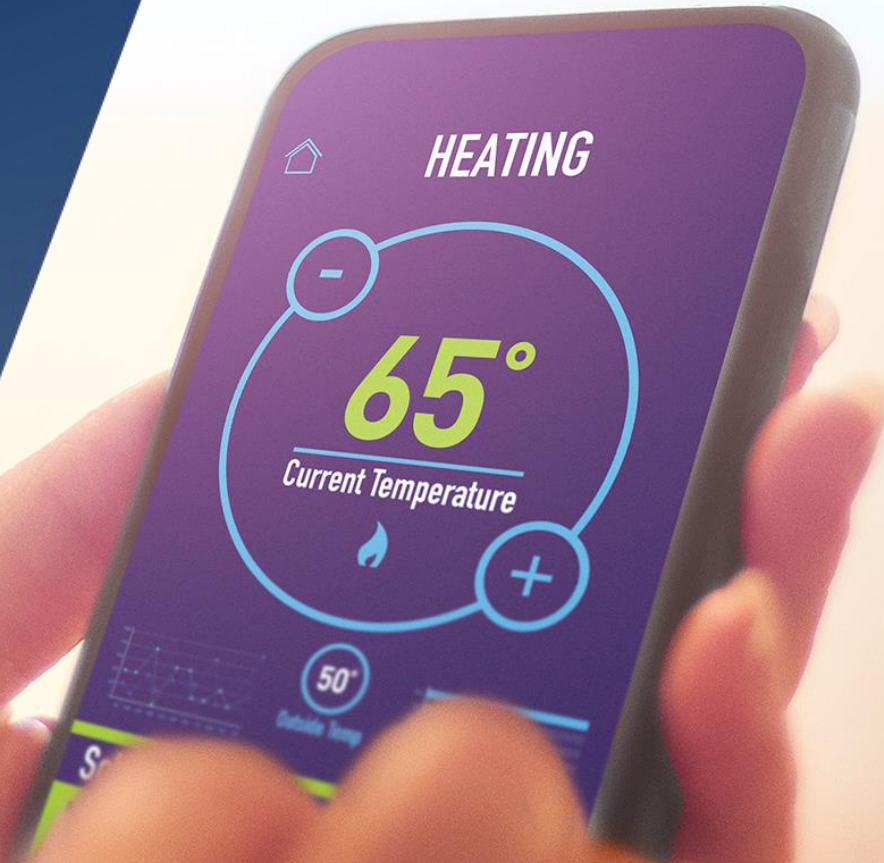


Smart HVAC: A Connected Communities Technology Landscape Deep Dive

Connected Communities Webinar Series

June 11, 2024



Welcome

- Updates from the Connected Communities Team
 - Community Information Hub
 - Community Change Grant
 - Get Connected: A Technology Landscape
 - Grid Interactive Efficient Buildings Implementation Guide
 - TVA Smart Thermostat Program
- Smart HVAC 101: **Bill Hughes, Guidehouse**
- Variable Capacity Heat Pumps, **Scott Harrell, TVA**
- Leveraging Advances in Heat Pump Technologies, **Steven Coley, TVA**
- Q&A
- Close Out

The Latest From Connected Communities

Connected Communities Initiative

We're helping communities embrace technology and data solutions to overcome their challenges and prepare to be part of the energy system of the future.

FOCUS AREAS		RESOURCES	
 Broadband and Digital Literacy	 Economic Empowerment	 Off-the-Shelf Guides and Tools	 Tailored Support and Success Coaching Through Partnerships
 Energy and Environmental Justice	 Enhanced Community Resiliency	 Pilot Project Funding	 Network to Share Information and Success Models



Upcoming Webinar

Your Playbook for Action:
Successful Pathways for Building
More Connected Communities

Tuesday, July 9, 1:00 – 2:00 pm ET

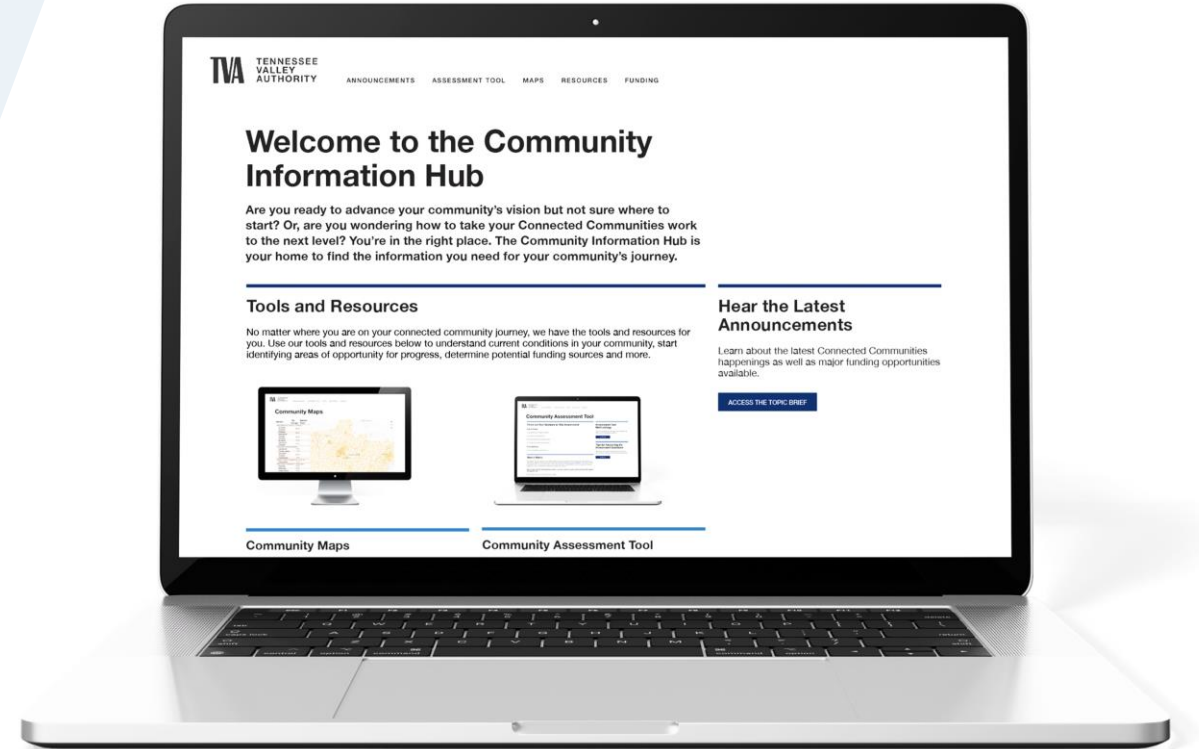


REGISTER NOW



Community Information Hub

A new, interactive tool is available to help **assess your community needs, prioritize solutions and identify funding opportunities.**





Community Change Grants Program

The U.S. Environmental Protection Agency's (EPA) [Community Change Grants Program](#) is a great opportunity for communities seeking to fund large-scale environmental and climate justice projects.



Community Change Grant Overview

Funded projects will benefit disadvantaged communities by reducing pollution, increasing community climate resilience, and building community capacity. This includes funding for workforce development activities related to clean technology and climate action.



Focus

- Climate-focused grant program
- Issued by Environmental Protection Agency (EPA)



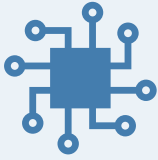
Funding

- \$10-20 million opportunity per award (estimated)
- No cost share



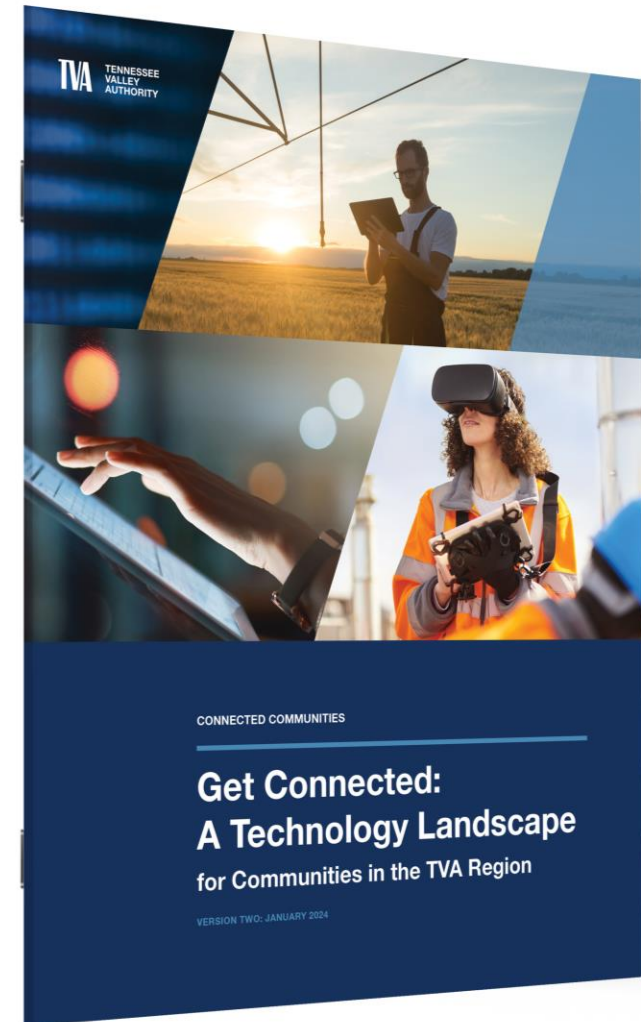
Application

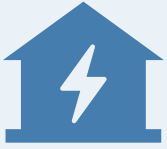
- Rolling application through November 2024
- Opportunity for rejected applications to reapply following debrief with EPA



Get Connected: A Technology Landscape

[This report](#) provides a high-level overview of key technology applications that can support the region's Connected Communities mission and vision. With 42 key technology solutions, read about Smart HVAC, EV charging infrastructure and more.





Grid-Interactive Efficient Building Solutions

Combining technology, information sharing and connectedness, [Grid-Interactive Efficient Buildings](#) (GEBs) can address individual and community-level problems and support sustainability and reliability while reducing the need for costly infrastructure upgrades.





TVA Smart Thermostat Program

TVA is partnering with LPCs for a **Bring Your Own Thermostat** program, available in the coming months. There are two pathways to participation:

- 1. If customers already own a smart thermostat:**
Register for our demand response program to receive a yearly incentive (if program requirements are met).
- 2. If customers do not own a smart thermostat:**
TVA will incentivize the purchase of the thermostat when they sign up for the program. Customers will also be eligible to receive a yearly incentive (if program requirements are met).



Meet Today's Speakers

Meet Today's Speakers



Bill Hughes

Principal Research Analyst,
Guidehouse Insights



Scott Harrell

Program Manager,
EnergyRight, TVA



Steven Coley

Manager, Grid Research
and Development, TVA

Smart HVAC 101

Bill Hughes

Defining Smart HVAC

Smart heating, ventilation and air conditioning (HVAC) are internet-connected devices that support an integrated approach to more efficient heating and cooling of buildings.

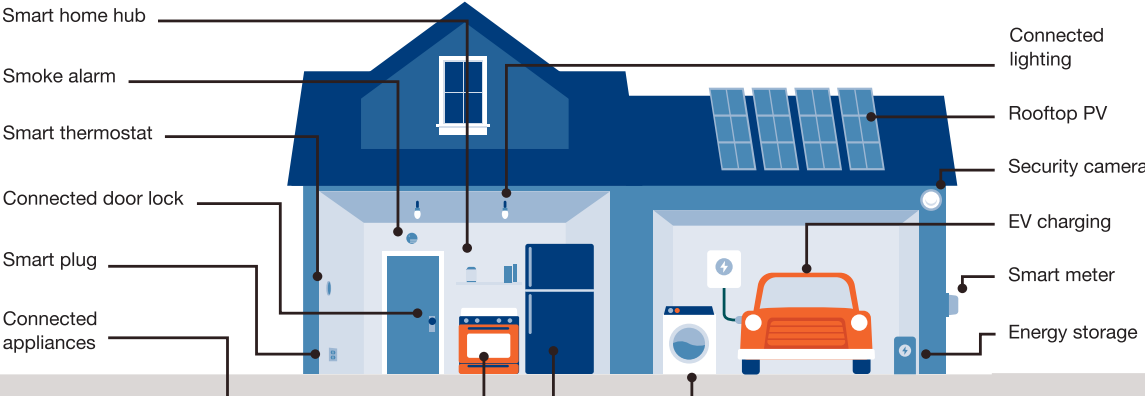
Smart HVAC allows for a holistic approach to building energy monitoring and management, helping realize energy savings and, with the appropriate platform, enabling grid interactivity.

These systems allow for remote monitoring and control, leading to increased learning, adaption and optimization of user preferences and needs.

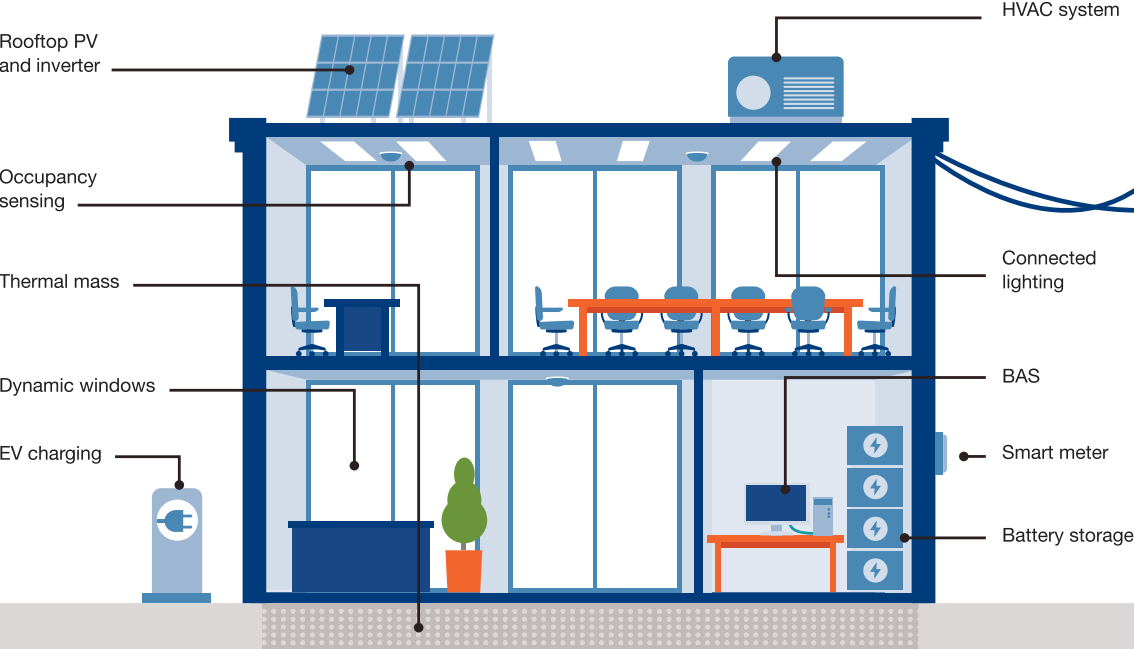


Smart HVAC in the Context of Smart Buildings

RESIDENTIAL EXAMPLE



COMMERCIAL EXAMPLE



Variable Capacity Heat Pumps

Scott Harrell

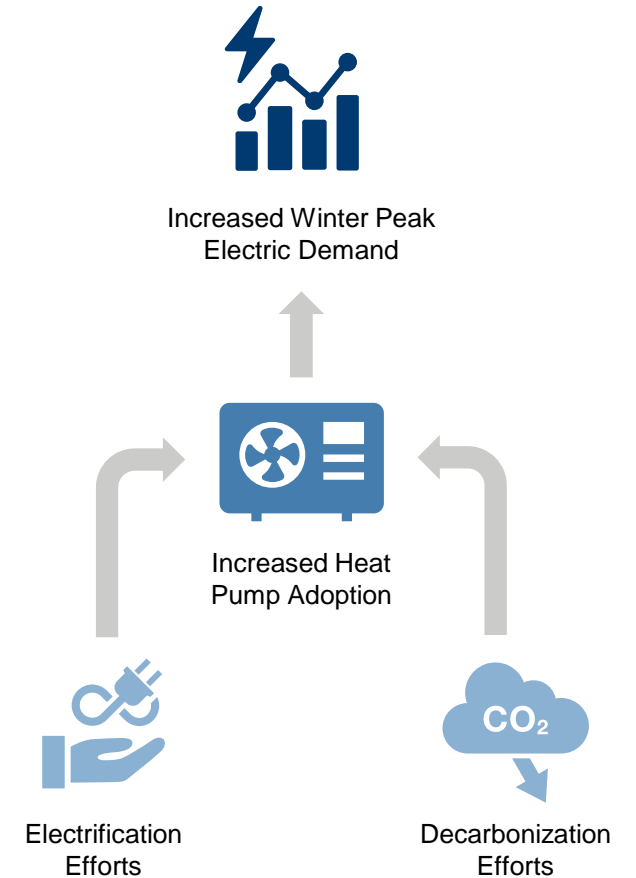
Heat Pump Adoption and Winter Peak

Heat Pump Adoption

- The Tennessee Valley is a region with very high electric heat penetration
- Significant heat pump adoption is expected in the coming years
 - 9.5 Years: average age of existing heat pumps
 - Tens of thousands of heat pumps to be replaced over the next 10 years

TVA Winter Peak

- Heating capacity/efficiency of conventional heat pumps drop significantly as outdoor temperature decreases.
- Conventional heat pumps lose around 40% of heating capacity as outdoor temperature drops from 47°F to 17°F
- To compensate, a backup heating source is required – typically 8-20 kW of electric strip heat
- **Residential electric strip heat is a primary contributor to winter peak demand**



General Heat Pump Technology Overview

1

Single-Stage Heat Pump

- **One level** of operation (single stage of output)
- **Runs on high speed** even if only a small amount of heating or cooling is needed
- Either on (**running at 100% capacity**) or off
- Often equates to a significant amount of **wasted energy** (and money)
- Uses **resistance heat** in extreme temperatures

2

Two-Stage Heat Pump

- **Two levels** of output – high speed for extreme temperatures and low speed for milder temperatures
- Runs for **longer periods** of time
- Turns on and off **less often**

3

Variable Capacity Heat Pump (VCHP)

- Also known as “**cold climate**” heat pump
- Operates according to the heating and cooling **load conditions of the home**
- Uses **only** the amount of energy needed to keep each room in your home at your preferred temperature or set point
- **Runs continuously, efficiently and quietly**, providing comfort and passive dehumidification in every room
- Uses **variable-speed compressors** which modulate in increments of 1% and fractions of a percent

VCHP Technology

VCHPs provide enhanced heating/cooling efficiency at extreme temperatures vs. conventional heat pumps.

- Up to **40% more efficient** than conventional heating and air conditioning systems
- Can be sized to meet the home's heating load **without electric resistance auxiliary heat**, while also providing good cooling and dehumidification performance in the summer
- Can provide **significant reduction to customer's electric bill** vs. conventional all-electric heat pump
- Because of little to no back up resistance heat, VCHPs **reduce the strain on the electric grid** during times of peak consumption



Benefit of VCHPs

FOR THE HOMEOWNER

- ✓ **Reduced Temperature Fluctuations**
Constant, consistent compressor speed avoids temperature swings
- ✓ **Improved Air Quality**
Integrated fan system provides improved airflow and enhanced performance
- ✓ **Reduced Humidity**
Keep humidity levels low by circulating air around the clock
- ✓ **Quiet Operation**
Reduced operating sound levels due to a compressor sound insulator
- ✓ **Longer Lasting**
Running at a variable speed vs. always running at full capacity
- ✓ **Increased Comfort**
Constant temperature vs. on/off cycling
- ✓ **Energy Efficiency**
40% more efficient than conventional systems, reducing electric bills

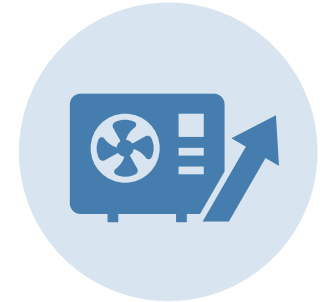
FOR TVA

- ✓ **Energy Efficiency**
40% more efficient than conventional systems, reducing the strain on the grid
- ✓ **Peak Demand Reduction**
reduction/elimination of electric resistance auxiliary heat reduces peak consumption

TVA Strategy

Increase market penetration and consumer adoption of VCHPs.

- TVA/EPRI Study
 - Install 24 VCHPs with little-to-no electric resistance backup
 - Avg. installed strip heat is 3 kW; Avg. reduction of strip heat per home is 5 kW (68%)
 - Monitor full cooling/heating load seasons and indoor conditions for 12-15 months
 - Conduct customer surveys to assess impact on indoor comfort, noise levels, and energy bills
 - Educate homeowners regarding expected performance of the VCHP (continuous operation vs. on/off cycling)
 - Educate HVAC contractors/builders on proper sizing method, costs, and benefits for VCHPs
- TVA's is offering a \$1,500 rebate/incentive to homeowners to replace an existing heat pumps with a VCHP and to builders to install VCHPs instead of minimum efficiency heat pumps
- TVA is aiming install 900 VCHPs in Home Uplift homes in FY25
- See www.energyright.com/residential/rebates/ for more information



**VCHP
Installations**

Leveraging Advances in Heat Pump Technology

Steven Coley

How Does Grid-Interactive HVAC Work?

PURCHASE

ENROLL

EARN

CONTROL

1

Purchase a Connected / Smart Thermostat

Many options and extra benefits

2

Enroll in a Utility Program

Options for electric vs. gas heat

3

Earn Rewards by Conserving Energy

Small, temporary adjustments to thermostat settings during “peak” energy events

4

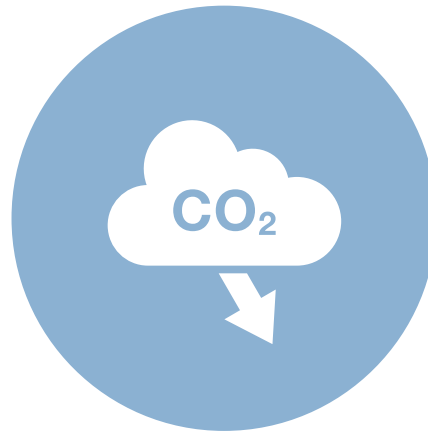
Stay in Control

Receive notifications during events and maintain comfort by readjusting settings at any time (“opting out” during the event)

Why Grid Interactive HVAC?



**Save
Money**



**Reduce
Emissions**



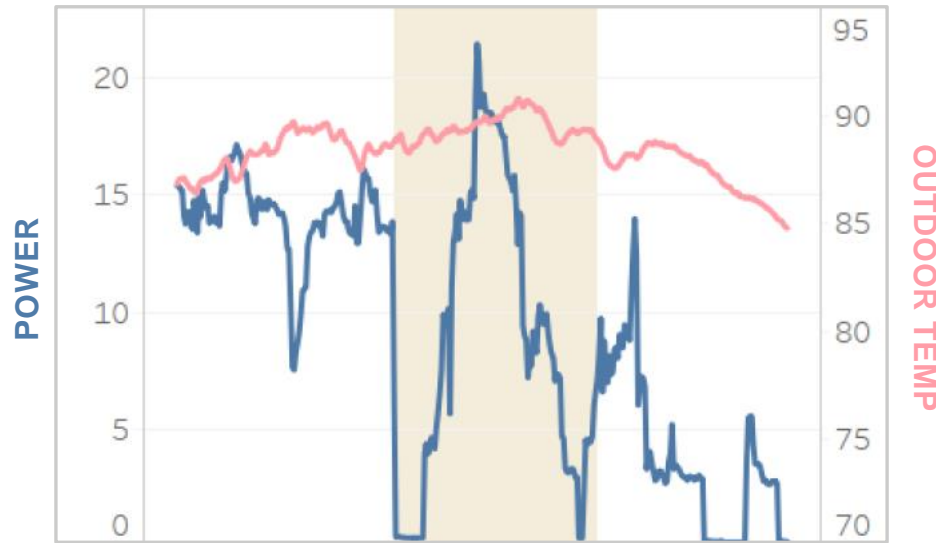
**Support Grid
Reliability**

What's Next for Grid Interactive HVAC?



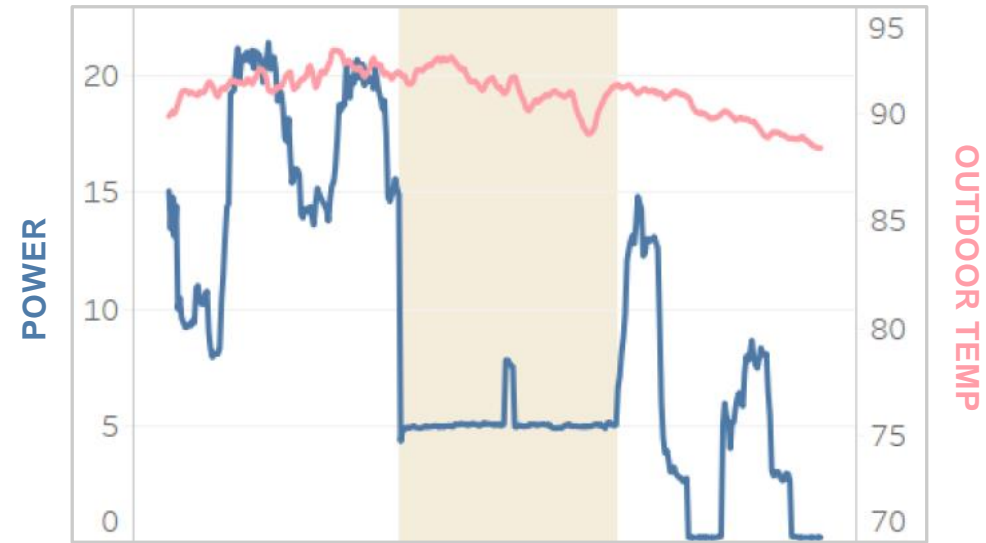
Example Field Results with Variable Capacity HVAC*

Baseline Approach: Setpoint Offset



Inconsistent power reduction
Inherent internal temperature rise

Optimized Controls: Capacity Limit



Predictable power reduction
Limited internal temperature rise

Discussion

Let's Stay Connected



Continue the Conversation

Contact Georgia Caruthers to learn more:

gmcaruthers@tva.gov

Or

ConnectedCommunities@tva.gov



Join Our Connected Communities Network

Visit the Connected Communities website and sign up to be part of the Connected Communities Network:

tva.com/connectedcommunities



Access Our Resources

Access the Community Information Hub and relevant guides:

- [Community Information Hub](#)
- [Get Connected: A Technology Landscape](#)
- [Grid-Interactive Efficient Building Solutions](#)

TVA

**TENNESSEE
VALLEY
AUTHORITY**