



Achieving commercial building resiliency
through plug load management:
Emerging technologies and strategies

Amy LeBar
National Renewable Energy Laboratory
May 10, 2022

Decarbonization is the current focus of the commercial building industry.

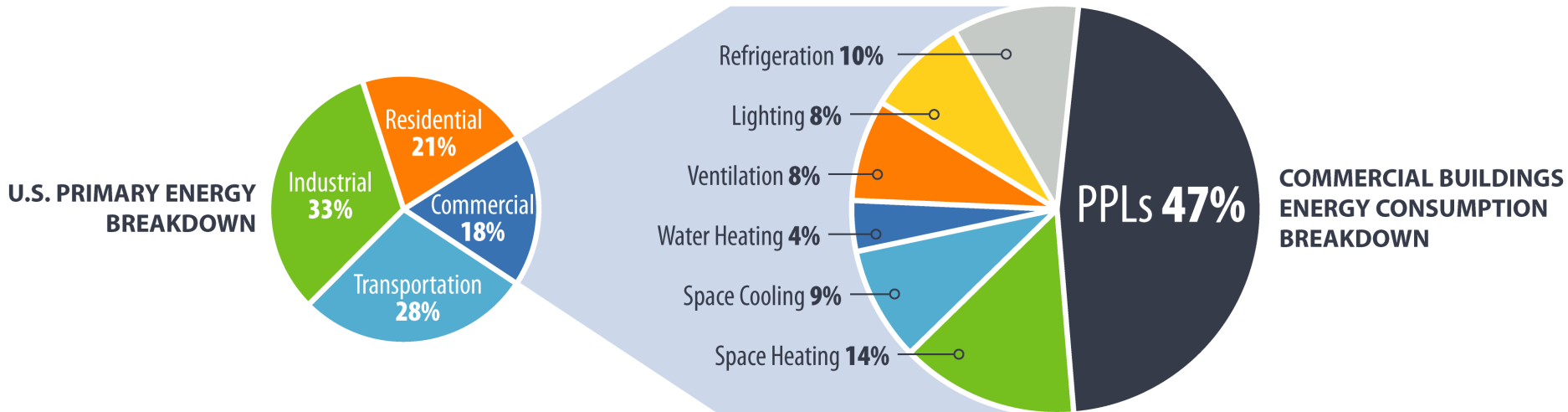
U.S. has set goal for net-zero GHG emissions by 2050.

90 companies and organizations have committed to reducing their building and factory carbon emissions by 50% by 2030 through Better Climate Challenge.

For commercial buildings, this means improvements in efficiency, electrification and control.



PPLs account for a growing percentage of commercial building energy use.



Managing PPLs can lower a building's baseload.

Energy efficiency is the first step in decarbonizing a building.

Consolidating devices and equipment can cut PPL energy consumption in half.

Current control technologies can cut PPL consumption by 30%.

Decarbonization Priority Waterfall



Electrification is the most direct way to cut a building's carbon emissions.

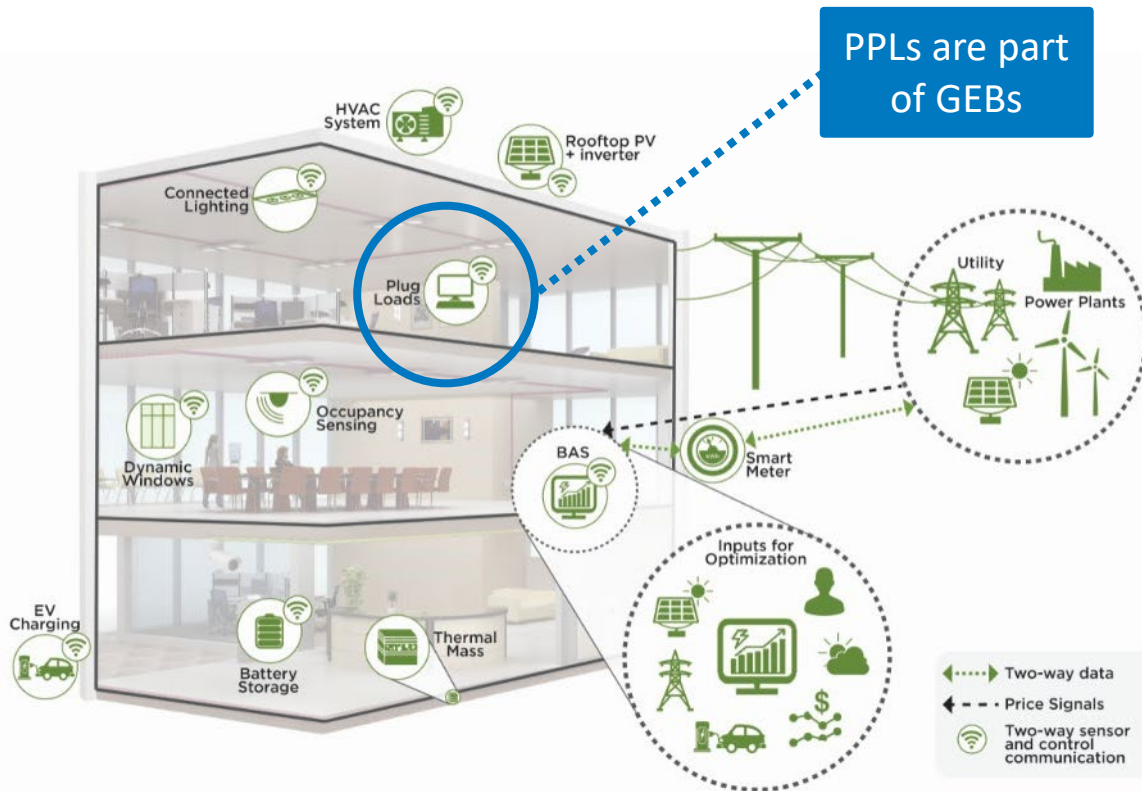
Replace gas powered equipment with electric.

- Kitchen equipment
- Laundry equipment

Update the building's electrical system to allow high-power and high-voltage electric equipment to come online.



PPL integration enables grid-interactive efficient buildings (GEBs).



Integrating PPL controls with a building automation system can enable whole building response to grid signals.

Shift, shed and modulate building loads.

Cornell University

Community-based social marketing efforts and campaigns resulted in increased sustainable behaviors among students and faculty.

- Powering down plug-in devices when not in use.
- Procuring ENERGY STAR-certified devices.
- Using advanced power strips and smart outlets.



POWER DOWN FOR WINTER ENERGY SETBACK
Unplug and power down your space before winter break
December 24th 2020 – January 1st 2021

Dear Cornell Staff and Faculty,

Whether you are working on campus or remotely, we encourage you to "power down" your workspaces over winter break. If you are currently working on campus, please join your colleagues in saving energy within your offices, labs, and common areas before you leave campus. Each year, your participation in Cornell's Winter Energy Shutdown avoids powering unused electronics, heating unoccupied buildings, and lighting empty offices. This collective action saves a huge amount of energy on campus, minimizes the use of natural resources, and reduces our university's carbon emissions – critical steps toward our [carbon neutral campus goal by 2035](#).

As you prepare to leave, please take the following key actions in spaces you occupy:

- Turn off power strips and unplug any electronics plugged directly into the wall. Many devices use electricity even when "turned off," including TVs, printers, chargers, copiers, coffee makers, microwave, lamps, and space heaters.
- Switch off all lights.
- Shut all windows & shades.
- Close all interior and exterior doors.
- Set your thermostat to 65F, if easily adjustable. Do not turn heat "off."
- Shut the cash completely on all fume hoods that cannot be hibernated. Any fume hood not in-use for six weeks or more is a candidate for hibernation. Lab personnel must inform their facility coordinator that they have fume hoods that are candidates.
- Report facilities issues like leaky faucets, running toilets, overly hot or cold rooms. Questions? Contact facerequests@cornell.edu
- Remind colleagues and students to take these actions before they leave too.

Our collective actions help the campus run more efficiently. Last year, we saved 1.2 million kWh of electricity during the weeklong winter shutdown saving the university nearly \$100,000. This is equivalent to eliminating 50 homes' energy use for one year, growing 14,000 trees, switching 32,200 light bulbs to LEDs, or charging 188,200,000 smartphones. The impact is huge – and needed as much now as in years past.

If you are currently working from home, you can check out the [Sustainability Life Recides](#) from the Campus Sustainability Office for more ideas on how to save energy at home. Thank you for your continued efforts to save energy, reduce carbon emissions, and adopt sustainable practices.

I hope you have an enjoyable, healthy, and restorative winter break.

Rick Burgess, Vice President, Facilities & Campus Services
Cornell University

Community College of Allegheny County

Campus reduced their computer energy use by 74% by implementing sleep settings on all computers.

Ample communication with staff and students resulted in a successful roll-out.



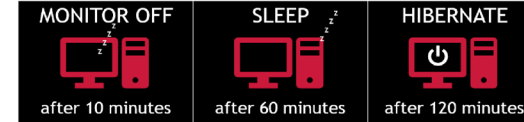
CCAC has been working with Pittsburgh 2030 District to help drive the Green Building Alliance Initiative! This initiative supports building owners and managers as they strive toward 50% reductions in energy use, water consumption, and transportation emissions by 2030 while improving indoor air quality.



CCAC found that putting its computers to sleep through a network-wide power management system reduced the college's overall energy consumption by 74%, saving \$66,000 to \$75,000 annually! That's a lot of green saved!

Last fall, CCAC also implemented a new power savings initiative that simply powered down computers when they were not in use. This included all student and employee computers and kiosks. This initiative was developed by IT as an additional way to save energy and money.

WHAT ARE THE SETTINGS???



IT continues to explore new ways to save power including improved server and digital infrastructure management and a new power down initiative targeting phones and digital signage, among other equipment. IT is also working to improve integration and communication among systems to minimize power consumption and maximize savings.

To learn about the initiative, check out [the highlight of CCAC on YouTube here!](#)

To read about CCAC and Pittsburgh power savings, [read this article from Next Pittsburgh!](#)

To learn more about the 2030 District, go to their website <https://www.2030districts.org/pittsburgh>

Houston Advanced Research Center

Implemented smart outlet system to meter and control their loads.

Paired with other measures:

- Consolidating equipment.
- Encouraging staff to power down computers at night.
- Working with IT to schedule updates.



Research Support Facility at NREL

A combination of thoughtful planning and engineering strategies enabled the building to reach NZE.

- Move to central multifunction devices.
- Procure ENERGY STAR-certified equipment.
- Install advanced power strips
- Enable timers and auto-off on devices (coffee makers).



Minnesota Department of Transportation

Cedar Truck Facility integrated automatic receptacle controls with existing lighting system.

Occupancy sensors power down lights and receptacles when the zone is unoccupied.

Ample communication with occupants resulted in a successful roll-out.

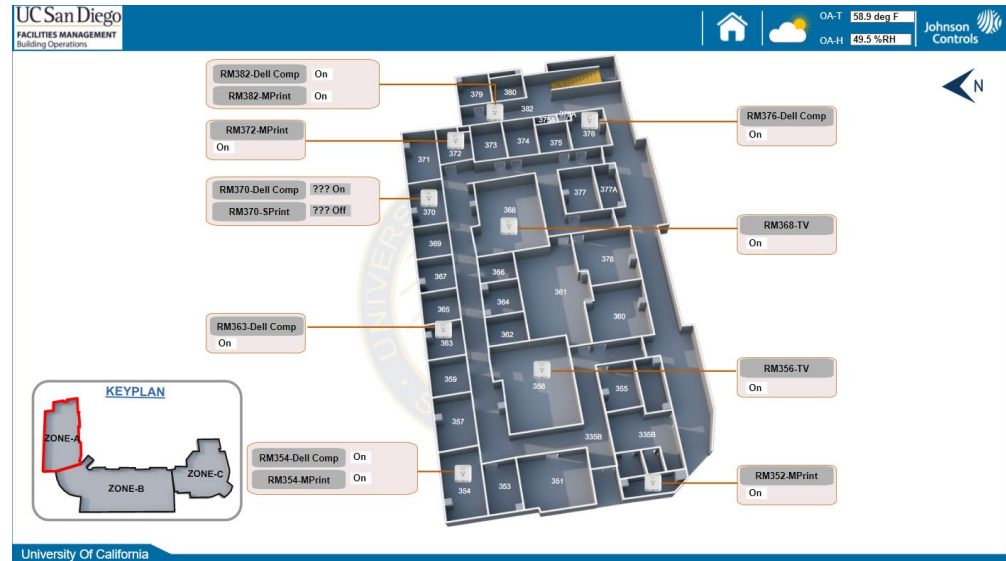


University of California San Diego

Ongoing research
integrating smart outlet
system with the BAS

Research topics

- Advanced smart outlet operation and controls
- Asset management
- Shared data to enable improved operation of other systems



Keep an eye out for these emerging PPL control technologies.

Automatic and Dynamic Load Detection

ADLD enables plug load management (PLM) systems to be plug-and-play by reducing installation time and reducing issues arising from moving devices around.

Learning Behavior Algorithms

LBAs learn occupant behavior and adjust plug load controls, accordingly, allowing for the automatic creation of optimized control schedules.

Looking to the future: resiliency

re·sil·ien·cy *noun* / ri-'zil-yən(t)-sē /

1. : an ability to recover from or adjust easily to adversity or change
2. : (commercial building) the ability to protect, maintain, or restore the functionality of, value of, and income generated by a building after a damaging event or circumstance within a prescribed time frame

Resilient buildings can shift, shed and modulate their loads to respond to grid signals or operate in grid-independent mode.



How can PPLs enable resilient buildings?



Efficiency

Lowering a building's baseload means it is less of a burden on the grid



Integration

Integration enables centralized control of all building systems, including PPLs



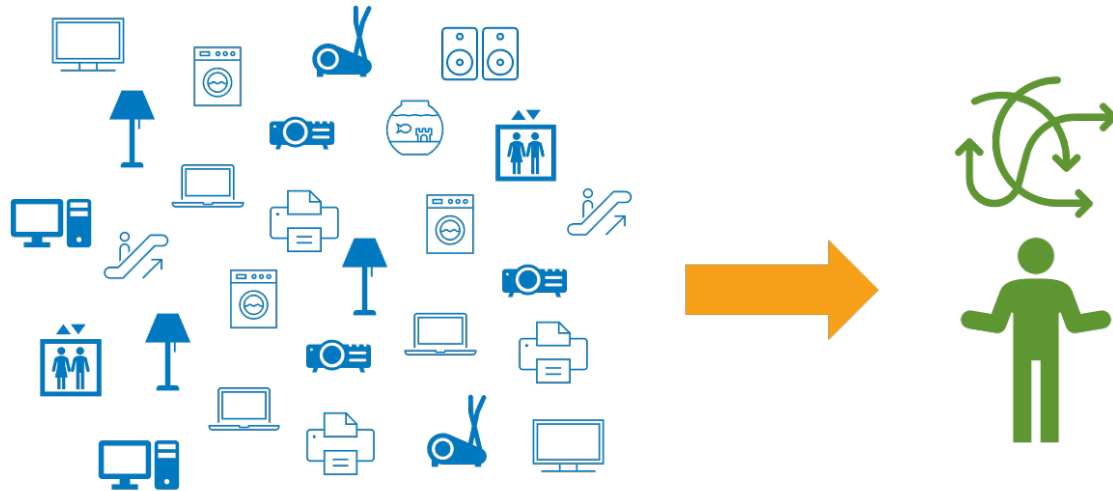
Grid-interactive

Knowing when and how to curtail a building's PPLs enables response to grid signals

Achieving integrated and grid-interactive PPLs

Automated, centralized control of PPLs has not yet been achieved.

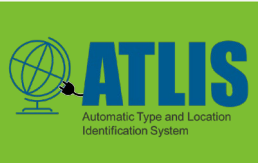




















As more devices become connected, there is an opportunity for PLM systems to tap into these intelligent capabilities and communication pathways.



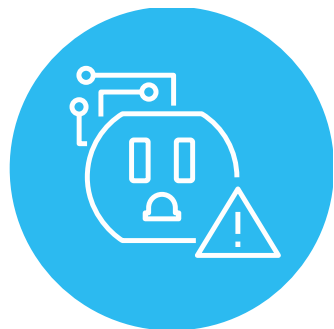
Automatic Type and Location Identification System

ATLIS is a PLM system framework that automatically identifies the location, energy use, and operating state of every connected, plug-in device in a commercial building.

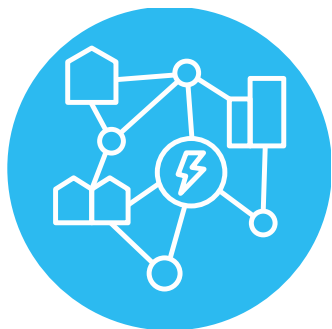
How does ATLIS stack up?

	Advanced Power Strips	Automatic Receptacle Controls	Smart Outlets	
Shutoff Power Based on Schedule				
Energy Monitoring				
Load Identification				
Plug-and-Play				
Location Identification				

ATLIS' impacts go beyond reducing PPL consumption.



Virtual Emergency
Circuits



Grid-Interactive
Efficient Buildings



Automated
Energy Audits



Asset
Management

K-12 Schools



Healthcare



Higher Education



Offices



On deck for PPLs

Codes and standards

Integration with other building systems

Validation of emerging PPL control technologies





Thank you!

www.nrel.gov

Amy LeBar

Amy.LeBar@nrel.gov

Photo from iStock-627281636

