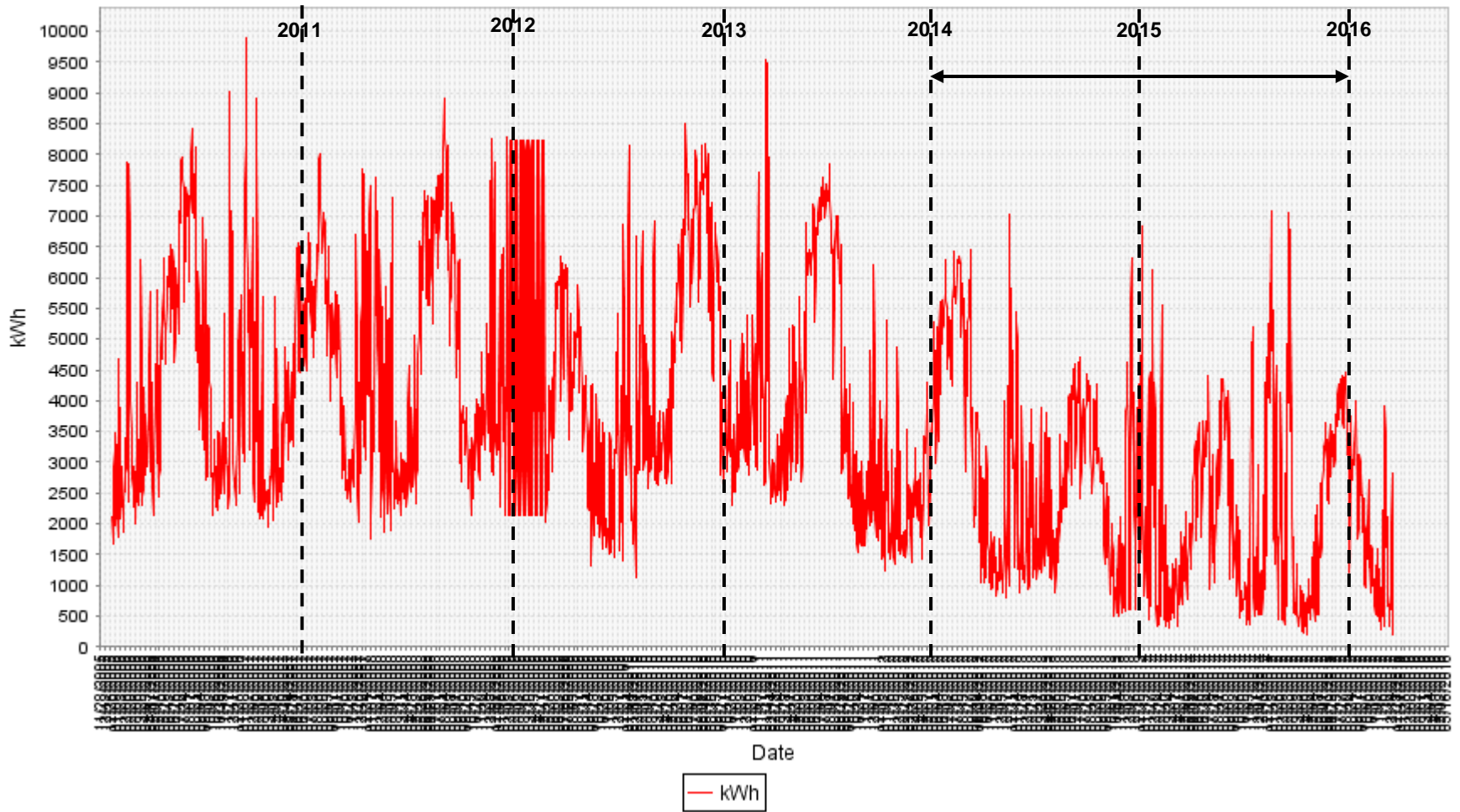


# Case Study Example; Existing RTU Replacements

## TOTAL HVAC: Daily Data: KWH

[01/01/2006 00:00 - 04/17/2016 00:00]

/ISTORES/TEXAS (ERCOT)0260 WAXAHACHIE, TX/VIRTUAL METERS

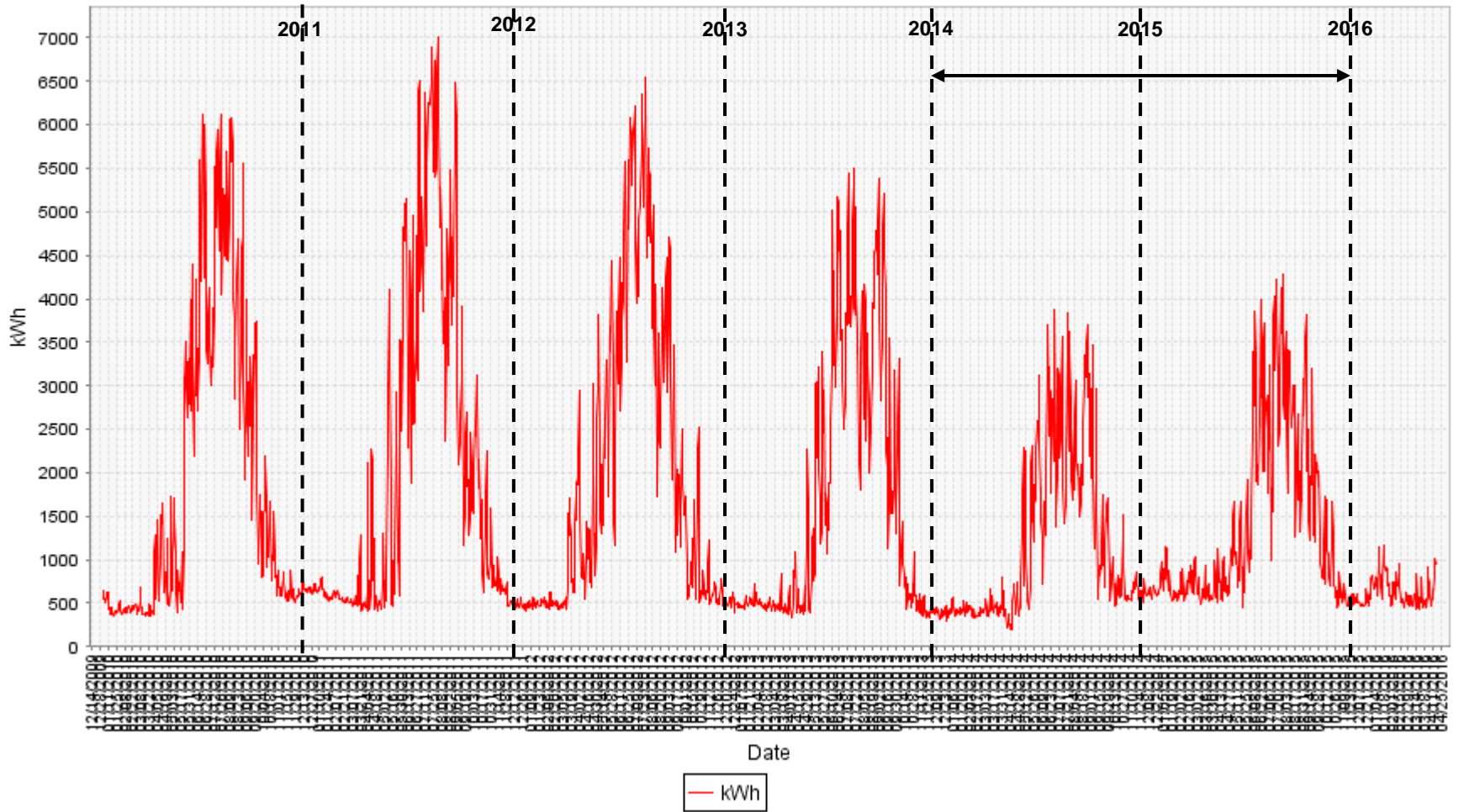


# Case Study Example; Existing RTU Replacements

## TOTAL HVAC: Daily Data: KWH

[01/01/2010 00:00 - 04/17/2016 00:00]

ISTORES/M & V PROJECT/2855 SHAWNEE, KS/VIRTUAL METERS

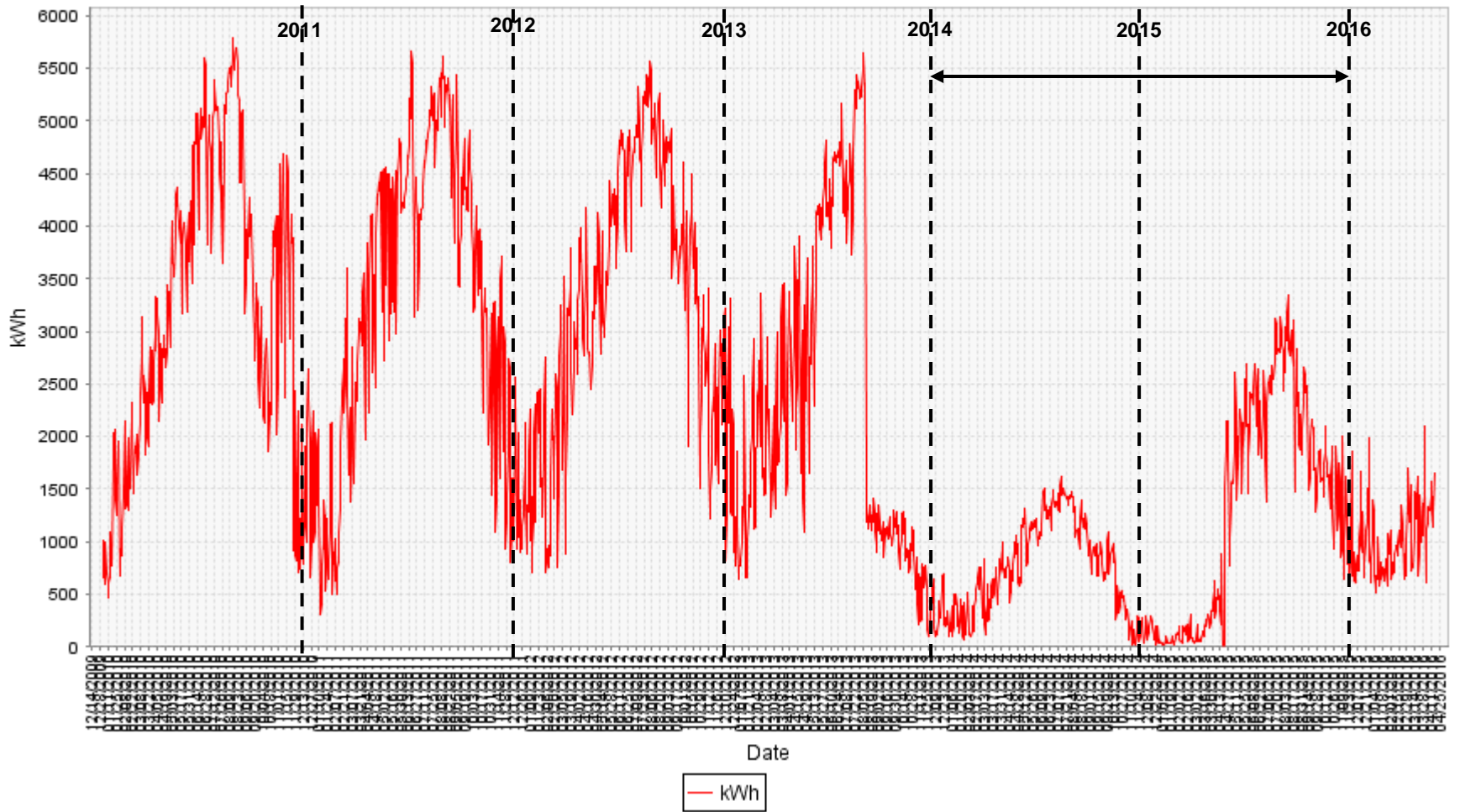


# Case Study Example; Existing RTU Replacements

## TOTAL HVAC: Daily Data: KWH

[01/01/2010 00:00 - 04/17/2016 00:00]

ISTORES/TEXAS (ERCOT)0397 MCALLEN, TX/VIRTUAL METERS



# RTU Upgrade Advantages

## Value Proposition:

- Annual Energy Savings → Immediate VOE Reduction on P&L
- LCC Savings that Exceeds the Asset Investment
- Reset Depreciation Schedule
- Lifetime Energy Costs are 6 ~ 8 Times Initial Capital → OpX vs CapX

## Replacement Approach:

- RTU age (>10yrs), M&R spend and energy cost
- Upgrade entire roof, not unit by unit ...replace vs retrofit...
- Plan into annual capital budget cycle (financials + impacts...downtown, etc)
- Lower energy forecast accordingly
- Coordinate with Remodel where possible

## Added Value:

- Comfort & Controls...connectivity / IoT...'intel ready' = > savings
- 5 yr warranty = M&R → VOE protected for ~½ the book life...
- Leverage your footprint thru proactive program ...pros/cons of scale

**Thank You**





Melissa Green,  
Starbuck Coffee Company



# RTU BEST PRACTICES

Melissa Green  
Starbucks Coffee Company



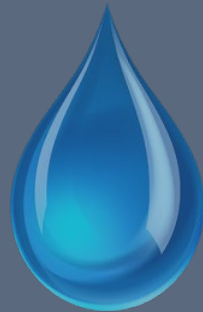
**over 23,000 Stores**  
**70 countries**  
**90 million customers a week**

# VISION, GOALS & TARGETS

*In 2008 amidst a shifting business landscape, we set out to use our **scale for good**, establishing bold ambitious goals to **reduce our impact on the environment***

**25%**

**REDUCTION  
IN WATER  
USE**



**100%**

**OF STORES  
WITH  
CUSTOMER  
RECYCLING**



**25%**

**REDUCTION  
IN ENERGY  
USE**



**100%**

**RENEWABLE  
ENERGY  
COVERAGE**





# VISION, GOALS & TARGETS

*In 2008 we also began work with the USGBC to develop a volume based certification for retail. In 2010 we launched our **Green Building Goal**.*

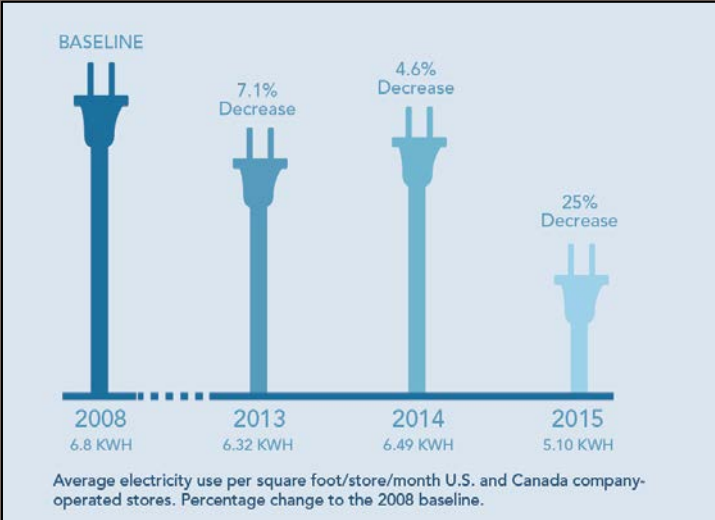


**GOAL:  
100% OF NEW  
STORES BUILT TO  
MEET LEED  
CERTIFICATION**



# ENERGY PERFORMANCE

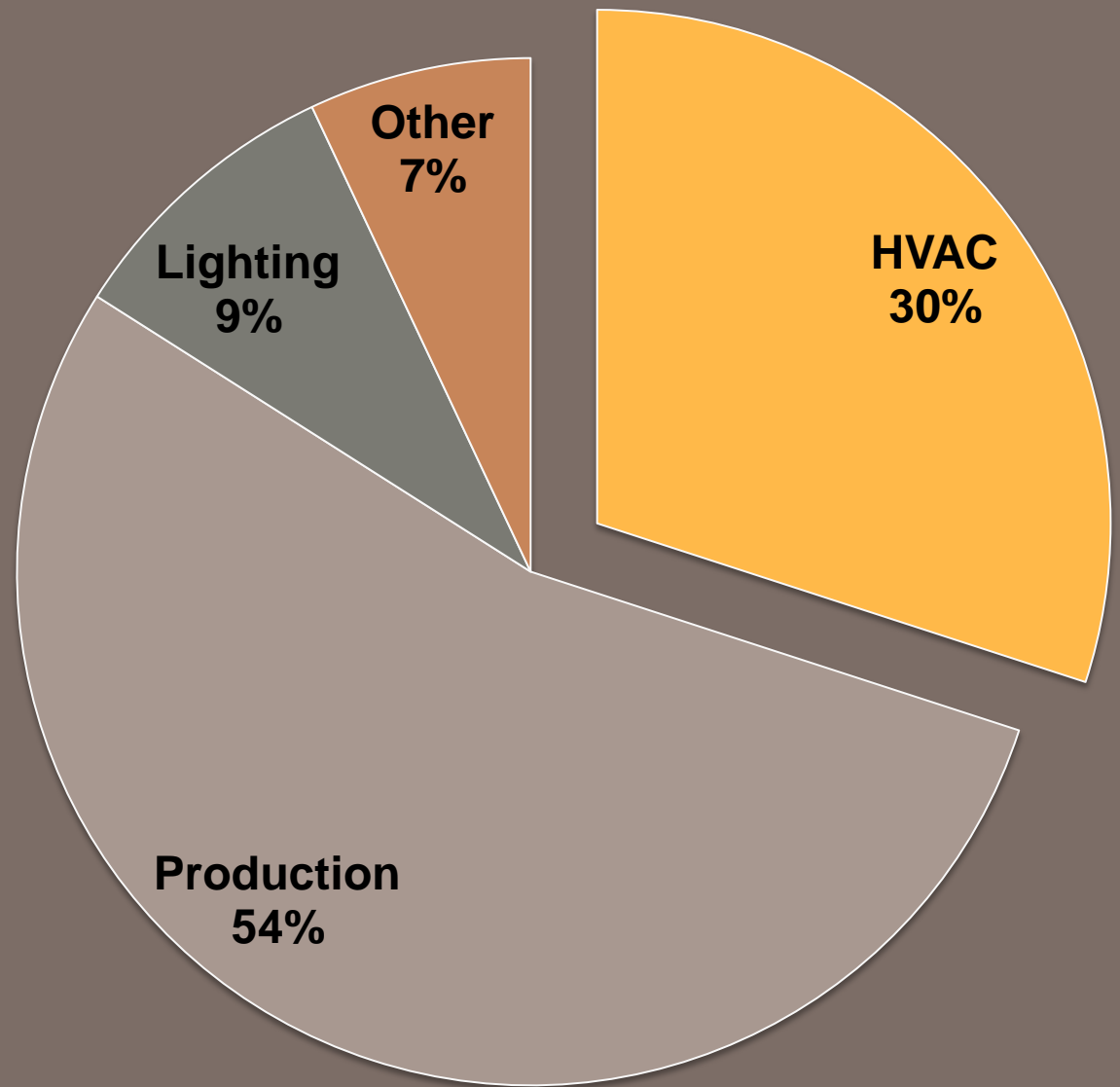
4.6% reduction in energy use in U.S. and Canada company-operated stores by since 2008



## KEY INITIATIVES & OPPORTUNITIES



# AVERAGE STORE ENERGY USAGE\*



# HVAC LIFECYCLE APPROACH

## EQUIPMENT SPECIFICATION OPTIMIZATION

Sizing | Type | Installation practices | Controls

Repair &  
Maintenance

New Stores  
&  
Renovation



# NEW STORE & RENOVATIONS



## Landlord Negotiations

- Landlord Workletter
- Tenant design package



## New Stores

- Equipment load worksheet
- Starbucks Mechanical Guidelines
- Commissioning

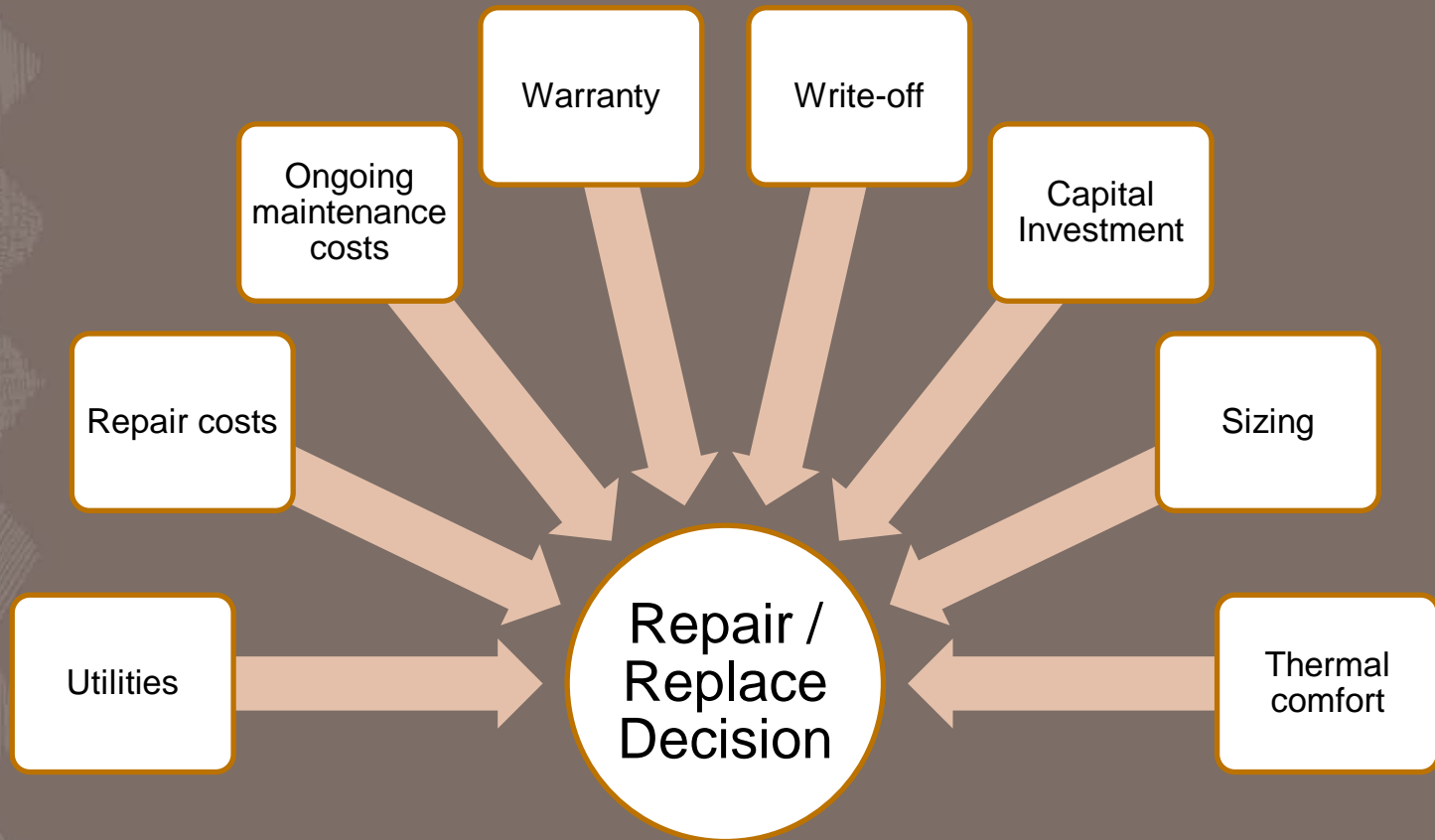


## Renovations

- Store Condition Assessment
- Repair History
- Lease life



# REPAIR & MAINTENANCE





# OTHER STRATEGIES

- Purchasing
- Systems Design
- Proactive Replacement Program Expansion







# Thank you!

**Jim McClendon, Walmart Stores Inc.**  
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**Melissa Green, Starbucks Coffee Company**  
[mgreen@starbucks.com](mailto:mgreen@starbucks.com)

**Marta Schantz, Waypoint Building Group**  
[MartaSchantz@waypointbuilding.com](mailto:MartaSchantz@waypointbuilding.com)

**Michael Deru, National Renewable Energy Laboratory**  
[Michael.deru@nrel.gov](mailto:Michael.deru@nrel.gov)