No Purchase Necessary: Low to No Cost Plug Load Management Strategies
Better Buildings Alliance Plug and Process Loads (PPLs) Team Webinar
Technical Lead: Dr. Kim Trenbath, NREL
December 8, 2021
Agenda

BBA PPL Team Update

Technical Presentation – Elaine Sadowski and Tim Myers, Community College of Allegheny County
PC Power Management at CCAC

Technical Presentation – Kimberly Anderson, Cornell University
Plug Load Management Strategies

Technical Presentation – Dr. Paul Torcellini, National Renewable Energy Laboratory
Plug Load Management Strategies in a Zero Energy Office Building

Q&A
Omkar Ghatpande
National Renewable Energy Laboratory
Research Engineer, Electrical Engineering
Omkar.Ghatpande@NREL.gov
BBA PPL Team Update
Plug and process loads (PPLs) consume about 47% of primary energy in U.S. commercial buildings. As buildings become more efficient, PPL efficiency has become pertinent in achieving aggressive energy targets. Through the PPL Technology Research Team, partners participate in a platform to share experiences and learn from their peers and work together to create resources on PPL energy reduction strategies and their applications, covering a wide variety of electronic, computer, refrigeration, and cooking devices, including equipment essential to information processing, medical treatment, and foodservice businesses.

https://betterbuildingssolutioncenter.energy.gov/alliance/technology-solution/plug-process-loads
PPL Resources for Building Owners

• The PPL Team worked alongside DOE in developing **Low Carbon Technology Strategies** guidance documents.

• Documents will aid owners and operators of existing buildings in planning retrofit and operational strategies to achieve deep carbon reductions.

• Toolkit is can be found on the [BBA website](http://www.betterbuildings.gov).
Featured Resources

- On-Demand PPL Webinars

- Houston Advanced Research Center (featured at left); Getting to Net Zero Energy Through Strategic Building Operations and Plug Load Management

- California Plug Load Research Center; Beyond Energy Efficiency: How Your Device Usage Patterns Affect Energy Consumption
LEVERAGE UTILITY INCENTIVES FOR EFFICIENCY UPGRADES
By Better Buildings Beat Team on Jun 07, 2021

Efficiency upgrades often present a dilemma: they save costs once completed, but the initial investment can be prohibitive. A case in point is high-efficiency equipment and building system controls for space conditioning and plug and process loads (PPL). The good news is that utility incentives can help mitigate these costs.

The Better Buildings Space Conditioning and PPL Technology Research Teams have recently updated their utility incentive lists. These lists provide a central place to find utility incentives available across the U.S. and can also be downloaded here: Space Conditioning Incentives; PPL Incentives.

Building owners and operators can search these incentive lists by utility, state, type of offering/incentive, or product type. The incentives fall into three categories:

- Custom incentives relate to a reduction in energy consumption.
- Prescriptive incentives are based on the installation of a specific device.
- Upstream incentives are offered directly from the vendor or manufacturer.

Utility Incentives Across the United States

Smart Outlets: Wireless Meter and Control Systems for Plug and Process Loads

What are smart outlets?

Smart outlets control the flow of power to devices, suggest reduced or increased power use, and can alert customers to safety hazards and energy inefficiencies. Smart outlets vary widely in function and pricing, from simple plug-in units that provide turn-on and turn-off capabilities for selected appliances to complex devices that can respond to power consumption and other variables.

A major benefit of smart outlets is their ability to control individual devices, which makes them ideal for tracking energy use and identifying opportunities for cost savings.

Smart outlets are often used in conjunction with other home automation devices, such as smart thermostats and lighting systems, to create a more connected and efficient home. By linking smart outlets to a central hub, homeowners can manage their energy use from a single device, ensuring that only the necessary appliances are on when they’re not in use.

The future of smart outlets looks promising, with advances in technology and lower prices making these devices more accessible to consumers. As smart outlets continue to evolve, they will likely play an increasingly important role in the world of home automation and energy management.
PPL Team Updates: Recent Accomplishments

**Best Paper** at the International Conference on Alternative Energy Sciences and Technologies

**Integrated Lighting Campaign Winners**
Integrated Controls for Plug Loads and Lighting Systems

**A Commercial Building Plug Load Management System That Uses Internet of Things Technology to Automatically Identify Plugged-In Devices and Their Locations**

**Authors:** Amy LeBar, Kim Trenbath, Bennett Doherty, Bill Livingood

Photo Credit: Johnson Controls

Photo Credit: Minnesota DOT
PPL Team Updates: Project Highlights

Automatic Receptacle Controls
• Working on strategies for increased market uptake

Energy Efficiency in Medical Imaging Equipment
• Supporting DOE efforts

Control marked receptacle
Wireless controlled receptacle

Nighttime load is 7-8 kW

Figure 4-B  MRI 15-minute load profiles for an example weekday (Wednesday)

Source: BBA TRT Webinar 4/30/20 - Harold Jepsen
Contact us

Team Inbox:

PPL@NREL.gov

Website:

https://betterbuildingsinitiative.energy.gov/alliance/technology-solution/plug-process-loads

Technical Team Lead:

Dr. Kim Trenbath
National Renewable Energy Laboratory (NREL)
Kim.Trenbath@nrel.gov
Phone (office): (303) 275-3710
Technical Presentations
Elaine Sadowski
Community College of Allegheny County

Timothy Myers
Community College of Allegheny County
PC Power Management at CCAC

REDUCING DATA PROCESSING ENERGY AT A COMMUNITY COLLEGE
Community College of Allegheny County

Founded in 1966 in Pittsburgh, PA

Annual Enrollment 24,000 credit, 17,515 noncredit students

Programs in Arts and Humanities, Business, Education, Social & Behavioral Sciences, Human Services, Health, STEM, and Skilled Trades, as well as CDL, Casino Dealer, Film Production, and Aviation

Four campuses, four centers - approx. 1.6 million sf of buildings

Annual Energy/Water bill $3.5 million

CCAC is a member of the Pittsburgh 2030 District and the U.S. Department of Energy’s Better Buildings Challenge

Community colleges generally don’t have huge endowments
CCAC Has Saved Significant Amounts of Energy

- On track to meet Better Buildings Challenge and 2030 goals
- Over $4.25 million and 239,627 million Btu saved since the college has been keeping track
- Working on our 4th (and biggest) solar installation of about 0.5 Megawatt
- South Campus project cut energy and water costs at that campus by 43% and energy use by 51%
- Building new LEED Silver Workforce Center
- Actively upgrading lighting, HVAC, and building envelopes
  Example Chalfant Hall – Former Mansion – Historic Property – New Windows, insulation in walls, converted from gas-fired hot water to VRF heat pumps and LED lighting – To become Center for Teaching and Learning and Virtual Center
- Aiming for deep retrofits
CCAC Has Approximately 4000 Computers

Computer power consumption amounts to about 6% of CCAC’s total of 17,680,965 kWh/year.

In addition to this, the Data Center, located in our administrative building, consumes an additional 6% of our electricity use and accounts for 65% of this building’s annual $132,000 electricity bill.

This computer-related electricity costs CCAC about $240,000 every year.

Many computers were always on in labs, whether used or not, but we got substantial savings in office spaces as well.

Energy Manager estimated savings from PC power management of about $75,000 per year.
Reducing IT Energy Consumption and Costs

- The Facilities Department recognized that major energy and cost savings could be realized in IT systems

  Consolidation/virtualization of servers – reduce footprint – improve data center air management and temperature control

  Switching to laptops where possible

  PC Power Management – the college had no funds to spare for the purchase of power management software at a cost of about $50,000.

  So, Facilities talked with IT!
Past Practices and Benchmark

Sleep and Hibernate Disabled

This meant that possible power states were only:
- Computer On
- Computer Off (user action required)
- Monitor Off

Why was sleep disabled?
- Outdated negative experiences with sleep settings on older hardware
- Outdated system management strategies

Measuring consumption
- Monitoring Software - System Center Configuration Manager (SCCM)
- Also called Endpoint Configuration Manager
Microsoft Group Policy

- Used by virtually all IT organizations to manage Windows computer settings on their networks
- Leveraged to apply custom power plans to computers based on their use case
- Users unable to change settings

<table>
<thead>
<tr>
<th>Setting (plugged in)</th>
<th>Windows Defaults</th>
<th>Most Desktops</th>
<th>Classroom Instructor PCS</th>
<th>Laptops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Off</td>
<td>10</td>
<td>10</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>Sleep</td>
<td>30</td>
<td>30</td>
<td>80</td>
<td>240</td>
</tr>
<tr>
<td>Hibernate</td>
<td>180</td>
<td>120</td>
<td>120</td>
<td>---</td>
</tr>
</tbody>
</table>
Communicating Changes

Gaining Acceptance and Managing Expectations

- “Growing pains” and complaints expected
- Communication campaign to notify users and inform them of what to expect
- Feedback was used to make adjustments when necessary
  - Kiosks, classroom instructor PCs and laptops all have unique needs
Benchmark Data

**Monthly Consumption by All Computers**

- **3,666 Computers Reporting**
- **120,908 kWh**
- **Single Computer Avg**
  - 32.98 kWh/month

**Daily Consumption by All Computers**

**September 2019**
Savings Data

Monthly Consumption by All Computers

3510 Computers Reporting

Single Computer Avg

9.03 kWh/month

31,708 kWh

February 2020

Daily Consumption by All Computers

Energy Consumption (kWh)

Report Dates
Comparison

Monthly decrease of \textbf{89,200 kWh} overall for a \textbf{73.77\%} drop in consumption.

Daily average activity during a normal semester week
Lessons Learned

- Saving money and energy doesn’t have to be expensive.
- Facilities and IT can help each other out – Talk to each other!
- Substantial savings can be hidden – look around!
- Look at the problem and don’t fixate on a specific solution – e.g. specialized software for power management.
- Keep people affected by a change in the loop so they know what to expect.
- Be patient and expect a little pushback when changes are made.
- Capital cost = $0; Annual savings $65,000 to $75,000
PLUG LOAD MANAGEMENT STRATEGIES

Kimberly Barth Anderson
kab94@cornell.edu
Sustainability Engagement Manager
Cornell University
Quick Overview

• Community-Based Social Marketing (CBSM)

• Behavior Change Campaigns

• Purchasing Standards
Cornell University

• Building types
  • Residential, academic, labs, offices, greenhouses …

• Population
  • 25,000+ students
  • 13,000+ employees

• Plug load types
  • From microfridges and desk lamps, to coffee machines and lasers
Campus Sustainability Office Mission

Equip, empower, and engage all members of the campus community to create a more sustainable campus, region, and world.

QUADRUPLE BOTTOM LINE FRAMEWORK

Cornell has developed a four-part sustainability framework to support decision-making.

- Does it support a sustainable planet?
- Does it support justice & health for people?
- Does it support institutional and regional prosperity?
- Does it help us serve our academic and land grant purpose?
Intro

Community-Based Social Marketing

Community-Based Social Marketing

PSYCHOLOGY
habits, perceptions, change

+ SOCIAL MARKETING
peers, community, culture

= Behavior Change

Credit: photo-dictfaq.org, Geller, 1989; Andreasen, 1995; McKenzie-Mohr, 2000
Community-Based Social Marketing

1. Select Behaviors
2. Uncover Barriers & Benefits
3. Develop Strategy
4. Pilot Strategy
5. Implement Broadly & Evaluate

Selecting Behaviors

Type of behaviors you want:

- High impact – *biggest impact in focus area (e.g. energy, waste)*
- High probability – *most likely to be adopted*
- Low penetration – *low #s of people already engaged in the behavior*
- High applicability – *most broadly applicable to target audience(s)*
Climate Literacy Survey

What is your level of engagement with each of the following sustainable behaviors?

- Recycle plastic, aluminum, paper...
- Reduce energy consumption
- Engage in service and experiential...
- Compost food scraps
- Choose local/other sustainable food...
- Use reusable mugs/water bottles
- Consume less meat

Options:
- Did before coming
- Started since Cornell
- Plan to start soon
- No plans to do this for now
<table>
<thead>
<tr>
<th>Behavior</th>
<th>Guidelines</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Impact(1-5)</td>
<td>Penetration</td>
</tr>
<tr>
<td>Thermostat</td>
<td>5</td>
<td>75</td>
</tr>
<tr>
<td>Private Lights</td>
<td>3</td>
<td>85</td>
</tr>
<tr>
<td>Public Lights</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Showers &lt;10m</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>Colder Showers</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

### Community-Based Social Marketing

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Behaviors</td>
<td>Uncover Barriers &amp; Benefits</td>
<td>Develop Strategy</td>
<td>Pilot Strategy</td>
<td>Implement Broadly &amp; Evaluate</td>
</tr>
</tbody>
</table>
Community-Based Social Marketing

1. Select Behaviors
2. Uncover Barriers & Benefits
3. Develop Strategy
4. Pilot Strategy
5. Implement Broadly & Evaluate

## Develop Strategy

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of motivation</td>
<td>Commitment</td>
</tr>
<tr>
<td></td>
<td>Social Norms</td>
</tr>
<tr>
<td></td>
<td>Incentives</td>
</tr>
<tr>
<td>Forget to act</td>
<td>Prompts</td>
</tr>
<tr>
<td>Lack of social pressure</td>
<td>Social Norms</td>
</tr>
<tr>
<td>Lack of knowledge</td>
<td>Communication</td>
</tr>
<tr>
<td></td>
<td>Social Diffusion</td>
</tr>
<tr>
<td>Lack of experience, low confidence</td>
<td>Social Diffusion, Modeling, Incentives</td>
</tr>
<tr>
<td>Structural barriers</td>
<td>Convenience</td>
</tr>
</tbody>
</table>

Community-Based Social Marketing

1. Select Behaviors
2. Uncover Barriers & Benefits
3. Develop Strategy
4. Pilot Strategy
5. Implement Broadly & Evaluate
# Community-Based Social Marketing

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Behaviors</td>
<td>Uncover Barriers &amp; Benefits</td>
<td>Develop Strategy</td>
<td>Pilot Strategy</td>
<td>Implement Broadly &amp; Evaluate</td>
</tr>
</tbody>
</table>
Site Resources
This site consists of five resources for those working to foster sustainable behaviors, such as those involved in conservation, energy efficiency, transportation, waste reduction, and water efficiency. The site includes the complete contents of the book, Fostering Sustainable Behavior, as well as searchable databases of articles, case studies, and turnkey strategies. Further, it includes discussion forums for sharing information and asking questions of others. If you take a moment to complete the free registration for this site resources added since your last visit, will be highlighted, in the table below and you will be able to post to the discussion forums and receive the daily discussion forum digest by email.

Please note: To gain the full functionality of this site please login or create an account

Note
Place your cursor over the above icons to reveal which behaviors have been assigned to each category. Clicking on a behavior will display all of the content on this site related to that behavior. Enjoy!
Using CBSM

Behavior Change Campaigns
POWDER 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 2050.

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, ovens, coffee makers, microwaves, lamps, and space heaters.
- **Switch off all lights.**
- **Shut all windows & shades.**
- **Close all interior and exterior doors.**
- **Set your thermostat to 65°F, if easily adjustable.** Do not turn heat “off.”
- **Shut the sash completely on all fume hoods that cannot be fumecycled.** Any fume hood not in-use for six weeks or more is a candidate for fumecycling. 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 facilitiesrequest@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 week-long winter shutdown saving the university nearly $400.000. This is equivalent to eliminating 58 homes’ energy use for one year, growing 1,000 trees, switching 32,290 light bulbs to LEDs, or charging 100,200,000 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 Recipes 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
Social Diffusion & Social Norms

Sustainability Teams

• Partnering with colleges & departments to create sustainability teams
  • Senior leader support
  • Members from every level of organization
  • Peer-to-peer education & engagement
  • Small budgets

• Leading initiatives within unit
  • Experts in their work, knowing the community
  • Collaborate on university priorities
  • Model behaviors
  • Create and implement new projects
Social Diffusion & Incentives

Sustainability Teams

- Spreading the word
  - Communicate with peers
  - Host workshops & events
  - Integrate tips into newsletters & meetings

- Recognizing efforts
  - Sustainability Champions HR Recognition portal
  - CU Partners in Sustainability Awards

Sustainability Champions HR Recognition

For Cornell employees, nominations accepted on a rolling basis.

Sustainability Champions is an employee recognition program for anyone to recognize a colleague who exemplifies Cornell University’s commitment to sustainability, and have shown leadership and initiative to catalyze change for a more sustainable campus and planet with actions big and small. Make someone’s day - show them you care by pointing out their leadership for actions big and small!

Monthly winners will receive prizes. Uses the Cornell HR Portal.

Purchase a Smart Power Strip

Protect your electronics and reduce energy waste at your workstation.

Why Take Action? Plugging electronics such as computers, monitors, and printers into a power strip, or “surge protector” prevents power surges from ruining expensive equipment. But traditional strips draw energy even when electronics are turned off. This is called the phantom load. Studies show it can add up to 10% to an annual electricity bill. Cornell has a goal of reaching campus carbon neutrality by 2035, and our biggest source of greenhouse gas emissions comes from our energy use (and energy waste). Turning off electronics can really add up on a big campus.

What Can You Do? Switching to an Energy Smart Power Strip will still protect your electronics while giving you the option to completely power down and prevent phantom load. We prefer the kind that has an
Welcome to Cornell’s Mission Sustainability course!

In this course, you will discover how sustainability and climate change is integrated into campus operations and the student experience at Cornell. This course will introduce you to several ways you can live, learn, and engage in sustainable change during your time as a Cornell student. Specifically, during about one hour, you will...

- Complete a survey
- Watch a short video
  - and reflect on one key takeaway
- Consider ways to live more sustainably on campus
  - and test your knowledge
- Learn how sustainability is embedded in Cornell’s coursework
  - and identify one course that intrigues you
- Explore opportunities for getting engaged in sustainability activities at Cornell
  - and imagine one way you could get involved

Commitments & Communication

Education and Engagement

- Mission Sustainability module
  - Short course for all incoming students, launched summer 2020
  - Communicates university expectations
  - Encourages students to make commitments
  - Survey informs social norm campaigns

Cornell’s Top 10 Tips for Moving-in and Living Sustainably on Campus

Cornell’s move-in days are just around the corner! The following tips will help you move-in more sustainably, connect to campus resources, and better understand Cornell’s approach to sustainability.

4. Power your room efficiently

Bring a power strip to plug in all your electronic devices, and simply flip the switch when they are not in use. This avoids having devices, like phone chargers, draw energy even when turned off or not in use. Switch off lights when you leave a room, even in common rooms and classrooms, if you are the last one to leave.

Student rooms come equipped with natural lighting, desk lamps, and overhead lighting (basically). If you intend to bring additional lighting, be sure to use energy efficient LED bulbs.
Sustainability GooseChase

- 30 day ‘scavenger hunt’ during Orientation for students & employees
- Missions focused on sustainable behaviors
- Submit pictures & videos, as well as text and GPS
- Encourages daily actions
- Social norms and modeling via Feed

Social Diffusion & Modeling

Education and Engagement
Commitments & Social Norms

Education and Engagement

• **Energy Smackdown**
  • 4-week competition for students & employees
  • Engagement activity focused on energy conservation behaviors
  • Encourages daily actions
  • Social norms and modeling via Feed

---

It’s #Energy #Smackdown at Cornell! I did something over Fall break that basically sums up what you should do during this energy smackdown period. Please watch for a low-quality video with “high-quality” content. [1/4]

@SustainCornell #CUSciStory

youtube.com/watch?v=sJBwv...
Incentives

Grants & Giveaways

• Campus Energy Reduction Grant
  • Motivates teamwork & innovative thinking
  • Identifies community needs
  • Reduces energy use
  • Modest budget

• Prizes & Giveaways
  • Give items that connect & encourage desired behavior
    • Remote-controlled power strips
    • Kill-a-watt devices
    • Solar chargers & lights
Make Sustainability the Default Purchasing Standards

- Preferred supplies for computer hardware
  - Energy Star compliant
  - Meet Electronic Product Environmental Assessment Tool (EPEAT) silver and/or gold standards

- Integrating sustainability into procurement
  - e-SHOP filters for Energy Star
  - Climate Pledge Friendly filter on Amazon
  - Encourage employees to make purchases using QBL framework

- NY State procurement guidelines for state agencies, like SUNY colleges & universities
  - https://ogs.ny.gov/greenny
Make Sustainability the Default Purchasing Standards

- Preferred supplies for computer hardware
  - Energy Star compliant
  - Meet Electronic Product Environmental Assessment Tool (EPEAT) silver and/or gold standards

- Integrating sustainability into procurement
  - e-SHOP filters for Energy Star
  - Climate Pledge Friendly filter on Amazon
  - Encourage employees to make purchases using QBL framework

- NY State procurement guidelines for state agencies, like SUNY colleges & universities
  - [https://ogs.ny.gov/greenny](https://ogs.ny.gov/greenny)
Make Sustainability the Default Purchasing Standards

- Preferred supplies for computer hardware
  - Energy Star compliant
  - Meet Electronic Product Environmental Assessment Tool (EPEAT) silver and/or gold standards

- Integrating sustainability into procurement
  - e-SHOP filters for Energy Star
  - Climate Pledge Friendly filter on Amazon
  - Encourage employees to make purchases using QBL framework

- NY State procurement guidelines for state agencies, like SUNY colleges & universities
  - [https://ogs.ny.gov/greenny](https://ogs.ny.gov/greenny)
PLUG LOAD MANAGEMENT STRATEGIES

Kimberly Barth Anderson
kab94@cornell.edu
Sustainability Engagement Manager
Cornell University
Dr. Paul Torcellini
National Renewable Energy Laboratory
Plug Load Management Strategies in a Zero Energy Office Building

Paul Torcellini, Ph.D., P.E.
Principal Engineer
National Renewable Energy Laboratory
About the Research Support Facility (RSF)

• 360,000 sqft office building on NREL’s campus
• Completed in 2010
• RSF uses 50% less energy than if it were built to current commercial codes at no extra capital cost.
• RSF increases space at NREL by 60%, but only increases energy use by 6%.
RSF Energy Modeling

NREL RSF Energy Use Breakdown

End Use: kBu/ft²
- Space Heating: 8.58
- Space Cooling: 0.85
- Pumps: 0.48
- Ventilation Fans: 1.88
- Domestic Hot Water: 0.90
- Exterior Lights: 0.12
- Lights: 2.07
- Office Plug Loads: 7.87
- Task Lights: 0.10
- Data Center: 12.11
- Data Center Cooling: 0.02
- Data Center Fans: 0.20

Credit: Chad Lobato/NREL
NREL reduced plug loads by 50%

- Inventory of anything that was using electricity
- Was that still needed?
- Did it need to be operated when the space was unoccupied?
- Was there a more efficient way to perform the service?
When do we really “need” plug loads?

• Nights, weekends, and holidays account for 66% of the year
  • A typical office building is unoccupied during this time

• During a typical workday, building occupants are only at their desk less than 30% of the time
  • Workstations are vacant and should be powered down during more than 70% of business hours

• Workstations should only be powered 7% of the year!

References:

Credit: Chad Lobato/NREL
Computer Equipment Power Modes

• Evaluate policies and operations to ensure effectiveness
  • NREL used a screensaver to lock unused computers
    • The screensaver consumes on average 5W more than an idle computer
  • Instead of a screensaver, if the monitors and computers went into standby there would be a savings of 70W per person
• ~$500,000 of PV saved
• Anything multiplied by 800 is a lot!
Measured Plug Load Data from NREL RSF

Credit: Marjorie Schott/NREL

Note: The elevators are included in the plug loads
### Ideas...

<table>
<thead>
<tr>
<th><strong>No Cost</strong></th>
<th><strong>Low Cost</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Inventory and shut off equipment that runs when building is not occupied</td>
<td>• Move to central 3-in-1 document processing systems (and get rid of fax machines)</td>
</tr>
<tr>
<td>• Enable Energy Star on computers, monitors, disk drives</td>
<td>• Put Wi-Fi routers and other computer equipment on time clocks</td>
</tr>
<tr>
<td>• Unplug game consoles when not in use</td>
<td>• Use laptops (match computing power with needs)</td>
</tr>
<tr>
<td>• Disconnect power to plug load circuits</td>
<td>• Use task lights and minimize overhead lights</td>
</tr>
<tr>
<td></td>
<td>• No electric space heaters—fix the HVAC issues related to comfort</td>
</tr>
<tr>
<td></td>
<td>• Create a laptop/screen package that minimizes energy</td>
</tr>
<tr>
<td></td>
<td>• Provide off switches for A/V equipment in conference rooms (especially the projectors)</td>
</tr>
<tr>
<td></td>
<td>• Install advanced power strips to control loads</td>
</tr>
</tbody>
</table>

Get a Plug Load Champion!
Other Ideas…

- Remove water coolers (and use RO filters)
- Use Voice over IP phones—or better yet soft phones
- Purchase Energy Star Equipment
- Purchase refrigerators based on annual energy consumption—forgo auto ice makers, water dispensers
- Auto off/on coffeemakers (also a safety feature)
- Install Energy Star dishwashers
- Use regenerative elevators (avoid hydraulic elevators)
- Use cameras that work with low light levels (and then turn off lights)

Get a Plug Load Champion!
Thank You!

Paul Torcellini
NREL
Paul.Torcellini@nrel.gov
Question & Answer
Thank You!

Kim Trenbath
Kim.Trenbath@NREL.gov