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Energy Efficiency Program

HIGHLIGHTING PLUG LOAD DEVICES IN COMMERCIAL ENERGY EFFICIENCY PROGRAMS FULL REPORT

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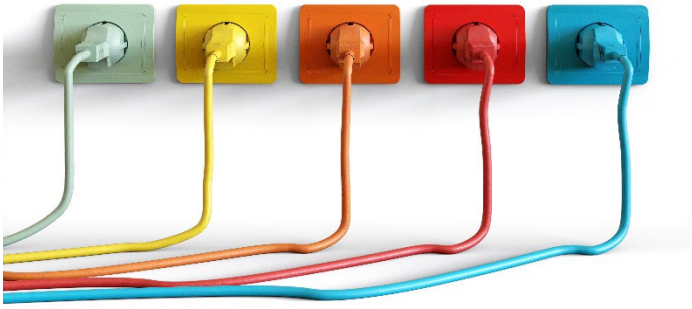

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ACRONYMS AND ABBREVIATIONS

Term/Acronym	Definition
AC	Air conditioner
ACEEE	American Council for an Energy-Efficient Economy
ADR	Automated demand response
AMI	Advanced metering infrastructure
APS	Advanced power strip
BGE	Baltimore Gas & Electric
CalPlug	The California Plug Load Research Center, at the University of California, Irvine
CFS	Commercial food service
ComEd	Commonwealth Edison
ConEd	Consolidated Edison
DOE	U.S. Department of Energy
DR	Demand response
EE	Energy efficiency
EESP	Energy Efficiency Service Provider
EM&V	Evaluation, measure, and verification
EMS	Energy management system
EV	Electric vehicle
FPL	Florida Power and Light
FSTC	Food Service Technology Center
GEB	Grid-interactive efficient building
GHG	Greenhouse gas
HDD	Hard disk drive
HVAC	Heating, ventilation, and air conditioning
IT	Information technology
MAID	Massive array of idle disks
MELs	Miscellaneous Electric Loads
NREL	National Renewable Energy Laboratory
NYSEG	New York State Electric & Gas
PG&E	Pacific Gas and Electric
PLM	Plug load management
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SMUD	Sacramento Municipal Utility District
SoCalGas	Southern California Gas
SSD	Solid state drive (data storage)
UPS	Uninterruptible power supply
VSD	Variable speed drive (motors)
Wh; kWh; GWh; MWh; TWh	Watt hour; kilowatt hour (1,000 Wh); Megawatt hour (1,000 kWh); Gigawatt hour (1,000 MWh); Terawatt hour (1,000 GWh)
ZNE	Zero net energy

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1.0 EXECUTIVE SUMMARY

Introduction

Energy efficiency (EE) programs are motivated by growing concerns about the increasingly serious effects of climate change, grid instability, and lack of energy security (Hafer, 2015). The goal of these programs is to promote cost-effective solutions that reduce and manage energy consumption. Like many other utilities, ComEd has been successful in reducing energy consumption of traditional end uses, specifically lighting and HVAC. However, measures targeting consumer electronics, food service equipment, or appliances contributed only marginally to the total net savings in 2019. This reflects the fact that plug load devices are considered an emerging area (Relf, Cooper, Gold, Goyal, & Waters, 2020) and have not yet been a major focus for EE programs (York et al., 2015).

Plug load devices are appliances and equipment that plug into standard electrical sockets. In commercial settings this includes devices such as computers and printers in offices, projectors in conference rooms, cash registers in retail outlets, televisions and food service equipment in restaurants, and refrigerators and water coolers in staff breakrooms. Total energy use attributed to plug load devices has risen as the number of such devices in commercial buildings has increased, and there is consensus that plug load energy consumption will continue to grow (Sofos, 2016; U.S. Energy Information Administration, 2014, 2019). There is evidence that organizations that implement both technological and behavioral strategies observe a significant decrease in plug load energy consumption and waste (Hackel et al., 2016; Lobato, Pless, Sheppy, & Torcellini, 2011; Mercier & Moorefield, 2011; Sheppy, Metzger, Cutler, Holland, & Hanada, 2014; U.S. General Services Administration, 2014). Utilities can support their commercial customers in reducing their plug load by offering EE programs that are tailored towards this goal.

This report reviews and compares EE programs concerned with commercial plug load devices, with the aim of suggesting possible avenues for integrating new approaches or measure categories into ComEd's current programs.

Approach and Methodology

CalPlug took a three-pronged approach to identify potential opportunities for plug load device EE program recommendations. First, CalPlug compiled a list of plug load devices and selected devices that were the most promising for achieving energy savings. Second, CalPlug identified and examined all the energy efficiency programs that involve plug load devices in ComEd's current program portfolio and in the portfolios of a list of 18 selected comparison utilities. Third, CalPlug compared ComEd's programs with the comparison utilities' programs and with best practices to identify potential opportunities for more effectively advancing plug load efficiency.

Key Devices

A master list of 92 devices was assessed for potential energy savings through energy-efficient alternatives or through being controlled by a plug load control system. Thirty plug load devices were identified as presenting energy-efficient options, including computing, imaging, and networking devices, room air-conditioners and dehumidifiers, and many kitchen and laundry appliances. Five plug load control devices were identified, including

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two types of advanced power strips (Tier 1 and Tier 2 APS), plug load occupancy sensors, smart plugs, and vending machine miser controls. Twenty-three devices (including eight from the first list) were categorized as potentially saving energy if managed by a control device, including many types of office and audio-video equipment. The remaining devices were determined to be out of scope for consideration due to not being a plug load device, having no energy saving potential, or showing a trend toward declining population.

Plug Load Devices in ComEd's Commercial EE Programs

ComEd boasts a mature EE program portfolio that has earned the utility a high ranking in the American Council for an Energy-Efficient Economy (ACEEE) utility scorecard (Relf et al., 2020). Thus, it is not surprising that ComEd already offers measures addressing plug load devices within several programs. ComEd offers rebates for plug load devices and controls in the standard incentives program. ComEd's data center program uses a custom incentives approach, based on achieved kWh savings; many plug load measures can be accommodated within this program. ComEd also offers direct installation plug load control measures (such as Tier 1 APS and vending machine controls) within the small business programs and multi-family programs, and also supplies Tier 1 APS devices in free, self-install small business kits. Web-based platforms, like ComEd's Business Energy Analyzer, give customers feedback about their energy use and provide personalized and actionable advice, such as upgrading or shutting off equipment. ComEd also offers facility assessments and helps their customers implement no-cost or low-cost strategies, such as shutting off idle equipment, within the operational savings program.

Any assessment of commercial EE programs and approaches should consider the constitution of the utility's commercial customer base. The vast majority of ComEd's accounts (95%) are in ComEd's small load delivery classes (less than 100 kW peak demand) and thus eligible for small business EE programs (ComEd, 2020a). One third of ComEd's commercial customers belong to the office segment (ComEd, 2020a) and most commercial businesses include at least some office space in their facilities, emphasizing the importance of targeting computers, servers, printers, and other office equipment. Only 7% of customers are in the food service sector, but commercial kitchen equipment consumes high amounts of energy, making the food service segment one of the most energy-intensive in the commercial sector (Opinion Dynamics, 2018).

Conclusions

Lessons Learned

CalPlug identified many barriers to effectively incorporating plug load devices into EE programs for commercial customers:

- The wide range of plug load devices and the diversity of the commercial sector make it difficult to design programs that are effective for multiple types of devices across multiple types of businesses.
- Many individual plug load devices do not use much energy, but the waste accumulates over large numbers of devices. Limited savings per device lead to low incentive amounts, making standard incentives less effective.

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- Many plug load devices are difficult to control, either for energy management or demand response purposes, because they cannot have their power cut or reduced without complete loss of functionality.
- Smart connected solutions can potentially link devices, sensors, and energy monitors, to save energy, but this future ideal has not been yet realized, due to interoperability problems between smart connected devices at the building level. Also, connectivity features in smart connected devices and appliances do not necessarily save energy and have a concurrent overhead energy demand for cloud computing needs.
- In the absence of clear measurement and feedback mechanisms, energy use is invisible in everyday life, and most people are unaware or misunderstand how much energy is consumed by the devices they use. Even IT managers, who are experts about computers and data centers, may dismiss or overlook the energy use of these devices.
- Effective communication and education is especially important for plug load devices, as user behavior can greatly impact devices' energy consumption. Factors such as effective installation of control devices, enabling on-board power management settings, and selecting efficient water temperature settings affect whether projected energy efficiency gains are actually realized.
- Website interface has an important impact on user experience; problems with navigating across web pages and finding relevant offerings can hinder program participation.
- Money and time constraints are common barriers to major investments such as data center hardware and commercial food service equipment, especially for small businesses. Pressures on short term cash flow can prevent customers from investing in energy efficient upgrades, even if it would save money in the medium to long term.

Recommendations

Standard Incentives

Based on comparisons to other utility offerings and to additional research on these devices, CalPlug recommends that ComEd consider making the following changes to their standard incentive offerings.

- Increase the incentive amounts:
  - Solid-door reach-in refrigerators
  - Glass-door reach-in refrigerators
  - Convection ovens
  - Combination ovens
  - Griddles
  - Commercial clothes washer

- Offer a range of incentives by size:
  - Solid-door reach-in refrigerators
  - Glass-door reach-in refrigerators
  - Solid-door reach-in freezers
  - Glass-door reach-in freezers

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  - Hot food holding cabinets
  - Fryers

- Extend residential standard incentives to commercial customers:
  - Dehumidifiers
  - Residential refrigerators
  - Residential clothes washers (multifamily building owners only)

- Add new device to standard incentive program:
  - Room air conditioning units
  - Commercial dishwashers
  - Wrap machine
  - Heat pump dryers
  - Tier 1 APS and Tier 2 APS

In addition, CalPlug recommends numerous alternate strategies for encouraging energy savings for specific devices instead of or in addition to offering standard incentives. Many steps could be taken during field assessments and other customer interactions. For instance, service providers should encourage the purchase of energy efficient devices, especially those that are not otherwise incentivized (e.g., desktop computers); install plug load controls to control a range of devices (e.g., computers and other office equipment, televisions, cash registers, and water coolers); and advise customers to remove wasteful personal devices such as mini-refrigerators. CalPlug also recommends clarifying information about plug load occupancy sensors and other plug load control strategies, as well as providing installation guides.

Online Marketplace

To increase customer engagement, CalPlug recommends that ComEd create an online marketplace targeted to business customers, as an extension of the existing residential online store. This store should include direct sales of plug load devices including plug load occupancy sensors, the full range of Tier 1 and Tier 2 APS devices, and EV chargers, as well as lighting. CalPlug also recommends participating in an online brokering platform to provide a common exchange site where customers can obtain verified product reviews, compare prices between models across retailers and distributors, see Enervee energy savings scores for products, and connect customers with third-party trade allies.

Midstream Programs: Commercial Food Service Equipment Pilot Program

CalPlug's recommendations are intended for consideration when ComEd evaluates results for the ongoing pilot program. These recommendations summarize best practices exhibited by comparison utilities with more established midstream CFS programs. Many of these practices are details that were not included in CalPlug's sources for ComEd's CFS pilot and may already be utilized. CalPlug recommends that ComEd:

- Add commercial dishwashers and wrap machines to the offered devices
- Consider requiring distributors to pass on a percentage of their incentives directly to end use customers, and whether to include "spiffs" for individual sales representatives
- Consider instituting higher incentives for ENERGY STAR Most Efficient products

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- Develop and test an online tool to facilitate instant rebate distributions to retail partners and customers
- Use consistent branding for the midstream program across utility and distributor partner websites
- Offer online webinars to engage end-use customers and potential retail partners
- Offer in-person courses and CFS product demonstrations at utility sites for distributor partners for deeper training on marketing strategies and new technology
- Compare the metrics and methodologies for evaluation, measure, and verification procedures used for the midstream program to those used by other utilities with more established programs

Data Center (Custom Incentives)

ComEd currently addresses data center measures, such as closet-to-colocation, within the custom incentives program. The existing program for data centers is robust and effective for larger retrofit projects but may be more complicated than required for businesses seeking more modest investments or upgrades. ComEd could reach a wider audience by linking the existing standard incentives catalog webpage (e.g., HVAC and lighting) to the data center program webpage and adding standard incentives for ENERGY STAR qualified servers, UPS devices, and data storage equipment. This program should target customers with older IT equipment and low levels of UPS utilization. CalPlug also recommends requiring ENERGY STAR-certified devices as part of the custom incentive process. CalPlug also recommends encouraging other energy reduction strategies for high-consuming plug loads on their webpage and factsheets: specifically, unplugging comatose servers, replacing HDDs with SDDs and using MAID technology. ComEd could also benefit from expanding the education offered online (e.g., webinars, factsheets, online training) to include data center specific energy efficiency strategies, and from partnering with government agencies that offer online and in-person trainings to train utility personnel to identify energy efficiency opportunities in data centers.

Small Business Programs

CalPlug recommends that ComEd expand their small business direct install measures to include plug load occupancy sensors and the full range of Tier 1 and Tier 2 APS devices. This will give Energy Efficiency Service Providers (EESPs) greater flexibility to select the plug load control strategies that are most effective for individual customers' specific combinations of devices and usage needs. CalPlug also recommends exploring alternate business kit combinations that vary in the type of plug load control device(s) included, to tailor to specific customer needs. In order to increase visibility and generate interest, ComEd should consider adding factsheets on no- and low-cost plug load management strategies.

Financing

Offering financing with zero or low interest has been successfully promoted by other leading utilities to help small businesses pay for energy-efficient upgrades. CalPlug recommends that ComEd consider adding financing options to the small business program, data center program, commercial food service program, and other programs involving high upfront investment costs for equipment upgrades.

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Plug Load Education and Training

CalPlug makes several recommendations aimed at advancing plug load device awareness and solutions through enhanced training of EESPs and education of customers. Both approaches help promote no- and low-cost strategies for reducing plug load energy consumption, such as effective use of plug load control systems, ensuring that energy-saving settings are engaged, and unplugging or removing extraneous devices. CalPlug recommends training EESPs to identify and solve specific plug load devices inefficiencies in facility assessments and EE project recommendations, including determining which type of plug load control strategy is appropriate for the situation. EESPs should demonstrate for customers (and the rest of the staff) how exactly to set up an APS or occupancy sensor with a range of devices, and how to check whether multiple types of devices have their standby modes activated. Training and outreach should extend to all stakeholders, including building occupants as well as building managers, IT managers at data centers, and distributers involved in midstream programs. Courses and demonstrations could be held at the utility's sites or remotely.

CalPlug recommends expanding educational materials offered on ComEd's website for a greater focus on plug load devices. Several comparison utilities examined for this report provide excellent examples to follow, such as providing tips pages to promote no- and low-cost plug load reduction strategies, factsheets on plug load savings aimed at offices, instructions for how to install plug load control devices, and worksheets that organize plug load-related incentives into one place. Where relevant, these pages should link to ComEd's programs and incentives.

To facilitate engaging and educating customers, CalPlug recommends a usability assessment of the ComEd website, aimed toward making the energy efficiency pages easier to navigate.

Future Trends

CalPlug identified two future trends for which ComEd does not currently have EE programs in place: the growing importance of zero net energy grid-interactive efficient buildings (GEBs) and the growing need for electric vehicle (EV) chargers.

To prepare for implementing GEB-related programs, CalPlug recommends that ComEd conduct research on GEB technology as it pertains to its commercial customer base. Research would ideally focus on how to measure and incentivize savings of plug load control devices and smart controlled devices and how to leverage existing AMI and ADR systems to integrate with plug load controls in smart buildings. ComEd should also plan to conduct feasibility studies, including the possibility of integrating plug load controls with temperature and lighting controls in future program designs.

Given trends toward electric transportation, CalPlug recommends that ComEd consider implementing an incentive program for EV chargers. This would require research on EV trends in Illinois and the Midwest more generally, followed by research and cost effectiveness analyses on possible program designs. CalPlug identified several features based on comparison utilities' established programs, including offering rebates on charging stations, selling discounted charging stations through an online marketplace, and providing

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free consultations to customers on where best to install the chargers, as well as free infrastructure installation for grid connection.

Summary

ComEd boasts a full and robust energy efficiency portfolio for its commercial customers, and already effectively incentivizes many key plug load devices. The assessment and recommendations given here are intended to identify opportunities for highlighting plug load devices more effectively in ComEd's portfolio, both to boost the uptake of the existing programs and to add more energy-saving elements.

CalPlug had no access to internal documents on ComEd's program design or administration, and the scope of this project did not allow for interviewing program managers; as such, suggestions about training, educational materials, and other inward-facing program elements are necessarily generalized, and may refer to practices already being used.

This project focused on breadth rather than depth, prioritizing identifying the widest and most comprehensive range of plug load problems and solutions rather than detailed analysis of any specific program recommendation. This prevented CalPlug from spending time on deep-dive assessments of programmatic elements that ComEd has already explored and is not interested in. The next step is for ComEd to decide which of the recommended changes to prioritize, given their greater knowledge of past and current offerings, and then to pursue more in-depth assessments.

Summarizing key projects based on the recommendations given above, next steps could include:

- Pilot studies, device testing, and assessment analyses
    - Cost effectiveness analyses of adding devices to standard incentive list or modifying incentive amount/range
    - Expand online marketplace and/or investigate product brokerage page possibilities
    - Assess proposed changes to data center program
    - Consider recommendations in commercial kitchen pilot evaluation
    - Explore offering financing
    - Conduct research into GEB/smart building technology, incentivizing smart controls
    - Research regional EV trends; EV charger program design options

- Reviewing and revising education and training resources
    - Assess usability of website and available online materials
    - Group office-related plug load information into one fact sheet
    - Group plug load incentives into one work sheet
    - Revise EESP training materials and facility assessment procedures to clearly address plug load control options
    - Revise educational materials and demonstrations aimed at building operators and occupants on plug load management
    - Incorporate plug loads into demonstrations at utility sites

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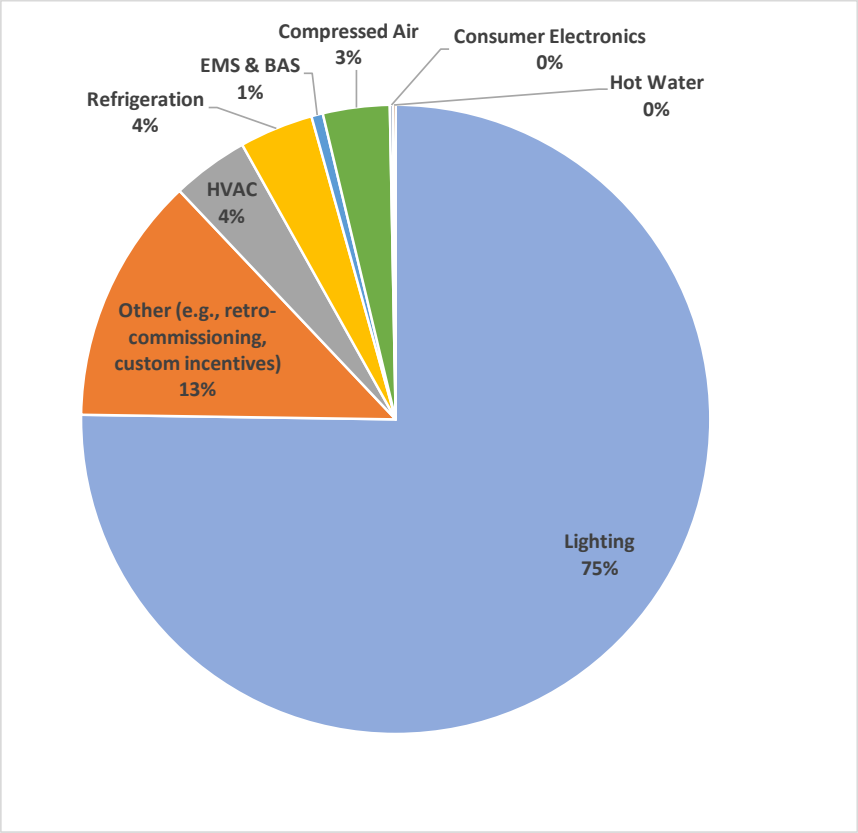
2.0 INTRODUCTION

State of the Market

Energy efficiency (EE) programs have emerged in response to growing concerns including the increasing negative effects of climate change, grid instability, and lack of energy security (Hafer, 2015). ComEd has been successful in reducing energy consumption of traditional end uses, specifically lighting and HVAC, since the rate-payer-funded electric EE programs started in June 2008 (Illinois Energy Efficiency Stakeholder Advisory Group, 2020). The verified net electricity savings from ComEd's EE programs in the business sector amounted to 892 GWh in 2019 (Guidehouse, 2020g). Figure 1 shows the proportion of these savings attributed to each type of measure. The major contribution of measures in the lighting category to the overall net savings reflects the ongoing opportunity to switch from linear fluorescent lighting to LEDs, especially in some commercial building types, such as educational facilities and public administration (Itron, 2020). However, the U.S. Energy Information Administration (2019) estimates that by 2030 LEDs will dominate over fluorescent lighting in commercial spaces, a success of stringent federal EE standards (U.S. Energy Information Administration, 2014) and utility programs such as ComEd's. As the return on investment for established programs like lighting and HVAC is diminishing (Choi, Eom, & McClory, 2018), other opportunities for EE savings must be sought.



Source: Guidehouse (2020g), graph by CalPlug

Figure 1. Contribution of Measure Categories to Total Electricity Net Savings of 892 GWh (2019)

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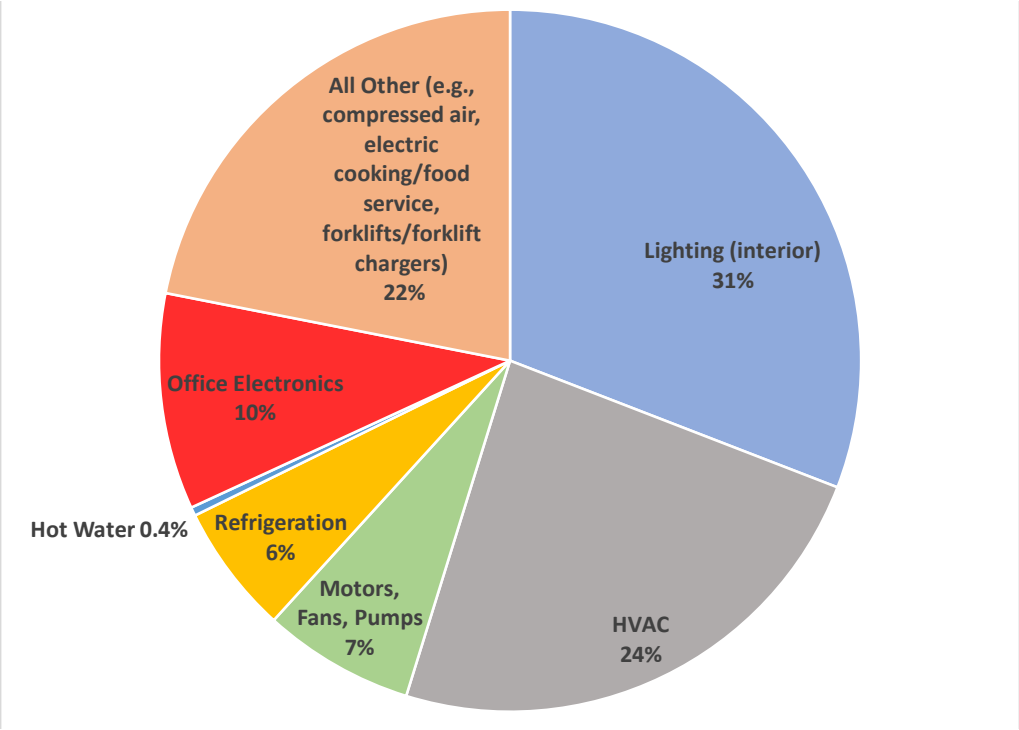
Plug load devices, such as office electronics and other appliances, are garnering attention as they use significant amounts of electricity in buildings (Goetzler, Guernsey, Foley, Young, & Chung, 2016; Hackel et al., 2016; Hafer, 2017; McKenney, Guernsey, Ponoum, & Rosenfeld, 2010; Moorefield, Frazer, & Bendt, 2011). For ComEd's commercial customers, a 2012 baseline study estimated that office electronics such as desktop computers, monitors, or printers made up ten percent of the total electricity use, and other uses such as compressed air, electric cooking, and food service amounted to 22 percent. Together, these two categories used as much electricity as interior lighting (see Figure 2) (Opinion Dynamics, Vermont Energy Investment Corporation, & Mad Dash Field Services, 2013). However, measures targeting consumer electronics in commercial buildings, food services, or appliances (see Figure 2) only contributed marginally to the total net savings in 2019. This reflects the fact that up until now plug load devices have not been a major focus for EE programs (York et al., 2015) and are considered an emerging area (Relf et al., 2020). This report focuses on assessing EE programs concerned with commercial plug load devices, with the aim of suggesting possible avenues for integrating new approaches or measure categories into ComEd's current programs.



Source: Opinion Dynamics et al. (2013, page 8), graph by CalPlug

Figure 2. Electricity Usage by Individual End Uses of Commercial Accounts (2012)

Importance of Plug Load Devices for EE

Plug load devices or appliances are defined as devices that plug into regular AC sockets. In commercial settings this includes devices such as computers and printers in offices, projectors in conference rooms, cash registers in retail outlets, televisions and kitchen appliances in restaurants, and refrigerators and water coolers in staff breakrooms. These devices are considered a subset of miscellaneous electric loads (MELs). MELs consist of plug loads and hard-wired process loads that are not associated with HVAC or lighting, the

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traditional end uses targeted by utility EE programs (Doherty & Trenbath, 2019; Kandt & Langner, 2019; Nordman & Sanchez, 2006; Sofos, 2016). Hard-wired process loads are outside the scope of the current project, as they are not plug loads. The distinction is mentioned to clarify terminology, because some of the prior research cited in this section deals with all MELs together (plug loads and process loads). Table 1 classifies commercial building end uses by categories and provides more examples (adapted classification and examples from Kandt & Langner, 2019; Nordman & Sanchez, 2006; Sofos, 2016). The majority of MELs are not regulated by federal standards (Hafer, 2015; U.S. Energy Information Administration, 2014), which creates an opportunity for EE programs to steer the market towards more energy-efficient solutions (York et al., 2015).

Table 1. Commercial Building End Use Categories

Targets of EE Programs	End Use Categories	Examples
Traditional	HVAC, Lighting, Water heating, Major Appliance	--
Miscellaneous Electric Loads	Plug load	Electronics: Audio visual equipment, money exchange (e.g., credit card reader, barcode scanners, order/payment touch screens), computer (e.g., desktop computer, network computer), display (e.g., computer monitor), imaging (e.g., copier, fax, receipt/order printers), networking (e.g., modems, server rooms), peripherals (e.g., computer speakers, docking stations), set-top boxes, telephony (e.g., phone with answering machine, mobile phone charger) Other equipment: Business equipment (e.g., shredder, cash drawer), portable HVAC units (e.g., space heaters), kitchen equipment (e.g., office refrigerator), electric housewares (e.g., microwave oven, electric kettles, coffee makers), portable lighting (e.g., task lights), outdoor appliances (e.g., irrigation timer), personal care (e.g., air freshener), power (e.g., uninterruptible power supply), medical equipment, transportation (e.g., electric carts), utility (e.g., battery chargers), instantaneous/point of use water heating, vending machines
	Hard-wired loads	Escalators, elevators, security systems, fire detectors

MELs are getting more attention as the traditional end uses, such as lighting, HVAC, etc., have become more energy efficient in commercial buildings (Kwatra, Amann, & Sachs, 2013). Thus, the relative contribution of MELs to a buildings' total energy consumption is

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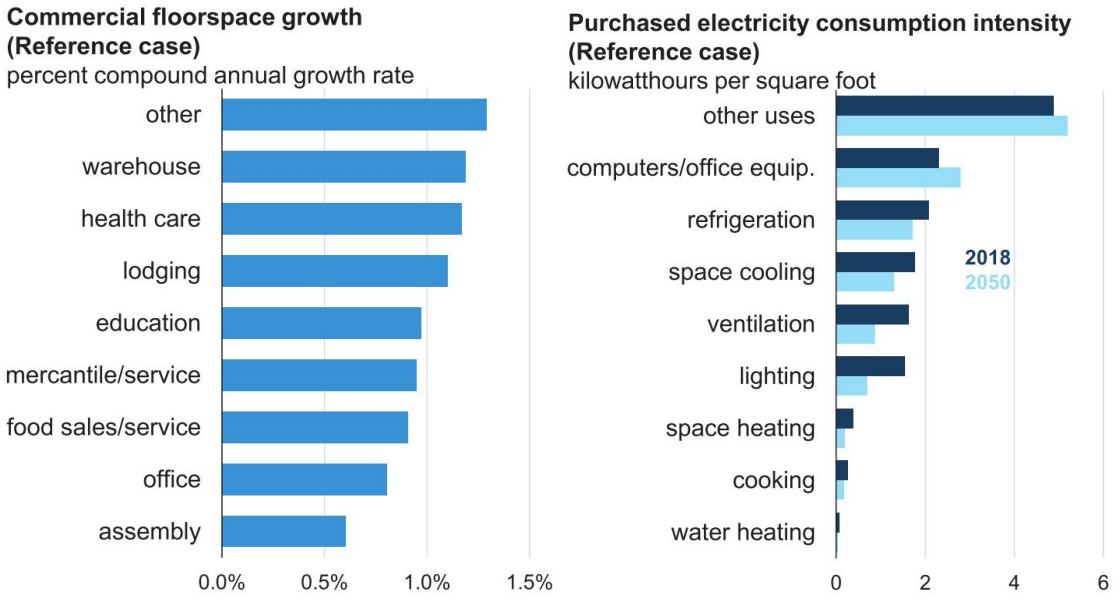
increasing (Hafer, 2015; Kaneda, Jacobson, & Rumsey, 2010). Moreover, the amount of building energy use attributed to plug load devices has also been on the rise as the absolute number of such devices in commercial buildings has been increasing, and there is consensus that the energy consumption from plug loads will continue to grow (Sofos, 2016; U.S. Energy Information Administration, 2014, 2019), jeopardizing the attainment of energy performance goals (Hackel et al., 2016; Kaneda et al., 2010; Kwatra et al., 2013; Schantz & Langner, 2016). In 2019, within commercial buildings computing used 96.71 TWh purchased electricity, office equipment consumed 120 TWh per year, and consumption from "other uses" such as transformers, medical imaging and other medical equipment, elevators, escalators, off-road electric vehicles, laboratory fume hoods, laundry equipment, coffee brewers, and water services was over 436.68 TWh (U.S. Energy Information Administration, 2020a).

Energy intensity, defined as the ratio of energy consumption to floorspace, can help guide EE priorities. The energy intensity of MELs is expected to increase by 21.4% by 2040 (U.S. Energy Information Administration, 2014); this trend was confirmed again in the newest forecast projecting to 2050 (U.S. Energy Information Administration, 2019). Figure 3 shows how the amount of kWh used per square foot is predicted to decrease in all the traditional end use categories, but increase for the "computer and office equipment" category, which is comprised entirely from plug loads, and the "other" category, which includes the "other uses" as outlined above. The U.S. Energy Information Administration (2019) predicts that the overall growth of energy consumption will be slowed down by the increased efficiency of appliances and lighting; however, due to the expansion of floorspace and the expansion of information technology, there will still be an increase in electricity consumption.



Source: U.S. Energy Information Administration (2019, page 139)

Figure 3. Projection Electricity Consumption Intensity 2018 – 2050

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Results from monitoring studies show that plug load devices contribute substantially to total building energy consumption. Specifically, most of these studies reveal the major role of devices related to information and communication technology (ICT), such as servers, computers, and monitors (Agarwal, Weng, & Gupta, 2009; Hafer, 2015; Kamilaris, Kalluri, Kondepudi, & Kwok Wai, 2014; Kamilaris, Ngan, et al., 2014; Moorefield et al., 2011). A monitoring study conducted on the Stanford campus surveying 220 buildings of various types (such as office buildings, lab buildings, and lecture halls) estimated that plug load equipment consumed nearly 50 GWh per year, making up 22% of Stanford's overall building electricity use, and 32% of the energy consumption of the monitored buildings. Computers, monitors, and servers comprised 36% of the total plug load electricity consumption, with servers consuming the most (Hafer, 2015). This result aligns well with other studies. For example, office plug loads consumed 20% of the electricity used in office buildings in California, with computers, monitors, and other peripherals like speakers and printers accounting for 82% of the plug load energy use (Moorefield et al., 2011). A report published by the U.S Department of Energy (DOE) evaluated energy consumption of eight commercial appliance categories: cooking appliances, food preparation appliances, dishwashers, commercial laundry appliances, water heaters, pool heaters, information technology and office equipment, and miscellaneous appliances such as coffee makers or vending machines. This report, comparing findings from multiple organizations (including the U.S. Energy Information Administration and third-party evaluators such as Navigant Consulting), found consistently high contributions of information technology (IT) and office equipment plug loads to the total energy consumption (Goetzler, Guernsey, et al., 2016). Their results show that office plug loads constituted 10 to 26% of energy consumption within commercial buildings, significantly higher than other plug load categories, and that the savings potential in this category could be as high as 41% (based on 2015 U.S. consumption) (Goetzler, Guernsey, et al., 2016). Consensus among many reports solidifies the growing concern of excessive energy consumption and energy waste within the plug load category (Goetzler, Guernsey, et al., 2016; Hafer, 2015).

Challenges with incentivizing Plug Load Devices in EE Programs

There are a number of ways that energy efficiency of plug load devices can be incentivized through utility programs. EE programs address plug loads either by incentivizing upgrades to more energy-efficient devices and appliances or by encouraging solutions to more efficiently control plug load devices. Investments in more efficient devices can be accomplished through direct downstream or midstream rebates or as part of custom incentive programs, encouraged with online marketplaces, or included in combination approach programs such as audits and retrofits. More efficient plug load controls can be accomplished by incentivizing external control devices such as advanced power strips (APS), internal control applications like computer power management software, or behavioral measures, like turning off equipment when it is not needed.

The diversity of products and usage patterns within the plug load category pose challenges for program design: essentially, a large number of small problems that add up. Plug load devices contain a range of distinct mechanisms, each requiring different energy saving strategies and approaches that must be considered and monitored (Klopfer et al., 2020; Kwatra et al., 2013).

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Programs that aim to reduce energy consumption for traditional end uses (e.g., lighting and HVAC) have largely focused on monetary incentives for customers in the form of rebates, or standard incentives (Backen, Burmester, & Sheehan, 2016). One challenge with making plug load standard incentives cost-effective is that, with the exception of major appliances, most plug load devices use relatively little energy on a per-device basis. As a result, even if an ENERGY STAR®-certified device reduces energy use by a large percentage, the absolute energy savings is modest. The low energy savings per device may not justify incentives that are large enough to influence a customer's decision to purchase the device (Dooley, Kopf, Michel, & Fleming, 2012; Dunn, Clock, Conzemius, & Dimetrosky, 2016; York et al., 2015). Part of the problem is the set cost of the work required to obtain the standard incentive payment: negotiating the multi-step process is likely not worth it to save $10, even if customers would be willing to do so for a $50 rebate off a device that cost five times more.

These factors encourage the consideration of midstream-focused programs to supplement downstream-focused programs (Dooley et al., 2012; Dunn et al., 2016; York et al., 2015). Midstream programs shift the focus from calculating the rebate amounts paid to each customer to the number of efficient products sold (Backen et al., 2016; York et al., 2015). By influencing the stocking, selling, and marketing practices of retailers and wholesale distributors, more energy-efficient products gradually replace older, less efficient technology (ENERGY STAR, 2019b; Lukasiewicz et al., 2013; York et al., 2015). Midstream programs can target larger groups of individuals by changing the market (Backen et al., 2016; Milostan, Levin, Muheleisen, & Guzowski, 2017; York et al., 2015). This approach may be especially effective for devices with lower potential energy savings: a low per unit incentive amount may be too small to motivate customers to purchase the product, but through the volume of sales, the same incentive amount can be motivating for retailers (Lukasiewicz et al., 2013). Product labeling, such as the ENERGY STAR® program, may also help commercial customers with the procurement of energy-efficient equipment (York et al., 2015) and replace available devices on the market with more energy-efficient models. This is especially relevant as ENERGY STAR products can include appliances and devices that do not have federal standards associated with them.

Many plug load devices use electricity even when the device is turned off by the user, as they remain in a soft-off or standby state. The resulting "vampire" or "parasitic" load may be small for each individual device, but can quickly add up across multiple devices at a building level (Lawrence Berkeley National Laboratory, 2019; Lobato et al., 2011; Thorne & Suozzo, 1998; Valmiki & Corradini, 2015). This problem has been solved for some devices (and should be pursued for others) with improved product designs that enable low-power standby and standards that require such design changes (Delforge, 2015). As with traditional end uses such as lighting and HVAC, energy consumption from some plug load devices can be lowered simply by switching to more efficient products. However, energy savings for other devices involve user cooperation, including effectively employing automated control strategies and modifying user behavior. For example, the energy consumption of many plug load devices can be greatly impacted by whether users disable power-management settings or turn off devices when not in use (Hafer, 2015; King & Perry, 2017; Lobato et al., 2011). Monitoring studies in offices have found that most of plug load devices' energy consumption takes place during unoccupied periods, on weekends and during the night (Gunay, O'Brien, Beausoleil-Morrison, & Gilani, 2016; Mercier &

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Moorefield, 2011; Picklum, Nordman, & Kresch, 1999; Webber et al., 2006; York et al., 2015). This is a clear indication that devices have had their low-power modes disabled, which provides opportunities for no-cost and low-cost solutions that take advantage of existing features or utilize external control strategies.

Many field studies suggest the effectiveness of advanced power strips in plug load reduction (Hackel et al., 2016; Sheppy et al., 2014; Valmiki & Corradini, 2015). Automatically controlled smart plugs based on a timer, occupancy sensor, or other control system are also an option for plug control (King & Perry, 2017). Studies have reported up to 39% of office plug load reduction compared to a baseline period through occupant engagement via an online app, equipment scheduling, and automated controls (Hafer et al., 2017; Jenkins et al., 2019; Yun et al., 2017). Since the 2010 revision of the ASHRAE 90.1 standard, at least 50% of all outlets in newly constructed or renovated offices, conference rooms, copy rooms, break rooms, and individual workstations need to be equipped with controlled outlets (Forte, 2017). However, it is not clear yet whether or how effectively controlled outlets are being utilized; more field research is needed.

In this report, CalPlug reviews and categorizes utility EE program opportunities for plug load devices. The results from these assessments are compared against a list of plug load devices to recommend additions and changes to ComEd programs. The report also investigates different program strategies (e.g., down-stream versus mid-stream incentives) to reach the goal of reducing energy consumption and thus greenhouse gas (GHG) emissions from plug loads.

3.0 APPROACH AND METHODOLOGY

CalPlug took a three-pronged approach to identify potential opportunities for plug load related program recommendations. First, CalPlug compiled a list of plug load devices and selected devices that were the most promising for achieving energy savings. Second, CalPlug identified all the energy efficiency programs that involve plug load devices in ComEd's current program portfolio and in the portfolios of a list of comparison utilities. Third, CalPlug compared ComEd's programs with the other utilities' programs and with best practices to identify three types of potential opportunities: adding a plug load-related program ComEd does not currently offer; adding specific plug load devices to a current ComEd program; or modifying the approach of a current program.

Device Assessment

The first step was to identify commercial plug load devices that should be considered and compared to ComEd's current portfolio. CalPlug compiled an initial list using inventory and monitoring studies conducted in a range of office buildings and other institutions (Hafer, 2015, 2017; Kwatra et al., 2013; Sheppy & Lobato, 2011) and from the product list of the Office of Energy Efficiency & Renewable Energy (2020a).

Establishing Energy Saving Options

The next step required determining whether each device offered an energy efficient alternative that could in theory be incentivized and adding this information to database.[1] For the majority of devices, this meant locating data on average energy consumption for

[1] The spreadsheet database is considered supplemental materials and is available upon request.

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ENERGY STAR-certified models versus non-efficient models. Some devices did not have ENERGY STAR (or other certification) options but did offer specific types or models that saved energy due to a technological improvement.

Unfortunately, no single data source could provide energy consumption estimates for all the devices on the list. The main priorities in selecting a data source for any given device was that it provided estimates for both the energy efficient and non-energy efficient versions using the same methodology (to ensure comparability), was a trusted source, and was as recent as possible. Data sources were prioritized as follows, with any devices not available through the top choice sought at the next level, until all devices were accounted for:

1) Federal Energy Management Program
   a) Office of Energy Efficiency & Renewable Energy (Energy.gov)
   b) Compares current calculated annual energy usage of devices identified as "less efficient," "ENERGY STAR certified," and "best available."
   c) Provided data for 19 devices, including most of the commercial and residential kitchen appliances and selected electronics and information technology equipment.

2) Stanford Study
   a) Hafer, Moira. (2017). Quantity and electricity consumption of plug load equipment on a university campus. Energy Efficiency, 10(4), 1013-1039.
   b) A study conducted in 2014 at Stanford University that used published data to evaluate energy consumption for a wide range of plug load devices, explicitly comparing energy efficient and non-efficient models. The study specified the duty cycles (e.g., number of hours used versus in sleep mode) used to calculate consumption for each device.
   c) Provided data for 26 devices, particularly miscellaneous office equipment, small kitchen equipment, and a few audio-visual devices

3) Office Plug Load Field Monitoring Report
   a) Moorefield, L., Frazer, B., & Bendt, P. (2011). Office Plug Load Field Monitoring Report (CEC-500-2011-010). Sacramento CA: California Energy Commission.
   b) A monitoring study conducted in 2007-2008 that measured energy consumption of plug load devices. Provided energy consumption data for smaller office related plug loads which consume negligible amounts of energy such as the electric sharpener, table radio, and cell phone chargers.
   c) Provided data for 9 devices, particularly small office related.

4) ENERGY STAR
   a) The ENERGY STAR product finder provides a list of all devices that are ENERGY STAR certified the list includes details of the device, rebates, and retailers that have the device in stock. This source was used for things that do not have many too many types or versions of a specific device because the many different parameters do not yield reliable results. For example, Apple devices such as integrated desktop computer, laptop, and Apple TV were some of the energy consumption datapoints that were collected from this source.

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b) Provided data for 6 products.

After exhausting the top four sources, additional individual sources were found for the remaining devices, most providing data for only one device each.

The estimates for energy usage and energy savings derive from many disparate sources and thus reflect a range of unspecified assumptions and selection criteria. Given this, CalPlug is cautious about quoting energy savings for devices, which implies the ability to compare savings across devices. CalPlug cannot justify using this information to make more detailed calculations about cost-effectiveness. Instead, the estimates are accepted as prima facie evidence that a potential for energy savings exists, and no minimum bar is set for potential consideration.

Device Selection
CalPlug determined whether each device was in scope for the current assessment by using a decision tree, shown as a flowchart in Figure 4.

Specifically, a device was considered in scope if it:

1) Offers the potential to save energy through an available energy-efficient alternative, usually an ENERGY STAR-certified option, but possibly another energy-efficient technology; OR
2) Can be made more energy efficient by using plug load control strategies; AND
3) Shows sufficient device population; OR
4) Is a system that controls plug load devices

Selection was biased toward inclusion rather than exclusion. For instance, any device with an energy saving alternative met that criterion, regardless of the extent of the savings potential. Only two devices were determined to have low enough future population in the commercial sector to justify excluding: DVD players and VCR players.

The device flowchart narrows down selection by removing devices that do not have energy savings alternatives and are declining in the current market. In addition, the flowchart helps to identify which plug load devices can be controlled by external systems. Such systems can be implemented with existing or new devices, for example a Tier 2 APS with computers and computer peripherals such as speakers and printers.

EE Program Assessment

The next step was to identify all EE programs related to plug load devices and plug load control systems that were already in ComEd's portfolio or in other utilities' portfolios. This effort was divided into two distinct approaches. Programs focused on individual devices with standardized incentive amounts assigned to those devices, whether downstream standard incentives or midstream rebates, were analyzed as "individual device" programs. Programs that utilize more complicated approaches and include multiple plug load devices were analyzed as "combination" programs.

CalPlug examined ComEd’s current (2019 and 2020) program portfolio and compiled information on all programs that included or could possibly include plug load devices.

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Information was collected from ComEd's website, ComEd's quarterly reports, and numerous evaluation reports of ComEd's programs from Navigant and Guidehouse.

In discussion with ComEd, a list of utilities and other EE program providers was selected for comparison (all are referred to as " utilities" in this report for the sake of brevity). Selection was based in part on whether utilities' plug load programs or overall portfolio had earned accolades in the 2020 American Council for an Energy-Efficient Economy (ACEEE) utility scorecard, which is considered a “gold standard” resource for utility program analysis and rankings (Relf et al., 2020), or had other indications of strong performance on EE programs in general. Utilities in nearby or similar geographical and climate regions were also prioritized. The final list is shown in Table 2; for links to these utilities' business programs, see Appendix A.

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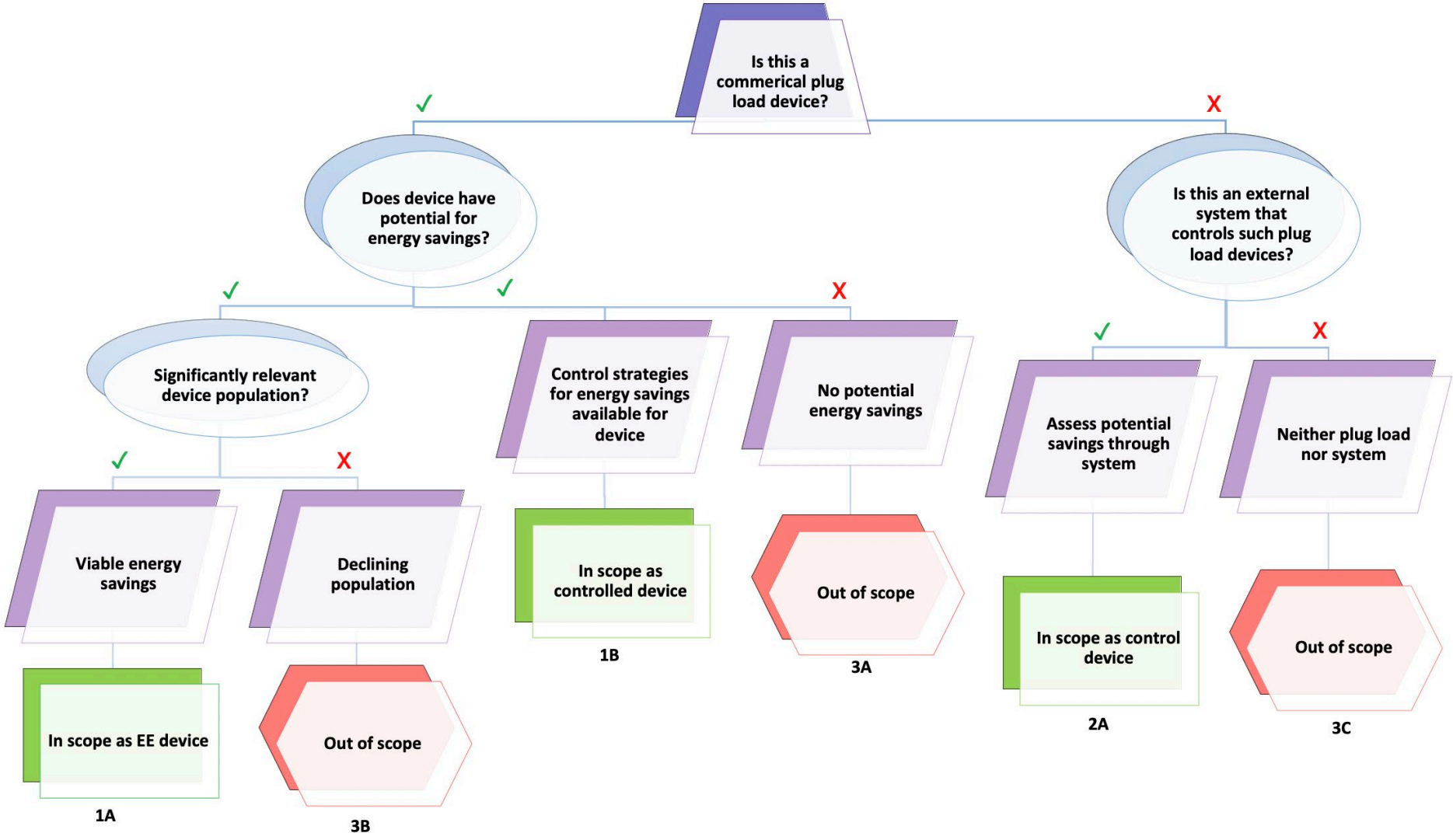

Figure 4. Device Selection Flowchart

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Table 2. List of Comparison Utilities and EE Program Providers (in alphabetical order)

	Utility	Abbreviations	State
1	Ameren Illinois	Ameren	Illinois
2	Baltimore Gas and Electric	BGE	Maryland
3	Consolidated Edison	ConEd	New York
4	Consumers Energy		Michigan
5	Efficiency Vermont	Efficiency VT	Vermont
6	Energy Trust of Oregon	Energy Trust OR	Oregon
7	Eversource Connecticut (Energize CT)	Eversource CT	Connecticut
8	Eversource Massachusetts (Mass Save)	Eversource MA	Massachusetts
9	Florida Power and Light	FPL	Florida
10	Georgia Power		Georgia
11	National Grid (Mass Save)		Massachusetts
12	New York State Electric and Gas	NYSEG	New York
13	Pacific Gas and Electric	PG&E	California
14	Sacramento Municipal Utility District	SMUD	California
15	San Diego Gas and Electric	SDG&E	California
16	Southern California Edison	SCE	California
17	We Energies (Focus on Energy)		Wisconsin
18	Xcel Energy	Xcel	Minnesota

CalPlug then examined the current program portfolios of all these utilities and compiled pertinent information about each utility's relevant offerings into the same database created for ComEd's programs.[2] For ease of analysis, information on standard incentive programs for individual devices was compiled and compared in one spreadsheet, while information on all other "combination" programs was treated separately. Collecting and compiling data on ComEd and other utilities' programs was an iterative process, as new issues that arose when collecting data on later utilities, or during the program comparison process, occasionally required examining additional details and adding them to the notes.

EE Program Comparisons

CalPlug used a systematic decision tree to ensure that all appropriate comparisons were conducted to identify possible avenues for recommended changes. The primary comparisons are shown the "program to device" flowchart (see Figure 5). Comparing ComEd's programs to those offered by other utilities, CalPlug identified whether ComEd does not have a specific program in place. If ComEd has the program, CalPlug checked for differences with other utilities' programs that might offer possible improvements, either by including a

[2] The spreadsheet database is considered supplemental materials and is available upon request.

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specific plug load device or by changing program features (such as the incentive amount or delivery mechanism).

CalPlug used a third decision tree to ensure that all plug load devices identified earlier as important were assessed for inclusion in all relevant programs (see Figure 6). This reduced the possibility of missing an opportunity to add a specific device to an existing program due to it not being included in any of the current utilities' offerings. The filtration process between these flowcharts ensured that all device or system(s) and programs were thoroughly assessed both from the device and programmatic side.

The comparisons listed above identify the existence of differences between ComEd's portfolio and other options, and thus potential improvements. The next and most important step was to conduct in-depth analyses of the nature of those differences, to determine best practices and recommendations for program revisions and additions. If a device or system is not part of ComEd's portfolio, CalPlug considered whether it might effectively be added. If a device or system is already part of ComEd's offering, CalPlug considered whether the product could be offered within a different program or with a different approach, aiming to maximize program participation and revenue.

Given the limitations of comparable quantitative data across utilities programs, this is necessarily a qualitative assessment, but it is based on accumulated knowledge and a wide range of program evaluations. CalPlug used third-party evaluation documents and guidelines to identify best practices in program design and applied these to ComEd's and other providers' programs. Sources that informed our program assessments and recommendations included industry standard best practice reports from agencies such as ACEEE, the National Renewable Energy Laboratory (NREL), and ENERGY STAR; utility-specific program evaluations compiled by private consultancy firms; as well as CalPlug's own previous research on plug load devices. For standard incentive programs, CalPlug compared the incentive amount offered across utilities, as well as variations in program design. For programs that were not well represented among the comparison utilities, CalPlug expanded the search to include programs on the Updated Plug Load Efficiency Utility Incentive List (henceforth referred to as Utility Incentives List), a database that is curated by the Better Buildings® Alliance from the DOE (Better Buildings, 2020b).

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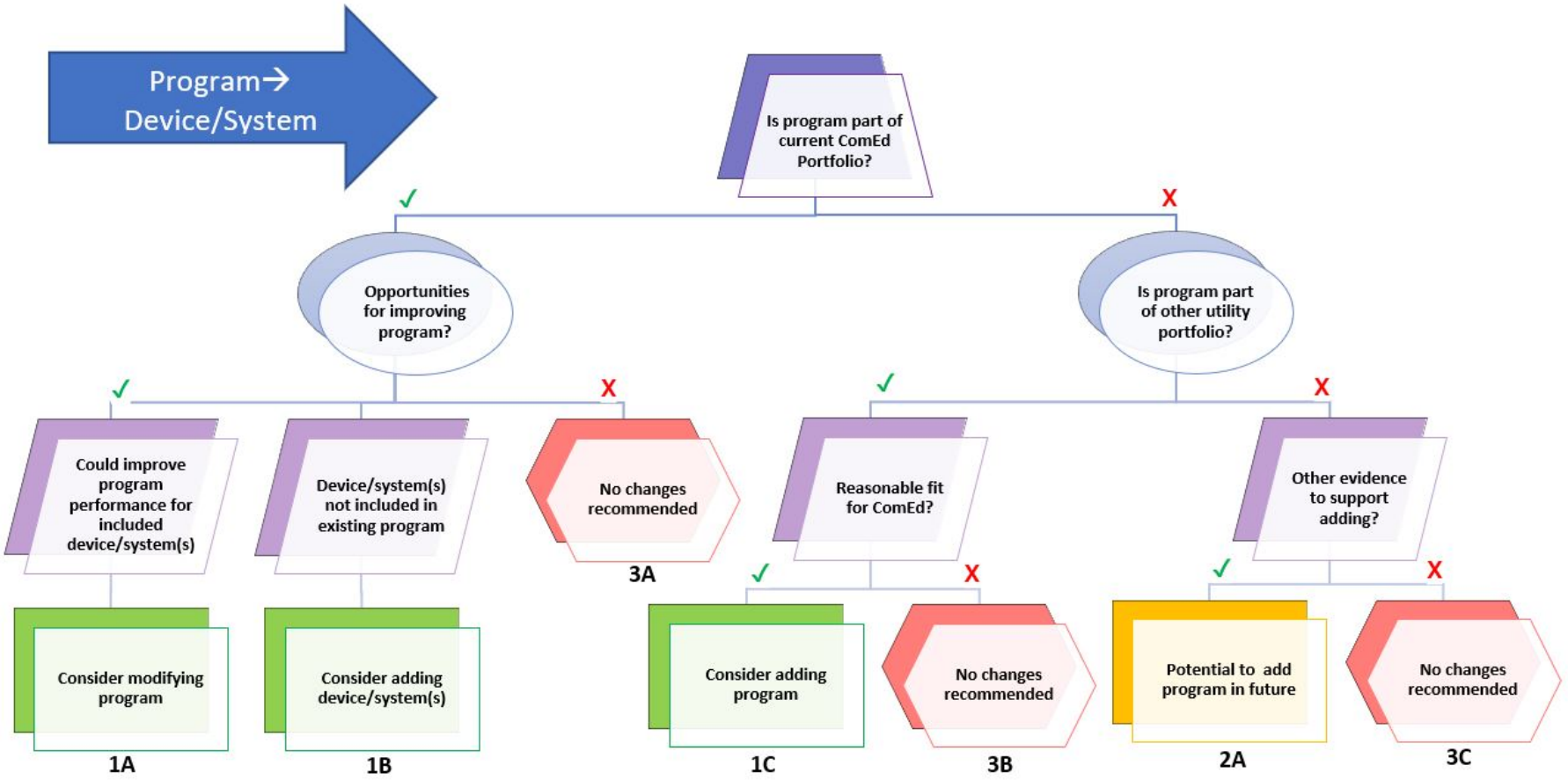

Figure 5. Program-to-Device Comparison Flowchart

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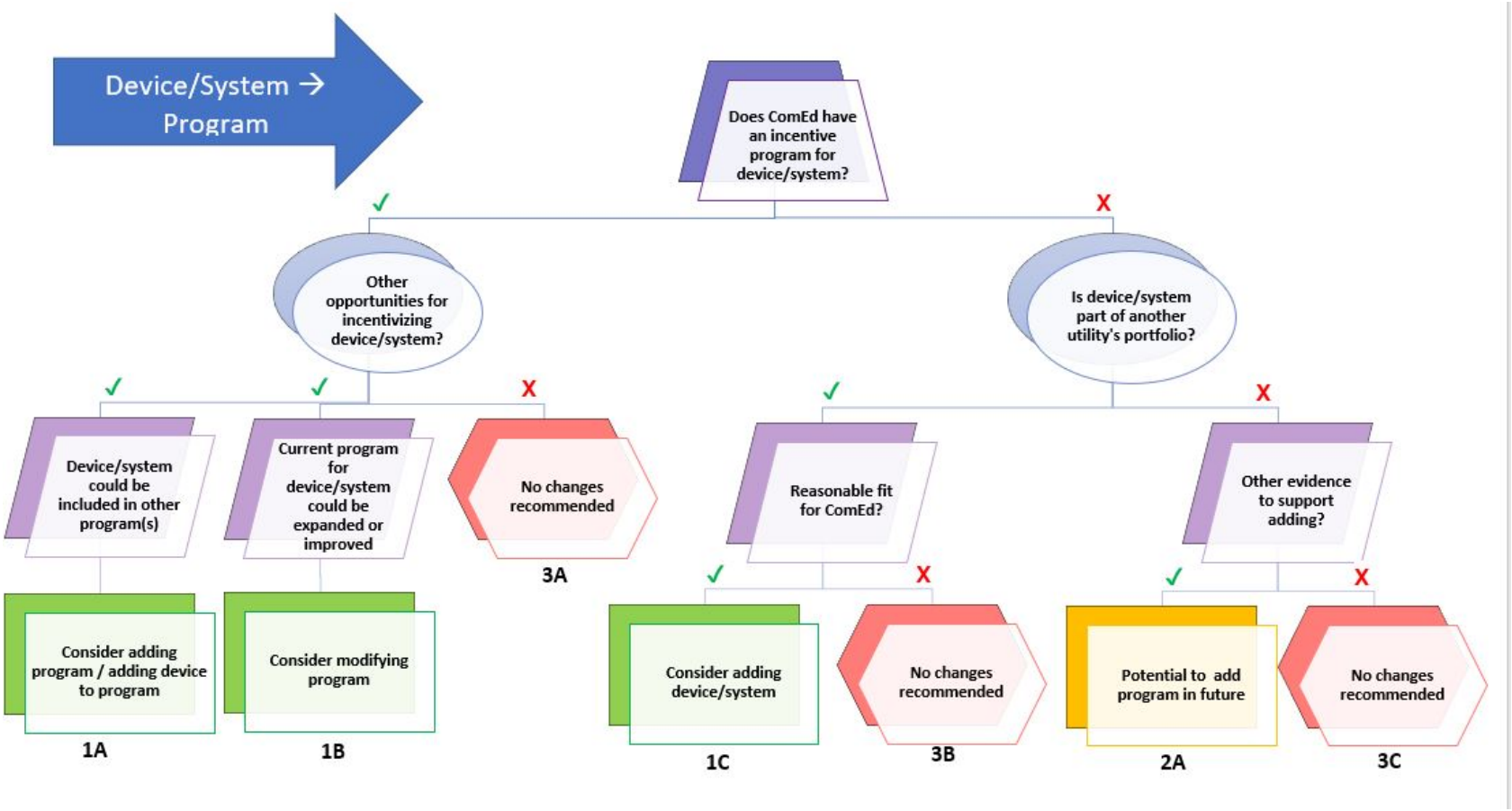

Figure 6. Device-to-Program Comparison Flowchart

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4.0 KEY DEVICES

The device selection process described in the methodology section determined whether devices fit the scope of the current report. The main focus is on devices that have energy-efficient alternatives available that could potentially be incentivized. However, devices that can control plug load devices to save energy were also included, as were devices whose energy consumption could be reduced by being controlled by such devices. The full list of devices that were considered is shown in Appendix B.

First, devices that were not plug loads were excluded. These were either process loads (such as hardwired security devices or escalators) or parts of appliances (such as motors) that were drawn from the third-party sources used to compile the initial list.

The most common reason for eliminating plug load devices as energy-efficient devices was the lack of ENERGY STAR or other energy-saving alternatives. This includes many low-energy-use office devices such as electric staplers, phones, sharpeners, label makers, table radios, chargers, and docking stations for laptops. In a few cases, other types or models of a device were found that use less energy but could not be considered functional alternatives: for instance, it would be unreasonable to expect customers to save energy by downgrading to a lower-capacity chest freezer or a smaller-sized smart board. A similar special case is lamps: although users can save energy with lamps by using a more efficient light bulb, that falls into the lighting category and is not considered an energy-efficient plug load device. Finally, although DVD players and VCR players do offer ENERGY STAR options, they were excluded as potentially incentivized energy-efficient devices due to their low population in commercial settings and market decline.

Most devices that met criteria for inclusion did so because ENERGY STAR-certified alternatives were available. (See Table 3 below for a full list.) For some devices, ENERGY STAR identifies "Most Efficient" options that exceed the standard criteria. Similarly, the Federal Energy Management Program gives energy estimates for the "best available" devices on their site.

Two types of APS, occupancy sensors, and smart plugs were included because these can be used as control systems for other plug load devices.

Devices were also coded for whether they present energy-saving opportunities if controlled by an external device, such as an APS. Many devices that did not meet criteria for having energy saving alternatives were included for minor consideration in this category.

Table 3 shows the devices that were considered in scope and included in the program evaluations in subsequent sections. Note that this list represents baseline categories of devices to be considered, and does not specify variations on devices that may be incentivized individually, such as multiple types of commercial dishwashers.

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Table 3. Plug Load Devices Considered for EE Programs

Device	Energy-efficient Device (result 1A)	Controllable Device (result 1B)	Control System Device (result 2A)
Computer, Desktop	✓	✓	
Computer Monitor	✓	✓	
Computer, Laptop	✓	✓	
Printer/Copier	✓	✓	
Scanner		✓	
Multi-function Device		✓	
Plotter		✓	
Server	✓		
UPS Units	✓		
Television	✓	✓	
Projector		✓	
Audio System		✓	
Speakers		✓	
Advanced Power Strip, Tier 1			✓
Advanced Power Strip, Tier 2			✓
Smart Plug			✓
Plug Load Occupancy Sensor			✓
Paper Shredder		✓	
Task/Desk/Floor Lamp		✓	
Room AC	✓	✓	
Dehumidifier	✓	✓	
Space Heater		✓	
Fan		✓	
Cash Register	✓		
Residential Freezer	✓		
Residential Refrigerator	✓		
Mini-Refrigerator	✓		
Commercial Freezer	✓		
Commercial Refrigerator	✓		
Residential Dishwasher	✓		
Commercial Dishwasher	✓		
Commercial Oven	✓		
Fryer	✓		
Hot Food Holding Cabinet	✓		
Griddle	✓		
Wrap Machine	✓		

(continued)

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Table 3 (continued)

Device	Energy-efficient Device (result 1A)	Controllable Device (result 1B)	Control System Device (result 2A)
Steam Cooker	✓		
Refrigerated vending machine	✓		
Vending Machine Control/Miser (Refrigerated)			✓
Ice Machine	✓		
Microwave		✓	
Coffee Maker		✓	
Espresso Machine		✓	
Toaster/Toaster Oven		✓	
Hot Water Dispenser		✓	
Water Cooler	✓	✓	
Clothes Dryer	✓		
Commercial Clothes Washer	✓		
Residential Clothes Washer	✓		
Pool pump (VSD)	✓		

5.0 PLUG LOAD DEVICES IN ComEd's COMMERCIAL EE PROGRAMS

ComEd boasts a mature EE program portfolio that has earned the utility a high ranking in the ACEEE utility scorecard (Relf et al., 2020).

Thus, it is not surprising that ComEd already offers plug load-related measures within several programs. ComEd offers rebates for over a dozen types of plug load devices and controls in the standard incentives program (see Table 4). ComEd's data center program uses a custom incentives approach, based on achieved kWh savings, and also includes some standard incentives; a wide variety of plug load measures can be accommodated within this program. Midstream programs are also suitable for plug load measures; currently ComEd's Instant Discount program offers mostly lighting measures, with forklift battery chargers as the only plug load device included. To reach small businesses, utilities often provide free energy-efficient equipment: ComEd supplies advanced power strips and, starting in 2020, smart plugs within their small business kits program, and free direct install measures such as advanced power strips or vending machine controls within the small business program.

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Table 4. Plug Load Device Measures in ComEd's Current EE Program Portfolio

EE Program	Plug Load Device Measure
Standard incentives	ENERGY EFFICIENT EQUIPMENT (new or replacement) Electric steam cooker Electric convection oven Electric combination oven Commercial refrigerator Commercial freezer Hot food holding cabinet Griddle Fryer Ice machine Commercial clothes washers EQUIPMENT UPGRADE Vending machine refurbishment installation kit Pool pumps CONTROL EQUIPMENT Beverage/snack vending machine controls (misers) Reach-in (novelty) cooler controls Plug load occupancy sensor Network desktop power management software
Instant Discounts	Forklift battery chargers
Custom incentives	Data center: Closet-to-colocation
Small Business--Private/ Public Small Facilities (Direct install)	Advanced power strips (Tier 1) Beverage/snack vending machine controls (misers) Cooler control for glass front refrigerated cooler
Small Business Kits	Advanced power strips (Tier 1) (for small offices, self-install) Smart plugs
Business Energy Analyzer	Recommendations for behavioral, operational, and capital investments: e.g., power down computer and office machines; upgrade/refurbish equipment; replace equipment
Facility Assessments (Operational savings)	No-cost/low cost strategies: for example, shutting off idle equipment, optimizing existing systems, changing occupants' habits
Multi-family Program (Direct install)	Tier 1 APS (in-units, common areas) Beverage/snack vending machine controls (common areas)
Retro-commissioning	Possibly includes control of plug devices
Strategic Energy Management	Possibly includes control of plug load devices

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ComEd's commercial customers include a large number and variety of businesses, in both the public and private sectors. In 2019, ComEd had 332,131 commercial accounts (ComEd, 2020a). This number excludes extra-large users with more than 10 MW, since they do not contribute to the state of Illinois' general efficiency fund and are thus not eligible for ComEd's EE programs (Itron, 2020). The vast majority of ComEd's accounts (95%) were in ComEd's small load delivery classes (less than 100 kW peak demand)(ComEd, 2020a). Table 5 shows the percentage of accounts in each commercial segment and the percentage of annual energy use of that segment by size. The segment (e.g., office, education, entertainment) of each account was based on Itron's methodology and classification that was used for the forthcoming baseline study (Itron, 2020).

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Table 5. 2019 Number of Commercial Accounts and Percent Annual Use by Size and Segment

Commercial Building Type	Small (0-100 kW)		Medium (100-400 kW)		Large (400 kW-10 MW)		All	
	% in segment	% annual use	% in segment	% annual use	% in segment	% annual use	% of total customers	% annual use
Education	72%	7%	21%	32%	7%	61%	3%	9%
Entertainment	87%	17%	10%	32%	3%	51%	2%	4%
Food Service	95%	68%	5%	25%	0%	7%	7%	7%
Grocery/Convenience	90%	29%	6%	23%	4%	49%	2%	5%
Health	95%	21%	4%	23%	1%	56%	9%	10%
Lodging	71%	5%	20%	22%	10%	74%	1%	3%
Office	97%	29%	2%	19%	1%	52%	33%	26%
Public Administration	90%	22%	8%	32%	2%	45%	3%	5%
Religious	93%	46%	6%	37%	1%	17%	2%	2%
Retail	94%	37%	4%	22%	2%	41%	9%	11%
Service	98%	58%	2%	21%	0%	21%	7%	3%
Wholesale	91%	20%	6%	22%	3%	58%	5%	8%
Unclassified/Unknown	98%	37%	2%	19%	1%	44%	17%	7%
Total	95%	29%	4%	23%	1%	48%	100%	100%
Number of accounts	314,603		13,323		4,205		332,131	
Annual Use in GWh		9,924		7,822		16,109		33,855

Note: Extra-large customers with a demand exceeding 10 MW are excluded; commercial accounts only.

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One third of ComEd's commercial customers belong to the office segment, accounting for 26% of the annual energy use of commercial accounts (ComEd, 2020a). The office segment typically has the highest share of office equipment such as computers, servers, printers, and copiers; however, it is worth noting that nearly all other business types also have office equipment (Itron, 2014). For example, many businesses have at least small server rooms (e.g., education, health, lodging). Within the public sector, municipal facilities and educational facilities are the largest electricity users in the public sector in Illinois (Baker, Mutyal, & Galiasso, 2016). Both of these segments have significant shares of computing equipment, office equipment such as copiers and printers, and other miscellaneous electric loads (U.S. Energy Information Administration, 2016). Thus, it makes sense for EE programs to focus on offices and office equipment within various segments.

While commercial food service equipment is only a small proportion of total energy use across business types, devices have high per-unit energy consumption, making the food service segment among the most energy-intense in the commercial sector (Opinion Dynamics, 2018). Kitchen equipment is also present in many other segments: for example, many businesses have kitchen equipment in staff breakrooms, and educational, public, and health care facilities often have cafeterias and kitchens (Statewide Evaluation Team, 2019). Kitchen equipment has high upfront cost and is also a good target for EE programs.

Due to the varied nature of plug loads, EE programs can also address plug load control that can be applied to any segment and any suitable device. The following sections address the integration of plug load devices into ComEd's EE programs in more detail.

6.0 PROGRAM COMPARISON: INDIVIDUAL DEVICE-BASED PROGRAMS

Standard Incentives

Standard incentive programs offer prescriptive incentive amounts or rates for pre-approved qualified products or behaviors. Most standard incentives encourage customers to purchase more energy-efficient equipment; the exception is the standard incentive for networked computer power management.

ComEd offers standard incentives for several commercial devices in their program portfolio. Applications must be pre-approved, and the installation later verified prior to receiving the incentive (ComEd, 2020d). In 2019, ComEd's program was used by 2,687 commercial customers (2,132 from the private and 555 from the public sector), achieving verified electricity net savings of 207 GWh (Guidehouse, 2020c).

Comparing those incentives to those of other utilities revealed two types of possible opportunities for revisions: adding plug load devices that ComEd currently does not include under its commercial standard incentives (but may be offered to residential customers) and changing the incentive amount or type for plug load devices ComEd already includes.

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Computers and Imaging Equipment

Computers (desktops and laptops) and monitors are some of the most prominent plug load devices consuming 10-20% of total energy consumption in commercial buildings (ENERGY STAR, 2020i). ENERGY STAR options exist that save energy for these devices; for instance, ENERGY STAR computers are up to 65% more energy efficient than standard models (Reeves, Lauf, & Booher, 2012). According to the ENERGY STAR Unit Shipment and Market Penetration Report for 2018, nationally, 63% of the desktop and 82% of the laptop units shipped were ENERGY STAR-certified units (ENERGY STAR, 2019a). The forthcoming ComEd baseline study found that 77% of the surveyed sites were equipped with computers; the mean number of desktop computers per business was 9, the mean number of laptop computers was 7. The study estimates an ENERGY STAR penetration in the field of 39% (Itron, forthcoming); it is unclear why ComEd customers would have such a low penetration rate compared to that indicated by ENERGY STAR sales. Businesses using computers tend to also use imaging equipment such as printers, scanners, copiers, plotters, and multifunction devices. According to ComEd's 2012 baseline study, 92% of private commercial customers use imaging office equipment in their service territory (Opinion Dynamics et al., 2013). According to the ENERGY STAR Unit Shipment and Market Penetration Report for 2018, 99% of the imaging equipment units shipped were ENERGY STAR-certified units (ENERGY STAR, 2019a).

ComEd does not offer any standard incentives for computers or imaging equipment in its portfolio. Neither do any of the comparison utilities. Some utilities found in the Utility Incentives List (Better Buildings, 2020b) encourage upgrading to an ENERGY STAR computer by offering incentives of $5-12/unit. The list also includes utilities that offer incentives for ENERGY STAR imaging equipment, which can range from $5-10/unit. These office equipment incentives are offered by utilities through programs classified as "consumer equipment/ENERGY STAR equipment upgrades."

These results reflect the challenges inherent with motivating energy savings with computers and imaging equipment through standard incentives. Although ENERGY STAR versions of these devices exist, the generally modest amount of energy saved warrants an equally modest incentive (Chase, Ramos, & Pope, 2006), as the examples above show. However, these incentives are quite small compared to the cost of the devices, and are thus unlikely to be motivating factors, especially given the additional resource costs needed to apply for and receive the incentive. Also, the majority of products sold in 2018 were ENERGY STAR-certified products, especially in the imaging and notebook category (ENERGY STAR, 2019a), indicating a transformation towards more efficient products. For this reason, CalPlug does not recommend that ComEd adopt standard incentives for computers or imaging equipment at this time. At the same time, many businesses contain large numbers of these devices, and the small amounts of energy saved per device can add up, suggesting that they should not be ignored. CalPlug thus recommends considering creative approaches for promoting ENERGY STAR devices through other programs, such as minimum requirements for energy-efficient devices in large custom incentive projects, offering links to recommended energy-efficient models through an online program comparison database, highlighting them in energy saving tips aimed at office-intensive businesses, and emphasizing the non-financial benefits of choosing "green" versions of these products in marketing materials. These efforts should focus on the larger energy users in

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this category: desktop computers, printers (especially large networked printers), and larger multifunction devices. Other imagining equipment may be better managed through plug load controls.

Another reason computers and imaging equipment are challenging to incentivize is that they are subject to behavior-related energy inefficiencies. Current models of all these devices offer the option to automatically transition to standby or some other low-power mode after a period of inactivity which can save substantial energy during non-work periods (typically evenings and weekends). However, several case studies indicate that the energy-saving features of devices are not necessarily utilized effectively in everyday use (Kamilaris, Neovino, Kondepudi, & Kalluri, 2015; Pixley, Gago-Masague, & Fallman, 2018). The difference between a device with the power management settings enabled versus disabled can be greater than the difference between an ENERGY STAR versus a conventional device. For instance, an energy modeling study showed that a sample desktop computer operated for 5 hours per day used 609 Wh per day if the default sleep setting delay of 30 minutes was enabled, but 2204 Wh if power management was disabled (Klopfer, Pixley, Syed, & Li, 2019); the sample laptop, using the same parameters, was modeled at 112 Wh with power management enabled and 366 Wh if disabled (e.g., if used as a workstation). As such, measures that encourage effective use of existing efficiency features or of external control systems may reap substantial energy savings. Those approaches are discussed later, in the section on Plug Load Control Systems.

CalPlug recommends that ComEd:

- Develop creative solutions for promoting ENERGY STAR computers, printers, and multifunction devices including:
    - Offering links to recommended energy-efficient models through an online product database
    - Highlighting them in energy saving tips aimed at office-intensive businesses
    - Highlighting them in facility assessments, retro-commissioning, and "Strategic Energy Management" programs
    - Focusing on non-financial benefits of buying "green"
- Encourage efficient use of power management settings and external control systems for computers and imaging equipment (covered in more detail in the sections on control systems and on education and training)

Thin Clients

Thin clients are computers that operate on a server-based environment instead of a conventional desktop computer. These devices work by connecting remotely to a local server to access applications, manage protocols, and store data. As the demand for computer units in offices increases, so do the costs of purchasing and maintaining them. The total cost of ownership includes purchasing a computer, repairs to hardware, software updates, and the computing infrastructure. One way to reduce this cost is to use server-based computing: switching to thin clients reduces maintenance costs by removing the hardware component found in traditional desktops. Thin clients have been in the market for over a decade and demand has been increasing. Worldwide shipments increased from 3.2 million in 2009 to 24

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million in 2013 (Barr, Harty, & Nero, 2010), and the compound annual growth rate is expected to rise 1.8% by 2023 (ReportLinker, 2018).

Switching from desktop computers to thin clients can substantially reduce energy use. In a study conducted by the University of Pennsylvania, 10,000 desktop computers consumed an average of 3,000-4,200 MWh/year which translates to an estimated $257,250-$360,144/year. Assuming the same number of thin clients the energy consumption would be 800-1,400 MWh costing about $68,600-$120,048/year. The switch from desktop computers to thin clients results in a 66-73% reduction in annual energy consumption and a savings of $188,650-$240,096 per year (Penn Information Systems and Computing, 2016). Thin clients are also considered to be a greener option because they require less material to build, package, and transport, which also cuts down on costs. Since thin clients have minimal moving parts, they are easier to maintain which leads to a longer lifetime use out of the device. Typically, desktop computers have an operational lifetime of 3-4 years, but thin client can have a lifetime of 6-8 years (Penn Information Systems and Computing, 2016).

Only one of the comparison utilities has a standard incentive for thin clients. Xcel offers an incentive of $10/unit if 10 or more units installed. Four utilities listed in the Better Building Database incentivize thin clients, with a wide range of incentive offerings. Austin Utilities and PECO offer an incentive amount of $5/unit, Seattle City Light offers $25/unit, and Efficiency Works (Fort Collins Utilities) offers $50/unit. With so few utilities currently incentivizing the device, combined with limited data on claimable savings, CalPlug does not recommend a standard incentive for thin clients at this time. However, CalPlug does suggest monitoring the market trends for thin clients to seek opportunities to incentivize this device in the future.

CalPlug recommends that ComEd:

- Conduct an assessment of the thin client market for future opportunities.

Networking/Servers
ComEd does not currently offer standard incentives for any networking devices such as servers, uninterruptible power supply (UPS) devices, and data storage drives. These devices are considered in detail later, in the Data Center section.

Audio/Video
Televisions are the only plug load device in this category that offer energy efficiency alternatives. Many other devices are in scope as potentially saving energy if controlled by external plug load management system.

Television
Televisions are more often associated with homes than with businesses. However, televisions have long been common in many commercial settings. Televisions provide educational content in schools, entertainment in bars, gyms, waiting rooms, and hospital rooms, and advertising in retail settings; they are used for presentations in offices and as security displays. A study conducted by ACEEE shows that 47% of commercial sites have televisions and that larger businesses are significantly more likely to have televisions than smaller businesses (Jiang & Paulo, 2014). The most recent study of the ComEd service territory showed that in 2012, televisions had a 32% penetration rate for commercial

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customers, with an average number of 3.4 units per business (Opinion Dynamics et al., 2013). Television technology has evolved quickly, with advances such as smart televisions and 4K ultra-high definition screens emerging recently. These advances result in higher energy demand for these devices (Klopfer, Rapier, Luo, Pixley, & Li, 2017).

Upgrading to ENERGY STAR-certified televisions can save 25% more energy than a standard model (ENERGY STAR, 2020m). For instance, upgrading a 42-inch 1080p edge-lit LED screen television to an ENERGY STAR model will reduce energy consumption by an average of 23 kWh/year (Office of Energy Efficiency & Renewable Energy, 2020c).

ComEd does not offer a standard incentive for televisions, and neither do any of the comparison utilities, or any utility on the Better Buildings Alliance's Utility Incentives List. Standard incentives thus do not seem likely to garner energy savings for this device. However, given the high energy consumption of televisions, it is worthwhile to inform customers of the benefits of ENERGY STAR models, and how much energy can be saved with control strategies that turn televisions off when they are not being watched.

CalPlug recommends that ComEd:

- Use facility assessments and educational materials to identify energy savings opportunities for televisions, especially upgrading to ENERGY STAR devices and using plug load control strategies.

Miscellaneous Office Equipment

Most plug load devices in this category do not offer energy-efficient options but are in scope as possible saving energy as controlled devices, including paper shredders, lamps, portable fans, and space heaters. The two devices with ENERGY STAR options are room air conditioners and dehumidifiers. Although these are HVAC appliances in their functionality, they are also plug load devices, and as such present certain challenges from both sources.

Room Air Conditioners

Room air conditioning (AC) units are an intermediary solution to traditional HVAC end-use problems. Room ACs cool individual rooms, which can be an effective way to save energy. Using a centralized AC system to cool an entire building when only one or two rooms are occupied leads to considerable energy waste. Small business may turn to room ACs as a less expensive means for cooling a small space in an older building than retrofitting it with a centralized system. As large HVAC systems become more energy efficient, opportunities for saving energy through incentivizing equipment and behaviors in that area naturally decline. Room AC units can provide flexible options for commercial businesses and can be easily added to standard incentive programs. Room air conditioning units that are ENERGY STAR certified use 10% less energy on average and cost less than $75 annually to operate (ENERGY STAR, 2020k).

ComEd does not offer a standard incentive for room AC units. Two of the comparison utilities do: Efficiency VT and BGE. Their offerings are distinctly different. Efficiency VT uses a rebate of $200 to encourage customers in both residential and commercial sectors to purchase an ENERGY STAR-qualified air conditioning unit.[3] Efficiency VT's guidelines for this rebate are similar to what ComEd specifies in their standard incentive programs. The

[3] https://www.efficiencyvermont.com/rebates/list/window-air-conditioners

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guidelines include aspects of the program that pertain to the customer having service through the utility, a certain time period within which the measure must be implemented, and permanent removal of the older device (if any).[4] BGE also use similar standard application guidelines to promote high-efficiency equipment upgrades. However, the incentive amount for an air conditioning unit offered by BGE is only $25 per unit.[5] The much higher incentive for Efficiency VT is because the limited models that are eligible for the rebate are higher capacity models (950-12000 BTU),[6] whereas BGE allows ENERGY STAR products of all capacities, and assigns them all the same, lower incentive amount. For comparison, typical retail prices for air conditioners range from $150 to $600 depending on the capacity of the unit: a small AC (5,000-6,500 BTU) costs $150 to $250, a medium AC (7,000-8,200 BTU) costs $200-$400, and a large AC (9,800-12,500 BTU) costs $350-$600 (Consumer Reports, 2020). The different approaches of Energy Vermont and BGE thus both have merit. Generally, larger incentives are needed to motivate uptake of more expensive devices, so a $200 incentive is likely to be more effective at encourage upgrades for higher-capacity room ACs than a $25 incentive. However, BGE's more inclusive program expands its reach to lower-cost ACs. The detailed calculation of program benefits is beyond the scope of this report. A report by National Renewable Energy Laboratory identifies several other factors that affect the incentive amounts offered for such devices, including unit size, type of facility, and climate zone (Jacobson & Metoyer, 2017). CalPlug recommends considering both program options as well as a tiered approach, with a large incentive for larger capacity models and a smaller incentive for others.

CalPlug recommends that ComEd:

- Add room air conditioning units to the standard incentive program

Dehumidifiers

Dehumidifiers remove moisture from a limited area. The plug load models are standalone devices; whole-house or crawl-space dehumidifiers are considered HVAC equipment and are not in scope for this report. In the United States, the market for dehumidifiers is projected to increase by 2.5 million units by 2023 (ReportBuyer, 2018). The market value of dehumidifiers was USD 2.6 billion in 2017 and is expected to increase by a CAGR of 6.7% by 2025. This growth is due in part to an increase in product adoption in industrial and commercial sectors and introduction of strict energy-efficient regulations in the residential sector (Grand View Research, 2018).

In 2016, the DOE finalized new standards for dehumidifiers, which took effect in 2019. Relative to the previous standards, the current standards represent energy savings of about 15-25% (Appliance Standards Awareness Project, 2017a). ComEd offers a standard incentive of $50 for dehumidifiers in the residential sector, but does not offer one to commercial customers. The eligibility requirements are comparable to similar standard incentives offered to the commercial sector and thus could be easily transferred.

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[4] https://www.efficiencyvermont.com/Media/Default/docs/rebates/forms/efficiency-vermont-window-ac-rebate-form.pdf

[5] https://www.bgesmartenergy.com/sites/default/files/public/BGE_IC_Tech_Sheet_High_Efficiency_Equipment.pdf

[6] https://www.efficiencyvermont.com/Media/Default/docs/rebates/qpls/efficiency-vermont-window-ac-qualifying-products.pdf

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Two utilities in the CalPlug comparison group extend their dehumidifier rebates to the commercial sector in addition to the residential sector. BGE offers a $25 standard incentive for dehumidifiers within its standard incentives for commercial measures. Efficiency VT offers $25 for an ENERGY STAR-certified product and $40 for an ENERGY STAR Most Efficient product. Commercial and residential customers are both eligible for the rebate, but commercial customers must submit a W-9 tax form with the rebate application. Offering a higher rebate for an ENERGY STAR Most Efficient device is justified by the fact that they save an average of 19% over standard ENERGY STAR-certified models (U.S. Environmental Protection Agency, 2019).

CalPlug recommends that ComEd:

- Extend the residential standard incentive for dehumidifiers to commercial customers

Business Equipment

Cash Registers

Commercial retail sectors use point-of-sale equipment that needs a constant energy supply in order to function effortlessly for transactions. This equipment includes cash registers, demagnetizers, barcode scanners and scales, handheld barcode scanners, and conveyer belts. Combined, these devices can use 75–130 W. On average, point-of-sale equipment can cost $100/unit annually to power if left on continuously (Sheppy, Lobato, Pless, Gentile Polese, & Torcellini, 2013b). Upgrading cash registers to models with standby modes can save up to 222 kWh/year (Opinion Dynamics et al., 2013, Appendix 1). Doing a walk-through of the facility to identify equipment that can be updated can save 30-40% on energy consumption (Opinion Dynamics et al., 2013).

ComEd does not offer a standard incentive for cash registers, and neither do any of the comparison utilities. ENERGY STAR does not evaluate cash registers, despite the energy savings of models that include standby modes; CalPlug is not aware of any efforts in this area.

CalPlug recommends that ComEd:

- Ensure that facility assessments for relevant businesses include advice about upgrading cash registers and about using external plug load control strategies to ensure the devices are powered down outside of business hours

Kitchen Equipment

Appliances Already Included in Standard Incentives Program

ComEd current offers standard incentives to commercial customers for a range of kitchen equipment, including both residential and commercial grade appliances. In addition to downstream incentives, ComEd is currently involved in a pilot program for commercial kitchen equipment aimed at manufacturers and distributors, the CNP Upstream Food Service Equipment Pilot Program. This approach is discussed in detail in a later section.

Commercial kitchen energy consumption is on average 5 to 7 times higher per square foot than other commercial sectors (ENERGY STAR, 2013). There are approximately 105,100 standard electric appliances in the Illinois Commercial Food Sector which could yield a

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savings of 506 GWh per year if replaced with high-efficiency equipment (Smith & Zabrowski, 2018). Replacement of the equipment presents a challenge for both end-use customers and utilities because there are multiple players in the manufacturing, distributing, and marketing aspects of these appliances. Other barriers also interfere in the incentivization of these appliances such as the cost for new high-efficiency appliances, hard-to-reach customers who lack the resources to invest in high-efficiency appliances, and the incentive amount offered by the utility being too low (Smith & Zabrowski, 2018). The focus of this section is to provide recommendations on aligning incentives with those of other utilities, to expand the uptake of energy-efficient equipment.

Generally, adding or replacing standard commercial kitchen equipment is an expensive investment. Energy-efficient equipment is even more expensive, making it more difficult for businesses to justify. The price differentials between standard kitchen equipment and ENERGY STAR models are generally large enough that even with expected cost savings through energy savings, substantial rebates are needed to incentivize them (Smith & Zabrowski, 2018). ENERGY STAR has recommended incentive amount ranges that they deem appropriate for commercial kitchen appliances.

Only two of the standard incentive amounts for kitchen appliances offered by ComEd are comparable to those of other utilities: steam cookers and ice machines.

Many of the comparison utilities studied in this report offer higher incentives for certain types of commercial kitchen equipment than what ComEd offers, particularly for commercial refrigerators and freezers. See Table 6 for the full comparison. Several of them offer a range of incentives by size. The larger incentive amounts at other utilities are in line with the higher costs of higher-capacity equipment. For example, ENERGY STAR commercial refrigerators range in price from a few hundred dollars to a few thousand. A single, low incentive amount may be sufficient to motivate investment into models on the lower end of the price range, but is likely to be ineffective at incentivizing investments in larger, more expensive equipment.

One unusual exception is deep fat fryers, which shows a bimodal distribution in incentive amounts across comparison utilities. As shown in Table 6, five utilities offer an incentive amount in the $150-225 range (similar to ComEd's own), five offer incentive amounts in the $650-750 range, and one, Eversource CT, offers two incentives, $150 for standard size deep fat fryers and $550 for large models. This pattern suggests that the larger incentives would be aimed exclusively at larger deep fat fryers, but a closer look at the utilities' offerings indicated that all five incentives in the $650-750 range include standard fryers as well. Myriad factors affect the calculation of incentive amounts, and it is certainly possible that this bimodal pattern is effective for utilities with both high and low incentives. However, such a large discrepancy warrants additional analysis into the cost effectiveness of the current incentive offering.

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CalPlug recommends that ComEd:

- Consider increasing the incentive amounts for the following devices:
  - Solid-door reach-in refrigerators
  - Glass-door reach-in refrigerators
  - Convection ovens
  - Combination ovens
  - Griddles

- Consider offering a range of incentives by size for the following devices:
  - Solid-door reach-in refrigerators
  - Glass-door reach-in refrigerators
  - Solid-door reach-in freezers
  - Glass-door reach-in freezers
  - Hot food holding cabinets
  - Fryers

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Table 6. Range of Incentives Offered for ENERGY STAR-Certified Kitchen Equipment

Products	ComEd Incentives	Comparison Utilities Incentives	ENERGY STAR Incentive Range
Commercial Refrigerators	Solid Door Reach-In Refrigerator: $45	PG&E: $45-$120 SCE: $45-$120 Consumers Energy: $50-$125 Georgia Power: $75 BGE: $75-$225 Eversource CT: $100-$250 SMUD: $100-$400	$20-$1,975
	Glass Door Reach-In Refrigerator: $45	PG&E: $30-$100 SCE: $30-$100 Consumers Energy: $50-$125 BGE: $75-$150 Eversource CT: $80-$200 SMUD: $100-$400	
Commercial Freezers	Solid Door Reach-In Freezer: $100	Ameren: $35-$250 Consumers Energy: $50-$150 PG&E: $50-$350 Georgia Power: $75 SCE: $75-$350 Eversource CT: $80-$200 BGE: $100-$150 SMUD: $100-$400	$20-$1,975
	Glass Door Reach-In Freezer: $200	Ameren: $300-$500 Consumers Energy: $50-$150 SCE: $60-$515 Eversource CT: $100-$250 BGE: $100-$300 SMUD: $500-$800 SDG&E: $100-$250	
Commercial Ovens	Convection Oven: $170	Consumers Energy: $250 Energy Trust OR: $315 BGE: $350 PG&E: $350 SDG&E: $350 SCE: $350-$750 Eversource CT: $400 Ameren: $500 Eversource MA (Mass Save): $500 National Grid (Mass Save): $500 SMUD: $500 NYSEG: $500-$1,000	$100-$1,000

(continued)

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Table 6 (continued)

Products	ComEd Incentives	Comparison Utilities Incentives	ENERGY STAR Incentive Range
Commercial Ovens (continued)	Combination Oven: $1,100	Ameren: $500 NYSEG: $500-$2,000 BG&E: $1,000 Energy Trust OR: $1,000 SDG&E: $1,200-$3,500 Consumers Energy: $1,800 Eversource CT: $2,000 Eversource MA (Mass Save): $2,000 National Grid (Mass Save): $2,000 SCE: $2,000-$3,500 SMUD: $2,000-$4,000	
Hot Food Holding Cabinets	$320	BGE: $200-$300 Eversource CT: $200-$700 SCE: $200-$750 PG&E: $200-$750 Consumers Energy: $275-$600 Energy Trust OR: $350 Xcel: $400 NYSEG: $400-$800 SMUD: $400-$800 Eversource MA (Mass Save): $600-$900 National Grid (Mass Save): $600-$900 Ameren: $700-$1,100	$110-$900
Griddles	$130	Ameren: $180 BGE: $250 Consumers Energy: $300 Energy Trust OR: $400 Eversource MA: $400 National Grid: $400 NYSEG: $500 SMUD: $500 Eversource CT: $650 PG&E: $150/linear ft. SCE: $150/linear ft. SDG&E: $200/linear ft.	$25-$600
Fryers	$200	Consumers Energy: $150 Eversource MA (Mass Save): $150 National Grid (Mass Save): $150 Eversource CT: $150-$550 BGE: $200	$60-$1,350

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		Energy Trust OR: PG&E: SDG&E: SCE: NYSEG: SMUD:	$225 $650 $650 $650 $750 $750	

Commercial Dishwasher

The next sections cover kitchen equipment that ComEd does not currently include in the commercial standard incentive program.

Dishwashers are one of the most energy-intensive plug load devices in the commercial food sector. They require energy to power the machine as well as to heat water to run wash and sanitizing cycles. According to Market Watch, the global dishwasher market is expected to grow at a compound annual growth rate of 3.4% from 2021-2026, which will increase the collective revenue from $2,466.9 million USD for 2020 to $3,123.5 million USD by the end of 2026 (MarketWatch, 2020a). This growing market calls for programs that can fund and encourage customers to purchase the most energy-efficient options available.

Among the comparison utilities examined for this report, 13 of the 18 offered standard incentives for one or more types of commercial dishwashers. Most differentiate specific types of dishwashers (e.g., high versus low temperature and single versus multi-tank) and offer different incentive amounts for each type. Higher incentives are targeted at more expensive, energy-intensive dishwashers used by larger facilities, such as high temperature multi-tank conveyer and low temperature multi-tank conveyer models. This produces a large range of comparisons within and across utilities: for instance, Eversource CT offers incentives of $50-250 for the same types of dishwashers for which SMUD offers $700-$4000 (see the supplemental database for details). As Ameren also operates in Illinois and its overall guidelines for the standard incentive program are similar to ComEd's, it may provide the best initial comparison. Ameren lists dishwashers under the public hospitality sector and offers a range of incentives between the two extremes just mentioned, at $400-$2,000.[7]

Dishwashers also range within each type. National Grid and Eversource MA (operating through Mass Save's standard incentive program) offer customers an incentive of $100-$250 to purchase high-efficiency equipment.[8] The range of incentives is much lower and smaller than for Ameren, in part because Mass Save incentivizes more expensive higher-end dishwashers within each category type through its custom incentive program instead. This arguably simplifies the standard incentive program for the utility, at the price of complicating the process for larger facilities. Custom incentives offer tailored approach to specific facilities but require more processing time and labor compared to standard incentives.

SCE provides an innovative approach for incentivizing energy-efficient commercial dishwashers in a standard incentives program. SCE designed its dishwasher incentive in

[7] https://amerenillinoissavings.com/portals/0/business/forms/specialty-public-hospitality-application.pdf
[8] https://www.masssaveapplicationportal.com/resource/1579210584000/BusinessIncentives

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partnership with SoCal Gas, integrating the two services used by this one plug load device: electricity to run the motor and gas to heat the water. This shared incentive simplifies the process for the customer by clearly identifying which devices are approved by both utilities and sharing a single application. Commercial customers of SCE and SoCal Gas are eligible for a combined incentive of $600 for any Tier 2 dishwasher: $350 offered by SCE and $250 offered by Southern California Gas (SoCalGas).[9] The incentive was originally offered by SoCalGas alone, and the $250 is still available to their customers who are not also customers of SCE. The programs discussed above offer clear examples for incentivizing dishwashers through standard incentives. Given the similarity across programs and ComEd's existing list of commercial kitchen devices, the addition of dishwashers to its portfolio. should be simple and effective. Dishwashers are actively used in a range of commercial settings such as restaurants, schools, and hotels. As with any new device, this could give ComEd exposure to customers who have not participated in prior EE programs, but may be open to further involvement with other measures.

CalPlug recommends that ComEd:

- Add commercial dishwashers to the standard incentive program

Wrap Machines

Wrap machines are packing equipment commonly used to seal and protect foods and perishable items such as meat, produce, deli items, and baked goods. The wrap machine is designed to weigh and wrap a package and then place the wrapped package on a heated sealing pad to prepare it for storage or sale. The global packaging machinery market is forecasted to be valued at USD 50.21 billion by 2026, with a compound annual growth rate of 3.3 %. Food and beverage sectors are expected to be the largest occupants of this market because of an increase in processed food demands. In 2018, the food segment held approximately 35.3% of the packing market share (see Figure 7) (Fortune Business Insights, 2019).

[9] https://www.sceonlineapp.com/DocCounter.aspx?d id=972 page 14

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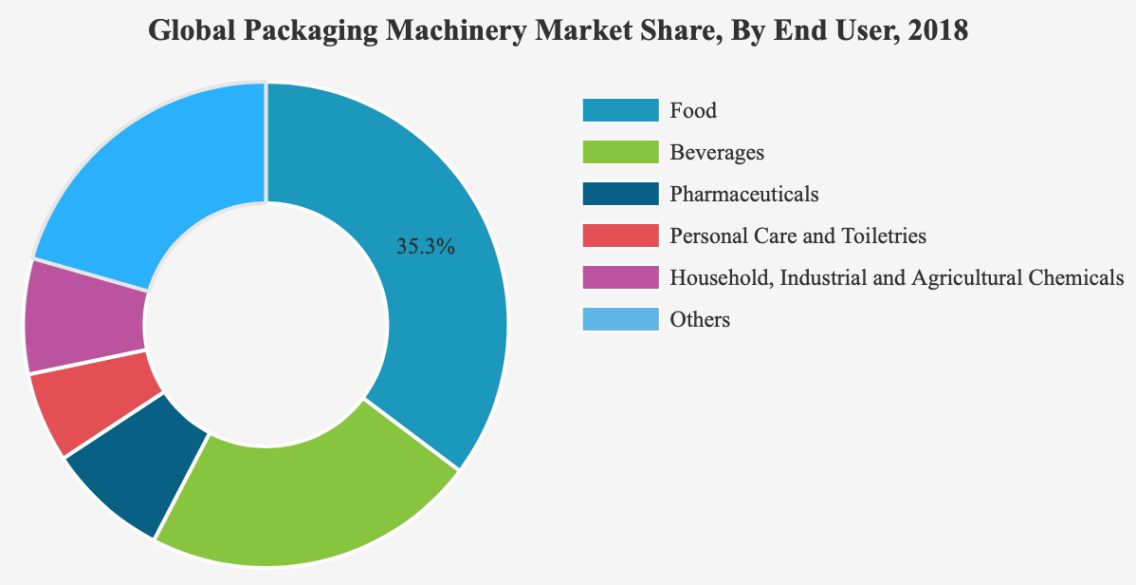

Source: Fortune Business Insights (2019)

Figure 7. Global Packaging Machinery Market Share, By End User, 2018

ENERGY STAR does not certify wrap machines. However, two distinct types of wrap machines are more energy efficient by design. The on-demand hand wrap machine is an upgrade for the always-on hand wrap machine. A workpaper by SCE discusses the savings achieved through the replacement of this equipment in commercial settings. The workpaper reports a saving of 1,564 kWh/year for on-demand hand wrap machines, with the baseline equipment cost of $350 (Southern California Edison, 2016a). The third and most efficient type is an on-demand over wrap machine, which differs from the on-demand hand wrap machine in that it takes less time to reach seal temperature and produces an average estimated savings of 1,584 kWh/year (Energy Trust of Oregon, 2019). Currently, the on-demand hand wrap machine is the more utilized model in the food sector. CalPlug's utility comparisons identified four utilities that incentivized wrap machines: Energy Trust OR, SCE, PG&E, and Eversource CT. SCE, PG&E, and Eversource CT all offer an incentive of $125 for an on-demand hand wrap machine. Energy Trust OR offers a $275 standard incentive for an on-demand over wrap machine, and categorizes it under the packaging category of their standard incentives program.

Precedent for incentivizes this device is so far limited but may be promising enough to warrant a more detailed cost effectiveness analysis.

CalPlug recommends that ComEd:

- Add wrap machines to the standard incentive program

Mini-Refrigerator

Mini-refrigerators or compact refrigerators are often found in small offices, dorms, and personal spaces for convenience. Mini-refrigerators can be energy exhaustive plug loads depending on the brand, size, age of the device, but overall, they use a disproportionate amount of energy for their size relative to full-size refrigerators. Mini-refrigerators range from 1.7 to 4.4-cubic-foot. ENERGY STAR-certified mini-refrigerators can use

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approximately 239.42 kWh/year (manual defrost) or about 318.4 kWh/year (partial automatic defrost) (Leigh, 2018). Although these ENERGY STAR options exist, the savings are not substantial. And although mini-refrigerators are often located in offices, they cannot be controlled like other office plug loads through power cuts or low-power modes. NREL's "Assessing and Reducing Plug and Process Loads in Office Buildings" guide discussed a walkthrough of office buildings to find and address problematic plug loads that waste energy (Sheppy, Lobato, Pless, Gentile Polese, & Torcellini, 2013a). NREL identifies mini-refrigerators as a problem that is best solved by discouraging their use altogether. NREL suggests removing personal mini-refrigerators and sharing a full-size refrigerator instead, which can save approximately 350 kWh/year for every mini-refrigerator that is removed.

CalPlug recommends that ComEd:

- Includes in the facility assessment advisors' training clear advice about identifying wasteful personal devices during the walk-through of offices and other worker spaces, along with solutions, including removing multiple mini-refrigerators when a single full-size refrigerator could be used instead.

Residential Refrigerators

Residential-grade refrigerators are purchased by commercial customers for staff breakrooms and to furnish multifamily apartment units. ComEd offers a $50 rebate for residential refrigerators that can be claimed by residential customers only. ComEd also includes residential refrigerators in a direct-install program for income-eligible multifamily buildings (Guidehouse, 2020d). Expanding the standard incentive to all of the commercial sector would encourage energy efficient purchases among those customers.

Two of the comparison utilities offer a rebate for residential refrigerators to multifamily property owners: Energy Trust OR and Efficiency VT. Both offer the same incentive amount as in their residential program. Energy Trust OR offers a rebate of $35 for ENERGY STAR-certified refrigerators[10] while Efficiency VT offers a higher rebate of $150-$250.[11] Three utilities on the Utility Incentives List (Better Buildings, 2020b) also offer incentives for residential refrigerators to commercial customers, with incentives ranging by size of the device.

While there is not a strong precedent among the comparison utilities for incentivizing residential refrigerators to commercial customers, the programmatic costs of extending an existing incentive to a group already being incentivized for similar products should be minimal, CalPlug believes the opportunity to motivate energy savings for residential refrigerators regardless of who purchases them justifies a closer look at the cost-effectiveness calculation.

CalPlug recommends that ComEd:

- Extend the residential refrigerator rebate to multifamily customers and potentially all types of commercial customers.

[10] https://www.energytrust.org/incentive-groups/multifamily-appliances/
[11] https://www.efficiencyvermont.com/rebates/list/refrigerators-residential-rental-properties

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Water Cooler

Water coolers can be found in the shared areas and break rooms of many businesses. Water coolers that offer hot water as well as cold water use more energy. Water coolers tend to be on at all times for the convenience of dispensing water when needed, even overnight and on weekends ENERGY STAR specification allows a water cooler that is "cold only" to use 0.16 kWh/day and the "hot and cold" water cooler to draw 0.87 kWh/day. These standards are not adopted by many states because there is no national efficiency standard for water coolers yet. However, some states have adopted local standards based on the ENERGY STAR criteria version 2.0. ENERGY STAR is currently in the works of finalizing a Version 3.0 by the Summer of 2020 which will establish more updated guidelines on water coolers (Appliance Standards Awareness Project, 2017b).

The current energy savings for upgrading to an ENERGY STAR water cooler is also considerable. According to the Illinois Statewide Technical Reference Manual, efficient "hot and cold" water coolers can produce an annual energy savings of 58.4 kWh and "cold only" can save 48.7 kWh (Illinois Energy Efficiency Stakeholder Advisory Group, 2019). However, understanding the market trends and accumulating more energy savings potentials will allow a better assessment of the device.

So far BGE is the only comparison utility which offers a standard incentive for this device. BGE gives a $50 incentive for both commercial and residential customers.[12] Water coolers can cost anywhere between $90-$400, depending on features such as capacity, temperature, size, and floor versus countertop (see for example GHP Group, 2020). Water coolers that are ENERGY STAR certified can save 30% more energy than conventional water coolers, saving approximately $70 over the lifetime of the device (ENERGY STAR, 2020n). But if this device was controlled by an external power management system such as a cooler control, an advanced power strip, or an occupancy sensor, it could potentially save more energy by cutting energy consumption overnight and on weekends. Rather than adding a standard incentive, CalPlug suggests that during facility assessments of shared work areas and break rooms, Energy Efficiency Service Providers (EESPs) encourage customers to upgrade to ENERGY STAR-certified water coolers or to attach existing coolers to control systems.

CalPlug recommends that ComEd:

- Include a facility assessment to identifying water coolers in shared work areas and break rooms that can be upgraded to ENERGY STAR water coolers and/or attaching existing coolers to control systems.

Laundry Appliances

Commercial Clothes Washer

Washers that are ENERGY STAR certified are about 25% more efficient and use about 45% less water than the standard models. Commercial washers considered for ENERGY STAR must have a capacity greater than 1.6 ft3 (ENERGY STAR, 2020d). ComEd offers incentives for new and replacement commercial washers that meet ENERGY STAR

[12] https://www.bgesmartenergy.com/sites/default/files/public/BGE_IC_Tech_Sheet_High_Efficiency_Equipment.pdf

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qualifications and have a modified energy factor of ≥ 2.2 ft3/kWh/cycle.[13] The incentives are $20 for front load and $50 for top load commercial clothes washers. Four of the comparison utilities also offer standard incentives for commercial clothes washers, and all of them use higher incentive amounts (see Table 7).

Another benefit of upgrading to ENERGY STAR commercial clothes washers is that they save water as well as energy. According to a field study conducted in Colesville Towers, a high-end apartment building in Silver Spring, Maryland, upgrading to ENERGY STAR washer saved the commercial unit approximately 50% in energy and water consumption. The projected savings of this field study with 14 ENERGY STAR washer running 1,138 cycles/washer/year would yield about $2,600 (ENERGY STAR, 2020f).[14] Efficient washers also remove more water from clothes, thus saving energy needed to run clothes dryers (Consumer Reports, 2019). These other benefits could be included in informational materials, to further motivate customers to use the incentive.

CalPlug recommends that ComEd:

- Increase the standard incentive for the commercial clothes washer
- Include information about how efficient clothes washers also save water and energy used for clothes dryers

Table 7. Standard Incentives for Commercial Clothes Washers

Utility	Standard Incentive
ComEd	$20 front loader $50 top loader
Consumers Energy	$70
BGE	$100 Tier 1 $200 Tier 2
Eversource CT	$200
Energy Trust OR	$200 (everyone) $300 multifamily only, front-loader only

Residential Clothes Washer

ComEd offers a rebate of $50 for washing machines to its residential customers.[15] This rebate applies to ComEd's residential customers and is capped at a limit of 10 washers. The rationale for extending this incentive to commercial customers is that residential washers are used in multifamily properties that provide individual laundry machines in each unit.

Washers usually are priced anywhere from $275 to $2,500, depending on the type, capacity, and features (Consumer Reports, 2019). Residential clothes washers can prove to be an expensive investment given that an average ENERGY STAR top-loading washer can range from $319 to $1,259 and a front-loading washer can cost $519 to $2,449 (Cluett, Amann, Chou, & Osann, 2013). ENERGY STAR-certified washers use about 25% less energy and

[13] https://www.comed.com/WaysToSave/ForYourBusiness/Documents/CommercialAppliancesWorksheet.pdf
[14] https://www.energytrust.org/wp-content/uploads/2016/10/be_pi_incentivebooklet.pdf
[15] https://www.comed.com/WaysToSave/ForYourHome/Documents/ApplianceRebateEligibility.pdf

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33% less water than conventional washers, saving about $370 in energy costs over the lifetime of the machine and an annual of $35 on the electricity bill (ENERGY STAR, 2020c).

CalPlug found two comparison utilities that offer a standard incentive for residential clothes washers targeted towards multifamily building owners: Energy Trust OR and SMUD. Energy Trust OR offers a $65 incentive for the front-loading washer with eligibility that extends to multifamily properties.[16] SMUD offers incentives from $50 to $125 depending on which participating water district the customer belongs to.[17] ComEd can use these utility examples to consider extending eligibility for the residential clothes washer standard incentive to multifamily property owners.

CalPlug recommends that ComEd:

- Extend the residential rebate for clothes washers to multifamily property owners.

Clothes Dryer

Heat pump clothes dryers are a relatively new technology that involves recycling heat while extracting moisture[18] and represent a major efficiency gain over previous dryer options. ComEd does not offer standard incentives for any type of clothes dryers in its commercial EE portfolio.[19] ComEd offers rebates for ENERGY STAR-certified electric dryers for residential customers, although these appear to be conventional models rather than heat pump.[20] It would be beneficial to consider adding heat pump dryers to ComEd's portfolio in light of new technological developments and energy trends.[21]

While other major appliances have undergone significant energy efficiency improvements in recent decades, the energy wasted by electric clothes dryers has been consistent since the 1970s (Bensch, Helvoigt, Webb-Cabrera, & Baker, 2017; Bonneville Power Administration, 2014; Horowitz, Calwell, Denkenberger, & Spak, 2014). In fact, dryers in the United States are estimated to consume as much energy per year (approximately 1000 kW/year) as a new energy-efficient refrigerator, clothes washer, and dishwasher combined (Horowitz et al., 2014). Heat pump dryers represent a major breakthrough. They received the esteemed ENERGY STAR Emerging Technology Award in 2013 (Denkenberger et al., 2013), are cheaper to run, and are gentler on clothes than conventional electric dryer (Badger, Foster, Granda, & Wold, 2012; Martin, Sutherland, & Parker, 2016).[22] As of 2020, ENERGY STAR offers a list of 10 dryers designated as “Most Efficient Products," all of which utilize heat pump technology (ENERGY STAR, 2020e).

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[16] https://www.energytrust.org/incentive-groups/multifamily-appliances/
[17] https://www.smud.org/en/Rebates-and-Savings-Tips/Rebates-for-My-Home/Home-Appliances-and-Electronics-Rebates
[18] https://www.energystar.gov/products/heat_pump_dryer
[19] https://www.comed.com/WaysToSave/ForYourBusiness/Documents/CommercialAppliancesWorksheet.pdf
[20] Although ComEd's description says only “ENERGY STAR electric dryers,” other utilities (such as Efficiency Vermont) specifically clarify heat pump dryers or hybrid as opposed to conventional electric. Moreover, the standard incentive amount ComEd offers for the electric dryer is comparable to the incentive amount other utilities offer for conventional electric (non-heat pump) dryers. Even if heat pump dryers were not explicitly excluded from this rebate, the incentive amount is far too low to incentivize them, given their higher cost.
[21] https://www.comed.com/WaysToSave/ForYourHome/Pages/ApplianceRebates.aspx
[22] https://neep.org/blog/energy-efficient-heat-pump-clothes-dryers-have-landed-us

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Data on energy and cost savings for residential grade heat pump dryers support the EE benefits to incentivizing heat pump dryers. The Super-Efficient Dryer Initiative's tests of heat pump technology in residential-grade dryers indicated that these dryers are 50%-60% more energy efficient than conventional dryers and about 47% more energy efficient than efficient electric dryers without heat pump technology (producing 333 kWh/year in energy savings) (Badger et al., 2012; Horowitz et al., 2014). Moreover, another study led by EVOCA, SEDI, and CLASP corroborated the energy efficiency findings of the previous study and added that energy savings were estimated to be between 415 kWh-507 kWh, annual savings to be $50-$60. ACEEE addressed the energy savings of heat pump dryers in a study on energy efficiency in buildings and reported that heat pump clothes dryers generated average annual savings of 36% (346 kWh/year or 0.85 kWh/day) when paired with energy-efficient washing machines (Martin et al., 2016). Although the washing machines accounted for 35% of the energy savings by removing more moisture prior to drying, the remaining savings were still significant when compared to the average consumption of conventional electric dryers, at 814 kWh/year (Martin et al., 2016).

Most recently, the Northwest Energy Efficiency Alliance and PG&E analyzed energy consumption of dryers using a revised metric (the "utility combined energy factor") that better reflects how dryers are actually used by American consumers than the metric traditionally used by the DOE (Firestone & Dymond, 2018). Their report aimed to retain the integrity of the original "combined energy factor" metric while also testing supplemental modes to capture the range in drying behavior. Using the new metric revealed that energy consumption had been consistently underestimated across all dryer types; however, general energy consumption differences across dryers were consistent with prior studies. This evaluation concluded that hybrid heat pump dryers save 30% more energy than market average while heat pump dryers save 50% more energy. Moreover, conventional ENERGY STAR rated dryers saved 8% more on average than the market average. This report emphasized the significant energy savings opportunity (200kWh-600 kWh) available through integration of heat pump technology (Firestone & Dymond, 2018).

A major motivation for investing in energy-efficient equipment is that saving energy saves money. Denkenberger and colleagues (2013) noted that Americans spend $9 billion annually to operate dryers. A briefing by the ACEEE predicted that upgrading residential dryers to optimal efficient versions could save U.S consumers $4 billion a year (Denkenberger, Mau, Calwell, Wanless, & Trimboli, 2012; Horowitz et al., 2014) This can be especially encouraging for commercial business customers whose facilities have numerous dryers, as they can save significantly more overall than individual households.

So far, only one of the comparison utilities assessed for this report has begun offering standard incentives for heat pump dryers: Efficiency VT. Only residential-grade dryers are currently sold in the U.S., but Efficiency VT's incentives are offered to both residential and commercial customers. Specifically, this utility offers $400 for ENERGY STAR-certified heat pump dryers and $200 for hybrid heat pump dryers that meet the ENERGY STAR Most Efficient certification.[23] Efficiency VT further specifies that hybrid heat pump dryers

[23] https://www.efficiencyvermont.com/rebates/list/clothes-dryers

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are required to have one or more electric resistance elements and non-hybrid models do not contain an electric resistant element.[24]

Several other utilities outside of our comparison utility list have also established standard rebates for heat pump dryers. Although these utilities were not selected for full consideration because their overall portfolios are not as robust, they exhibit particular strengths in including heat-pump dryers which are designated as "Most Efficient Products" by ENERGY STAR. The Public Service Enterprise Group, which serves Long Island, has identified 18 different models of heat pump dryers that are eligible for a $250 rebate.[25] The DC Sustainable Energy Facility identified 6 different models of heat pump dryers that are eligible for a $150 rebate.[26] These utilities do not have additional restrictions or specifications to be eligible for rebates. However, New Jersey Clean Energy Program offers a $300 rebate for ENERGY STAR Most Efficient dryers and specifies that the combined energy factor rating must be >4.3.[27] In comparison, rebates for conventional ENERGY STAR electric dryers ranged from $50-$100.

Residential-grade heat pump dryers and hybrid heat pump dryers first became available in the U.S market in late 2014 (York et al., 2015). An early ACEEE report estimated that these heat pump dryers resulted in 40% energy savings as opposed to the 20% energy savings that ENERGY STAR-qualified models saved. This indicates an even better savings opportunity than for other major appliances, given that projected energy savings for 2030 were estimated to be 30% for clothes dryers, 25% for clothes washers, and 22% for refrigerators assuming 50% participation) (York et al., 2015).

In 2015, ACEEE noted that U.S penetration of hybrid dryers was still relatively low. Given the reported energy saving potential estimates, heat pump dryers are expected to penetrate the market in the near future. Currently, the payback period for hybrid dryers is estimated at 9-12 years and full heat pump dryers are estimated to be a few years longer (TeGrotenhuis, Butterfield, Caldwell, & Crook, 2016). However, as dryers using heat pump technology begin to penetrate the market, unit costs are expected to decrease, reducing the payback period to approximately 5 years (TeGrotenhuis et al., 2016). As a result, ACEEE recommended that utilities incentivize heat pump dryers that meet ENERGY STAR's Most Efficient criteria, streamline the rebate process, and make rebates substantial enough to justify the costlier purchase (York et al., 2015).

Most research on heat pump dryers has focused on residential sectors. However, the results can be applied to commercial sectors because many businesses use residential-grade dryers (e.g., laundromats, hotels, hospitals, multifamily buildings, and universities) (Bonneville Power Administration, 2014; Foster Porter & Denkenberger, 2016). For dryers, commercial-grade is defined by capacity, and dryers with an 18 lb. capacity (approximately 5.6 to 7.5 cubic feet) represent an overlap between large residential dryers and small commercial dryers (Bonneville Power Administration, 2014; Foster Porter & Denkenberger, 2016). As such, heat-pump technology is already available for smaller dryers used in the commercial

[24] https://www.efficiencyvermont.com/Media/Default/docs/rebates/qpls/efficiency-vermont-clothes-dryers-qualifying-products.pdf
[25] https://www.psegliny.com/saveenergyandmoney/energystarrebates
[26] https://www.dcseu.com/Media/Default/docs/residential/qpl/dcseu-qpl-clothes-dryers.pdf
[27] https://njcleanenergy.com/dryers

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sector (Bonneville Power Administration, 2014). The CEC estimated that there were 88,400 18-lb. capacity dryers used in the commercial sector in the Northwest (Bonneville Power Administration, 2014; Foster Porter & Denkenberger, 2016) indicating a significant potential for energy savings. One study noted that 18 lb. capacity standard dryers use about 3,792 kWh per year while heat pump dryers the same size use 1,869 kWh per unit (Bonneville Power Administration, 2014), resulting in energy savings of approximately 50%.

Commercial-grade heat pump dryers are available in Europe, such as the Electrolux Tumble Dryer T5190LE and the DOMUS DDT-HP-11-18-23. Although industry experts expected that commercial heat pump dryers would be introduced within the U.S. by now (e.g., Foster Porter & Denkenberger, 2016), CalPlug could find no evidence of manufacturers selling to the U.S. market. Incentive programs should thus focus on residential devices for the time being.

Some barriers to incentivizing these devices include lack of market penetration and high cost (Denkenberger et al., 2013). Currently, residential market penetration for heat pump dryers is low in the U.S. compared to European countries (Horowitz et al., 2014). However, a study by the Northwest Energy Efficiency Alliance predicts that in the Pacific Northwest territory, adoption rates will reach 63% by 2033 (Lavoie et al., 2018).

To gain insights into how to best market heat pump dryers, a study by Evergreen Economics explored the effects of cost, drying time, and energy savings on the product's appeal to consumers (Bensch et al., 2017). Subjects reported believing that heat pump dryers are more expensive and take more time to dry clothes. However, the study also found that many more subjects preferred the super-efficient dryer at a cost of $800-$1400 (54%) than preferred a $700 ENERGY STAR dryer (37%) or a $600 Non-ENERGY STAR dryer (9%).

Overall, these results are promising, suggesting that utilities can effectively incentivize residential heat pump and hybrid heat pump dryers, and add commercial heat pump dryers when they enter the U.S. market.

CalPlug recommends that ComEd:

- Add a standard incentive for residential-grade heat pump dryers for commercial customers
- Prepare to incentivize commercial-grade heat pump dryers in the near future

Plug Load Control Systems

Utilities incentivize various control strategies in their standard incentive programs to reduce unnecessary energy consumption from plug loads. These strategies include power management software for network computers, external control devices like APS and plug load occupancy sensors, and vending machine controls (Better Buildings, 2020b). While using built-in low-power modes in devices such as computers, displays, and printers has a high potential for energy savings (Kawamoto, Shimoda, & Mizuno, 2004), field studies in commercial settings show that energy saving settings are frequently disabled (Moorefield et al., 2011) (Pixley & Ross, 2014). External control devices are especially useful for shared devices that users are likely to leave on and that do not transition to low-power modes.

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However, even when devices do transition to sleep or standby, the cumulative "vampire load" of a building's worth of sleeping plug load devices justifies cutting power on evenings and weekends with external control strategies. Control devices with metering capabilities can have the added benefit of providing users with feedback about the device energy use and periods when energy is being wasted (Lobato, Sheppy, Brackney, Pless, & Torcellini, 2012). Control devices of any type should allow manual override to accommodate usage during atypical times (Lobato et al., 2012) to avoid user frustration.

This section covers two device-specific strategies: power management software for computers, and miser controls for vending machines, both of which require a customized approach to reducing energy. It then covers advanced power strips and smart plugs, which can control a wide range of devices. Approaches to reducing energy consumption with specific devices using these methods are discussed in the "controlled devices" section at the end.

Computer Power Management Software

While computers come equipped with low-power modes, field studies show that these are often not enabled (Pixley et al., 2018; Pixley & Ross, 2014). Users are often not familiar with their power management settings and erroneously assume that they have their sleep settings enabled (Pixley, Ross, Raturi, & Downs, 2014). Businesses with computer networks can manage power management settings centrally via existing network or specialized software. Power management that is managed centrally by the business' IT departments is a plug load reduction strategy with substantial energy and also peak demand savings (Hackel et al., 2016).

ComEd offers $15 per networked desktop computer for the installation of network power management software; laptops, laptop stations, and monitor controls alone do not qualify. Among the comparison utilities, Consumers Energy and Georgia Power offer a standard incentive for power management for networked desktop computers at $10 and $20 per controlled desktop, respectively. The Utility Incentives List (Better Buildings, 2020b) lists more than 30 other utilities that offer network power management software, with the incentives ranging from $4 to $32 per unit.

Georgia Power also incentivizes network laptops and monitors with $10 per unit.[28] Laptop computers use less energy than desktop computers on average (Moorefield et al., 2011). By default, laptops transition to a low-power mode when closed for transport, and users are motivated to save battery power when treating laptops as mobile devices (NegaWatt Consulting, 2017). However, some laptops are treated as stationary devices, either left open all day or attached to a large monitor as a workstation, which requires disabling the setting that puts the laptop to sleep when closed. The extent of this practice in commercial settings is unknown, due to greatly limited research on how computers are used in situ. SDG&E commissioned a study to evaluate the savings potential of networked laptop computers NegaWatt Consulting (2017). Based on their review of existing research, the authors estimated the savings potential to be no more than 10-15 kWh per year per laptop, however, they noted that the prior data was sparse and problematic. Because of the rather small savings and the other Because of the rather small savings and the other complicating

[28] https://www.georgiapower.com/content/dam/georgia-power/pdfs/business-pdfs/Business%20Equipment.pdf

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factors (e.g., the need to discount the savings to account for off-site use), NegaWatt Consulting (2017) did not recommend a standard incentive for networked laptop computers to SDG&E at this time. However, they argue for a controlled field test on laptops in large commercial settings to gauge the potential of this measure. In the context of a business environment that has many such devices, savings can add up. The forthcoming ComEd baseline study found that 77% of the surveyed sites were equipped with computers (both laptop and desktop computers) (Itron, forthcoming). While there is no information available about how many of these computers are in a networked environment, it stands to reason that including laptops in the networked computer power management software incentive can potentially increase energy savings. However, more research is needed to explore laptop use in commercial settings, to monitor laptop energy consumption in situ, and to compare the default settings with network power management (NegaWatt Consulting, 2017).

CalPlug recommends that ComEd:

- Continue the incentive for desktop computer power management software
- Consider commissioning a field study about the savings potential of networked laptop computers

Vending Machine and Cooler Controls

Vending machine misers use a motion sensor to deactivate the lights and power down other systems when nobody is near, then activates the vending machine when somebody approaches it. Vending machine controls are preferable to other plug load controls, such as timers, because they save energy while maintaining key elements of the machine's mechanical system (Perry, 2017).

ComEd offers $100 per machine for refrigerated beverage vending machine controls, $40 per machine for non-refrigerated snack vending machine controls, and $40 for reach-in cooler controls. This measure applies to machines that are not ENERGY STAR certified. From the comparison utilities, several also offered incentives for refrigerated and non-refrigerated vending machines, with the incentives ranging from $65-$150 and $25-$50, respectively. For reach-in cooler controls, only Mass Save (Eversource MA and National Grid) from the comparison utilities offered a similar incentive ($115). The Utility Incentives List (Better Buildings, 2020b) shows incentives offered by several other utilities ranging from $30-$115. ComEd also offers an incentive of $50 to refurbish refrigerated beverage vending machines to fulfill the ENERGY STAR Tier 2 requirements for vending machines, which is a unique offer according to CalPlug's research.[29] ComEd's offer for vending machines and reach-in cooler controls is well within best practices.

CalPlug recommends that ComEd:

- Preserve the current incentives for vending machine and cooler controls

Advanced Power Strips Tier 1 and Tier 2

Plug load devices can also be controlled with external devices such as APSs. The primary benefit of APSs is that they automatically cut power to equipment that is not in use (Better Buildings, 2020a). Load-sensing first generation APS devices (now referred to as Tier 1)

[29] https://www.comed.com/WaysToSave/ForYourBusiness/Documents/CommercialAppliancesWorksheet.pdf

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feature a master or control outlet for the primary device and multiple outlets for controlled or "switched" devices. Load-sensing APSs typically use computers or TVs as the primary device. They disconnect power to secondary devices (such as speakers, printers, lamps, or chargers) after the primary device is turned off or otherwise enters a low-power mode. This means that this type of APS can only save energy on the peripheral devices, and only if the primary device is turned off or enters a low power mode. Other types of Tier 1 APS devices cut power to controlled devices based on a timer or occupancy sensor (Metzger, Sheppy, & Cutler, 2014), or can be paired with a button or footswitch that the user can press to turn off power to controlled devices (Hackel et al., 2016). Field studies show that Tier 1 APS devices are generally successful in reducing plug load energy consumption (Hackel et al., 2016; Metzger et al., 2014), however, different strategies work better in different spaces, and the full range of APS options should be considered.

Second generation APS devices (Tier 2) go a step further by detecting user inactivity on the primary device even when the device remains on (Valmiki & Corradini, 2015). Tier 2 APS devices use a range of inputs, external sensors, and algorithms to determine whether users are no longer actively engaging with the primary device; if users do not respond to an alert before the countdown timer finishes, the primary device is turned off or put into sleep mode. This in turn cuts power to the secondary devices. There are two main types of Tier 2 APS, depending on the primary device: television or computer. Some models require additional software setup or occupancy sensors. A technology evaluation based on 51 computer workstations calculated that a Tier 2 APS can save 336 to 371 kWh per year (Valmiki & Corradini, 2015). However, to CalPlug's knowledge, no field study has tested whether a Tier 2 APS saves more energy for computer workstations than installing a Tier 1 APS and engaging the computer's sleep settings. A recent field study for the Minnesota Department of Commerce (Marsicek, Hackel, Batkiewicz, Plum, & Colburn, 2019) tested two different brands of Tier 2 computer APS devices in three office buildings. The study found dramatic differences in performance for the two APS devices, with one device saving 27% of a workstation's energy consumption and the other device saving only 8%. Savings also varied by the type of computer (desktop, laptop, thin client) and the number and types of controlled peripheral devices. The study uncovered some operational challenges with the integration of APS devices into the workstations (e.g., placement of the APS and occupancy sensor, USB port functionality required). Also, general barriers to computer power management need to be overcome before deploying APS Tier 2 devices (e.g., additional labor for IT departments, remote access). User education and buy-in are paramount as the computer power management feature of Tier 2 devices can be disabled by unplugging the USB connection from the APS to the computer (Marsicek et al., 2019). The study recommended providing incentives and assistance to increase adoption of Tier 2 devices, along with education and encouragement to use computer power management strategies, both built-in and Tier 2 APS.

Table 8 summarizes the savings found in studies of APS devices. The energy savings can be substantial, although the range across types and studies suggests the importance of carefully matching the type of APS to the situation.

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Table 8. Energy Savings from APS Devices and Other Strategies

Study	Device(s)/strategies studied	Reported savings	Notes
Acker, Duarte, and Van Den Wymelenberg (2012)	Tier 1 occupancy sensing Tier 1 load-sensing Equipment replacement Behavioral intervention (e-mail)	19% 18% 14% 5%	Median (weekday) Median (weekday) Median (weekday) Median (weekday, unoccupied)
Metzger, Cutler, and Sheppy (2012)	Tier 1 load sensing Tier 1 timer-based Tier 1 load sensing and timer Overall average savings Average savings kitchens (breakrooms) Average savings print rooms Average savings miscellaneous	10%/23% 43%/52% 12%/23% 27% 46% 35% 51%	Results vary by test site Results vary by test site Results vary by test site E.g., toaster, coffee maker E.g., printers, scanners, copiers E.g., radios, speakers, pencil sharpeners, calculators, phone chargers
Sheppy et al (2014)	Tier 1 timer-based	28%	
Hackel et al (2016)	Tier 1 occupancy sensor Tier 1 with foot pedal Tier 1 with food pedal and campaign Centralized Computer Power Management	22% 19% 22% 29%	
Valmiki & Corradini (2015)	Tier 2 APS	65% 73%	Without vacant workstations With vacant workstations
Marsicek et al (2019)	Tier 2 Device A Tier 2 Device B	27% 8%	

ComEd currently does not offer standard incentives for either Tier 1 or Tier 2 APS in its commercial program. However, ComEd offers Tier 1 APS in their "Small Business Program" as a direct install measure for small offices (Guidehouse, 2020e) and includes them in free kits that are sent to small offices (Guidehouse, 2020f). ComEd also offers both Tier 1 and Tier 2 APS devices on their online marketplace aimed at residential customers, and gives an instant discount for the Tier 1 APS, suggesting that they might be open to incentivizing these devices more broadly. Table 9 shows the available incentives from the comparison utilities and the Utility Incentives List (Better Buildings, 2020b). Overall, more utilities offer Tier 1 than Tier 2 devices.

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Table 9. Incentives for Tier 1 and Tier 2 APS

APS Device	Comparison Utilities (incentive amount per unit)
Tier 1	BGE[30] ($10); load-sensing or timer-based Consumers Energy[31] ($4) Ameren ($10 discount offered in business eligible marketplace) Efficiency VT ($10 discount offered in business eligible marketplace)
Tier 2	Utility Incentives List: 10 utilities, range $10-$50
Tier unspecified	Utility Incentives List: 8 utilities, range $5-$25

The forthcoming ComEd baseline study found that only 4% of computers (including desktops and laptops) were connected to an APS (Itron, forthcoming) and thus helping to control other office plug loads. Offering APS devices within the standard incentive program can increase awareness and adoption of these devices (Marsicek et al., 2019). Given the variation in APS designs and inconsistent terminology across brands, one challenge is effectively communicating to customers which devices qualify under the program. Utilities with existing incentives take care to describe the specific features the device must have. An advantage of incentivizing through an online marketplace is that once a specific device has been selected to incentivize, it can be clearly and easily communicated to the customer. However, this necessarily limits customers' choices to a limited selection in terms of brand and model, which is problematic given the varied needs of commercial customers.

Another challenge is that APS devices are deceptively easy to install incorrectly (Sheppy et al., 2014), resulting in no energy savings even though the devices appear to be functioning. Given the complexity of installation, APS and especially Tier 2 APS devices may be especially suitable for direct install programs (Valmiki & Corradini, 2015) and other more holistic programs (Marsicek et al., 2019), where the customer works with an Energy Efficiency Service Provider that is trained in these kinds of installations. Moreover, different kinds of APS devices are appropriate for different spaces and devices (Better Buildings, 2015b; Hackel et al., 2016; Metzger et al., 2012), which also speaks to offering APS devices within combined programs where more interaction with the customer takes place: customers can benefit from guidance about the kind of APS that fits their needs. Both users and building managers need education and training about how to operate their APS devices in situ (Metzger et al., 2012). Considering all these factors, CalPlug recommends a multipronged approach, in which standard incentives for a list of multiple APS devices are paired with informational materials and targeted at more IT-savvy

[30] https://www.bgesmartenergy.com/sites/default/files/public/BGE_IC_Tech_Sheet_High_Efficiency_Equipment.pdf
[31] https://www.consumersenergy.com/-/media/CE/Documents/Energy%20Efficiency/business/business-catalog.ashx?la=en&hash=B56C47B8DB045792DD6AA79A79B7D419

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customers, while other customers are guided toward APS use through interactions with EESPs, advisors, and facility assessments. The latter approach builds upon the direct install program, although additional training specific to APS devices would be useful, including informational materials to leave with end-users.

CalPlug recommends that ComEd:

- Add both Tier 1 and Tier 2 devices to the standard incentive program, paired with information about choosing the appropriate APS device and installation guides
- Supplement methods for distributing APS devices in current programs with additional training for consultants and additional educational materials targeted to end-users

Plug Load Occupancy Sensors

Occupancy sensors detect a user's presence in a space; if the user is not present, the connected device or system shuts off, reducing plug load energy consumption (Better Buildings, 2020b). Plug loads can be controlled via occupancy sensor controlled power strips (a type of APS Tier 1 device), occupancy sensor controlled plug-in outlets, and occupancy sensor-controlled circuits (see Figure 8) (Kaneda et al., 2010).

(a) Tier 1 APS with sensor (b) motion-activated plug-in outlets (c) ceiling motion sensor

Figure 8. Examples for Plug Load Occupancy Sensors with Passive Infrared Technology

ComEd incentivizes passive infrared and ultrasonic plug load occupancy sensors to control plug load equipment with $10 per sensor.[32] The sensor must be used to control equipment in offices and cubicles, including lighting, shared copiers, and printers (ComEd, 2020c). The incentive is listed within the indoor lighting incentive worksheet and would be hard to find for customers that are interested in plug load control. Devising a "Plug Load Control Worksheet" or "Office Worksheet" that offers all plug load-related incentives, including the occupancy sensor, would be a good addition to ComEd's website.

When comparing programs incentivizing occupancy sensors, confusing terminology makes it difficult to determine what kind of technology the incentive covers (see Figure 8 for four examples that might be acceptable for incentives). According to their website, BGE

[32] https://www.comed.com/WaysToSave/ForYourBusiness/Documents/IndoorLightingWorksheet.pdf

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incentivizes personal occupancy sensors on power strips[33] (although this incentive was not listed in the latest incentive catalog[34]). The Utility Incentives List (Better Buildings, 2020b) lists several other utilities that offer plug load occupancy sensors, with incentives ranging from $5 (Entergy Mississippi) to $25 (Austin Energy, Public Service Company of New Mexico). Some specify that they incentivize occupancy sensors on power strips (e.g., Austin Energy, Entergy Mississippi), others, like Duke Energy, do not specify. CalPlug does not recommend any changes to the plug load occupancy sensor incentive amount. However, clarification about exactly what types of devices are covered would be useful, as would instructions to customers about why and how such devices might save energy in their businesses.

CalPlug recommends that ComEd:

- Offer clearer definitions about which kinds of plug load occupancy sensors are covered
- Make the program more visible to customers on the website
- Provide information about how to use occupancy sensors, along with installation guides
- Include the device(s) on a summary list of related devices, such as an information sheet about plug loads and plug load controls, a page listing all plug load incentives, or a fact sheet on plug loads in offices

Smart Plugs and Plug Load Management Systems

Smart plugs are placed between the socket and the plug load device. Users can remotely access the device to turn it on or off, schedule the device, and also monitor the device's energy consumption via mobile applications (Goetzler, Young, & Rosenblatt, 2016). Smart plugs are arriving in the residential sector as part of the "smart home" that allows users to control connected devices with the promise of offering more comfort, convenience, and energy savings (King, 2018). Applying the same premise, networked smart plugs in offices and other commercial spaces allow occupants and site managers to monitor plug load energy consumption over time and help with decision-making about turning devices off or putting them on a schedule (Perry, 2017). Smart plugs function similarly to hard-wired controlled outlets and can thus add flexibility in commercial buildings, supplementing existing controlled outlets, or providing control where controlled outlets have not been installed. However, they cannot be used to fulfil the ASHRAE 90.1 standard as they are removable (American Society of Heating Refrigerating and Air-Conditioning Engineers, 2019; Langner & Trenbath, 2019)

Evidence about the energy savings potential for smart plugs is mixed, especially in comparison to other plug load control technology, such as hard-wired controlled outlets, timers, or APS devices. A lab evaluation of three commercial plug load control devices using a TV and a refrigerated drinking water fountain showed energy savings of about 410 kWh per year for the TV and negative savings for the drinking fountain (Emerging Products, 2019). The energy consumption of the smart plugs themselves ranged between 3.4 to 22.2 kWh per year. Since each smart plug controls only one device (compared to the multiple

[33] https://www.bgesmartenergy.com/business/business-programs/energy-solutions-business/plug-load-equipment
[34] https://bgesmartenergy.com/sites/default/files/public/BGE_IC_Tech_Sheet_High_Efficiency_Equipment.pdf

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devices controlled by an APS), the energy saved by that one device must substantially exceed the device's own consumption to be worthwhile. To further complicate matters, the study showed that the TV in stand-by mode had a higher electrical demand with the attached smart plug than by itself. The water fountain used in the evaluation was a very efficient device to begin with and thus not a good candidate to be retrofitted with a smart plug. The study cautions that smart plugs might not be equally effective on all plug loads and recommends more studies, also in real-life settings.

A potential benefit of the smart plug technology is the web-based or mobile interface to manage the device or a network of devices. One field study conducted by the National Renewable Energy Laboratory evaluated a plug load management (PLM) system in two commercial buildings, a pet-oriented retail store and a combined eye-wear manufacturer and retail store (Kandt & Langner, 2019). The sites had a wide variety of plug load devices, such as retail, medical, kitchen, and office equipment. Devices of very low energy consumption or of very low numbers (e.g., pencil sharpeners, clocks) or devices that had to stay always on were not included in the study. The system consisted of smart plugs (called "intelligent socket devices" in the report), a gateway to manage the communication between the smart plugs and the PLM system, and the cloud-based PLM dashboard. Within the dashboard equipment, energy use can be analyzed and devices or groups of devices can be scheduled. The equipment was monitored for about four weeks; during the next four weeks specific devices were controlled by shutting them off when not in use. Overall, plug load energy consumption was reduced by a projected 1,040 kWh/year in one location and 2,730 kWh/year in the other location, or 11% and 18% of savings compared to baseline. However, given the number of smart plugs required and the annual software fees, it did not turn out to be cost-effective, with simple payback periods of 59 years and 24 years, respectively. Staff on site did not engage with the dashboard to monitor plug load energy use as intended because of lack of time. On one site, half of the smart plugs were unplugged because users were frustrated by devices that were not on when expected. The authors conclude that the PLM system under consideration has energy savings potential and non-energy benefits such as the possibility of identifying device health. The strategy might be cost-effective in areas with high utility rates or for businesses with a large percentage of plug loads. To realize the full benefits of the systems, users will need to engage with it regularly and all staff needs to be educated about the technology (Kandt & Langner, 2019).

Field tests of smart plugs tend to include other strategies in the field test, making it difficult to assess savings specific to the smart plugs themselves, and have modest samples given the variation in user behaviors involved. A few academic studies used smart plugs to collect device consumption data, transmitting feedback to web interfaces for building managers and online apps for building occupants to gauge the savings potential of occupant engagement and controls (Hafer et al., 2017; Jenkins et al., 2019; Yun et al., 2017). Equipment was controlled through scheduling (e.g., turned off at night and on weekends) and remote control of individual occupants' devices. Hafer et al. (2017) studied 20 office occupants utilizing 71 devices (51 individual and 20 communal). The study showed a 21% reduction in energy consumption across all devices with the most savings for speakers, shared printers, and TV screens. Jenkins et al. (2019) used the same system on 78 devices at a concession stand and at 31 office workstations containing 115 devices. Turning the equipment off remotely when the concession stand was not in use reduced the electricity

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consumption by 58%. Office plug load consumption was reduced by 32% through a combination of an energy reduction competition, scheduling, controlling devices remotely, feedback about energy use, and educational quizzes. Another study used a similar combination of feedback (consisting of self-monitoring, advice, and comparison to co-workers) along with online controls, obtaining data from 56 participants (Yun et al., 2017).The group that received feedback and had access to online remote controls plus a calendar scheduling function (14 participants) showed 39% of savings during the intervention period.

A recent study from National Renewable Energy Laboratory recognized that smart plugs offer an opportunity to integrate plug and process loads into a commercial building's energy management information system platform to manage the whole buildings' energy use (Langner & Trenbath, 2019). However, the study also points out that more research and field-testing are needed until all systems integrate seamlessly and plug load control can be more automated and refined. For example, currently each device that is plugged into a smart plug needs to be identified manually. Also, the devices are often controlled by a schedule which needs to be put in for each device individually.

Smart plugs are an emerging technology in the commercial sector. ComEd only recently began including smart plugs into the free small business kits. CalPlug is not aware of any utility that currently offers standard incentives for smart plugs for the commercial sector. More large and rigorous independent field studies are needed to understand the unique benefits of smart plugs in the commercial setting and in what situations they are most likely to be effective, especially in comparison to other plug load control strategies.

CalPlug recommends that ComEd:

- Closely observe trends in the smart plug market, especially the integration with energy management information systems
- Support independent testing, field trials, and cost-effectiveness analyses of smart plugs and plug load management systems relevant to ComEd's customer base

Controlled Devices

The sections above already alluded to the fact that there is no single control strategy that works with any plug load device under all circumstances (Lobato et al., 2012). For instance, some devices do not respond well to simple power cuts and should instead be transitioned into low-power modes. This is true not only for computers, as mentioned before, but for appliances with clocks and connectivity needs. In other cases, the fit depends on how devices are used in the business setting. For instance, devices that are used infrequently throughout the day and are in locations without much traffic are good candidates for motion sensor-based controls. Devices in more highly trafficked areas that experience long periods of not being needed are good candidates for load-based controls. Timer-based controls work well for devices with a long warm-up time that should stay on most of the workday but have predictable idle periods overnight and on weekends, such as laser printers or copiers (Metzger et al., 2014). NREL has developed an extensive guide to tailor plug and process load control strategies to individual locations (Lobato et al., 2012). Flowcharts guide the decision-making process about with control strategy is adequate for a given situation.

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Considerations include. among others, whether the device:

- has a built-in automatic low-power state
- needs to be accessed remotely
- needs to be available instantly (time to reach a ready-to-use state from being in a low-power mode is an issue)
- can be de-energized without requiring a shutdown procedure
- can be re-energized without requiring a reconfiguration to function
- is a primary versus secondary piece of equipment
- has a consistent predictable use pattern
- is only needed when users are present
- has a built-in auto-scheduling that allows to have the vice ready when needed
- has a high enough power draw that it is cost effective to purchase and implement external control to de-energize when not in use.

Depending on the answers to a long list of considerations, NREL recommends different strategies: most often, either using built-in power management options or hardware-based control solutions based on scheduling, load sensing, or occupancy sensing. The strategies are general rather than device-specific, which makes the advice still relevant after almost a decade, but means the question of exactly which current model and type of device must still be addressed. Table 10 shows some examples for recommended control strategies from the NREL guide, applied to CalPlug's controlled devices from the key devices list. Note that this summary simplifies the more detailed strategies that are determined by the flow charts under specific situations.

The Better Buildings Alliance developed a guide for plug and process load controls that address the specific needs of various building types (Better Buildings, 2015a). The guide summarizes a variety of plug load control strategies that were developed previously by NREL (see for example Lobato et al., 2012; Sheppy & Lobato, 2011; Sheppy et al., 2013a, 2013b), including the placement of APS devices and the integration of plug load controls with other building systems, but also "turn it off" campaigns and developing design strategies for consolidating plug and process loads. The document gives a rough assessment of total cost, potential savings, the ease of implementation, and the user acceptance of the strategy in question.

Last, as many customers are unfamiliar with using them, APS devices and other control systems can easily end up in a drawer, or set up inappropriately, saving no energy. Users who do not understand how to use plug load control strategies can also become frustrated and either disconnect or override the technology (Kandt & Langner, 2019). Thus it is important to effectively communicate to customers exactly how to save energy with these systems, including specific advice on which plug load devices are a good fit for which plug load control systems. Such information could be included in informational materials and online. Even more importantly, it should be emphasized in EESP training, so they can apply it with tailored advice and instructions during facility assessments and installation services. Existing materials, such as the aforementioned NREL guide for "Selecting a Control Strategy for Plug and Process Loads" (Lobato et al., 2012) and the "Decision Guides

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for Plug and Process Loads" (Better Buildings, 2015a), are great starting points that could be updated and adapted for ComEd's training protocols.

CalPlug recommends that ComEd:

- Develop a tailored control strategy selection guide to train EESPs how to choose between various plug load control strategies and how to guide the decision to best fit the customer's unique situation

Table 10. Recommended Controls Strategies for Select Plug Load Devices

Devices	Built-in automatic low-power state	Scheduling	Load Sensing	Occupancy Sensing
Audio system		✓	✓	✓
Coffee Maker		✓		
Computer Monitor	✓		✓	
Computer, Desktop	✓			✓ (Tier 2)
Computer, Laptop	✓			✓ (Tier 2)
Espresso Machine		✓		
Fan		✓		✓
Hot Water Dispenser		✓		✓
Microwave		✓		
Multi-function device	✓	✓		
Paper Shredder		✓	✓	
Printer/Copier, personal			✓	
Printer/Copier, shared	✓	✓		
Projector	✓	✓	✓	
Scanner	✓	✓		
Space Heater		✓		
Speakers			✓	
Task/Desk/Floor Lamp			✓	✓
Television	✓	✓		✓
Toaster/Toaster Oven		✓		
Water Cooler		✓		✓

Note: Devices from CalPlug device list.
Table adapted from Lobato et al. (2012, page 23)

Business Eligible Marketplace

Direct Sales Marketplace (Online Store)

As utilities are increasingly looking for new cost-effective measures, online business marketplaces represent a simple, yet profitable way of expanding program portfolios (Mehrhoff, 2020; Uplight and Escalent, 2019). ComEd offers an online store for residential customers that includes discounted products, including advanced power strips (both Tier 1

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APS and Tier 2 APS), smart thermostats, smart home products, water-saving aerators, and lighting.[35] Industry experts have identified ComEd's residential online store as an exemplary program (Uplight and Escalent, 2019). However, ComEd does not offer a parallel program targeting the commercial sector. Adding a business-focused marketplace program could increase commercial customers' engagement and expand their interest into other utility programs. Several plug load devices would be of potential interest to business customers, including the same APS devices offered in the residential marketplace program.

Many of the comparison utilities examined for this report offer residential marketplaces, including Focus on Energy, ConEd, Eversource CT, NYSEG, Ameren, Georgia Power, and Xcel. Ameren and Georgia Power have expanded their programs to commercial customers, while Consumers Energy and Efficiency VT offer marketplaces only to their commercial customers (see Table 11). Ameren is the only utility for which savings results are available, but they are promising. A measure and verification study in 2019 showed Ameren's program to be highly successful. Based on the utility's net-to-gross ratio calculations, APS devices achieved 100% of the targeted energy savings, while the smart thermostat category achieved 101% of its energy savings goals and lighting savings realized 94% of its target (Opinion Dynamics, 2020). Ameren operates within a territory near ComEd and complies with the same TRM guidelines and statewide codes and standards for utility service provision.

Ameren's business marketplace is displayed as a separate webpage from the residential store.[36] Georgia Power also has a large selection of devices on their online marketplace program, but unlike Ameren, Georgia Power offers one site for both residential and commercial customers.[37]

Table 11. Direct Sales Online Marketplaces for Commercial Customers

Utility	Direct sales offerings
Ameren	Discounted APS, LEDs, v-notched belts, pre-rinse spray valves, desk lamps, exit signs, smart thermostats
Consumers Energy	Tier 1 APS
Efficiency VT	Tier 1 APS
Georgia Power	Tier 1 APS, Tier 2 APS (for TV), EV chargers, lighting, wi-fi thermostats, water-saving aerators and faucets, and smart home products

The success of Ameren and the wide variety of offerings in Georgia Power's online store suggest that ComEd could achieve additional energy savings if they expanded access of their online marketplace products to business customers. While a common website could provide service to both residential and commercial customers, it is helpful to provide a

[35] https://comedmarketplace.com/
[36] http://www.energyfederation.org/amerenillinoisbusiness/more-products-non-rebated.html
[37] https://georgiapowermarketplace.com/

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dedicated page that focuses on the specific products, usage ideas, and instructions that appeal particularly to commercial customers.

Control mechanisms such as APS devices are particularly well suited to an online store, as they are small and easy to ship and install. Electric Vehicle (EV) chargers are costlier to ship due to their size; yet Georgia Power refers to them as "easy to use and install,"[38] which the prevalence of such devices on online stores like Amazon seems to confirm. In summary, the products that CalPlug recommends ComEd to include in the business-facing online marketplace include:

- Tier 1 APS (load-sending, scheduling, occupancy sensor)
- Tier 2 APS (computer and television control types)
- Occupancy sensing controls
- LED lighting
- EV chargers[39]

Brokering Platform

A second, more ambitious and integrated approach to designing a business-oriented online marketplace program is to create a brokering platform. The platform helps customers learn what types of products would work for them, which models are incentivized, and where to buy them. One way that other utilities do this is through providing lists of qualified products for their incentive programs. Among the comparison utilities, this type of brokering marketplace is currently only available to residential customers. However, the internet-powered platform would be easily adaptable to business clients.

Efficiency VT provides a page with product comparison tools for price and reviews, and links to retailers in the state that stock rebate-eligible products.[40] ConEd provides comparison tools along with Enervee energy usage and product performance scores on its residential marketplace site.[41] The California IOUs (SCE,[42] SDG&E,[43] and PG&E[44]) also host such platforms for residential customers, providing a common platform where the customer can obtain verified product reviews, compare prices between retailers, and see Enervee scores for products including home appliances, water heaters, smart thermostats, and other connected home devices. In addition to providing information about rebated products, these platforms also typically provide links to products that are not currently incentivized but that meet ENERGY STAR requirements and are promoted by Enervee.

General Best Practices

Online product marketplaces can potentially achieve higher visibility and traction than traditional downstream rebates, which require the customer to take additional steps to

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[38] https://georgiapowermarketplace.com/juicebox-pro-40-wi-fi-enabled-ev-charging-station---40-amp/P-JCBJBPR40.html

[39] Pending EV charger program implementation. Please refer to the “future trends” section for further advice on EV charging stations

[40] https://marketplace.efficiencyvermont.com/

[41] https://marketplace.coned.com/

[42] https://marketplace.sce.com/

[43] https://marketplace.sdge.com/

[44] https://marketplace.pge.com/

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learn about and apply for the incentive. The online purchase experience avoids the need of pre-approval and post-processing of rebate forms, which can be burdensome and confusing. However, the platform must be carefully designed to anticipate and meet customers' needs to encourage participation.

A survey conducted by Escalent Research of residential utility customers indicated that many respondents would be more satisfied with their experience of utility programs if the programs were easier to access and if they reduced customer effort for participation (Uplight and Escalent, 2019). Although commercial clients were not included in this survey, they likely share an interest in reduced effort for participation. Offering an online marketplace program where the customer receives instant point-of-sale discounts streamlines the sales for energy-efficient products.

There are several best practices identified in the relevant literature for reaching business customers through marketplace programs. The primary goals are to simplify the decision and purchasing process for busy commercial clients and to encourage investment in more energy-efficient products. One way to simplify is by focusing and curating product choice based on experts' understanding of the market for those products. This strategy may have different implications for the online store platform and the brokering platform. For the online store, best practices suggest that utilities select a few key marketplace products, drawing on their knowledge of the available technology and curating online stores to offer the branded devices that offer the best technology at the most affordable price (Uplight and Escalent, 2019). For the brokering platform, value-added services could include providing information sheets about product choice and using the utility's professional network to provide expert advice about the most important criteria for selecting energy-efficient products (Mehrhoff, 2020). Such detailed information could be provided as links after gaining customer interest using the same type of concise descriptions and instructions provided on ComEd's residential marketplace. Another way to address customer issues is to provide an easily accessible customer service center and to train staff at relevant partner sites to knowledgeably answer questions regarding products offered in the marketplace (Uplight and Escalent, 2019).

The design interface of the website itself can also be targeted to maximize both profits and customer participation (ICF, 2020; Uplight and Escalent, 2019). Consistency is key for any business presentation, so information and products on a marketplace website should be presented uniformly across various links. Moreover, the marketplace can be integrated into other parts of the utility's website to encourage cross-traffic to other utility offerings and programs. For example, Xcel's residential marketplace[45] has been successful in driving customers from the online store to other programs, such as their "AC Rewards" demand response program for smart thermostats[46] and their "Home Energy Squad" service, [47] a virtual auditing service that provides energy-saving recommendations (Uplight and Escalent, 2019).

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[45] https://www.xcelenergystore.com/

[46] https://www.xcelenergy.com/programs_and_rebates/residential_programs_and_rebates/heating_and_cooling/ac_rewards_smart_thermostat_program

[47] https://www.xcelenergy.com/programs_and_rebates/residential_programs_and_rebates/home_energy_efficiency/home_energy_squad

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A marketplace program interface taps into a growing market for procuring products and services online: customers are increasingly becoming accustomed to buying even large-ticket items online rather than in person. This trend is not limited to big box retailers and clearinghouses such as Amazon.com, but is consistent across all retail segments (ICF, 2020). A study conducted by Navigant Research has projected major increases in revenue through online utility marketplaces through 2029, when the market is set to exceed $450 million worldwide per year, with the North American market projected to see the largest increases of any region (Mehrhoff, 2020).

Looking farther ahead, creating the online infrastructure for a business eligible marketplace now would help ComEd prepare for projected new trends in buying and selling energy. Having a dedicated "one-stop shop" could act as a Georgia Power already offers EV chargers in their marketplace, signaling acknowledgement of the growing market share of EVs as well as the need of EV owners for new energy-efficient plug load products.[48] Smart grid technology is slowly being phased in across the U.S., and a utility that adapts early and asserts a useful way to integrate self-generated energy such as solar, wind, EV chargers, etc. into the grid mix will inevitably be in a good position to maximize profits from this growing industry (ICF, 2020; Mehrhoff, 2020; Uplight and Escalent, 2019).

CalPlug recommends that ComEd:

- Create an online marketplace targeted to commercial customers, based on existing residential marketplace
    - Include direct sales of plug load devices including Tier 1 and Tier 2 APS devices, occupancy sensors, and EV chargers, as well as lighting
- Create an online qualified products guide that helps customers choose which incentivized energy-efficient appliances and solutions fit their needs and connects them with purchasing opportunities through third-party trade ally networks.
    - Provides price comparison tools, Enervee scores, and verified product reviews
    - Creates infrastructure that can be used later to also buy and sell distributed energy resources

Commercial Food Service Midstream Program

The goal of midstream programs is to increase the market share of energy-efficient products by incentivizing distributors and retailers to stock specific energy-efficient products, rather than incentivizing customers directly as in downstream programs (Backen et al., 2016). Midstream programs are considered a promising approach to market transformation. By influencing purchasing decisions of energy-efficient products throughout the supply chain, the product choice set for end customers will tend to become more energy efficient over time.

Kitchen equipment is a good target category for midstream programs, because these devices are generally easy to self-install and do not require the deep infrastructure integration that HVAC equipment does. ComEd is currently conducting a midstream pilot program for commercial food service (CFS) products. ComEd recently began the Upstream Commercial Food Service Pilot, which issues midstream incentives for distributors and point-of-sale

[48] https://georgiapowermarketplace.com/ev-chargers/

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incentives for end-use customers, administered by the utility with minimal overhead (Navigant, 2019).[49] The first stage of the pilot program was launched in September 2019 and was planned to last 18 months; given interruptions due to the COVID-19 shutdown, the end date may have changed. The next stages involve evaluating the pilot program results and optimizing the program. CalPlug's recommendations in this section are aimed toward this evaluation stage, as points to consider during the development of the full-scale program. These recommendations are based on a report on the pilot program by Frontier Energy (Smith & Zabrowski, 2018), a description of the program in the ComEd CY2020-2021 Evaluation Plan (Navigant, 2019), and a presentation by the program administrators in 2019 (ComEd, Nicor Gas, Peoples Gas, & North Shore Gas, 2019). The program elements shown there were compared to comparable programs operated by other utilities and to field best practices. As CalPlug did not have insider access to program managers or internal materials, some of the practices recommended here may already be incorporated into the program.

Nine of the comparison utilities examined here already offer midstream incentive programs for food service equipment to commercial customers, including Focus on Energy (We Energies) (Cadmus, 2020), PG&E,[50] SCE,[51] Consumers Energy,[52] SMUD,[53] SDG&E,[54] and Efficiency VT.[55] Eversource MA and National Grid both offer midstream kitchen equipment incentive programs under the auspices of state-wide Mass Save.[56]

Devices

Best practice research stipulates several characteristics that make technologies and products successful in midstream incentive delivery: the product must constitute a defined market, be cost-effective for long-term energy savings, and produce enough energy savings to merit start-up program costs (York, Bastian, & Amann, 2017). Many plug loads, particularly commercial kitchen equipment, meet these criteria. CFS products that are commonly offered through midstream programs include ovens, fryers, griddles, ice machines, and refrigerator units (Pacific Gas & Electric Company, 2019; Parsons, 2019; Southern California Edison, 2019). ComEd's pilot program includes convection ovens, combination ovens, fryers, griddles, steam cookers, holding cabinets, ice machines, and reach-in refrigerators and freezers (ComEd et al., 2019).

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[49] According to Smith and Zabrowski (2018: page i) this program uses a different definition of upstream versus midstream than is used by certain other evaluators, including CalPlug: "'Upstream' in the context of this proposal means incentives paid to entities other than end-use customers, which includes CFS equipment dealers and distributors, considered "midstream" actors by the industry." Since the program involves incentivizing at the sales and distribution level rather than influencing what products are manufactured, CalPlug considers it a midstream program.

[50] https://www.pge.com/en_US/for-our-business-partners/channel-partners/partner-distributor-programs/partner-distributor-programs.page?ctx=business

[51] https://www.sceonlineapp.com/MidstreamPOP.aspx

[52] https://www.consumersenergy.com/business/energy-efficiency/special-programs/instant-discount-program#eligible-products

[53] https://www.smud.org/en/Business-Solutions-and-Rebates/Business-Rebates/Express-Energy-Solutions

[54] https://www.sdge.com/business-energy-solutions-program

[55] https://www.efficiencyvermont.com/rebates/list/energy-star-ice-machines
https://www.efficiencyvermont.com/rebates/list/reach-in-refrigerators-freezers

[56] https://www.masssave.com/en/saving/business-rebates/food-service-equipment/instant-rebates

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In the individual devices section, CalPlug argued the case for adding commercial dishwashers and wrap machines to ComEd's standard incentives program. Given their energy savings potential, they are also worth considering here. These devices are not common among other utilities' midstream programs, but some precedent exists. National Grid offers dishwashers in their midstream programs, and SCE offers wrap machines in their midstream point of purchase program.[57] Therefore, CalPlug also recommends adding dishwashers and wrap machines to ComEd's CFS midstream program offerings as well.

Incentive Structure

Midstream incentives are generally paid to the supplier or distributors. Although midstream programs may not require distributors to pass point-of-sale discounts directly to customers, most of the utilities in our comparison study do specify end-use customer incentive amounts. Focus on Energy's "Midstream Commercial Kitchen Equipment Offering" is one such example that has shown early success. In 2019, this program saved 118,037 kWh, with 100% savings goal achievement for each measure evaluated. Indeed, Focus on Energy has decided to eliminate downstream rebates for commercial kitchen equipment as of 2020 due to the high impact and cost effectiveness of their midstream program (Cadmus, 2020). CalPlug recommends that ComEd conduct studies on cost-effectiveness to determine how best to distribute midstream incentives, and possibly consider requiring distributors to pass on a percentage of their incentives directly to end use customers.

Another type of midstream model offers incentives to individual sales representatives to motivate them to promote energy-efficient equipment; the aim is to disrupt the status quo practice of highlighting the lowest-cost products to customers. PG&E and National Grid offer pre-approved sales commissions (known as "spiffs") to sales representatives at participating distributors for each qualified energy-efficient kitchen product they sell (Pacific Gas & Electric Company, 2019; Parsons, 2019). CalPlug suggests that ComEd consider adding spiffs to their current pilot program, and perform cost effectiveness analysis to determine the viability of providing incentivizes to sales representatives in addition to their distribution companies.

The standard practice established by ENERGY STAR is to set an incentive at 50% or less of the incremental purchasing cost of qualified products. However, ENERGY STAR also states that there is no fixed rate that guarantees or limits program success. As previously discussed in the individual device incentive section, there is evidence suggesting that promoting and selling energy-efficient commercial kitchen equipment may benefit from aggressive incentivization; this significantly lowers entry costs for small CFS customers who have low discretionary purchasing budgets. It may be useful to connect incentives to ENERGY STAR specifications on a tiered scale, so that ENERGY STAR Most Efficient products are more heavily incentivized than products that only meet basic ENERGY STAR qualifications. It is important to maintain consistency in the program by offering incentives at constant, fixed amounts, only lowering the incentive as the product begins to reach appropriate saturation levels.

[57] https://www.sceonlineapp.com/MidstreamPOP.aspx

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Likewise, incentive distribution should be simple and streamlined. To highlight one such example, SCE's "Midstream Point of Purchase Program" features an online invoicing tool for distributors; it collects customer data and sends the relevant information to the utility for instant verification of incentivized purchases. SCE improved their program reporting practices based on lessons learned to include automatic customer data reporting, and introduced automated calculation functions to reduce error in the distributor processing systems. SCE also added extra customer verification data to improve security when purchasing products through the midstream point of purchase (Southern California Edison, 2019). ComEd may consider developing a similar online tool to facilitate instant rebate distributions to retail partners and their customers in advance of a wider launch of ComEd's current pilot program.

Marketing

A key aim of any successful program is to increase program awareness and interest within the targeted audience. It is widely acknowledged that offering clear, simple, and coherent messaging to customers is the best strategy for successful marketing. Customers are often poorly educated on energy efficiency topics and do not prioritize energy savings in their purchasing decisions (Schubert & Stadelmann, 2015). The Itron baseline study asked customers what factors were most important when purchasing additional or replacing food service equipment: cost, the age of the newly purchased equipment, that the equipment be brand new, the efficiency, ENERGY STAR certification, or the length of time for delivery (respondents could mark all that apply) (Itron, 2020). Figure 9 shows the estimated weighted priority is highest for cost; efficiency considerations or that the equipment be brand new or ENERGY STAR certified have lower priority. The age of the newly purchased equipment does not show a high priority either, which is consistent with respondents' reports that only an average of 20% of their food service equipment was purchased new.

Utility marketing can address this lack of knowledge in two ways. First, utilities can educate customers on the long-term financial benefits of energy-efficient equipment by outlining how they cost less to operate than non-energy-efficient alternatives over time by saving energy and water. Second, marketing can highlight other, non-energy benefits, such as reduced noise and the conveniences provided by high-tech devices. Research indicates that non-energy benefits such as reducing pollution and health problems can increase the appeal of energy saving measures (Asensio & Delmas, 2015).

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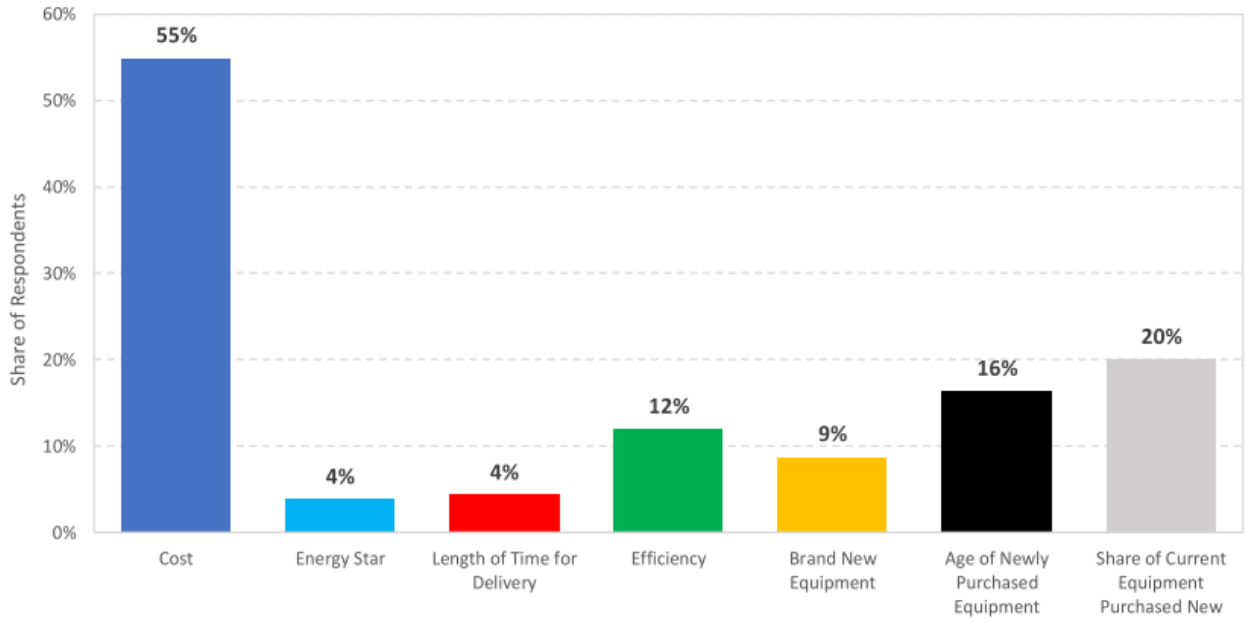

Source: Itron (2020, slide 32)

Figure 9. Equipment Replacement Purchase Criteria

Joint marketing between electricity and water utilities for products that save both energy and water can construct a coherent message across a variety of platforms. In this approach, utilities coordinate to create and distribute marketing literature for retailers to display on the floor or at point of sale, which sends a unified message to a wide range of customers. For example, as discussed in the standard incentives section, SCE has partnered with SoCalGas to offer a joint rebate for dishwashers (targeting customers with gas water heaters).[58] Similarly, SDG&E partners with the San Diego County Water Authority to provide small business customers with combined instant rebates for water and energy saving devices, including faucet aerators, pre-rinse spray valves, ice machines, and steam cookers. Businesses must not exceed monthly demand of 200kW during the past year in order to be eligible.[59]

Alternately, utilities can provide cooperative advertising funding directly to retailers and distributors to purchase point-of-sale marketing brochures, signage, and other messaging that best suit their business models (ENERGY STAR, 2013). In the most recent assessment of PG&E's midstream incentive program, the utility noted that the measured success of the program's expansion into commercial kitchen equipment was due in part to the consistent advertising messaging issued across different platforms by program administrators, trade allies, and third-party implementers (Pacific Gas & Electric Company, 2019).

Education and Salesforce Training

Salesforce training and education opportunities are especially important in midstream programs. Distributors and sales representatives who are knowledgeable about the specifications and performance features of energy-efficient equipment and understand the unique strengths of these devices will be better able to promote these products to CFS

[58] https://www.sceonlineapp.com/DocCounter.aspx?did=972
[59] https://www.sdge.com/business-energy-solutions-program

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clients (ENERGY STAR, 2013). PG&E's program includes an innovative Food Service Technology Center (FSTC) program, respected in the restaurant industry for its bench tests and reports on high efficiency kitchen equipment. The FSTC offers a number of educational opportunities for restauranteurs, distributors, and manufacturers. In addition to on-site seminars, PG&E's FSTC also performs equipment demonstrations to introduce state-of-the art-technology to local retailers and distributors. The FSTC also offers reference materials, such as equipment energy usage calculators and lists of products qualified for rebates in the PG&E territory.[60] CalPlug recommends that as ComEd prepares to launch a full-scale midstream program for CFS equipment, ComEd should ensure to devote resources to offer a spectrum of education and training opportunities depending on level of engagement, from simple online webinar tools for the general public, to in-person training course development and hands-on product demonstrations for retail partners.

Program Evaluation, Measurement, and Verification

Market transformation effects of midstream programs occur over a longer period of time than the immediate impact of downstream programs, commonly requiring five to ten years to show effectiveness. Traditional evaluation, measure, and verification (EM&V) calculations based on year-by-year savings can misrepresent the true benefits of midstream programs, as up-front costs of these programs are relatively high, and the first few years of the program may yield low values. This may be particularly problematic in states that rely on Total Resource Cost (TRC) calculations to determine program cost-effectiveness, including Illinois. However, in the medium to long term, midstream programs generally have greater potential to reach economies of scale, meaning that programs might recuperate and exceed earlier losses with overall high net gains by the end of the measure lifetime (York et al., 2017).

The dynamic nature of long term incentive programs requires more robust and multifaceted approaches to EM&V (Davis, Harris, & Violette, 2019). Some ways that EM&V can be adapted to longer range midstream programs include adding new elements to evaluation metrics, such as program design feedback from other utilities and stakeholders as well as non-energy related externalities that may affect or result from the program. For example, Focus on Energy has acknowledged a need for more dynamic and robust EM&V measures specifically for midstream programs, and plans to conduct interviews in 2020 with program administrators, product distributors, and contractors to further understand the needs of different market actors and implement new ways of evaluating results accordingly (Cadmus, 2020).

Although ComEd's EM&V plans are not detailed in the materials available to CalPlug, CalPlug assumes the program developers have already given this issue substantial consideration. Given its importance, CalPlug recommends regular reexamination of EM&V methods, particularly in terms of learning from the more mature programs conducted by other utilities, and how they have adapted to changes due to COVID-19 shutdowns.

Recommendations

In summary, CalPlug has several recommendations for ComEd as it further develops its midstream program for commercial kitchen equipment. Some of these features may already

[60] https://www.pge.com/en_US/small-medium-business/business-resource-center/training-and-education/food-service-technology-center.page

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be part of the pilot program but not known to CalPlug, in which case these suggestions should be taken as confirmation.

CalPlug recommends that ComEd:

- Add commercial dishwashers and wrap machines to the offered devices
- Consider requiring distributors to pass on a percentage of their incentives directly to end use customers, and whether to include "spiffs" for individual sales representatives
- Consider instituting higher incentives for ENERGY STAR Most Efficient products
- Develop and test an online tool to facilitate instant rebate distributions to retail partners and customers
- Use consistent branding for the midstream program across utility and distributor partner websites
- Offer online webinars to engage end-use customers and potential retail partners
- Offer in-person courses and CFS product demonstrations at utility sites for distributor partners for deeper training on marketing strategies and new technology
- Compare the metrics and methodologies for evaluation, measure, and verification procedures used for the midstream program to those used by other utilities with more established programs

7.0 PROGRAM COMPARISON: COMBINED PROGRAMS

Custom Incentives (Datacenter)

Custom incentive programs allow the customer to develop a tailored energy-efficiency plan for their facility which is evaluated and approved based on the expected energy savings and costs. This gives business customers a wide selection of options that are flexible enough to meet their unique needs. However, this process typically requires the involvement of an energy advisor and a complex application process. By comparison, the clear-cut nature of standard incentives makes the application process easier, faster, and more predictable for customers. These program approaches can function complementarily to encourage optimum participation, streamlining the process for customers with simpler projects that can be accomplished with standard incentives while still allowing enough flexibility to tailor more complex projects for other customers' needs.

An examination of the custom incentives program is beyond the scope of this report, as the parameters have little direct impact on plug load devices. This background is given because CalPlug has identified ComEd's data center program as a focus of interest. This program accounted for 22% of verified savings grossed by ComEd's custom program (Guidehouse, 2020b).

ComEd's Current Data Center Program

Data centers have increasingly been the focus of energy saving initiatives because of its tremendous energy demands and the lack of widespread adoption of energy-saving best practices, especially for small embedded centers. According to a report by Lawrence Berkley National Laboratory, data centers in the United States consumed 70 billion kilowatt hours in 2014, which was 1.8% of all energy consumed in the United States that year (Shehabi et al., 2016).

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As with other utilities, ComEd's data center program is mainly incentivized through custom incentives, which are performance based. As shown in Table 12, some comparison utilities which endorse data center equipment through their custom program offer higher incentive rates but also impose incentive caps or parameters that limit incentive amounts.

Table 12. Examples of Custom Incentive Amounts and Caps for ComEd and Comparison Utilities

Utility	Incentive Amount	Incentive Cap	Notes
ComEd[61]	$0.12/kWh	N/A	
Ameren[62]	$0.12/kWh	50% of project cost or $20,000	
ConEd[63]	$0.45/kWh	70% of total project cost	Only equipment and labor considered; other costs (e.g., taxes, shipping, administration) not included
Efficiency VT[64]	$0.10/kWh	Up to $25,000	Costs covered 100% during qualification stage; costs covered 50% during development stage
Energy Trust OR[65]	$0.22/kWh	100% of project cost for limited time (2020-2021)	Previously project cap was 60%-75% of project cost
FPL[66]	Project-specific based on results of cost-effectiveness testing[67]		Payback to customers is greater than 2 years Project must have benefit to cost ratio of at least 1.01 using the Rate Impact Measure Test Project must achieve a minimum benefit-to-cost ratio of 1.01 under the Participant Cost Test
Georgia Power[68]	$0.10/kWh	50% of project cost or $75,000/building/year	

[61] https://www.comed.com/WaysToSave/ForYourBusiness/Pages/Custom.aspx
[62] https://amerenillinoissavings.com/for-my-business/explore-incentives/custom-incentives
[63] https://www.coned.com/-/media/files/coned/documents/save-energy-money/rebates-incentives-tax-credits/rebates-incentives-tax-credits-for-commercial-industrial-buildings-customers/commercial-and-industrial-program/program-manual.pdf
[64] https://www.efficiencyvermont.com/services/project-support/retrocommissioning
[65] https://www.energytrust.org/incentives/existing-buildings-custom-incentives/#tab-two
[66] https://www.fpl.com/business/save/programs/customized-incentives.html
[67] https://www.fpl.com/content/dam/fpl/us/en/business/save/programs/pdf/Program%20Standards%20BCI.pdf
[68] https://www.georgiapower.com/business/products-programs/efficiency-maintenance/custom-ee-programs.html

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SMUD [69]	$0.30/kWh	50% of project cost up to $150,000	
SCE[70]	$0.06/kWh (to code) $0.12/kWh (above code)	N/A	$75 per kW saved (to code) 150/kW saved (above code)
We Energies (Focus on Energy)[71]	$0.04/kWh	50% of project (incentives capped at $300,000)	Qualifying projects include those with payback ≥1.5 years to ≤ 10 years $100 per peak kW reduced
Xcel[72]	$400/kW	N/A	

ComEd offers an EE program for data centers called "IT Rooms" through the custom incentives application. IT rooms fall into the small data centers category. Although it is unclear whether ComEd's datacenter program is restricted by size, this report will focus on small data centers since the website appears to market recommendations to these facilities. Small data centers can be defined using square feet of computer floor or number of servers. In a report produced by the Lawrence Berkeley National Laboratory, small data centers are defined as ≤1000 ft2 of computer floor while mid-sized data centers are between 1001 ft2 - 19,999 ft2, and larger data centers are considered to be ≥ 20,000 ft2 (Ganeshalingam, Shehabi, & Desroches, 2017). Many small, medium, and larger data centers are "embedded" which indicates that the center is located within an organization's building instead of in a separate facility (Ganeshalingam et al., 2017). Small and midsize embedded data centers are of special interest because they house half about 40% of all servers and tend to have difficulty with energy management (Ganeshalingam et al., 2017).

Data center programs have traditionally focused on modifications and device upgrades to lighting and HVAC systems. HVAC is especially key for data centers because they require optimal cooling measures to ensure efficient IT equipment functionality (Shehabi et al., 2016). Cooling measures lead to energy savings because better functioning equipment consumes less energy (Shehabi et al., 2016). Consequently, HVAC systems within these businesses can be made more energy efficient through upgrades, system modifications. and control measures.

Although various energy saving project ideas may be considered, the opportunities promoted by ComEd in regard to IT rooms mainly emphasize cooling solutions and energy management strategies.[73] Cooling initiatives including airflow management, upgrading or installing cooling equipment (e.g., computer room air conditioning unit, variable speed drives, economizers), and setting up control systems to monitor operations and mediate thermostat and fan functions. Custom incentives are also offered for power distribution units and UPS. Although ComEd offers standard incentives for lighting and HVAC

[69] https://www.smud.org/en/Business-Solutions-and-Rebates/Business-Rebates/Custom-Incentives
[70] https://www.sceonlineapp.com/DocCounter.aspx?did=728
[71] https://focusonenergy.com/sites/default/files/inline-files/2020_Custom_Incentive_Guide_FINAL_0.pdf
[72]https://www.xcelenergy.com/programs_and_rebates/business_programs_and_rebates/equipment_rebates/custom_efficiency
[73] https://www.comed.com/WaysToSave/ForYourBusiness/Pages/FactSheets/ImprovingYourITRoom.aspx

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equipment that can be applicable to data centers, ComEd does not link to or otherwise inform customers about this option on the "IT Rooms" web page. ComEd should consider endorsing standard incentives for this equipment to offer customers more flexibility to pursue simple upgrade projects.

ComEd provides educational materials to help clients identify energy efficiency options that meet their needs, such as specific cooling solutions and facility upgrades. ComEd presents information on costs, energy savings, cost savings, and payback period, illustrated through case studies. In addition to online resources, ComEd offers free targeted assessments: in-person walkthroughs by ComEd energy engineers who help customers to identify energy saving opportunities.[74] ComEd offers a generalizable "facility assessment" which can be applied to smaller data centers (defined as ≥ 100 kW) and a more involved "data center assessment" which includes a walkthrough and computer modeling (ASHRAE level 2 audit) for larger data centers (defined as ≥150 kW).

Plug Load Devices in Data Centers

As HVAC systems become more efficient, an increasing percentage of remaining energy waste is attributed to plug load devices, such as servers, data storage equipment, and other IT equipment. DOE reported that the IT devices in large data centers require more than 100 MW of power capacity which is enough to power 80,000 residential homes (U.S. Energy Information Administration, 2020b). The energy consumption of all IT equipment is expected to rise (Masanet & Lei, 2020). In particular, energy use by servers is expected to increase as the demand for data center services grows. Between 2010-2018, the applications hosted on servers increased six-fold (Masanet & Lei, 2020). This indicates that in data centers where cooling measures and other traditional end uses are efficient, plug load devices can still offer significant opportunities for energy savings.

Data center use modeling is difficult given the extraordinary evolution of digital services (Shehabi, Smith, Masanet, & Koomey, 2018), but trends in the past two decades highlight specific high energy consuming plug loads. An assessment done on electricity consumption in data centers found that computer equipment and servers are responsible for 38-63% of total energy in the building and is mediated by the systems air handler system (Andrae & Edler, 2015; Southern California Edison, 2017). One analysis showed that communication technology (e.g., servers, computer, network equipment) could account for as much of 51% of global electricity in 2030 if energy efficiency initiatives are not adopted (Andrae & Edler, 2015). Moreover, IT equipment, specifically servers and data storage devices, are estimated to account for at least 50% of the energy consumption in the average data center (Southern California Edison, 2016b). The energy consumption of midrange and high-end servers, which are typically found in embedded data centers, has been steadily increasing since 2006 (Shehabi et al., 2016). Midrange servers were estimated to consume approximately 890 W in 2014 and projected to double to 1880 W by 2020 with linear growth (Shehabi et al., 2018). However, ENERGY STAR servers are estimated to result in $240-$480 in energy savings over the course of the server life (4 years) (ENERGY STAR, 2020j).

A significant amount of energy use consumed by data centers is attributed to hard disk drives where data is stored, which typically constitute about 10% of system power and

[74] https://www.comed.com/WaysToSave/ForYourBusiness/Pages/AssessmentTypes.aspx

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consume about 8.6 W/disk (Shehabi et al., 2016). In addition, UPS device utilization has been shown to significantly increase energy efficiency (Southern California Edison, 2017). In fact, an ENERGY STAR rated UPS device can reduce energy losses by 30-55% (ENERGY STAR, 2020j). Despite positively trending energy consumption, energy usage by data centers can significantly be reduced if best practices are established (Shehabi et al., 2018).

Although a wide range of custom incentives are available, ComEd does not offer standard incentives for any high energy consuming plug loads. ComEd does not explicitly specify that servers, data storage equipment, and UPS devices are included in the custom incentives program, but the flexibility of the program suggests that these devices are eligible for incentives. ComEd also does not specify that any plug load equipment purchased as part of the custom incentives project must be ENERGY STAR certified. CalPlug will focus on the following plug loads as prime areas for standard incentive recommendations and energy conservation initiatives:

- Servers
- Data storage equipment
- UPS devices

Adding Standard Incentives to the Custom Data Center Program

ComEd's data center program could benefit from adding standard incentives for ENERGY STAR-certified plug load equipment. ENERGY STAR certifies a range of relevant energy-efficient IT equipment (ENERGY STAR, 2020b) which can be added to the list of equipment eligible for standard incentives. The high consuming plug loads that have this certification include servers, data storage (e.g., hard disk drives and solid-state drives), and UPSs. Replacing conventional equipment with ENERGY STAR versions has been shown to have significant impact on energy consumption. Specifically, servers with power supplies that meet the minimum recommendations by ENERGY STAR are 30% more efficient than other servers on average (Bruschi, Rumsey, Anliker, Chu, & Gregson, 2011). Replacing hard disk drives (HDDs) with more efficient ENERGY STAR options results in lower energy usage and annual energy cost savings (ENERGY STAR, 2020h). One estimate noted that annual energy use of ENERGY STAR-certified HDDs was 379 kWh compared to the less efficient option which used 648 kWh (Office of Energy Efficiency & Renewable Energy, 2020b). This change also resulted in an estimated annual savings of $23, assuming that the device was priced no more than $89 above the less efficient model (Office of Energy Efficiency & Renewable Energy, 2020b). These statistics suggest the saving potential for these devices, and an opportunity to simplify the process by incentivizing such plug loads through standard incentives.

CalPlug examined reports on best practices in small embedded data centers prepared for ComEd (Slipstream, 2019) as well as for two comparison utilities, Focus on Energy (all Wisconsin utilities including We Energies) (Shen & Plum, 2018) and PG&E (Cheung, Greenberg, Mahdavi, Brown, & Tschudi, 2013). All three endorsed the use of standard incentives for one or more of the ENERGY STAR-certified devices discussed here. Furthermore, all three reports recommended that ENERGY STAR equipment be purchased and installed whenever possible because it was a relatively cost-effective solution that significantly reduced energy consumption. In addition to specifically recommending

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replacing servers, the analysis of We Energies and the analysis of ComEd's data center programs highlighted purchasing ENERGY STAR-certified UPS devices because it generated a more efficient UPS efficiency curve and resulted in greater efficiency (75-80% utilization is optimal usage)(Shen & Plum, 2018). In the analysis of ComEd, average savings per small embedded data center (SEDC) were estimated to be the following: 270 kWh/SEDC for data storage, 70 kWh/SEDC for UPS, and 1236 kWh/SEDC for servers. The analysis of WE concluded that there was low market penetration of ENERGY STAR devices and noted that purchasing this equipment was company policy for only 15% of respondents surveyed (Shen & Plum, 2018); thus, incentivizing these devices is important for a greater presence in the market. These reports encouraged utilities to focus on providing standard incentives for ENERGY STAR UPS devices, data storage equipment and servers while considering midstream avenues.

As shown in Table 13, this movement toward promoting ENERGY STAR-certified data center equipment in energy incentives programs has been embraced by multiple utilities with We Energies and Georgia Power's experiences demonstrating promising results by generating significant energy savings.

In terms of screening for potential customers to take advantage of these standard incentives, the analysis for We Energies emphasized that data centers with good potential energy savings included those in which the age of equipment was >5 years (servers specifically have a five-year useful life) because these were considered to be prime opportunities to introduce ENERGY STAR equipment (Shen & Plum, 2018). The same report indicated that data centers in which UPS utilization was <40% were also considered to have good energy saving potential.

CalPlug recommends that ComEd:

- Promote standard incentives for HVAC and lighting by linking the standard incentive catalog webpage with the data center program web page to make simpler options available to customers
- Add standard incentives for ENERGY STAR qualified servers, data storage equipment and UPS devices to its "IT Room" data center program.
- Target customers who are most likely to benefit from these standard incentives (e.g., end of life equipment or low levels of UPS utilization).
- Consider requiring data center equipment purchased as part of a custom incentive project to be ENERGY STAR certified to qualify for incentives.

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Table 13. Utilities Emphasizing the Importance of ENERGY STAR Plug Loads

Utility	Standard Incentives for ENERGY STAR Data Center Equipment	Established Parameters in Custom Program or Standard Program	Endorse Upgrading to ENERGY STAR Servers, UPSs and/or HDDs in Factsheets and/or website	Notes: Highlights of Plug Load Devices
ConEd[75]		✓	✓	Requires all new servers to be ENERGY STAR certified UPS units must be upgraded to ENERGY STAR models with high efficiency ratings Peak load savings should be a least 5kW to qualify for custom incentives
FPL[76]			✓	Servers, UPSs, HDDs Upgrading inefficient IT equipment is the first step
Georgia Power[77]	✓	✓	✓	$100 incentive for high-efficiency ENERGY STAR servers
SMUD[78]			✓	High consuming plug load equipment (e.g., servers and HDDs)
SCE [79]			✓	Servers and HDDs
We Energies[80]	✓	✓	✓	Standard Incentives for UPS at ≥94% efficiency The cost difference is $2000/kW, annual energy savings is $280 kW, and premium payback period is 6.1 years

[75] https://www.coned.com/-/media/files/coned/documents/save-energy-money/rebates-incentives-tax-credits/rebates-incentives-tax-credits-for-commercial-industrial-buildings-customers/commercial-and-industrial-program/data-center-equipment.pdf
[76] https://fpl.bizenergyadvisor.com/article/data-centers
[77] https://www.georgiapower.com/content/dam/georgia-power/pdfs/business-pdfs/Business%20Equipment.pdf
[78] https://www.etcc-ca.com/sites/default/files/field/eventfile/etcc_quarterly_meeting_q4_2016_final_slide_deck.pdf
[79] https://www.sce.com/business/ems/data-center
[80] https://www.focusonenergy.com/sites/default/files/inline-files/2020_Catalog-Process_Systems_Supp_Data_Sheet.pdf

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Other Energy Reduction Strategies for Plug Load Devices in Data Centers

Server virtualization is another energy reduction strategy to consider. Server virtualization provides an avenue to consolidate underutilized servers by allowing one physical server to act as multiple virtual machines which run independent operation systems, applications and system resources as opposed to assigning individual physical servers for each application (Ganeshalingam et al., 2017; Whitney & Delforge, 2014). One report estimated that 50% of data centers with 10 or more servers in the Commercial Building Energy Consumption Survey CBECS would be able to reach a virtualization ratio of 5 to 1 (5 virtual server environments to one hardware) (Bennett & Delforge, 2012). Using this assumption, another report estimated that these data centers would then save 3.8 billion kWh annually which corresponds to 2 million metric tons of CO2 emissions (Ganeshalingam et al., 2017).

Utilities explicitly endorsing consolidation and/or virtualization of servers include Energy Trust OR, ConEd, SCE, Ameren and FPL. In a case study by the Energy Trust OR, virtualization resulted in $10,000 energy savings and 150% more in computational power. ENERGY STAR and reports outlining best practices have also promoted server virtualization and include savings, costs, and other considerations for adopting server virtualization (ENERGY STAR, 2020l). One specific consideration involved the poor uptake of this practice in small data centers (ENERGY STAR, 2020l; Ganeshalingam et al., 2017; Whitney & Delforge, 2014). Currently, ComEd does not incentivize this strategy based on direction from an evaluation team, who were concerned with the risk of free ridership (Slipstream, 2019). Due to the conflicting results of multiple evaluations, CalPlug will not recommend adopting this approach at this time. However, given the endorsement of this policy by other utilities, it would be prudent to re-evaluate potential gains in the future.

The following techniques that largely impact the energy efficiency of high energy consuming plug loads within data centers can be explicitly incentivized.

Improved Management of Servers

ComEd should consider reducing the energy footprint of servers by explicitly promoting improved management of servers (specifically reducing unused servers) through its custom incentives program and consider formulating a standard incentive option. "Improved management" refers to scenarios which include non-technical energy-efficient changes that require minimal fiscal investment (Shehabi et al., 2016). In relation to servers, this involves removing or unplugging “comatose” or “zombie” servers, which are powered on but are not being used for information or computing services, and using standardized data metrics to evaluate data usage and identify opportunities for potential energy savings (e.g., PUE and DCiM) (Ayanoglu, 2019; Better Buildings, 2017b; Shehabi et al., 2016). This section focuses on the unplugging aspect of improved management. The wide range of measures addressed by ComEd's current custom incentive program suggests that improved management strategies (including unplugging unused servers) is eligible for custom incentives. However, this strategy is not highlighted in the suggested opportunities to get started (along with cooling and UPS devices) or in the case studies on the ComEd website.

Research suggests that unplugging unused servers results in significant energy and fiscal savings. Previous studies have estimated that 10-30% of all servers are comatose (i.e., inactive), indicating a significant opportunity to save energy (Better Buildings, 2017b;

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Koomey & Taylor, 2015; Uptime Institute, 2020). It is estimated that removing one 1U rack server can annually save $500 in energy, $500 in operating system licenses, and $1,500 in hardware maintenance costs (ENERGY STAR, 2020g). One report used modeling techniques to predict that 2.5% of energy savings in data centers during 2020 would be due to removing inactive servers (Shehabi et al., 2016). In a 2012 case study, the global financial organization Barclays decommissioned 5,515 obsolete servers, generating power savings of approximately 3 megawatts, $3.4 million in annualized energy savings, and a further $800K savings in hardware maintenance (Uptime Institute, 2014). Eliminating comatose servers requires no new investments and is a cost-effective practice. Therefore, explicitly promoting and incentivizing this type of strategy as a first step is important to generate significant energy savings.

Utilities specifically encouraging removing unused servers include ConEd, SCE and FPL. See Table 14 for the specifics of these programs and how they are conveyed.

Table 14. Utilities Endorsing Unplugging Comatose Servers as Part of Their Custom Program

Utility	Website	Factsheet	Notes: Highlights of Requirements & Information
ConEd[81]	✓		Peak load savings should be a least 5kW to qualify for custom incentives
SCE[82]		✓	Unplugging: maximizes server utilization and increases computational efficiency
FPL[83]		✓	It is important to assess which servers need to be powered on to meet demands It is important to maximize server utilization/potential

Alternate approaches build on this development and encourage the use of standard incentives for removing servers. In an attempt to streamline and encourage decommissioning of servers, analysts have developed best practices for creating standard incentive programs for server consolidation (Shen & Plum, 2018). This involves offering an incentive for fewer physical servers and the removal of unneeded servers. It includes setting parameters for the program such as limiting project size or customer class (e.g., only applicable to small scale data centers), a description of which centers are eligible (e.g., servers in which utilization rates are below 10%), measure cost (e.g., the study approximated $2000 per server removed, including software license and servers and assuming new servers), measure life (> 5 years), and net-to-gross ratio (Shen & Plum, 2018).

[81] https://www.coned.com/-/media/files/coned/documents/save-energy-money/rebates-incentives-tax-credits/rebates-incentives-tax-credits-for-commercial-industrial-buildings-customers/commercial-and-industrial-program/data-center-equipment.pdf
[82] https://www.sce.com/sites/default/files/custom-files/pdf/5115_SCE_CenturyLink_FactSheet_20160824_AA.pdf
[83] https://fpl.bizenergyadvisor.com/article/data-centers

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Alternative Hard Disk Drive Replacement Options

As data centers expand, so does the need for increased data storage capacity. ComEd can increase energy efficiency by explicitly endorsing two HDD replacement options in their custom incentives program: replacing HDDs with solid state drives (SSDs) and introducing "massive array of idle disks" technology to limit HDD spin. Using a 2015 ASHRAE report and a New York State Energy Research and Development Authority report, Shehabi and colleagues (2016) estimated that energy consumption for HDDs was 8.6 W/disk while SSDs wattage is estimated to be constant at 6.5 W/drive (American Society of Heating Refrigerating and Air-Conditioning Engineers, 2015; Huang, Bard, Fisher, Masanet, & Bramfitt, 2015; Shehabi et al., 2016). Replacing HDDs with SSDs is beneficial because although SSDs store less data, they consume less energy than HDDs (Shehabi et al., 2016), have faster read/write times, generate less heat, and are more durable (American Society of Heating Refrigerating and Air-Conditioning Engineers, 2015; Better Buildings, 2017b; Kadve, 2016). HDDs are still useful because they have the capacity to store larger amounts of data (10TB/disk) than SSDs (5TB/disk) and are significantly less expensive than SSDs (Shehabi et al., 2016). However, introducing SSDs whenever possible is generally good practice, especially as these storage drives are expected to increase 3x-4x in their ability to store data/watt (Shehabi et al., 2016). HDDs must constantly spin in order for users to retrieve information, constantly using energy even when unused. A technology called "massive array of idle disks" (MAID) can mediate the excess energy consumption of unused disks. MAID conserves energy by shutting down unused disks which contain information that is infrequently accessed. The system will power the disks again if and when an application requires access to the data stored on the hard disk drive (ENERGY STAR, 2020a). MAID technology allows only those disks that are active to be spinning while the rest are idle (ENERGY STAR, 2020h; Office of Energy Efficiency & Renewable Energy, 2020b). Introducing MAID technology can save nearly 99% of energy consumed by HDDs (Florida Power and Light, 2020). Best practice guidelines suggest calculating average energy savings based on removal of disks, disk replacement (with SSDs) and/or offering a fixed incentive for introduction of MAID.

FPL endorses both of these alternative interventions.[84] Through their custom incentives program, FPL explicitly encourages customers to replace storage drives with more efficient SSDs when appropriate (e.g., when using less TB/disk is feasible or when the customer can afford the SSD option). This program also incentivizes customers to spin fewer hard drive disks by using MAID technology.

CalPlug recommends that ComEd:

- Consider explicitly endorsing server consolidation (specifically unplugging unused and underutilized servers), replacement of HDDs with SSDs, and introduction of MAID technology in their custom incentive program.

[84] https://fpl.bizenergyadvisor.com/article/data-centers

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Improving Education to Impact Usage

ComEd offers limited information on their website aimed at educating customers about optimal energy saving operations in data centers. IT staff in data centers can affect IT equipment in multiple ways. For example, IT staff's knowledge and application of internal or network power management settings can increase the efficiency of computer equipment, while ensuring optimal UPS utilization (percentages above 70%) can result in greater energy savings (Shen & Plum, 2018). IT staff can also affect the energy consumption of servers by unplugging unused servers and maximizing efficient server use (Shen & Plum, 2018).

Although IT staff directly impact energy consumption in data centers, IT staff often lack training to successfully implement energy efficiency measures (Cheung et al., 2013; Ganeshalingam et al., 2017; U.S. Department of Energy, 2019). One prominent barrier identified in improved management of servers is lack of access to energy data and lack of training on interpreting data (Shen & Plum, 2018). Research shows that many IT managers are unaware of the abundance of unused or underutilized servers (Cheung et al., 2013; ENERGY STAR, 2020g). IT staff are generally focused on managing servers to ensure optimal performance; unused servers are often overlooked as they are not considered an urgent priority (ENERGY STAR, 2020g). At times, IT staff may be hesitant to turn off servers because they are concerned about honoring Service Level Agreements, and deliberately keep extra servers running in the background in case there is an increase in server demand.

Utilities such as SCE and FPL offer online information for customers to access best practices and learn more about how to train IT staff to manage equipment most efficiently (Southern California Edison, 2020). These are presented in the form of fact sheets and involve information on how to use different techniques to manage the use of IT equipment according to need, the introduction of innovative measures, and information on methods to use metrics to calculate the energy savings using standardized measures.[85] Although this is limited to online access and does not extend to in-person training, this information is easily accessible and is user-friendly. Customers can use these resources to train themselves and to train IT staff, in the process communicating that saving energy should be an objective.

Reports focusing on best practice advise that utilities should consider providing programmatic education to IT staff through webinars (Better Buildings, 2017b). These efforts should focus on presenting material that illustrate measures to improve data center performance and energy use, demonstrate the intricacies of each measure, and identify options for future efficiency measures. As part of an effort to inform IT staff of future efficiency options, utilities can educate organizations on methods for assessing how energy is wasted in their facility, and how to address problems. Moreover, utilities should help data centers establish inventory systems to keep track of unused servers and have strategies for server use and disposal (Cheung et al., 2013; ENERGY STAR, 2020g; Shen & Plum, 2018).

Expanding the utility's network can enhance the robustness of their assistance program. Utilities can benefit from partnering with organizations such the Federal Energy

[85] https://fpl.bizenergyadvisor.com/article/data-centers

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Management Program and the Center of Expertise for Energy Efficiency in Data Centers, which are government organizations that offer webinars and trainings covering best practices and resources for data centers (U.S. Department of Energy, 2019). For instance, the "Data Center Energy Practitioner Training" program certifies utility staff to evaluate efficiency opportunities in data centers.[86] Moreover, specialized workshops help utilities target other pitfalls when providing education and services to IT staff. In addition, various webinars are available that communicate the best practices in data centers. One webinar that targets plug loads is, "Data Center Energy Efficiency: IT Equipment and Software Efficiency," which focuses on energy management and IT equipment, such as opportunities to increase server energy efficiency, and consolidation best practices.[87] Ensuring that utility advisors have optimal training and are knowledgeable of best practices can assist in establishing and training opportunities for IT staff in data centers. As advisor training is an internal matter, it is difficult to determine whether and how other utilities are leveraging such resources, so comparisons cannot be made.

CalPlug recommends that ComEd:

- Expand the general education offered online to include specific data center energy efficiency strategies. This includes:
    - Educate IT staff on technical strategies (e.g., power management, UPS utilization, server consolidation, using standardized metrics)
    - Consider partnering with government agencies to enhance the training of utility advisors and ensure that these personnel is equipped to identify energy efficiency options and promote best practices

Financing Options

Although the energy saving opportunities for small embedded data centers are significant, these facilities often struggle to finance larger energy efficiency projects. Data centers are costly to operate because of the need for expensive IT and cooling equipment which must be running constantly (Shehabi et al., 2016). Larger data centers have the economic capital to afford large upfront costs and can wait to recoup the spending through energy savings. However, small data centers have difficulty addressing energy inefficiencies because limited resources only permit implementation of smaller measures which result in minimal energy savings (Center of Expertise for Energy Efficiency in Data Centers, 2020; Ganeshalingam et al., 2017). Nevertheless, small data centers are prime targets for energy efficiency measures because they are often unfamiliar with energy saving best practices for IT systems (Ganeshalingam et al., 2017; Shehabi et al., 2016).

Financing offered through utility programs can help small data centers invest in more expensive energy efficiency measures. Utilities that offer on-bill financing with no interest or low interest include Eversource CT, BGE, National Grid, SCE, SDG&E, and PG&E. Best practice reports suggest that distributing the cost of upgrades over a longer period of time will increase affordability and encourage small businesses, such as small data centers, to participate in energy efficiency programs despite operating on low profit margins (Meath, Linnenluecke, & Griffiths, 2016; Nowak, 2016).

[86] https://datacenters.lbl.gov/training
[87] https://fpl.bizenergyadvisor.com/article/data-centers

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CalPlug recommends that ComEd:

- Assists small data centers in implementing energy efficiency measures by providing low- or no-interest financing

Small Business Program

The vast majority of ComEd's commercial accounts (95%) are in ComEd's "small commercial" delivery classes (up to 100 kW peak demand) and thus qualify for small businesses offerings (ComEd, 2020a). ComEd's small business program shares many features with similar programs offered by other utilities. ComEd's program is already recognized as a category leader, particularly for its direct install lighting solutions (Nowak, 2016). The program is also well developed for improving HVAC equipment and systems, and refrigeration optimization.[88] However CalPlug has identified opportunities for improvement regarding its inclusion of plug load devices.

ComEd offers parallel small business programs for private companies and for public facilities; these are marketed and evaluated separately, but appear to offer all the same incentives and resources. Program participation begins with a free in-person facility assessment conducted by a ComEd-approved Energy Efficiency Service Provider. The service provider installs no-cost direct install measures, such as showerheads, bathroom and kitchen faucet aerators, Tier 1 APS, and vending misers (Guidehouse, 2020e). The assessment results in a comprehensive report including specific recommendations for EE measures and projects. Customers then choose which projects they wish to pursue, and the service provider offers full installation services. ComEd estimates that up to 75% of the cost of recommended projects are covered through incentives. Most of these projects are for HVAC and lighting; the only types of upgrades related to plug loads are for refrigeration controls [89]. Assessment paired with direct install offers robust opportunities to effectively integrate plug load control strategies into energy efficiency efforts. Depending on the types, locations, and usage patterns of their equipment, some businesses will benefit more from load-sensing Tier 1 APS devices, while others will benefit more from timer-based APS devices, Tier 2 APS devices, or occupancy sensors. CalPlug recommends adding the full range of Tier 1 and Tier 2 APS devices and occupancy sensors to the direct install program, and tailoring these measures to customer needs.

ComEd also offers free small business kits that can be requested by qualified customers. The kits are segmented according to business type (e.g., office, restaurant, retail) and include Tier 1 APS devices, lighting measures for small offices, and faucet aerators and pre-rinse spray valves for food service customers (Guidehouse, 2020f). As of 2020, smart plugs are also now included in the kits (ComEd, 2020b). This program allows an easy first step to engage customers, and provides an introduction into further EE programs. However, the gesture could potentially backfire if customers do not end up using the free devices. CalPlug recommends exploring additional types of business kit combinations that vary the type of plug load control device(s) included, and offering clear information about how to use the device.

[88] https://www.comed.com/WaysToSave/ForYourBusiness/Pages/SmallBusiness.aspx
[89] https://www.comed.com/WaysToSave/ForYourBusiness/Pages/SmallBusiness.aspx

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Best Practices

There are several ways that utilities can increase program participation for small business customers. For example, expanding financing options and providing specialized services to individual market segments can help to reach new participants. For plug load devices in particular, focusing on small offices may offer significant benefits.

Financing

Time and money constraints are common issues for smaller businesses. Companies that must focus on short term return on investment to stay in business are unlikely to highly prioritize energy efficiency (Meath et al., 2016). Small businesses often lack the cash flow for heavy upfront investments in their building infrastructure and equipment, even if those investments will save money over time (Meath et al., 2016). Constrained finances also limit the ability of small businesses to hire dedicated personnel for energy management, and time pressures may impede business owners from researching energy savings opportunities. Compared to large businesses, these businesses tend to be less knowledgeable about and less able to implement IT integrated solutions to energy savings, such as constructing teleconferencing networks or e-commerce platforms (Taylor & Murphy, 2004).

Offering financing is thus a promising way to increase small business participation in EE programs. Many utilities offer on-bill financing with no interest or low interest to help small businesses pay for energy efficiency upgrades, including Eversource, BGE, National Grid, SCE, SDG&E, and PG&E. This measure is also widely supported by industry best practice reports (Meath et al., 2016; Nowak, 2016): as small businesses often operate on very low profit margins, spreading the cost of upgrades over a longer period of time can encourage these companies to invest in energy-efficient equipment and building improvements that they otherwise could not afford. ComEd does not offer a financing option for small businesses; doing so would help its customers make larger energy efficiency investments.

Small Offices

Addressing plug loads in offices is especially important. Offices use a wide range of plug load products, such as computers, monitors, projectors, shredders, TV screens, printers, and multifunction devices (combining printing, scanning, and copying). Research shows that such devices cumulatively waste considerable energy by being left on when not used, especially overnight and on weekends (Moorefield et al., 2011). Yet most office occupants appear unaware of how much energy could easily be saved by simple control strategies (see the section "Plug Load Control Systems"). Energy Trust OR offers a program specifically targeted at small offices that provides measures for lighting, lighting controls, APS devices, power management software, and data server measures such as UPS and mini-split air conditioning units for server closets. Energy Trust OR also offers this program on a tiered scale, offering greater incentives for more complex and integrated projects.[90]

[90] https://www.energytrust.org/wp-content/uploads/2016/10/NBE_TL_SOWorkbook.pdf

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ComEd's website does have a page geared toward small office customers.[91] However, the page makes only a few suggestions about saving energy[92] and then invites customers to call to request a facility assessment. While it is helpful to offer full service for small business upgrades, not all businesses will want or be able to engage these services right away. Calling and setting up a two-hour assessment is a fairly involved process; customers may need more encouragement and information about how they would benefit before committing to it. To this end, ComEd could add informational materials and links to fact sheets about savings options, including plug load products and how they can be managed to save energy (see also the section on "Plug Load Education and Training"). Including information on simple, do-it-yourself ways for office customers to reduce energy can serve as an intermediary step bringing greater awareness about energy waste. Customers would also gain insights into how a facility assessment by an expert could be useful. For example, SCE has a "Guide for Offices" page that links to white papers published by the utility on plug load devices and lighting controls, as well as case studies on energy management systems put into practice in the utility's territory.[93] SDG&E features a page describing "6 Simple Steps to a More Efficient Office."[94] Lastly, National Grid offers a dedicated page for tips on how to maximize equipment efficiency and reduce energy usage, such as turning off devices or enabling sleep modes.[95]

Recommendations
To summarize, there are several ways that ComEd's small business program could be further developed to include plug load measures and to increase energy savings for those plug load devices.

CalPlug recommends that ComEd:

- Expand the offerings of the small business direct install program to include the full range of Tier 1 and Tier 2 APS devices and plug load occupancy sensors (where appropriate, based on assessment results).
- Explore additional types of business kit combinations that vary the type of plug load control device(s) included, and offer clear information about how to use the devices.
- Offer low or no interest financing options for small business customers.
- Add factsheets to the small business program website to promote plug load energy savings.

Plug Load Education and Training

Education and training are necessary to raise awareness of plug load energy consumption and to encourage effective solutions. Customer behavior is an important element in any EE program, as behavior encompasses whether customers consider, research, and purchase

[91] https://www.comed.com/WaysToSave/ForYourBusiness/Pages/SmallOffice.aspx
[92] The text reads, "Energy efficiency upgrades can reduce your operating costs and help improve your overall indoor environment. For example, you can reduce operating costs by replacing T12 lighting fixtures with high-performance T8s. You can also help improve the overall indoor environment with programmable thermostats that manage the temperature during both business and non-business hours. And with careful planning and the right ComEd Energy Efficiency Program incentives, you can maximize efficiency and ensure a reasonable return on your investment."
[93] https://www.sce.com/business/ems/Buildings
[94] https://www.sdge.com/businesses/savings-center/tools-energy-tips/office-efficiency
[95] https://www.nationalgridus.com/MA-Business/Energy-Saving-Tips/Office-Engagement-and-Equipment-Tips

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energy-efficient equipment. Equipment must be properly installed, particularly plug load control systems, and maintained in the correct configuration. For devices that offer energy-saving features, such as on-board power management, customers can choose to enable, disable, or otherwise alter those settings. Thus, variations in customer behavior continue to affect energy efficiency over time. The energy consumption of many plug load devices depends on the amount of active use and the extent to which power management features (manual or automatic) are used (Klopfer et al., 2019). Variance in user behavior can lead to discrepancies between the lab test results assuming idealized or average usage configurations and real-world outcomes, as even efficient devices can be used inefficiently. The effects on energy consumption of inefficient usage are even more exacerbated for non-energy-efficient devices.

Key behaviors that increase plug load energy consumption include:

- Disabling power management and other energy-saving settings
- Improper or ineffective installation of controlled devices into control systems such as APSs, smart plugs, or controlled outlets
- Post-installation changes to which devices are plugged into control systems
- Leaving devices on when they are not needed
- Keeping unnecessary and underutilized devices plugged in

By contrast, the opposite behaviors decrease energy consumption, such as using more aggressive timer or sleep settings and turning devices off when leaving a room.

This section highlights possibilities for educating and training EESPs, customers, end-users, and other stakeholders to address the potential of energy savings through correct usage of plug load devices and control equipment. This includes recommendations for targeted EE messages about plug loads on the website.

Customer Education

The detrimental behaviors listed above can be addressed with relatively simple no-cost/low-cost educational strategies. Providing customers with actionable advice on the website does not necessarily result in more efficient behavior and its effects are not easily quantifiable like other measures. However, it is an important prerequisite for taking steps towards more efficient behavior (Abrahamse, 2019) and it signals ComEd's holistic approach to energy savings. ComEd offers some energy saving tips on the website, but they are geared towards household energy use.[96] ComEd does not currently offer business customers any such tips page about saving energy with plug load devices or fact sheets about plug loads. About half of the comparison utilities offer plug load-related tips on the business portal of their websites, which helps bring attention to these issues (see Table 15).

[96] https://www.comed.com/WaysToSave/ForYourHome/Pages/EnergySavingTips.aspx

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Table 15. No-cost/Low-cost Tips about Plug Load Devices for Businesses

Utility	Title	Examples
Consumers Energy	Business Energy Efficiency Tips[97]	Unplug battery chargers when the batteries are fully charged. Plug electronic devices into an easy-to-reach power strip and turn it off when the devices are not in use. Use the energy saving feature or sleep mode on office equipment that is not in use, when it is available. Turn off office equipment at night.
Energy Trust OR	Tips to Save Energy and Money at Work[98]	Turn equipment off when leaving for the day, use an advanced power strip to shut down equipment when it's not in use, consolidate stand-alone office equipment to be shared by multiple users, look for ENERGY STAR-certified refrigerators and freezers
Georgia Power	Energy Tips for your Business[99]	Install vending machine controls; perform regular after-hours facility walk-throughs (identify energy waste, check settings on equipment, …), replace old vending machines with newer models, know the high cost of preheating cooking equipment, don't overlook ice machines (turn off, clean regularly)
National Grid	Operations and Maintenance Tips[100]	Take a walk through your facility, during the day and after hours. Make note of wasteful patterns and opportunities for saving energy.
	Office Engagement and Equipment Tips[101]	Turn off machines or put them in sleep mode when they're not in use, including computer monitors; unplug cords when not in use, or use an advanced power strip that can be turned off or that will turn off automatically
	Data Center and IT Tips[102]	E.g., make use of more efficient UPS units

(continued)

[97] https://www.consumersenergy.com/business/energy-efficiency/tips
[98] https://www.energytrust.org/about/explore-energy-trust/low-cost-and-no-cost-tips-to-save-energy-and-money/
[99] https://www.georgiapower.com/business/save-money-and-energy/save-money-and-energy-tips-ideas.html
[100] https://www.nationalgridus.com/MA-Business/Energy-Saving-Tips/Operations-Maintenance
[101] https://www.nationalgridus.com/MA-Business/Energy-Saving-Tips/Office-Engagement-and-Equipment-Tips
[102] https://www.nationalgridus.com/MA-Business/Energy-Saving-Tips/Tips-for-Data-Centers

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Table 15 (continued)

Utility	Title	Examples
PG&E	25 Money Saving Tips for Businesses (e-book)[103] Energy Reduction Strategies (large businesses)[104]	Turn off equipment when not in use; choose ENERGY STAR labeled office equipment For schools: turn off all non-essential office equipment and foodservice equipment that is not in use; turn off decorative features, such as fountains, lighting, and ambient audio-video displays
SDG&E	6 Simple Steps to a more efficient office[105]	Look for ENERGY STAR qualified products; turn off machines when they are not in use; unplug cell phone chargers when the chargers are not in use
SCE	Plug In To Greater Energy Savings: With Smart Plug Load Management[106]	Simple low- or no-cost steps to reduce plug load energy use: e.g., take advantage of low-power modes, use APS, switch off unused servers, replace desktops with laptops
We Energies (Focus on Energy)	Money Saving Tips for Business Customers[107] Booklet for energy savings in school and government facilities - Best practices for kitchen operation and technology[108]	No-cost strategy for equipment: enable power management settings on computers, printers and copiers and unplug electronic devices that are not being used. Low-cost strategy: use a smart power strip to eliminate phantom power drain Kitchen operation: Unplug coffee pots, toasters, and other appliances when not in use Technology: Educate building occupants on computer usage and power management; select ENERGY STAR rated equipment; utilize advanced power strips

Other utilities offer a brief explanation of plug load equipment and control technologies. For example, BGE offers a quick explanation about plug load equipment, explaining the

[103] http://image.em.pge.com/lib/fe8c13727666037a72/m/5/25_Money_Saving_Tips_eBook_FINAL.pdf?cid=ifra_SMB_RESOURCES_AND_TOOLS_25_moneysaving_tips_for_businesses&_ga=2.98190751.1485279966.1593280609-1129581056.1590878233

[104] https://www.pge.com/en_US/large-business/save-energy-and-money/energy-management-programs/energy-incentives/energy-reduction-strategies.page

[105] https://www.sdge.com/businesses/savings-center/tools-energy-tips/office-efficiency

[106] https://www.sce.com/sites/default/files/inline-files/Plug%2BLoad5_WCAG_0.pdf

[107] https://www.we-energies.com/business/money-saving-tips-business.htm

[108] https://www.focusonenergy.com/sites/default/files/inline-files/Energy%20Best%20Practices%20Guide-School%20%26%20Government%20Facilities.pdf

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rationale of offering incentives for smart power strips and other plug load measures.[109] Efficiency VT explains various measures, such as APS,[110] energy-efficient computers and monitors,[111] and data center efficiency.[112] Mass Save (Eversource MA, National Grid) addresses, among other things, the rationale of using vending machine misers.[113] The Business Energy Advisor library[114] (offered by FPL, Georgia Power, and We Energies) has explanations about plug load technologies and tips for a variety of business types. Appendix C shows various examples of how utilities present plug load-relevant tips and technologies. CalPlug recommends that ComEd considers issuing energy savings tips and fact sheets similar to the examples presented above and in the appendix. These materials should center around plug load energy consumption in commercial settings and be easily accessed in the business section of the website. The "Resource Center" page may be an adequate location for these materials, within or separated out from "Factsheets". The sheets can also refer back to ComEd's EE programs and incentives and how to get started.

One very effective educational EE approach that ComEd offers is the Business Energy Analyzer. This free interactive software tool allows customers to monitor and track their total energy use.[115] Customers can view their energy use compared to the previous year and to similar facilities and also have access to more detailed usage analyses (e.g., usage during off-hours). The software has a solutions page that shows customized strategies to reduce energy consumption and displays ComEd's EE program incentives. These strategies can target behavior, more efficient operations, or investments; they are organized by end use, such as lighting, ventilation, office equipment, and cooking. Recognizing that EE portfolio revisions can involve deleting as well as adding program elements, CalPlug recommends that this best-practice online tool continues to be offered to commercial customers.

ComEd offers free in-person facility assessments, as do most comparison utilities. Facility assessments are often a steppingstone towards more extensive EE projects, such as custom or retro-commissioning projects. However, facility assessments are also a good opportunity to encourage customers to reduce plug load energy consumption. ComEd's facility assessment program offers no-cost and low-cost measures to increase the operational efficiency of existing equipment at the site (Guidehouse, 2020a). In 2019, the program had 154 participants and 219 installed projects. Seven percent of the measures concerned plug loads (Guidehouse, 2020a). For the plug load measures, the EESPs implemented computer power controls in nine instances and advised turning off the TV in seven instances. Other plug load-related measures may have been taken but not reported by the energy engineer and there is no record about the educational content of the assessment. Even so, this reflects weak attention to plug load interventions, given that field test case studies focused on plug loads have located numerous energy-saving opportunities in every location (Lobato et al., 2011; Metzger et al., 2012). The few interventions reported in ComEd's facility

[109] https://www.bgesmartenergy.com/business/business-programs/energy-solutions-business/plug-load-equipment
[110] https://www.efficiencyvermont.com/products-technologies/electronics/advanced-power-strips
[111] https://www.efficiencyvermont.com/products-technologies/electronics/computers-monitors
[112] https://www.efficiencyvermont.com/products-technologies/industrial-special-equipment/data-center-it-equipment
[113] https://www.masssave.com/en/learn/business/vending-misers
[114] https://www.esource.com/BusinessEnergyAdvisor
[115] https://www.comed.com/WaysToSave/ForYourBusiness/Pages/FactSheets/BEAFlyer.aspx

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assessments reveal an opportunity to save energy by highlighting plug load measures more effectively in EESP training and protocols.

EESP Training

There is evidence that organizations that implement both technological and behavioral strategies for office plug loads observe a significant decrease in plug load and overall energy consumption and waste (Hackel et al., 2016; Lobato et al., 2011; Mercier & Moorefield, 2011; Sheppy et al., 2014; U.S. General Services Administration, 2014). These behavioral strategies need not depend on convincing users to change their daily habits, but on changing the plug load systems and settings so that users' normal behaviors are not as wasteful. A study conducted by NREL achieved an estimated 47% savings for plug and process loads in a low-energy building by employing rigorous and wide-spanning plug load reduction strategies (Lobato et al., 2011). Strategies in this study included replacing equipment with more efficient alternatives, most notably replacing and virtualizing servers, increasing the amount of multifunction devices, reducing the number of personal devices and instead sharing devices, exchanging desktops for laptops, encouraging occupants to monitor and ensure the functionality of standby mode on devices, and eliminating equipment with parasitic loads (Lobato et al., 2011).

The EESPs have a central role in communicating both technical and behavioral solutions to the customers. Hence, training the EESPs on plug load issues and solutions is paramount. CalPlug does not have access to the current EESP training materials. However, CalPlug would like to highlight some opportunities and refer to some best practice guidelines. EESP training (e.g., webinars) should include materials (guidelines, checklists) that help EESPs recognize and systematically solve plug load-related problems. NREL developed targeted guidelines to reduce plug and process load consumption in office buildings (Sheppy et al., 2013a) and retail buildings (Sheppy et al., 2013b). The ten-step process underscores the necessity of engaging building occupants in the process. The strategies include turning off equipment, removing under-used equipment (e.g., extra vending machines), consolidating equipment (e.g., using one full-size refrigerator instead of many individual mini-refrigerators), replacing old and inefficient equipment, and implementing adequate control strategies. NREL provides a workbook to guide a plug load walk-through with an inventory worksheet and a calculator that estimates the potential energy savings.[116] The U.S. General Services Administration (GSA) uses aspects of these guidelines as checklist to develop and implement a plug load reduction program in its facilities.[117] Better Buildings (2015a) issued another decision guide for plug and process load controls that is based on the various building types, such as education, hospitality, or office solution. NREL also offers a guide to selecting adequate control strategies for specific types of equipment (Lobato et al., 2012).

CalPlug recommends working with EESPs to systematically address plug load devices in walk-throughs, assessments, and efficiency recommendations. The guidelines mentioned above, along with other resources, could be updated to reflect the latest technological options, combined, and adapted to fit into ComEd's EESP programs, including training materials and on-site checklists and calculators. CalPlug also recommends that EESPs be trained to not only install energy-efficient equipment such as APS devices, but to

[116] http://www.nrel.gov/buildings/assets/docs/office_ppl_reduction_tool.xlsx
[117] https://www.gsa.gov/cdnstatic/PlugLoad_Checklist_Form_Fields_508.pdf

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demonstrate the installations and educate end-users about these systems to encourage continued use. Other ComEd programs that could offer enhanced educational opportunities about plug load energy consumption and control strategies are the "Retro-Commissioning" and "Strategic Energy Management" programs. In both programs. EESPs work closely with the customers for an extended period of time. Within these programs, EESPs can help educate building operators and occupants about various plug load management strategies, and implement no-cost and low-cost strategies, using the resources cited above as guidelines.

Stakeholder Buy-in

The complexity that surrounds plug loads is partially due to their decentralized nature. There is typically no single decision-maker involved that can affect the reduction of plug load energy consumption (Lobato et al., 2011). There may be different stakeholders involved in procuring, managing, and using plug load equipment, each with different priorities. The buy-in of all stakeholders is required to reduce energy consumption from plug loads. Any plug load reduction strategy that depends on user cooperation needs to ensure that these users receive the necessary training and ongoing technical support. The aim is to reduce deliberate or accidental dismantling of plug load control systems, such as office workers plugging devices into the wrong sockets in APS devices or maintenance workers unplugging smart plugs (Marsicek et al., 2019; Metzger et al., 2012). Another example is networked computer power management, which depends on the support of the IT department (Korn, Huang, Beavers, Bolioli, & Walker, 2004; Pollard, 2016). IT managers have to deal with competing priorities, primarily security and performance issues for the end-user; computer sleep can be a real or perceived performance problem, and without support for prioritizing energy efficiency, IT managers may solve the problem by disabling sleep settings rather than exploring other avenues.

EESPs should be trained to anticipate and address problems with end-user and stakeholder buy-in and practice engaging and motivating customers' employees at all levels. This may be important in many EE programs, but especially so for interventions with plug load devices and plug load control strategies, as they can be strongly impacted by user behavior.

Targeted EE Program Messages

Classifying categories of businesses helps to identify similar characteristics and tailor design strategies to customers' particular wants and needs. Furthermore, market segmenting reveals the variation in the equipment prioritized by different types of businesses. While office buildings can benefit from APS and computer power management software, small grocers and restaurants can save more energy with specialized refrigeration equipment (Nowak, 2016). On the website, ComEd markets programs to specific business types (e.g., restaurants, hotels, small office) and sectors.[118] For the public sector, ComEd tailors programs and markets them to specific entities: local, state, and federal government institutions, public schools, police and fire departments, colleges and universities, park districts, and libraries.[119] Organizing the website messages this way guides customers toward programs and incentives most relevant to their type of organization, increasing the site's appeal and ease of use. Several other utilities in the comparison group also offer

[118] https://www.comed.com/WaysToSave/ForYourBusiness/Pages/BusinessTypes.aspx
[119] https://www.comed.com/WaysToSave/ForYourBusiness/Pages/PublicSector.aspx

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dedicated portals or sites for public sector customers, including Focus on Energy, [120] Ameren,[121] and Eversource CT/energize CT.[122] CalPlug supports this practice of segmenting by business types and encourages it to be continued. However, ComEd may benefit by periodically revisiting the specific segments and comparing to the current customer base, to ensure effective messaging. For instance, CalPlug noticed that for "offices" the segmentation is unclear as there is only a link to "small office" in the business types section. Some businesses that would be helped by this page may not recognize themselves as belong to that segment. for instance, companies that are primarily something else (e.g., a restaurant, store, or dentist) but also use office equipment, or a company that considers itself a large office. CalPlug recommends adding a general "office" link. Within the various business types, ComEd could enhance the visibility of plug load issues and link to the respective technical solutions, tips, and incentives (see Customer Education above).

Website

A utility's website is a crucial form of communication to the customer. It should be as simple and intuitive to navigate as possible, so that customers can easily find what they need. In the course of this project, CalPlug engaged at length with ComEd's website, and repeatedly experienced difficulties finding certain pages, incentives, or factsheets, even those that had been successfully located many times before. In addition to the additions and clarifications to the website and specific web pages listed above, CalPlug recommends conducting a thorough usability assessment of the website user interface design.

CalPlug recommends that ComEd:

- Post information sheets about plug loads and plug load management (energy saving tips, information about available technologies) aimed at commercial customers, for instance within the resource center (within "factsheets" or separated out) and linked in segment web pages; where relevant, tips pages or info sheets should refer back to ComEd's programs and incentives
- Continue to offer best-practice online tools (such as the BEA or the ENERGY STAR Portfolio Manager) to commercial customers.
- Train EESPs to include plug load devices systematically in the facility assessments and EE project recommendations, including how to conduct hands-on demonstrations to teach customers how to enable computer power management settings or how to connect an APS device properly
- Include education materials and information about plug loads also in programs that include prolonged and personal customer interaction, such as "Retro-commissioning" and "Strategic Energy Management"
- Address potential engagement and buy-in problems among plug load device end-users within customers' companies in EESP training and guidelines.
- Continue to target specific business types and segments on the website, but add or rename a section for "offices" that are not "small offices"
- Enhance the visibility of plug load issues and link to the respective technical solutions, tips, and incentives

[120] https://focusonenergy.com/business/school-government
[121] https://amerenillinoissavings.com/for-my-business/explore-incentives/government-incentives
[122] https://www.energizect.com/your-town/find-a-solution

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- Conduct a usability assessment of its website user interface design

8.0 PROGRAM COMPARISON: FUTURE TRENDS

CalPlug has identified two areas of growing interest that ComEd has not yet incentivized: grid interactive efficient buildings (GEBs) and EV charging stations. These are both emerging issues of distributed resource generation that will be increasingly important in coming years as smart grid technology, transportation electrification, and renewable resources are more fully integrated into existing grid architecture. Other utilities are already beginning to experiment with pilot programs and full programs aimed at GEBs and EVs. This section outlines the current state of the technology and describes the types of program designs and incentives currently in deployment in the U.S.

Grid Interactive Efficient Buildings

Background

"Smart" buildings are an emerging target for EE programs, spurred in part by the growing need for flexible grid management to handle an increasingly dynamic distribution of energy resources. While definitions of this emerging technology are constantly evolving, the key feature is deploying building-wide energy management systems (EMS) that allow holistic internal control of multiple systems and enable dynamic external interactions with the energy grid. As a whole, these buildings are referred to as GEBs. GEBs often incorporate elements of zero net energy (ZNE) building construction projects, which aim for carbon neutral commercial offices and homes. ComEd does not currently offer any EE programs relating to GEBs, CalPlug recommends planning ahead for investment in smart building technology.

A diagram outlining the integrated systems of GEB elements and distributed resources is shown in Figure 10. As one part of such a complex system, plug load devices can be easily overlooked. However, plug loads can be an important part of EE and demand response (DR) strategies. In addition to energy efficiency criteria, ENERGY STAR qualified appliances must be able to accommodate load shift cycles (postponing operations) of up to four hours. Most ENERGY STAR appliances also require load shed capability (ability to tolerate power cuts), of 10-20 minutes. There are numerous ways that appliances, process drives, and other miscellaneous electric loads can contribute to smart buildings (Klopfer et al., 2020; Neukomm, Nubbe, & Fares, 2019),

- Smart appliances – Can be programmed to both shift and shed load in response to Automated Demand Response (ADR) commands
- Refrigeration – Systems have thermal ranges that can be temporarily expanded to accommodate load shift or shed
- VSD motors – Allow greater flexibility than single- or two-speed drives in order to adjust speed for load shed or load modulation
- Electronics – Solid state devices can be employed at different voltage settings for load shed and modulation
- Other plug loads and miscellaneous electric loads – Can be programmed to transition to low-power modes when not needed, and connected to sensors and connected control systems

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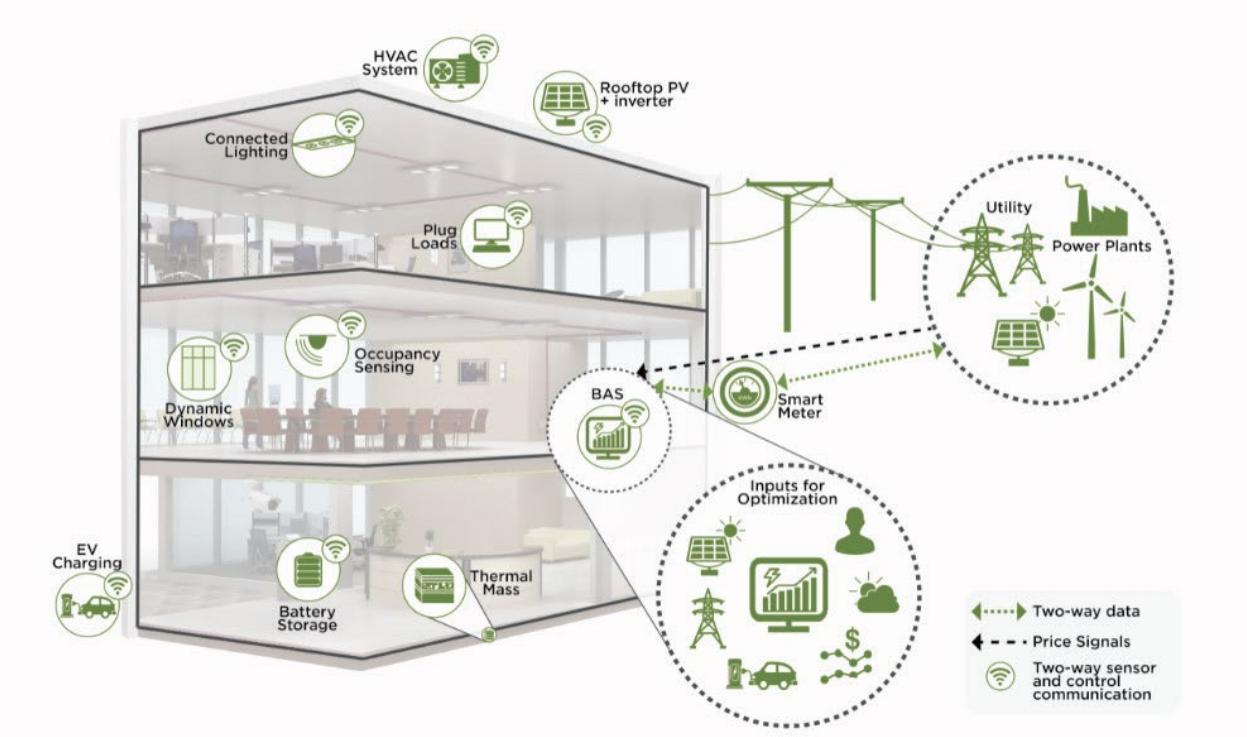

Source: Neukomm et al. (2019, page 2)

Figure 10. Diagram of Grid-interactive Building Elements

The ultimate goal of the GEB is to integrate energy efficiency, demand response, distributed generation sources, EVs, and energy storage measures into a holistic, synergistic system of energy management and savings. At the building level, a centralized management system should be able to prioritize between connected appliances as well as balance the demand of these devices with lighting and HVAC needs for optimal efficiency (Neukomm et al., 2019; Perry, Bastian, & York, 2019).

State of the Market

While many GEB technologies are promising, there are caveats specific to connected plug load products. CalPlug's research on residential smart connected appliances found that much of the energy savings of these new products comes from improved technology rather than from the connectivity features specifically (Klopfer et al., 2020). For the devices studied, connectivity potentially improved the user experience in other ways, but offered no direct mechanism for saving energy. For example, smart variable speed pool pumps save energy due to the efficient nature of pumps that can be slowed down during non-intensive regular pool sweeping activities. Similarly, smart washing machines are usually front-loading devices that save energy through reduced water heating requirements and reduced churning compared to traditional agitator designs. Most energy savings from smart device features are thus currently due to the notifications that customers receive regarding energy use feedback, energy saving tips, time-of-use warnings, and maintenance alerts. Studies have shown that these behavioral strategies save only 3-6% over baseline energy usage for the device (Sastry, Pratt, Srivastava, & Li, 2010).

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Another issue is that smart devices are designed with a range of benefits in mind, including added convenience and security, and are not necessarily optimized for energy efficiency: in fact, they may use more energy than they save. Smart appliances are unique in that they consume electricity not only directly, but also through computer processing mechanisms that interface with cloud and data center infrastructure. In 2018, data centers consumed about 205 TWh, or 1%, of global electricity use (Masanet & Lei, 2020). This overhead electricity consumption and resulting GHG emissions needs to be included in the lifecycle analysis when determining how much energy smart products save. While cloud processing energy consumption at the individual business level may be miniscule, it can add up and have major impact at the aggregate level of energy savings in a utility's service area.

For an integrated GEB system to function effectively, all the embedded devices and subsystems must seamlessly communicate with each other. Any problem with interoperability between connected devices from different manufacturers is a major impediment. Although some manufacturers are beginning to design their products to enable cross-functionality with other operating systems, this practice is not yet widespread. At the grid management level, lack of interoperability between utility protocols are a similar problem. Greater coordination between utilities and government entities will be needed to promote open ADR standards to enable grid interaction on city-wide, regional, and national scales (King & Perry, 2017).

Finally, for ADR signal response, plug loads pose a particular problem for user experience. HVAC, lighting, and some other types of building infrastructure can be automated without causing substantial discomfort for building occupants. For instance, air conditioning settings can be increased a few degrees without major impact on user experience. Most plug load devices, by contrast, cannot have their power cut or reduced without complete loss of functionality. End users expect devices like computers, projectors, copiers, and cash registers to function when needed, which limits opportunities for shifting or shedding loads. Appliances with washing cycles or cooking cycles face similar problems with stopping in the middle of a cycle, although load shifts could be planned in advanced if users are informed through feedback mechanism. Refrigerators and freezers must maintain certain temperatures for food safety. While current controls do offer some load shift opportunities for refrigeration, there is a physical limit to the kinds of DR actions that these devices can tolerate without sacrificing basic functionality (ENERGY STAR, 2018).

Current Program Offerings

GEB technology is still in its infancy, and GEB initiatives offered by other utilities currently exist as enhanced ADR programs. These programs incorporate EE measures into existing DR programs and use advanced metering infrastructure (AMI) technology to identify energy waste and suggest upgrades. For example, PG&E offers to install efficient equipment for large commercial customers if done in conjunction with enrollment in their ADR program.[123] The Real Time Energy Management program, offered by the New York State Energy Research and Development Authority, promotes a GEB prototype system that collects real-time AMI data from commercial, industrial, and multifamily buildings. Data analytics software performs assessments of the participating properties and generates

[123] https://www.pge.com/en_US/large-business/save-energy-and-money/energy-management-programs/demand-response-programs/automated-demand-response-incentives/automated-demand-response-incentives.page

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information on energy optimization opportunities for each site.[124] ConEd's "Brooklyn-Queens Demand Management" program takes a different approach. This program has shown early success in integrating microgrid infrastructures connecting buildings in the Queens and Brooklyn boroughs to generate demand-side power. Collectively, these measures relieve 52 MW of energy in these service areas from the centralized supply-side grid (Perry et al., 2019).[125]

Programs supporting ZNE construction also contribute to GEB development. As municipalities and regions increasingly enact decarbonization legislation, utilities will need to find ways to further incentivize energy savings at the whole building level. For example, California's Energy Efficiency Strategic Plan set the ambitious goal that by 2030, all new commercial construction will be ZNE and at least half of all existing commercial buildings will be retrofit to ZNE (ZNE Stakeholders, 2011). As ZNE construction typically includes renewables generation on site, as well as load controls and sensor mechanisms for hard-wired infrastructure, there is significant overlap between GEBs and programs aimed at ZNE. In California, the "Savings by Design" program[126] is a statewide offering encouraging ZNE building practices, administered through public and municipal utilities (specifically, Los Angeles Department of Water and Power, PG&E, SCE, SDG&E, SMUD, and SoCalGas). The program covers up to $150,000 of building costs for ZNE architectural design (determined as 10% better efficiency than the ZNE requirements outlined in Title 24 legislation). Additionally, the design team is eligible for up to $50,000 in incentives. Although most installed controls are for lighting and HVAC end uses, plug load related systems such as refrigeration, manufacturing, and food processing may also be incentivized. Energy Trust OR[127] and Xcel[128] also have notable programs supporting ZNE construction.

The Energy Trust OR's "Path to Net Zero Program" is for new buildings that meet identified energy use intensity targets (determined on a custom basis) and follow the energy-efficient design strategies included in the utility's online modeling program, "Zero Tool." The program pays up to 60% or $40,000 towards the cost of the initial energy analysis studies; at the end of the installation, the utility pays up to 50% of the energy usage based on metering (maximum $20,000). Solar panel infrastructure is incentivized at $35,000 if the panels are installed at the time of construction or $15,000 if installed onto solar-ready buildings.[129] Xcel's program provides energy savings consultation for new construction, providing customers with a personalized report recommending potential energy savings and which utility incentives the project could include. The business then hires an independent design team and contractors to construct the building. After construction, the utility representative conducts an audit to ensure that the energy-efficient

[124] https://www.nyserda.ny.gov/All-Programs/Programs/Real-Time-Energy-Management
[125] https://www.coned.com/en/business-partners/business-opportunities/brooklyn-queens-demand-management-demand-response-program
[126] https://www.savingsbydesign.com/start-here/incentives-assistance/
[127] https://www.energytrust.org/commercial/new-buildings-path-to-net-zero/
[128]https://www.xcelenergy.com/programs_and_rebates/business_programs_and_rebates/new_construction_and_whole_building/energy_efficient_buildings
[129] https://www.energytrust.org/commercial/new-buildings-path-to-net-zero/

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equipment installation plan was followed before delivering rebates on the installed measures.[130]

There is not yet an industry consensus on how to best integrate advanced controls in smart buildings and incentivize them in a comprehensive utility program. One method that showed promise in a DOE case study was including plug load control measures in combination with other controls and EE strategies, such as lighting measures, lighting controls, and smart thermostats, was likely more effective than installing plug load controls alone for reducing energy consumption (Better Buildings, 2017a). King and Perry (2017) likewise suggest that program designs are most cost effective when emerging advanced technology, such as smart plug load controls, are mixed into the existing set of standard incentives, and are installed concurrently with more established types of energy saving measures, such as LED retrofits. King and Perry also suggest incentivizing subscription services for EMS software that perform real-time analytics. As there are still very limited verified results for these strategies, CalPlug suggests that ComEd conduct research and feasibility studies with an eye toward including advanced plug load controls and EMS systems in smart buildings and integrating them with existing standard incentive measures.

Summary

There are many different approaches for ZNE construction, and GEB programs overall have not reached maturity. However, the evolving trends of grid interaction, sustainable and distributed resource generation, and increased requirements for internet connectivity infrastructure all suggest that GEBs should be further considered as an increasingly important aspect of utility incentive programs.

CalPlug recommends that ComEd:

- Conduct research on GEB technology
    - How to measure and verify savings of plug load controls in order to incentivize
    - How to measure and verify savings and effectiveness of smart controlled devices
    - How to leverage existing AMI and ADR systems to integrate with plug load controls and EMS systems in smart buildings
- Conduct feasibility studies for potential GEB-related programs in ComEd's territory
- Plan to integrate plug load reduction strategies into existing incentive measures for temperature and lighting controls in a comprehensive program design for GEBs

Electric Vehicle Charging Stations

Background

EVs are another emerging area of technology expected to trend upwards in coming years. While EVs are covered under transportation programs, EV chargers overlap between transportation and plug load devices, and thus represent an interest for CalPlug and for EE programs more generally. ComEd has a web page offering advice about EVs, including

[130] https://www.xcelenergy.com/programs_and_rebates/business_programs_and_rebates/new_construction_and_whole_building/energy_efficient_buildings

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information about EV options and explaining the process of installing EV charging stations.[131] However, ComEd does not currently incentivize EV chargers. CalPlug's research indicates that this area offers significant potential energy savings and program opportunities. Through 2025, the global market for EVs is expected to have a compound annual growth rate of 18.4% (MarketWatch, 2020b). With this added demand, cities and businesses will need to upgrade infrastructure to include more charging stations in parking lots, to accommodate the intermittent charging needs of EVs. This represents an opportunity for utilities to incentivize charging stations on commercial properties, both private and public. However, unlike EE programs for GEBs, which are still in a very early phase of development, utilities across the country have already converged onto a common program structure for EV charging stations. States that have higher market shares of EVs have generally led in utility program development. For example, in 2018, California had the highest market share of EVs, at 7.8% of total light vehicles sold in the state, whereas Illinois only had a market share of 1.2%. However, EVs are clearly a growing trend in Illinois, and the observed year-over-year increase between 2017 and 2018 was 93.5% (EVAdoption, 2020).

Program Structure

Over half of the comparison utilities encourage commercial customers who own or operate parking spaces to help expand infrastructure for EVs through EV charging station host programs (ConEd, Consumers Energy, Eversource MA, Georgia Power, National Grid, NYSEG, PG&E, SCE, SMUD, and Xcel Minnesota). This measure affects a wide range of commercial customers, including retail businesses, office buildings, universities, government buildings, and large multifamily residences. The customer initiates program participation by submitting an application. If accepted, the utility visits the property to conduct a consultation, assessing a suitable location for installation. The customer purchases the charger(s) from a vendor qualified by the utility. Note that for many utilities, such as Eversource MA and National Grid, the customer is responsible for the cost of the charging station and initial installation. After sending in proof of purchase, the utility takes on all infrastructure work to connect the charging station to the grid. The utility generally pays for 100% of the consultation and grid infrastructure requirements (e.g., laying new line). Utilities also provide coordination assistance to complete permitting paperwork and equipment inspections (for example, Eversource MA[132], SCE[133], National Grid[134]).

The program structures exhibit a few small differences across utilities. Eversource[135] only incentivizes Level II and Direct Current Fast Electric Vehicle Charging Stations, while SCE also incentivizes Level I stations.[136] Only SCE specifies a minimum scope, requiring at least ten charging stations to be installed on the site (or five stations if the site is located in

[131] https://www.comed.com/SmartEnergy/InnovationTechnology/Pages/ElectricVehiclesInfo.aspx

[132] https://www.eversource.com/content/ema-c/residential/save-money-energy/explore-alternatives/electric-vehicles/charging-stations/enrollment-process
[133] https://www.sce.com/sites/default/files/inline-files/4950_SCE_ChargeReadyFactSheet_20160412_1.pdf
[134] https://www.nationalgridus.com/media/pdfs/bus-ways-to-save/ee7170-evchargingfactsheet4pager_ma-ri.pdf
[135] https://www.eversource.com/content/ema-c/residential/save-money-energy/explore-alternatives/electric-vehicles/charging-stations/frequently-asked-questions
[136] https://www.sce.com/sites/default/files/inline-files/4950_SCE_ChargeReadyFactSheet_20160412_1.pdf

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an area designated by the utility as disadvantaged). SCE provides an additional rebate to defray the costs of the charging station and initial installation. Likewise, SMUD's commercial charging pilot currently offers a $1,500 incentive for each Level 2 station installed on the property,[137] and Consumers Energy offers up to $5,000 for Level 2 chargers and up to $70,000 for DC Fast Chargers installed in workplace parking lots or multifamily home parking areas. [138] PG&E also directly incentivizes chargers, offering 50% rebates for chargers as part of their EV fleet program.[139] Finally, Georgia Power offers discounted Level 2 stations in their online marketplace store. [140]

Summary

Based on prevailing trends in EV sales, the issue of EV chargers in commercial settings will grow in importance in ComEd territory in the near future.

CalPlug recommends that ComEd:

- Consider implementing an incentive program for EV chargers
- Research EV trends in Illinois and the Midwest region
- Research possible program design options:
    - Rebates on charging stations
    - Inclusion of discounted charging stations in online marketplace store
    - Free consultations
    - Free infrastructure installation for grid connection

9.0 CONCLUSION

Key Outcomes and Lessons Learned

ComEd has a mature EE program portfolio that has successfully helped customers save energy since 2008. Lighting measures currently generate about three quarters of the portfolio electricity net savings. As lighting and other major end uses such as HVAC become more efficient, while the number of plug load devices in buildings is increasing, plug load energy consumption is garnering attention as an emerging program category. ComEd has several measures in place to reduce energy use from appliances and devices. CalPlug assessed which other plug load devices and control systems could be added to ComEd's current standard incentives program and which existing measures should be modified. CalPlug also identified other ComEd programs that could benefit from greater emphasis on plug load devices and control strategies. CalPlug formulated its recommendations by comparing ComEd's programs to those of the comparison utilities and assessing them against best practices.

CalPlug found that ComEd has a very comprehensive overall program portfolio that incorporates many EE program best practices, such as tailoring programs according to the size, segment, and needs of the business. CalPlug identified several additional ways for ComEd to incentivize the transition to energy efficient equipment via standard incentives,

[137] https://www.smud.org/en/Going-Green/Electric-Vehicles/Business

[138] https://www.consumersenergy.com/residential/programs-and-services/electric-vehicles/level-2-charging-station-rebates

[139] https://www.pge.com/en_US/large-business/solar-and-vehicles/clean-vehicles/ev-fleet-program/ev-fleet-program.page

[140] https://georgiapowermarketplace.com/ev-chargers/

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midstream programs, direct install, and an online marketplace. Since plug load energy consumption also depends heavily on user behavior, CalPlug addresses technical and behavioral plug load control strategies, along with educational approaches, that can be added to ComEd's offerings.

Barriers

CalPlug has identified several key barriers to reducing plug load energy consumption through utility EE programs. These barriers broadly include plug load diversity, plug load functionality issues, behavioral barriers, and customers' financial concerns.

Plug Load Diversity

The wide range of plug load devices and the diversity of the commercial sector make it difficult to design programs that are effective for multiple types of businesses. Other types of EE programs apply very broadly, as every building needs lighting, HVAC, and envelope measures such as insulation and windows. But plug load devices--such as printers, ovens, cash registers, and clothes washers--are more specialized and thus have more limited application. As devices do not fit into every program type, utility programs need to take more care to correctly align each device with specific measures that fit the targeted customers.

Plug Load Functionality

Plug loads have unique operational characteristics that make them harder to target in EE programs than HVAC and lighting measures. Individual plug load devices do not use much energy, but the waste accumulates over large numbers of devices. Limited savings per device and relatively short product lives translate to low incentive amounts, which can be discouraging for utilities and customers.

Most plug load devices involve a close level of user involvement, and any perception that energy-efficient appliances translate to a lower quality user experience can be problematic. For instance, energy-efficient dryers and dishwashers have longer run cycles than traditional appliances. Particularly for devices operating in commercial settings, longer operation times can be a strong negative factor. This disadvantage must be outweighed, along with the higher cost, to persuade the customer to purchase energy-efficient options.

There are also special considerations for plug load products when integrated into GEB and ADR programs. Few plug load devices can have their power cut without complete loss of functionality. Users expect devices like computers, projectors, copiers, and cash registers to function whenever needed. Refrigerators and freezers also have physical limitations for load shift and shed without risking food spoilage. Smart connected solutions promise to link up webs of devices, sensors, and energy monitors, but this has not been realized yet. The connectivity features in smart connected devices and appliances do not necessarily save energy; worse, they require a concurrent overhead energy demand for cloud computing needs. Meanwhile, the behavioral strategies that connected devices do enable only save between 3-6% energy over baseline, which is similar to savings that can be achieved by purely behavioral interventions. Finally, interoperability problems--between smart connected devices at the building level and between utility protocols at the grid level--need further resolution before comprehensive GEB programs can achieve goals; GEB programs

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available in other utility service areas today are largely ADR programs with some integration of energy-efficient building controls and sensors.

Behavioral Barriers

For many plug loads, user behavior greatly impacts the device's ability to save energy. Factors such as selecting temperature and speed settings, load type, and load size greatly influence the ability of some appliances (such as heat pump dryers and dishwashers) to achieve the energy savings promised by the device. Other devices require users to pro-actively enable power management settings, or at least comply by not disabling default settings, to ensure that devices transition to standby mode when not used. Customers generally prioritize energy efficiency rather low in purchasing decisions, unless it is connected to saving money. It can be difficult to communicate and convince individual businesses about the importance of reducing plug load energy use at the aggregate building level. In the absence of clear measurement and feedback mechanisms, energy use is invisible in everyday life, and most people are unaware or misunderstand how much energy is used by personal devices in office spaces such as mini-fridges and desktop computers. Similarly, CFS customers and distributors are poorly informed on the energy-saving benefits of ENERGY STAR equipment. Even IT managers, who are experts about computers and data centers, may dismiss or overlook the energy use of these devices.

Changing behavior is generally approached by providing clear information about what to do and motivation about why to do it: in EE programs, this means improving educational resources and incentives. Although education about how to achieve plug load energy savings is universally needed for all business types, the kind of comprehensive training that is required is difficult to provide to each individual business due to the variability of businesses in the commercial sector.

Website interface has an important impact on customer engagement. This is especially important for promoting information on saving energy with plug load devices, as few customers are even aware of plug loads or plug load controls as device categories and are unlikely to be actively seeking them. Any lack of consistency or problems with navigating across website pages can confuse users and hinder program participation.

Financial Concerns

ENERGY STAR-certified equipment and other energy-efficient options can be much more expensive than alternatives, and researching which energy-efficient appliance might be cost-effective takes time. Money and time constraints are common barriers to major investments such as data center hardware and commercial food service equipment, especially for small businesses. Pressures on short term cash flow can prevent customers from investing in energy efficient upgrades, even if it would save money in the medium to long term. For example, low profit margins in the CFS industry lead to replacing equipment only on burnout, which can result in buying the least expensive option that is immediately available. In response, the suppliers and distributors who compete for their business tend to stock older models and refurbished equipment, which are less expensive but also less energy efficient. Similarly, heat pump dryers are considerably more expensive than conventional products, which may inhibit their uptake in commercial laundry facilities, multi-resident apartment buildings, and institutional settings such as hospitals, assisted

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living, and universities. In terms of power management strategies, Tier 2 APS devices cost more than Tier 1 APS devices, which may discourage businesses from using Tier 2 products, even when their facilities would be more suited to these more sophisticated devices.

Recommendations

CalPlug's recommendations are split into two sections: program-specific recommendations with tailored insight into particular program offerings, and general recommendations compiled based on themes that recur across multiple programs.

Program-Specific Recommendations

Standard Incentives

ComEd currently incentivizes the replacement or new acquisition of energy efficient commercial kitchen equipment and clothes washers. Moreover, ComEd also gives incentives for refurbishment kits for vending machines and for plug load control systems, in particular network desktop power management software, plug load occupancy sensors, and vending machine and cooler controls. CalPlug assessed ComEd's standard incentive program by comparing its offerings to the list of devices identified as potentially energy-savings, and whether and how those devices were addressed in the standard incentive programs of the comparison utilities. After assessing each device, CalPlug made the following types of recommendations:

1) Increase the standard incentive amount and/or use a range of standard incentive amounts, with larger incentives for higher-capacity, more expensive equipment
2) Extend the current residential standard incentive to commercial customers
3) Add new device to the commercial standard incentive program
4) Consider other strategies instead of adding a standard incentive

For some devices, ComEd suggested considering another strategy for reducing energy consumption, either instead of or in addition to the standard incentive. The recommendations are listed below.

Increase standard incentive amount or add a range of incentives. These recommendations are based on observing that other utilities generally offer higher standard incentives for the same device and/or offer a range of incentives, with higher rebates for larger, more expensive devices. As incentives that are too low are less effective at motivating customers to purchase energy-efficient equipment, CalPlug recommends conducing cost-effectiveness tests for these devices.

- Consider increasing the incentive amounts for:
    - Solid-door reach-in refrigerators
    - Glass-door reach-in refrigerators
    - Convection ovens
    - Combination ovens
    - Griddles
    - Commercial clothes washer

- Consider offering a range of incentives by size for:

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  - Solid-door reach-in refrigerators
  - Glass-door reach-in refrigerators
  - Solid-door reach-in freezers
  - Glass-door reach-in freezers
  - Hot food holding cabinets
  - Fryers

Extend existing residential standard incentive to commercial customers. The rationale for these recommendations is that these devices are used in nonresidential settings, and ComEd has already acknowledged the value in incentivizing them by offering standard incentives to residential customers. In particular, it is common for staff breakrooms to include residential-grade refrigerators. Residential clothes washers, by contrast, are likely only relevant to multifamily building owners.

- Dehumidifiers
- Residential refrigerators
- Residential clothes washers

Add new device to commercial standard incentive program. The rationale for these recommendations is that energy-saving alternatives exist for the device and at least some comparison utilities offer standard incentives for commercial customers. CalPlug believes these devices are all worth exploring; however, the type and weight of evidence varies for the five devices (listed below). For instance, room AC units show modest savings and are only incentivized by two comparison utilities. By contrast, ENERGY STAR-certified models of commercial dishwashers save considerable energy, and the majority of comparison utilities include them in their standard incentive programs. Wrap machines using "on demand" technology require substantially less energy than conventional types, and over-wrap models use even less than hand-wrap models; four comparison utilities incentivize one of these types of on-demand wrap machines. Similarly, heat pump and hybrid heat pump dryers represent a major efficiency gain over conventional electric dryers. However, penetration in the U.S. market is still low and only one comparison utility so far offers a standard incentive to promote this relatively new technology. Only residential heat pump dryers are currently sold in the U.S., but the largest of these (18 lb. capacity) is a common size for commercial use. Commercial-grade heat pump dryers are expected to enter the market in the near future. Finally, APS devices can be useful tools for controlling energy waste in a wide range of plug load devices. ComEd offers load-sensing Tier 1 APS devices through other programs, such as direct installs for small businesses, which is an excellent way of introducing commercial customers to the technology. CalPlug argues that offering standard incentives would encourage more customers to install APS controls throughout their offices and broader facilities, particularly if additional education and tips about plug load control strategies are highlighted on the EE website. Furthermore, CalPlug recommends expanding beyond the common load-sensing Tier 1 type APS devices to also include those based on occupancy sensors and timers, and to Tier 2 APS devices.

- Room air conditioning units
- Commercial dishwashers
- Wrap machine (for commercial kitchens)

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- Heat pump dryers
- Tier 1 APS and Tier 2 APS

Consider other strategies. Some devices are not recommended for standard incentives because their energy savings are not large enough to justify meaningful incentive amounts and/or because there is little precedent for incentivizing them this way. However, energy waste from such devices can still be reduced with alternative approaches. Other devices are already included (or are recommended for inclusion) in the standard incentive program but would also benefit from alternate strategies. CalPlug's recommendations for each device are as follows:

Computers, printers, and multifunction devices: Develop creative solutions for promoting ENERGY STAR devices including:

- Offering links to recommended energy-efficient models through an online product database
- Highlighting them in energy saving tips aimed at office-intensive businesses
- Highlighting them in facility assessments, retro-commissioning, and SEM programs
- Focusing on non-financial benefits of buying "green"
- Encourage efficient use of power management settings and external control systems for computers and imaging equipment (covered in more detail in the sections on control systems and on education and training)

Thin client computers: Conduct an assessment of the market for future opportunities

Televisions: Use facility assessments and educational materials to identify energy savings opportunities for televisions, especially upgrading to ENERGY STAR devices and using plug load control strategies.

Cash Registers: Ensure that facility assessments for relevant businesses include advice about upgrading cash registers to energy-efficient models and about using external plug load control strategies to ensure the devices are powered down outside of business hours.

Mini Refrigerators: Include in the facility assessment advisors' training clear advice about identifying wasteful personal devices during the walk-through of offices and other worker spaces, along with solutions, including removing multiple mini-refrigerators when a single full-size refrigerator could be shared instead.

Water Coolers: Include in the facility assessment advisors' training clear advice about identifying water coolers in shared work areas and break rooms that can be upgraded to ENERGY STAR water coolers and/or installing control systems onto existing water coolers.

Smart plugs: Closely observe trends in the smart plug market, especially the integration with energy management information systems, and support independent testing, field trials, and cost-effectiveness analyses of smart plugs and plug load management systems relevant to ComEd's customer base.

Tier 1 and Tier 2 APS: In addition to adding to the standard incentive program, also:

- Provide clear information about choosing the appropriate APS device

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- Provide installation guides
- Supplement methods for distributing APS devices in current programs with additional training for consultants and additional educational materials targeted to end-users

Plug load occupancy sensors: Continue including in the standard incentive offerings, and also:

- Offer clearer definitions about which kinds of plug load occupancy sensors are covered
- Make the program more visible to customers on the website
- Provide information about how to use plug load occupancy sensors, along with installation guides
- Include the device(s) on a summary list of related devices, such as an information sheet about plug loads and plug load controls, a page listing all plug load incentives, or a fact sheet on plug loads in offices

Online Marketplace

To increase customer engagement, CalPlug recommends that ComEd create an online marketplace targeted to business customers, as an extension of the existing residential online store. This store should include direct sales of plug load devices including Tier 1 and Tier 2 APS devices, plug load occupancy sensors, and EV chargers, as well as lighting. The basic template for the online residential marketplace store could be simply extended to business customers. An additional benefit is that implementing a well-developed online store and information exchange system for plug load devices now would establish infrastructure that can be used later to redistribute energy generated on the premises of commercial enterprises.

CalPlug also recommends participating in an online brokering platform to encourage adoption of a wider range of energy efficient plug load devices. This would provide a common exchange site where customers can obtain verified product reviews, see Enervee energy savings scores for products, compare prices between models and across retailers and distributors, and connect to third-party trade allies for purchasing.

Midstream programs: Commercial Food Service Equipment

ComEd is currently testing a pilot midstream incentive program for commercial food service (CFS) equipment and will be evaluating the results in the next year. CalPlug's research on midstream food service product programs offered by other utilities yielded promising results, offering examples of effective practices as well as encouragement for ComEd's implementation of midstream incentives. CalPlug's recommendations summarize best practices exhibited by comparison utilities with more established midstream CFS programs, who have published program reviews. These recommendations are intended for consideration when evaluating the initial pilot program results and determining next steps. Many of these practices are details that were not included in CalPlug's sources for ComEd's CFS pilot and may already be utilized. CalPlug recommends that ComEd:

- Add commercial dishwashers and wrap machines to the offered devices
- Consider requiring distributors to pass on a percentage of their incentives directly to end use customers, and whether to include "spiffs" for individual sales representatives

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- Consider instituting higher incentives for ENERGY STAR Most Efficient products
- Develop and test an online tool to facilitate instant rebate distributions to retail partners and customers
- Use consistent branding for the midstream program across utility and distributor partner websites
- Offer online webinars to engage end-use customers and potential retail partners
- Offer in-person courses and CFS product demonstrations at utility sites for distributor partners for deeper training on marketing strategies and new technology
- Compare the metrics and methodologies for evaluation, measure, and verification procedures used for the midstream program to those used by other utilities with more established programs

Data Center (Custom Incentives)

ComEd currently addresses data center measures, such as closet-to-colocation, within the custom incentives program. The existing program for data centers is robust and effective for larger retrofit projects but may be more complicated than required for businesses seeking more modest investments or upgrades. ComEd can better reach this audience by adding links to the existing standard incentives catalog web page (e.g., HVAC and lighting) within the data center program web page and adding standard incentives for data center-specific plug load devices. Specifically, CalPlug recommends adding ENERGY STAR qualified servers, UPS devices, and data storage equipment as standard incentives. This aspect of the program should focus on customers with older IT equipment and low levels of UPS utilization. These changes will help to make simpler options more accessible to customers. Customers using the custom program may also benefit from purchasing ENERGY STAR certified data center equipment; thus, ComEd should consider requiring this certification as part of the process.

CalPlug also recommends that ComEd endorses other energy reduction strategies for high-consuming plug loads in data centers on their webpage and factsheets: specifically, unplugging comatose servers, replacing HDDs with SDDs and using MAID technology. ComEd currently does not have a section in the data center program webpage devoted to education, and there is no data center specific information in the general education webpages. Although IT staff are knowledgeable about IT equipment functionality, they may overlook opportunities to save energy, as that is not their main objective. It is important to educate IT staff to recognize and implement technical strategies to reduce energy consumption (e.g., UPS utilization, server consolidation, standardized metrics). Expanding the general education offered online (e.g., webinars, factsheets, online training) to include data center specific energy efficiency strategies can result in a more significant energy savings. ComEd can also ensure that utility personnel are equipped to identify energy efficiency opportunities and best practices by partnering with government agencies that offer online and in person trainings. Lastly, CalPlug recommends providing low- or no-interest financing to assist small data centers in implementing larger, more complex projects.

Small Business Programs

ComEd's existing set of small business programs is highly regarded in the industry. It offers direct install measures during and after comprehensive facility assessments and free

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do-it-yourself small business kits with devices such as APS devices, smart plugs, water saving measures, and lighting. There are several ways that ComEd's small business program could be further developed to include plug load measures and to increase energy savings for those plug load devices, especially for small offices. CalPlug recommends expanding small business direct install measures to include other types of Tier 1 APS devices (e.g., motion sensor and timer-based instead of only load-sensing), Tier 2 APS devices, and plug load occupancy sensors, based on service providers' assessments of which plug load control strategies would work best for their office space and business segment. CalPlug also recommends exploring alternate business kit combinations that vary in the type of plug load control device(s) included, to tailor to specific customer needs. With any plug load control device, it is important to provide clear, detailed information on proper device use. Similarly, CalPlug also recommends creating factsheets and tips pages on low- and no-cost plug load management strategies, especially for office spaces, to promote plug load savings and to generate interest in the program. Finally, offering financing at zero or low interest could help convince small businesses to make EE upgrades.

Future Trends

CalPlug identified two future trends for which ComEd does not currently have EE programs in place: the growing importance of ZNE grid-interactive efficient buildings (GEBs) and the growing need for electric vehicle (EV) chargers.

To prepare for implementing GEB-related programs, CalPlug recommends that ComEd conduct research on GEB technology as it pertains to its commercial customer base. Research would ideally focus on how to measure and incentivize savings of plug load control devices and smart controlled devices and how to leverage existing AMI and ADR systems to integrate with plug load controls in smart buildings. ComEd should also plan to conduct feasibility studies, including the possibility of integrating plug load controls with temperature and lighting controls in future program designs.

Given trends toward electric transportation, CalPlug recommends that ComEd consider implementing an incentive program for EV chargers. This would require research on EV trends in Illinois and the Midwest more generally, followed by research and cost effectiveness analyses on possible program designs. CalPlug identified several features based on comparison utilities' established programs, including offering rebates on charging stations, selling discounted charging stations through an online marketplace, and providing free consultations to customers on where best to install the chargers, as well as free infrastructure installation for grid connection.

General Recommendations

In addition to the program-specific recommendations, CalPlug has also identified several important areas of convergence that can be applied more generally across programs. These general recommendations involve financing, education and training, and website development.

Financing

As previously discussed, lack of capital investment capability is a major hindrance to most business customers when deciding whether to pursue energy-efficient infrastructure upgrades and when purchasing commercial appliances and equipment. Offering financing

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with zero or low interest has been successfully promoted by other leading utilities to help small businesses pay for energy-efficient upgrades. CalPlug recommends that ComEd consider adding financing options to the small business program, data center program, and other programs where comprehensive upgrades to equipment and infrastructure are the suggested measures.

Education and Training

Education and training are necessary to raise awareness of plug load energy consumption and to encourage effective solutions. Customer behavior is an important element in any EE program, as behavior encompasses whether customers consider, research, and purchase energy-efficient equipment. Equipment must be properly installed, particularly plug load control systems, and maintained in the correct configuration. For devices that offer energy-saving features, such as on-board power management, customers can choose to enable, disable, or otherwise alter those settings. Thus, variations in customer behavior continue to affect energy efficiency over time. CalPlug recommends optimizing this behavior through enhanced EESP training and user education.

A prime example is facility assessments in small businesses and especially small offices, where training and protocols for EESPs should highlight plug load and plug load control solutions. EESPs should be given explicit guidance on how to identify and solve a wide range of plug load efficiency problems. Training should cover how to engage and get buy-in from a wide range of end-users. EESPs could be encouraged to conduct demonstrations explaining how to install plug load control devices--and why--in order to reduce the likelihood that end-users will disconnect them later. CalPlug does not have access to EESP training protocols, so some of these practices may already be in place.

Virtually all programs offered by ComEd could benefit from focused training opportunities and educational materials that draw out energy saving solutions for plug load devices. For example, ComEd can increase energy efficiency in data centers by investing in educating IT staff on how to apply metrics to assess energy use, identify inefficient IT equipment and practices, formulate energy saving strategies, and overcome potential financial barriers. Similarly, to promote midstream CFS equipment programs, it is important to commit resources to educating partner retailers and distributors. Offering courses and demonstrations at utility sites may help engage both retailers and end use customers. For building energy management programs, building operators and occupants should be educated about various plug load use and management strategies, so that no-cost and low-cost solutions can be implemented. CalPlug recommends including information about plug loads in any program that includes prolonged and personal customer interaction.

CalPlug does not have access to any educational materials ComEd distributes to customers; however, many of the comparison utilities offer much more customer-facing information about plug load savings on their websites than ComEd does. CalPlug recommends adopting similar strategies for enhancing the visibility of plug load issues, such as posting energy-saving tips and information sheets about plug loads and plug load management. Adding factsheets on plug load energy savings to the small business website could also help educate customers and make further program participation more enticing. Similarly, eventual EV charging station program webpages can include factsheets and interactive tools to help customers understand and choose the best EV chargers for their needs. Factsheets should

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refer back to ComEd's EE incentives and programs and show customers how to get started with implementing energy savings measures.

Website

A key mechanism of education and motivation is the utility's EE website. Customers' user experience with the website impacts how they perceive utility EE programs and whether they can identify and understand opportunities for further engagement. Many of ComEd's program offerings for plug load devices could be improved through better communication on the program's dedicated website. CalPlug recommends conducting a usability assessment of the ComEd website, aimed toward making the energy efficiency pages easier to navigate.

Summary

ComEd boasts a full and robust energy efficiency portfolio for its commercial customers, and already effectively incentivizes many key plug load devices. The assessment and recommendations given here are intended to identify opportunities for highlighting plug load devices more effectively in ComEd's portfolio, both to boost the uptake of the existing programs and to add more energy-saving elements.

CalPlug had no access to internal documents on ComEd's program design or administration, and the scope of this project did not allow for interviewing program managers; as such, suggestions about training, educational materials, and other inward-facing program elements are necessarily generalized, and may refer to practices already being used.

This project focused on breadth rather than depth, prioritizing identifying the widest and most comprehensive range of plug load problems and solutions rather than detailed analysis of any specific program recommendation. This prevented CalPlug from spending time on deep-dive assessments of programmatic elements that ComEd has already explored and is not interested in. The next step is for ComEd to decide which of the recommended changes to prioritize, given their greater knowledge of past and current offerings, and then to pursue more in-depth assessments.

Summarizing key projects based on the recommendations given above, next steps could include:

- Pilot studies, device testing, and assessment analyses
    - Cost effectiveness analyses of adding devices to standard incentive list or modifying incentive amount/range
    - Expand online marketplace and/or investigate product brokerage page possibilities
    - Assess proposed changes to data center program
    - Consider recommendations in commercial kitchen pilot evaluation
    - Explore offering financing
    - Conduct research into GEB/smart building technology, incentivizing smart controls
    - Research regional EV trends; EV charger program design options

- Reviewing and revising education and training resources

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- Assess usability of website and available online materials
- Group office-related plug load information into one fact sheet
- Group plug load incentives into one work sheet
- Revise EESP training materials and facility assessment procedures to clearly address plug load control options
- Revise educational materials and demonstrations aimed at building operators and occupants on plug load management
- Incorporate plug loads into demonstrations at utility sites

APPENDIX A

Table A1. Links to Utility Commercial Energy Efficiency Program Webpages

Utility	Business programs main portal link
Ameren Illinois	https://amerenillinoissavings.com/for-my-business/explore-incentives
Baltimore Gas and Electric	https://www.bge.com/WaysToSave/ForYourBusiness/Pages/default.aspx
Consolidated Edison	https://www.coned.com/en/save-money/rebates-incentives-tax-credits/rebates-incentives-tax-credits-for-commercial-industrial-buildings-customers
Consumers Energy	https://www.consumersenergy.com/business/energy-efficiency
Efficiency Vermont	https://www.efficiencyvermont.com/rebates/list?cat=&hvacfilter=&type=Business
Energy Trust of Oregon	https://www.energytrust.org/commercial/
Eversource Connecticut (Energize CT)	https://www.eversource.com/content/ct-c/business
Eversource Massachusetts (Mass Save)	https://www.eversource.com/content/ema-c/business https://www.masssave.com/en/saving/business-rebates
Florida Power and Light	https://www.fpl.com/business.html
Georgia Power	https://www.georgiapower.com/business.html
National Grid Massachusetts (Mass Save)	https://www.nationalgridus.com/MA-Business/Energy-Saving-Programs/ https://www.masssave.com/en/saving/business-rebates

(continued)

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Table A1 (continued)

Utility	Business programs main portal link
New York State Electric and Gas	https://www.nyseg.com/wps/portal/nyseg/saveenergy/!ut/p/z1/pZJPb4JAEMU_DUcyC_LPIyUEQhAqSIG9kAW2iCkL4sbqty-kJu1FMe3eNpk3b-b3BjBkgBk5tw3hbc_Ix_TPsVaspI3tKhYKQj-U0RZ5znqdRCvb0yF9VGDGKuBn9OjOM9GS_g0w4Irxge8hZ9cTbUgzFj87CGhPSU1HAZ06MnLK6NhcZ81QtTXkJZVlTddrsdSqSlR0TRJLpGqiQmu5elcVCSnGXJ1am8LxwxfTL6ww2NnZDnIBBXlsO6YTFcEvP_fmF89-9rdfuoQRP4aQzjMscF7qkU8z6Pc6vGoqpOeWfkLC-rGbko__Bmmb2NHk9E9eLgJvKfnpNNvD8YjNKf-ecXrhkD19AEOXJJ2x6sQMHdSmMy6ik34BW0vWyQ!!/dz/d5/L2dBISEvZ0FBIS9nQSEh/?WCM_GLOBAL_CONTEXT=%2FNYSEGAGR_Navigation%2FHeader%2FSmartEnergy
Pacific Gas and Electric	Portal for small and medium businesses: https://www.pge.com/en_US/small-medium-business/small-medium-business.page Portal for large businesses: https://www.pge.com/en_US/large-business/large-business.page
Sacramento Municipal Utility District	https://www.smud.org/en/Business-Solutions-and-Rebates
San Diego Gas and Electric	https://www.sdge.com/businesses/savings-center/tools-energy-tips
Southern California Edison	https://www.sce.com/business
We Energies (Focus on Energy)	https://www.we-energies.com/business/bus_emgt_tools.htm https://www.focusonenergy.com/business
Xcel Energy	https://www.xcelenergy.com/programs_and_rebates/business_programs_and_rebates

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APPENDIX B

Table B1. Flowchart Decision Tree Results for Full Initial List of Plug Load Devices

Device	1A EE Device	1B Controlled Device	2A Control System	3A No Potential Energy Savings	3B Declining Population	3C Neither Plug Load nor System
Computer/Imaging						
Computer, Desktop	Yes	Yes				
Computer Monitor	Yes	Yes				
Computer, Laptop	Yes	Yes				
Dock station, laptop				Yes		
Battery Charger				Yes		
External Drive				Yes		
Printer/Copier	Yes	Yes				
Scanner		Yes				
Multi-function device		Yes				
Plotter		Yes				
Networking/Servers						
Servers	Yes					
UPS Units	Yes					
Network Switch				Yes		
Audio/Video						
Television	Yes	Yes				
Projector		Yes				
Audio system		Yes				
Speakers		Yes				
Game Console				Yes		
Digital Video Recorders (DVR)				Yes		
DVD player					Yes	
VCR Player					Yes	
Blu-ray Player				Yes		
Set-top Box				Yes		
Over-the-top (OTT) Internet Protocol TV(IPTV)				Yes		
Table Radio				Yes		
Telephony						
Phone				Yes		
Charger, Mobile Phone				Yes		
Fax Machine				Yes		

(continued)

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Table B1 (continued)

Device	1A EE Device	1B Controlled Device	2A Control System	3A No Potential Energy Savings	3B Declining Population	3C Neither Plug Load nor System
Hardware Power Management						
Advanced Power Strip, Tier 1			Yes			
Advanced Power Strip, Tier 2			Yes			
Smart Plug			Yes			
Plug Load Occupancy Sensor			Yes			
Office Miscellaneous						
Electric Pencil Sharpener				Yes		
Electric Stapler				Yes		
Electric Hole Puncher				Yes		
Label Makers/Printer				Yes		
Smart Board				Yes		
Paper Shredder		Yes				
Task/Desk/Floor Lamp		Yes				
Room AC	Yes	Yes				
Dehumidifier	Yes	Yes				
Space Heater		Yes				
Fan		Yes				
Business equipment						
Credit Card Machine				Yes		
Bar Code Scanner				Yes		
Adding Machine				Yes		
Cash Register	Yes					
Kitchen Equipment						
Refrigerated Drinking Fountain				Yes		
Residential Freezer	Yes					
Chest Freezer				Yes		
Residential Refrigerator	Yes					
Mini-Refrigerator	Yes					
Commercial Freezer	Yes					
Commercial Refrigerator	Yes					
Residential Dishwasher	Yes					

(continued)

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Table B1 (continued)

Device	1A EE Device	1B Controlled Device	2A Control System	3A No Potential Energy Savings	3B Declining Population	3C Neither Plug Load nor System
Commercial Dishwasher	Yes					
Commercial Oven	Yes					
Fryer	Yes					
Hot Food Holding Cabinet	Yes					
Griddle	Yes					
Wrap Machine	Yes					
Steam Cooker	Yes					
Refrigerated Vending Machine	Yes					
Vending Machine Control/Miser (Refrigerated)			Yes			
Non-refrigerated Vending Machine				Yes		
Vending Machine Control/Miser (Non-refrigerated)				Yes		
Spray Rinse Valve						Yes
Ice machine	Yes					
Microwave		Yes				
Coffee Maker		Yes				
Espresso Machine		Yes				
Toaster/Toaster Oven		Yes				
Hot Water Dispenser		Yes				
Water Cooler	Yes	Yes				
Laundry						
Clothes Dryer	Yes					
Commercial Clothes Washer	Yes					
Residential Clothes Washer	Yes					
Utility and Maintenance						
Pool Pump (VSD)	Yes					
Vacuum Cleaner				Yes		
Gym/ Fitness Rooms						
Treadmill				Yes		
Stationary Bicycle				Yes		
Elliptical Machine				Yes		
Motors						
Q Sync Motor						Yes

(continued)

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Table B1 (continued)

Device	1A EE Device	1B Controlled Device	2A Control System	3A No Potential Energy Savings	3B Declining Population	3C Neither Plug Load nor System
Security/Accessibility						
Security Video Surveillance						Yes
Access Control						Yes
Intruder and Fire Detection						Yes
Electronic Article Surveillance Systems (EAS)						Yes
Vertical Transport						
Elevator						Yes
Escalator						Yes
Standard Elevator						Yes
Service Elevator						Yes
Escalator						Yes

Number of 1As (EE Devices)	30
Number of 1Bs (Controlled Devices)	23
Number of 2As (Control System)	5
Number of 3As (No Potential Energy Savings)	29
Number of 3Bs (Declining Population)	2
Number of 3Cs (Neither Plug Load nor System)	11
Total	**100**

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APPENDIX C

Consumers Energy: Business Energy Efficiency Tips

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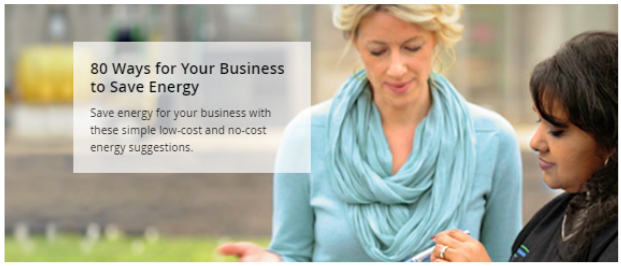
Business Energy Efficiency Tips



Lighting Tips

If your business is looking for ways to save money, you don't have to look far for a solution. These illuminating suggestions won't leave you in the dark.

View More

Heating and Cooling Tips

Don't sweat your energy bill. If you follow these suggestions, your business and your budget will be comfortable year-round.

View More

Kitchen Tips

Take some of the heat out of the kitchen with these suggestions to save you energy.

View More

Other Tips

Running your business already takes enough energy. Save some money by following these suggestions.

- Turn the water heater down to 120° F (if codes allow).
- Repair any leaky faucets or pipes promptly.
- Keep your hot water hot by making sure pipes in unheated areas are well insulated.
- Only use hot water when necessary.
- Consider installing water saving faucets.
- When purchasing a new water heater, buy the most efficient model possible. Look for the ENERGY STAR label to ensure savings.
- Unplug battery chargers when the batteries are fully charged.
- Plug electronic devices into an easy-to reach power strip and turn it off when the devices are not in use.
- Use the energy saving feature or sleep mode on office equipment that is not in use, when it is available.
- Turn off office equipment at night.
- When buying new computers, consider laptops rather than desktop models.
- Manually turn off computer monitors when they are not in use, rather than using the screen saver.
- Install plug load controllers in cubicles to control multiple loads like monitors, task lights and fans. They use a motion sensor with a plug load surge suppressor, so inactive equipment can be shut down when the cubicle is unoccupied.
- Consider using ink-jet printers. They use 90% less energy than laser printers.
- Think about your facility's actual needs when purchasing. Avoid purchasing more or less power and capacity than you need, especially when purchasing copiers.
- Encourage employees to use double-sided printing and copying whenever possible.
- Upgrade to energy efficient LCD computer monitors.
- When upgrading or purchasing new office equipment, always look for ENERGY STAR qualified products to ensure energy efficiency.
- Turn off the lights in your facility's vending machines to reduce energy use.
- Place your vending machines in cool, shaded areas.
- Consider retrofitting your elevators with new, more efficient motors and drives.
- Train staff on proper maintenance procedures to ensure the most efficient use of office equipment.
- Encourage your employees to be aware of energy efficiency and to give their ideas of how energy can be saved at your facility.
- Consider forming an energy team at your business that will be responsible for discovering and pursuing energy efficiency opportunities at your facility.
- Compare your equipment's efficiency ratings with the benchmarks available on www.energystar.gov to identify your facility's inefficiencies.
- Call Consumers Energy at 877-607-0737 to set up a free energy assessment of your facility, and let us help you find opportunities to save.

Project Status Lookup
Locate the status of your project right now.
Check Status

Save Energy and Money
Discover energy efficiency solutions for your business.
Get Started

Ways Your Business Can Save
Get practical ideas to cut your energy use and costs.
Get Started

Manage Your Business Account
Easily access quick links to pay your bill, transfer service and more.
Take Me There

Source: https://www.consumersenergy.com/business/energy-efficiency/tips

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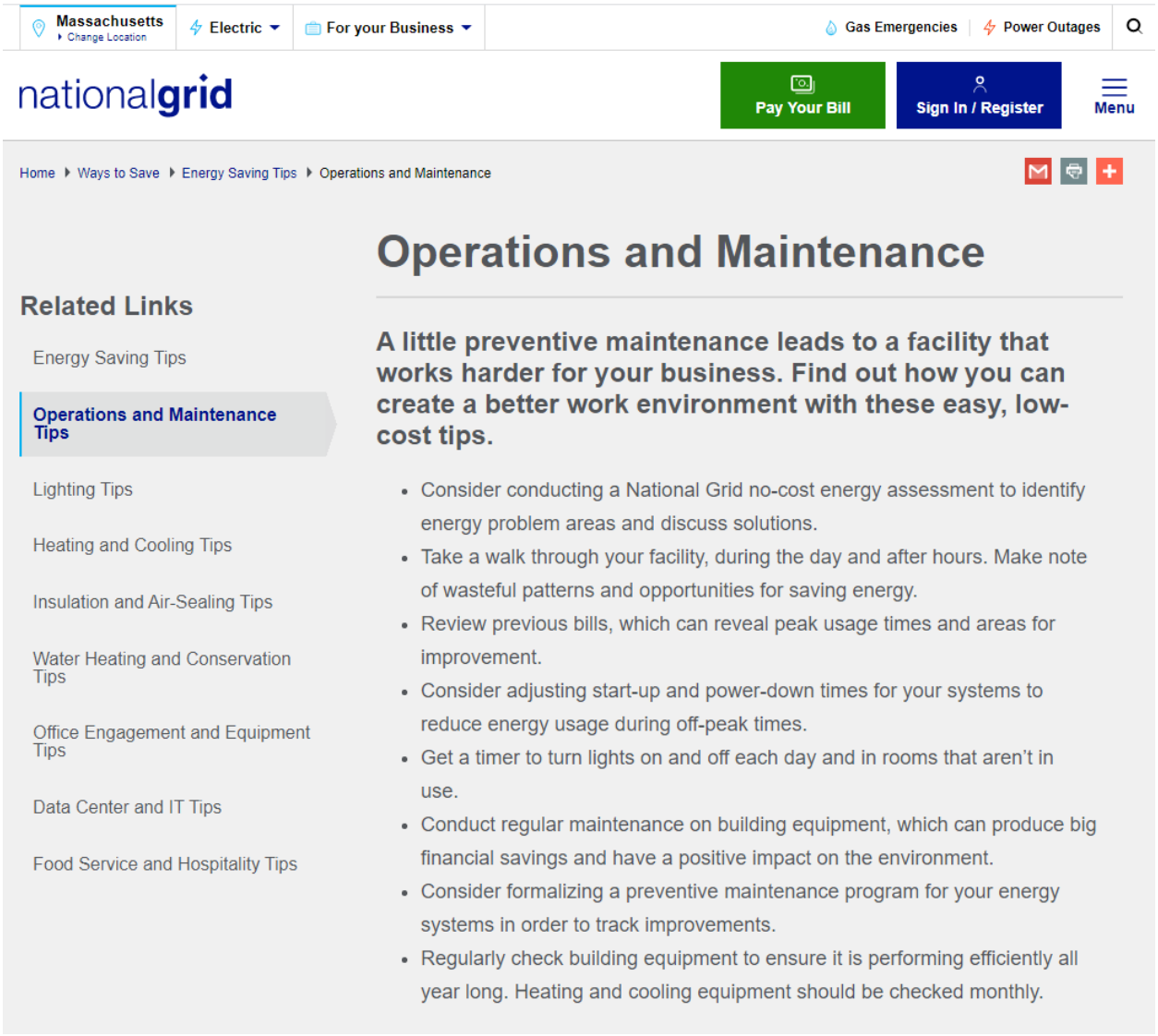
National Grid (MA): Operations and Maintenance



Source: https://www.nationalgridus.com/MA-Business/Energy-Saving-Tips/Operations-Maintenance

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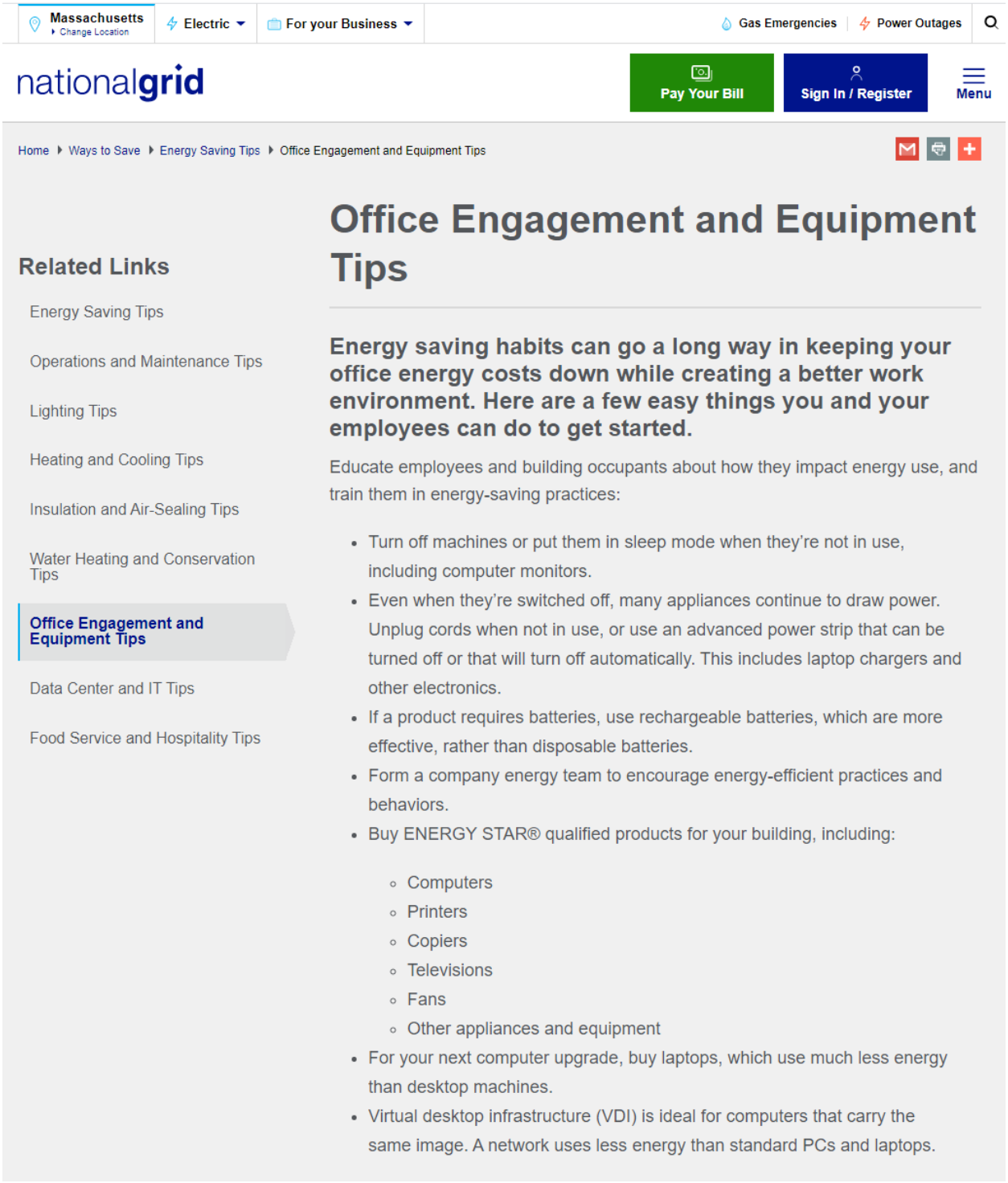
National Grid (MA): Office Engagement and Equipment Tips



Source: https://www.nationalgridus.com/MA-Business/Energy-Saving-Tips/Office-Engagement-and-Equipment-Tips

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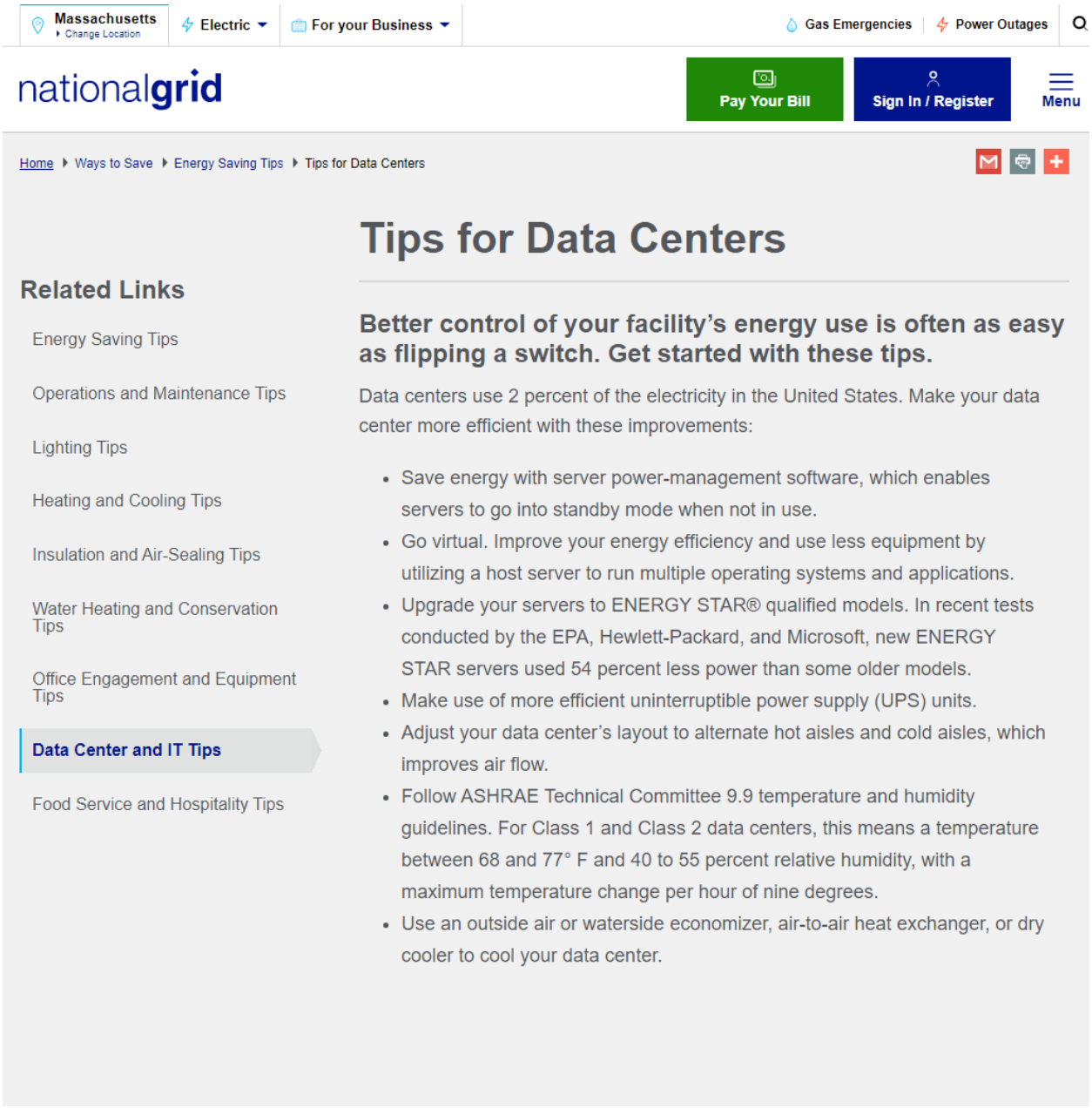
National Grid (MA): Tips for Data Centers



Source: https://www.nationalgridus.com/MA-Business/Energy-Saving-Tips/Tips-for-Data-Centers

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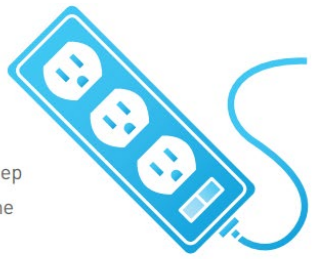
Pacific Gas & Electric: 25 Money Saving Tips for Businesses (e-book)



MONEY-SAVING TIP #1

Turn off equipment when not in use.

During the course of a busy day, it's easy to get distracted and keep equipment running longer than necessary. So encourage everyone to power down when equipment is not in use.

In addition, many types of equipment can unknowingly use energy. That's why it pays to install PC power management software solutions. Here are some of the benefits:[1]

- **Cut electricity use to save $25 to $75 per PC annually**
- **Reduce office cooling loads to save an additional $10 to $25 or more**
- **Enhance data security**
- **Improve productivity by eliminating the daily computer boot-up wait time**

"Turning off equipment reduces unnecessary power drain and is a no-cost step to reduce energy use and lower bills."

1. ENERGY STAR, "The business case for power management"

MONEY-SAVING TIP #15

Choose ENERGY STAR®-labeled office equipment.

Look around most offices and what do you see? Chances are, there are laptop and desktop computers, copy machines and networking equipment. Did you know that all of this office equipment can offer you opportunities to save?

When it's time to purchase new equipment, simply look for the ENERGY STAR label. In general, these office products use about half the electricity of standard equipment. Along with saving energy directly, this equipment can reduce air-conditioning loads, noise from fans and transformers, and electromagnetic field emissions from monitors.

For example, on average, displays with the ENERGY STAR label are 25% more energy efficient than standard options.[1]

Source:
http://image.em.pge.com/lib/fe8c13727666037a72/m/5/25_Money_Saving_Tips_eBook_FINAL.pdf?cid=ifra_SMB_RESOURCES_AND_TOOLS_25_moneysaving_tips_for_businesses&_ga=2.98190751.1485279966.1593280609-1129581056.1590878233

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San Diego Gas and Electric: 6 Simple Steps to a More Efficient Office

6 Simple Steps to a More Efficient Office

1. Look for ENERGY STAR®-qualified products. The ENERGY STAR mark indicates the most efficient computers, printers, copiers, refrigerators, televisions, windows, thermostats, ceiling fans, and other appliances and equipment.
2. Turn off machines when they're not in use. Automatically switching to sleep mode or manually turning monitors off is a better energy saving strategy than counting on your screen saver.
3. To charge and power a laptop, put the AC adapter on a power strip that can be turned off.
4. Consider buying a laptop for your next computer upgrade. Laptops use much less energy than desktop computers.
5. Many appliances continue to draw a small amount of power when they are switched off. These "phantom" loads occur in most appliances that use electricity, such as monitors, copy machines, computers, and coffeemakers. Consider unplugging the appliance or using a power strip to cut all power to the appliance.
6. Unplug cell phone chargers when the chargers are not in use.

For more information, talk to your Account Executive or call our Energy Savings Center at 1-800-644-6133.

Source: https://www.sdge.com/businesses/savings-center/tools-energy-tips/office-efficiency

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Southern California Edison: Plug Load Devices White Paper

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

SCE Energy Conservation Series

Plug In To Greater Energy Savings: With Smart Plug Load Management

Simple low- or no-cost steps could reduce your plug load energy use by up to 40%[1].

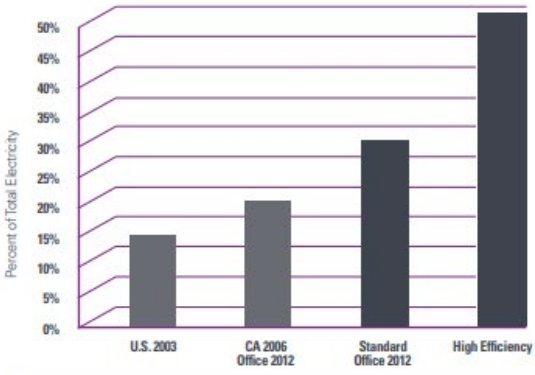
A typical business these days uses an ever-increasing array of electronic devices that plug into a wall outlet, and which have multiple power modes. The resulting "plug loads" are now one of the fastest growing uses of energy.

Once you've determined your energy goals, understanding and managing plug loads can help you reach them and may substantially lower your energy usage.

We offer this handy guide to assist you in that effort.

Office Equipment Plug Loads as a Percent of Total Office Electricity[2]

Plug load energy use for computers and office equipment is increasing. In office buildings that have improved the efficiency of lights, heating and cooling it can represents as much as 50% of the total electricity use.



How and When Plug Loads Use Energy

Today's electronic equipment operates in a variety of power levels or modes. Switching from a higher to lower power mode is an easy way to save energy. Yet, the very best way to save energy is to always ensure devices are turned off or unplugged when not in use for long periods, or at the end of the work day.

Know Your Power Modes

Understanding and adjusting machine settings to take advantage of different power modes can help your business save a significant amount of energy every year.

- ✓ **Active Mode** – Equipment is on and performing its intended function
- ✓ **Idle Mode** – Equipment is on, ready to perform work, but not active. Surprising amounts of energy can be used in this mode.
- ✓ **Sleep or Standby Mode** – Equipment has been powered down, but is not fully off, drawing reduced power. Equipment is also ready to wake up and return to active mode in response to demand.
- ✓ **Off Mode** - Equipment draws no power. This is the ideal mode for maximizing energy savings.

Knowledge Is Power!

The **"vampire"** or **"phantom"** load is the energy a device consumes while in the Sleep or Standby mode. It can be substantial.

[1] *Plug Load Best Practices Guide.* New Buildings Institute (NBI), 2014.
[2] US-Energy Information Agency; CA-CEUS; 2012 offices–NBI Measured Data

(continued)

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Southern California Edison: Plug Load Devices White Paper (continued)

Advanced Power Strips Can Help

Advanced power strips (APSs) can be an effective means for managing plug loads. They're a lot like regular power strips, but with built-in "intelligence" that shuts off the supply power to unused or idle devices based on various situations.

Along with reducing plug loads, APSs can also save you time by eliminating the need to retrain staff or keep adjusting power modes on office equipment.

Manage Your Server Loads

For many office-based organizations, 30 to 70% of electricity use stems from powering and cooling servers than run 24/7.[3] Start saving energy by measuring or estimating the energy consumption of your server room.

Switch off unused servers or set them to go into a low power mode when inactive. Also consider optimizing server use through consolidation and virtualization.

Consider Your Computers

Computers are becoming more and more energy-efficient every year. So, it's very possible that replacing old equipment with new models could reduce energy demand in your business. Something else to think about: laptops with dockings station use less energy than most desktops, and enable a more mobile workforce as well.

Energy Star® recommends setting computers and laptops to sleep after 15 to 60 minutes of inactivity. By doing so, savings up to $50/computer/year are possible.

Talk To SCE

Contact your Account Manager about our energy incentive programs for your industry. Or check with your local contractor who may also have access to incentive programs.

Help Us Help You—and Our Community

Managing plug loads is not only good for your business and bottom line; it's also good for our community as a whole.

The information we've provided in this guide can aid you in achieving your energy goals and assist SCE in better managing the electric grid—which benefits everyone.

Just What Is a Plug Load?

A plug load is the energy consumed by any electronic device plugged into a wall outlet, i.e., computers and peripherals, printers, television monitors, break room equipment (coffee makers, microwave ovens) or any other equipment you may use for your specific industry.

Additional Resources

Sheppy, Michael, et al. *Assessing and Reducing Plug and Process Loads in Office Buildings*. National Renewable Energy Laboratory (NREL), November 2014.
apps1.eere.energy.gov/buildings/publications/pdfs/alliances/20111121_webinar_assessing_ppls.pdf

***Plug Load Best Practices Guide. New Buildings Institute (NBI).* 2014.**
advancedbuildings.net/index.php?q=plug-loads

Interested In Learning More?

Choose from the many topics in our Energy Conservation Series:

- LED Lights: A Bright New Way to Conserve Energy
- Switch To a More Energy-Efficient Business—With Smart Lighting Controls
- Manufacturing Motors & Compressors: Start Your Energy-Efficient Engines
- On The Menu: Major Energy Savings With Restaurant Refrigeration
- Cold Hard Facts About Refrigeration and Energy Conservation for Grocery and Convenience Stores
- Energy Efficiency Is In the Air: Optimizing Your HVAC
- Agricultural Pumping: Pumped and Primed to Save Energy

Source: https://www.sce.com/sites/default/files/inline-files/Plug%2BLoad5_WCAG.pdf

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ComEd
Energy Efficiency Program

We Energies: No-cost and Low-cost Tips

Money-saving tips for business customers

No-cost and low-cost ways to save. Invest to save more.

Heating and cooling

No cost

- In winter, set your thermostat at 68 degrees F when your business is open. Turn your thermostat down 5 to 15 degrees while you are closed. You can save 5 to 10 percent a year on your bill if you can make that adjustment eight hours each day.
- In summer, set your thermostat at 78 degrees F when you are open. Turn your thermostat up 5 to 15 degrees while you are closed. Again, you can save 5 to 10 percent a year on your bill if you can make that adjustment eight hours each day.
- Reduce or eliminate the use of electric space heaters. Heating with electricity is significantly more expensive than heating with natural gas.
- Clean the condenser coil on HVAC rooftop units. When condensing temperatures increase as little as 10 degrees F due to a dirty coil, power use goes up 10 percent and increases electricity costs. Condenser coils should be checked for debris on a quarterly basis and cleaned at least once a year.

Low cost

- Install a programmable thermostat to manage your temperature settings automatically and bring the temperature to a comfortable setting by the time you open.
- Use ceiling and room fans to help circulate air. A ceiling fan can make a room feel up to 10 degrees cooler and delay the need to turn up your air conditioning – saving energy and money.

Invest to save more

- Choose high-efficiency products when replacing equipment. High-efficiency HVAC equipment uses 7 to 10 percent less energy than standard equipment.
- In Wisconsin, check with Focus on Energy for high-efficiency HVAC incentives.
- In Michigan, contact Efficiency United for rebates on energy-efficient equipment.

Lighting

No cost

- Turn off lights you're not using and use natural light whenever possible.
- Keep light fixtures clean and dust-free to maintain optimum light output.

Low cost

- Replace incandescent or fluorescent exit lights with LED exit lights.
- Install occupancy sensors in rooms that are not continuously occupied – conference rooms, bathrooms and break rooms – so lights are on only when needed.

Invest to save more

- Replace T12 fluorescent lamps with T8s. Consider LEDs when replacing lights.
- In Wisconsin, the Focus on Energy Small Business Program provides lighting assistance and incentives for small businesses on energy-saving lighting.
- In Michigan, Efficiency United offers a variety of lighting incentives.

Equipment

No cost

- Turn off equipment during nonbusiness hours.
- Enable power management settings on computers, printers and copiers and unplug electronic devices that aren't being used.
- Set water heaters at 120 degrees F unless 140 degrees F is needed for specific equipment or sanitation requirements.

Low cost

- Many electronic products use power when not in use. Instead of manually unplugging equipment, use a smart power strip to eliminate phantom power drain. Combined with power management features, almost any device can be turned on and off automatically.
- De-lamp the lighted display on your refrigerated vending machine and reduce its energy use by 35 percent.

Invest to save more

- Buy Energy Star equipment when it's time for replacement.
- Replace electric water heaters with natural gas water heaters, which save up to 75 percent of the cost of electric water heating.
- Replace desktop computers with laptop computers to save 80 to 90 percent in electrical cost.
- In Wisconsin, check with Focus on Energy for equipment incentives.
- In Michigan, contact Efficiency United for energy-efficient equipment rebates.
- Consider a compressed air audit (PDF).

Additional resources

Take your energy savings even further.

Incentives and rebates

Wisconsin:
Focus on Energy
focusonenergy.com
800-762-7077

Michigan:
Efficiency United
efficiencyunited.com
877-367-3191

Information

- Get customized energy efficiency advice online: Business Energy Advisor
- Request help to start managing energy costs: Request form
- Call for answers to energy questions:
  Business Care Center
  800-714-7777
  8 a.m. to 5 p.m. M-F
  Automated phone system available 24/7

Source: https://www.we-energies.com/business/money-saving-tips-business.htm

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Focus on Energy: Energy Best Practices Guide: School and Government Facilities

TECHNOLOGY

The best way to decrease energy use with technology – computers, tablets, smartboards, copiers, printers, laminators is to make people aware that their actions make an impact. In most cases, energy-using equipment in a building is never directly controlled by its occupants. For example, everyone knows the benefit of HVAC equipment, yet they have little direct impact on its energy use. Technology is different in this aspect as its energy use is primarily controlled by building occupants. Therefore, education is as important as the equipment purchased. Even the most energy-efficient computer uses large amounts of energy if the user does not use the energy-saving functions.

BEST PRACTICES

BEST PRACTICES 1 TECHNOLOGY

EDUCATE BUILDING OCCUPANTS ON COMPUTER USAGE AND POWER MANAGEMENT

Energy saving actions taken by technology users have replaced centralized PC Power Management software. Computers now come with energy saving features and the power can be directly controlled by the user. Educate building occupants on the following energy-saving actions:

- Screen Savers — Avoid screen savers as they use twice as much energy as when the computer is in use.
- Sleep Mode — Instead of a screen saver, set your monitor to go into sleep mode after 5 to 15 minutes of inactivity, and the hard disk to turn off after 30 to 45 minutes of inactivity.
- Monitor Display — Adjust your display/monitor's brightness to be below 50 percent, as the brightest setting consumes twice as much power as the dimmest setting.
- Power Down — Turn off your computer at night and on weekends (if you require remote access, sleep mode is an acceptable alternative).
- Settings — For other appliances, such as smart boards, copiers, and printers, enable similar energy-saving settings.

Building occupants can learn from monitoring equipment energy usage and accompanying utility costs. There are a number of inexpensive energy meters on the market. Plug the meter into a wall socket, then plug the equipment into the meter. Energy use is metered and displayed.

BEST PRACTICES 2 TECHNOLOGY

SELECT ENERGY STAR RATED EQUIPMENT

Look for the ENERGY STAR® rating and pre-qualification information when purchasing new technology. ENERGY STAR® technology must meet maximum power consumption requirements. These requirements apply to when the equipment is actively being used and also when in sleep or idle mode.

ENERGY STAR

(continued)

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Focus on Energy: Energy Best Practices Guide (continued)

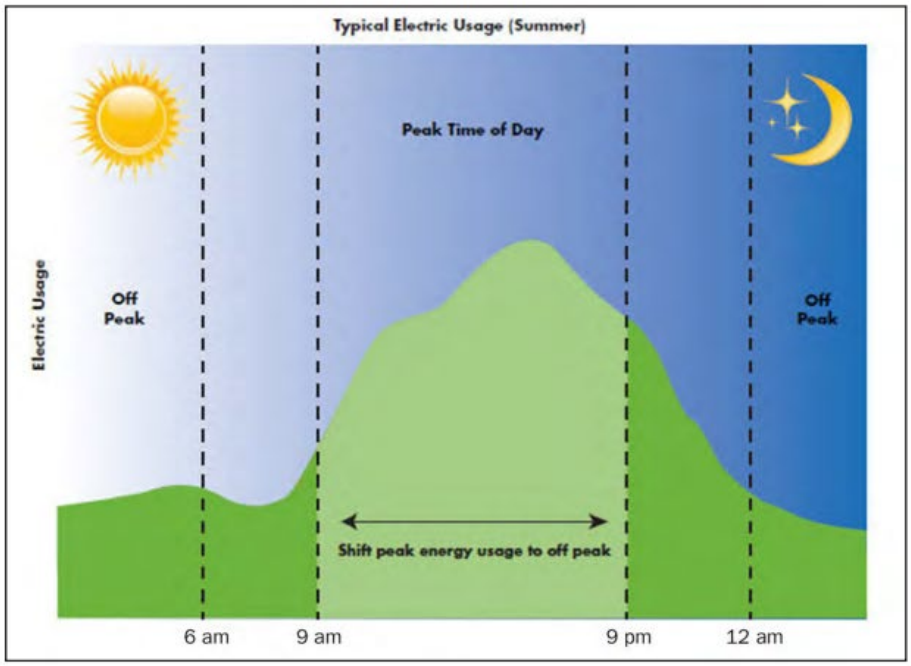
TECHNOLOGY

UTILIZE ADVANCED POWER STRIPS

Utilize power strips with a timer designed to turn off power at a preset time to ensure copiers, printers, and laminators are switched off at the end of the day.

CHARGE COMPUTERS OFF-PEAK

School and government facilities possess many laptops and tablets, which need to be charged for optimal use. Charge these devices during off-peak hours to reduce peak load and kW demand charges on the electric bill. Review your electric bill to determine peak demand times. A typical on-peak time period is 9 am to 9 pm Monday through Friday, excluding legal holidays.



(continued)

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Focus on Energy: Energy Best Practices Guide (continued)

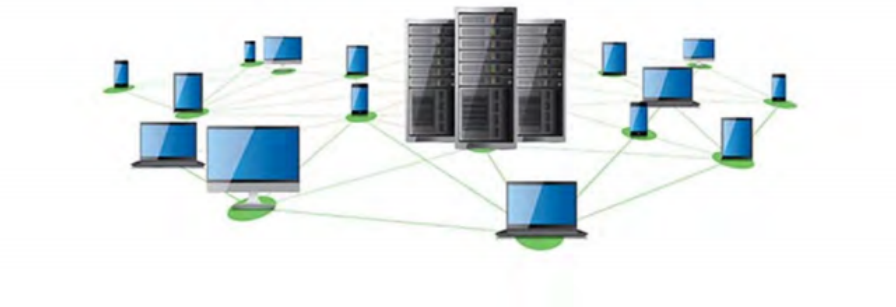
TECHNOLOGY

5 USE VIRTUAL SERVERS

A computer containing virtual server software replaces multiple computers running a single application. Virtual server software on one computer can have servers for each of the following tasks:

- Security
- Printing
- Building Automation System (BAS)
- Accounting software

By virtualizing servers, IT departments are able to reduce the number of computers and therefore, reduce the amount of energy being used. Server virtualization allows you to add a new server in minutes, instead of hours. If there's ever an issue with an application, simply access a virtual snapshot backup and redeploy it on a newly created virtual server. By consolidating applications on one server, you'll reduce your electricity consumption and save on cooling costs since multiple servers generate considerable heat. When you make the switch, your maintenance costs will decrease, plus you won't have to buy new machines when you need to add a new server.



6 MONITOR SERVER ROOM TEMPERATURE

Server rooms are often kept at temperatures lower than the recommended or appropriate temperature. A 2011 study on server fan and cooling levels at various room temperatures identified a sweet spot between 75 and 80 °F as the optimal temperature range for saving energy. (Dell Technologies, 2011) However, newer servers are able to handle even higher temperatures, closer to 90 °F.

The study focused on using economizers in addition to or completely replacing compressor-based cooling, depending on the climate where the server resided. For Wisconsin, it is doubtful a cooling system without a compressor could handle the full range of temperatures and humidity levels. However, economizers, if available, are an excellent way to reduce energy use during times of the year when outside cooling is available.

Consult your server supplier or manufacturer for recommended server room temperatures.

(continued)

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Focus on Energy: Energy Best Practices Guide (continued)

TECHNOLOGY

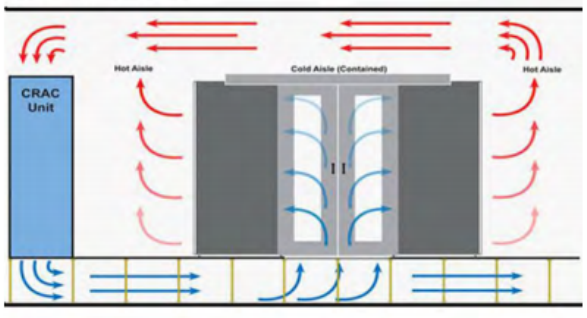
BEST PRACTICES 7 TECHNOLOGY

IMPLEMENT COLD-AISLE COOLING

Place cold-aisle cooling partitions in the server room to separate the heating aisle from the cooling aisle. Locate servers in a rack in the center of the server room. The exhaust side (back side) of the server row is the hot aisle while the front side (where cooling needs to be directed) of the server row is the cold aisle. The racks themselves are a barrier between the cold aisle and hot aisle. Use blanking panels to complete the separation. Provide cooling to the cold aisle side underneath a raised floor while return air from the hot aisle feeds the cooling system.

By separating the cold aisle from the hot aisle, cooling capacity will not have to overcome heat from the servers as is typical in a server room being served by split systems or other means of centralized cooling. Efficiency is gained through this more efficient use of cooling capacity.

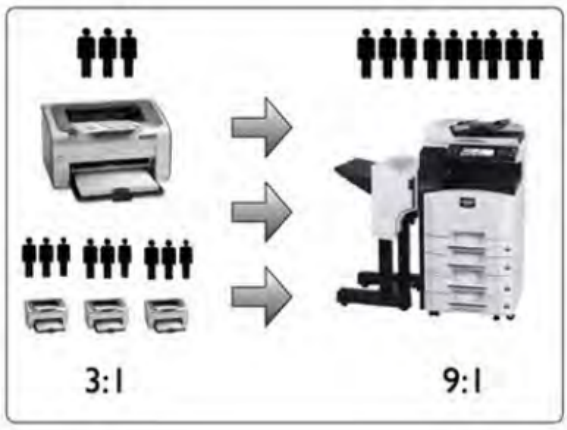
Cold aisle containment



BEST PRACTICES 8 TECHNOLOGY

CONSOLIDATE PRINTERS

Consolidate large fleets of printers or old printers into fewer, more efficient models. Replace existing printers with newer networked printers and/or multi-function devices to save energy and maintenance costs.



BEHAVIORAL TIPS

- ✔ Turn off printers, copiers, and scanners at the end of the day.
- ✔ Unplug TVs, DVD players and other electronics when not in use.

ENERGY BEST PRACTICES GUIDE: TECHNOLOGY 57

Source: https://www.focusonenergy.com/sites/default/files/inline-files/Energy%20Best%20Practices%20Guide-School%20%26%20Government%20Facilities.pdf

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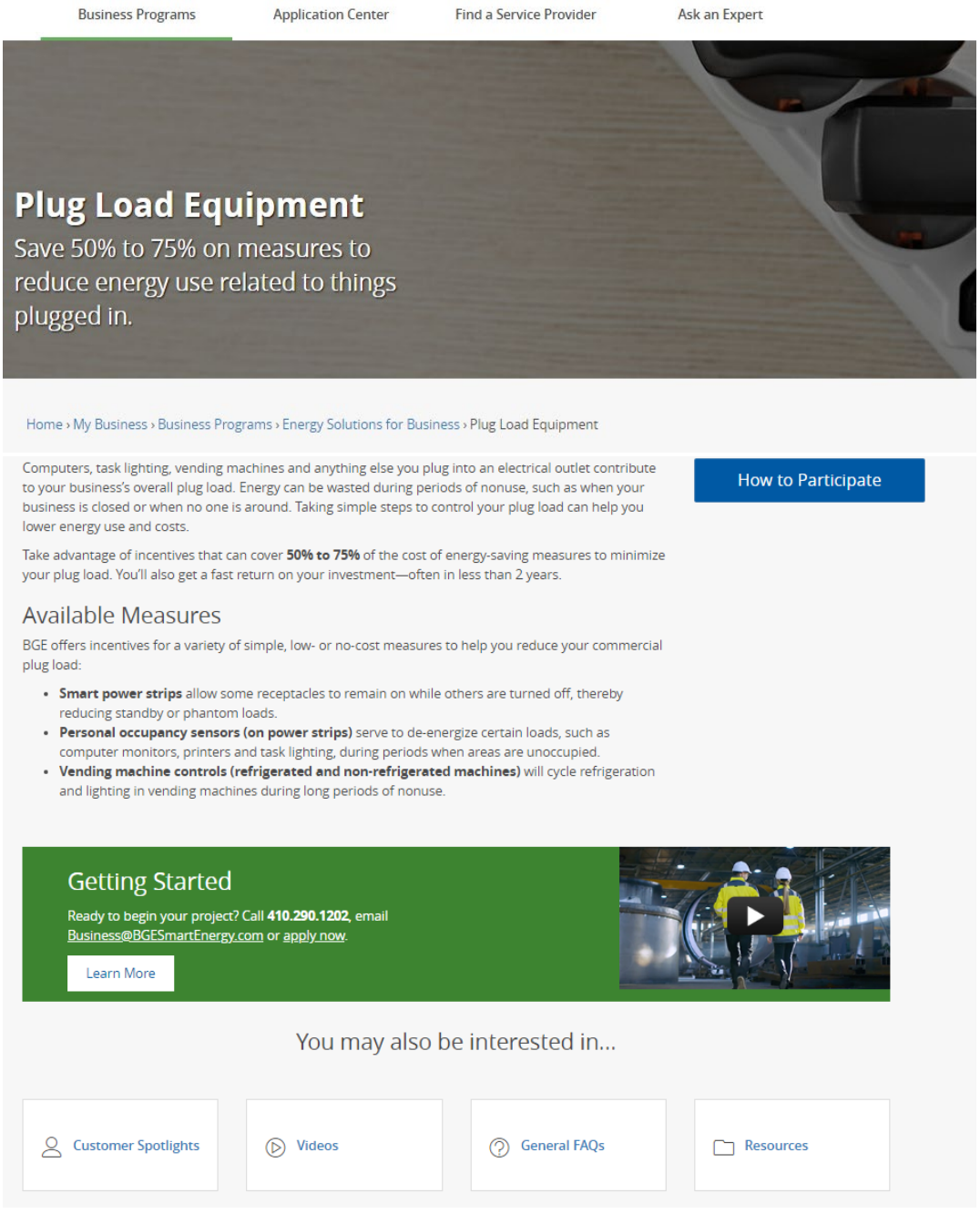
Baltimore Gas and Electric: Plug Load Equipment



Source: https://www.bgesmartenergy.com/business/business-programs/energy-solutions-business/plug-load-equipment

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Efficiency Vermont: Advanced Power Strips

REBATES | SERVICES | PRODUCTS & TECHNOLOGIES | TIPS & TOOLS | FIND A CONTRACTOR OR RETAILER

Advanced Power Strips

Advanced power strips are an easy, low-cost way to manage your home electronics while saving energy and money.

An advanced power strip (APS) looks like a surge protector, but there's a big difference. To prevent "standby load," the electricity a device uses when turned off, a surge protector has to be switched off entirely (or each device must be unplugged). With an APS, you designate one device as the "control"—so when you turn off your TV, for example, other electronics plugged into the strip are automatically shut off. This saves time, effort, and money in the form of lower electric bills.

See Our Offers

Contact Us

Advanced Power Strips in the Home

An APS saves electricity when used with home entertainment systems, home offices, and other places where electronics are operated as a group. Setting one up is easy: First, plug your control device (a TV, for example) into the strip's "control" outlet. Next, plug related devices into the "switched" outlets. Last, plug anything you wish to remain on into the "always on" outlet. Now when you control your TV, any "switched" electronics turn on and off, too.

- Save energy and money: as much as $100 per year by avoiding standby load for game consoles alone
- Save time, simplify your life: one click turns a group of devices on and off
- State-of-the-art surge protection

Advanced Power Strips in the Office

"Current-sensing" advanced power strips work in tandem with computer power management features (PMF). First, set PMFs so your computer goes to sleep after a period of inactivity (15 minutes, for example). A current-sensing APS detects that the control device is in low-power mode, then shuts down attached peripherals such as task lights or printers, which turn back on once the computer exits sleep mode. This saves energy and simplifies workstation routines.

Source: https://www.efficiencyvermont.com/products-technologies/electronics/advanced-power-strips

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Efficiency Vermont: Computer and Monitors

Products & Technologies | Electronics

Computers & Monitors

Energy-efficient computers and displays with power management features can save money for your business or home.

A home desktop computer uses about $20 per year in electricity. Businesses that run multiple computers all day long use even more electricity, and the dollars can really add up. ENERGY STAR® certified desktops and monitors use less electricity in both standby and sleep modes. When shopping, look for the Smart Choice label—these are Efficiency Vermont's top picks, even more efficient than baseline ENERGY STAR models. And if possible choose a laptop, which uses as little as 25% of the electricity that a desktop uses.

Find a Retailer

Contact Us

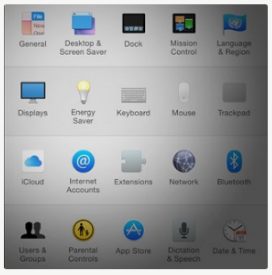
Reasons to Choose ENERGY STAR

In order to earn the ENERGY STAR, a computer must have power management features built into its operating system. Power management allows you to set your computer and display to go into sleep mode after a set amount of time. In sleep mode, these models use about 70% less electricity than those without power management features. In addition, monitors labeled with the ENERGY STAR are on average 25% more efficient than standard models. This results in less energy used, and lower bills for you.

- ENERGY STAR monitors are 25% more energy efficient
- Our Smart Choice label helps you find the most efficient models
- Set power management to put your computer to sleep after 5 to 20 minutes of inactivity

Tips for Saving Even More

Turning off a computer and display when not in use is the best way to save energy, but it's not always practical. After setting your power management, consider a few other easy ways to reduce electricity usage. An advanced power strip will cut down on standby power losses. Screen savers can be energy wasters, so think about disabling that feature. And be sure to close any open windows running games or videos—they can prevent your computer from entering sleep mode.



Source: https://www.efficiencyvermont.com/products-technologies/electronics/computers-monitors

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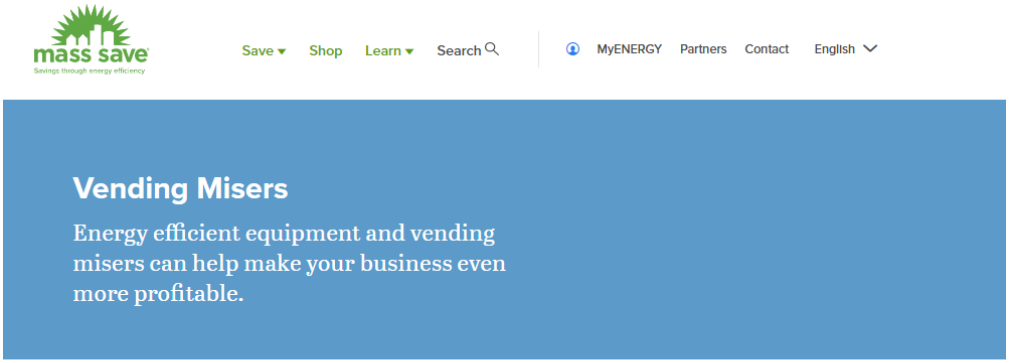
Mass Save (Eversource, MA and National Grid, MA): Vending Misers



Vending misers provide your business with extra income, but they also use electricity even when your building is unoccupied. Energy efficient ending equipment can help you cut energy usage even during down times.

Make Your Vending Equipment Work Smarter For You

vending misers typically use electricity 24 hours per day even if no one is around to use them. ENERGY STAR® qualified new and rebuilt refrigerated beverage vending misers can save building and business owners more than 1,700 kWh/year, or $150 annually on utility bills.

- New and rebuilt refrigerated beverage vending misers that have earned the ENERGY STAR are 50 percent more energy efficient than standard machine models.
- ENERGY STAR qualified new and rebuilt vending misers incorporate more efficient compressors, fan motors, and lighting systems to keep beverages just as cold and the machine visible while using less energy.
- ENERGY STAR qualified new and rebuilt machines come with a low power mode option that allows the machine to be placed in low-energy lighting and/or low-energy refrigeration states during times of inactivity.

In addition, an easy-to-install vending misers device uses a motion sensor to automatically power down the vending machine when the area around it is unoccupied, and power up the machine when a person approaches it. A temperature sensor powers the machine back up as needed to keep drinks cold. A single unit can control up to four vending misers located near each other. Vending misers life is also extended by reducing lamp and compressor use.

Current Incentives for Vending Misers

Energy Management Systems and Vending Misers

We offer financial incentives for the installation of energy management systems and vending misers controls that automatically turn off equipment when not in use.

Explore More Topics

Energy Management Systems and Vending Misers® Offer

Find Your Mass Save Sponsor

Enter Zip Code

GO

Source: https://www.masssave.com/en/learn/business/vending-misers

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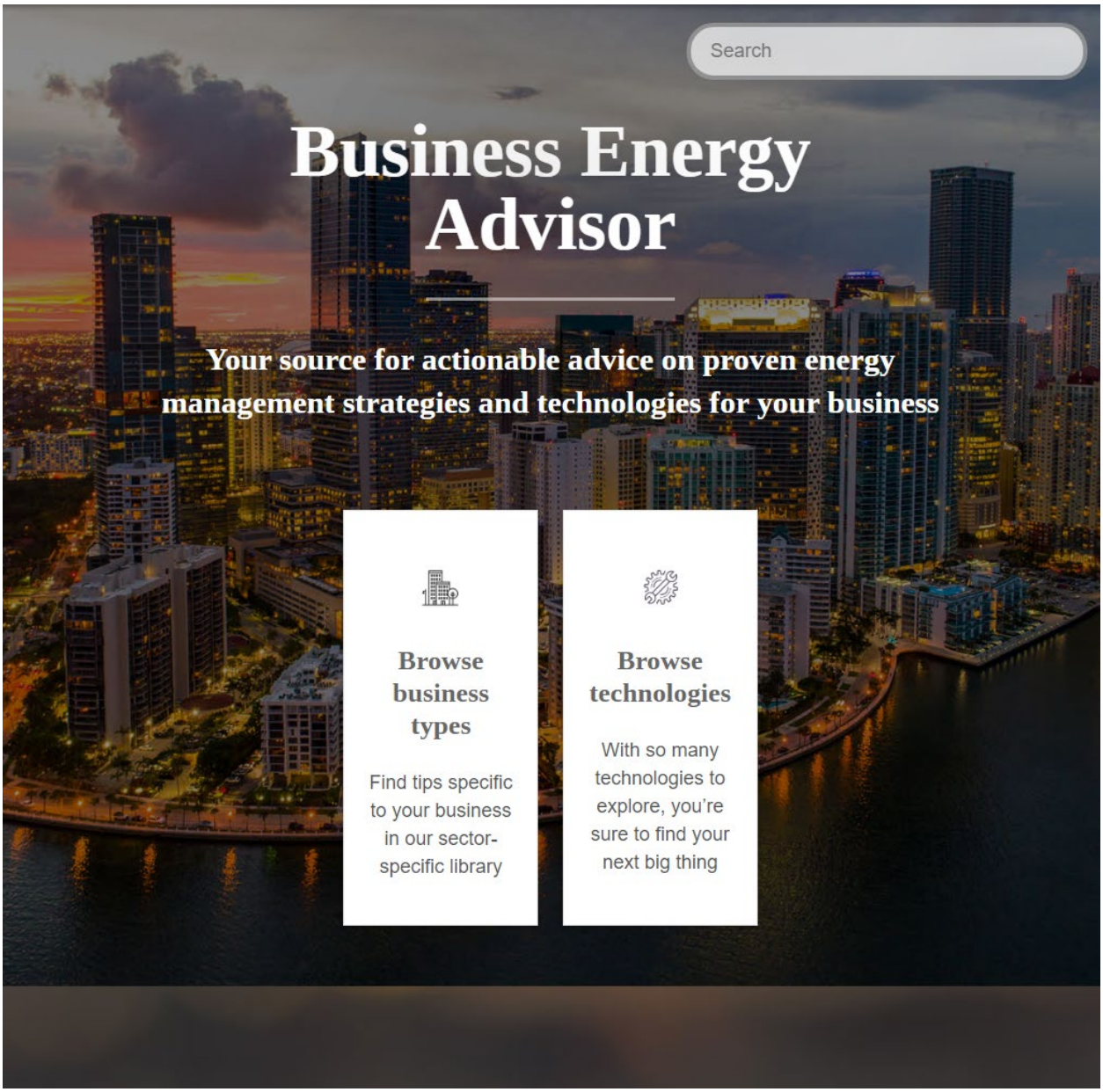
Georgia Power, Florida Power and Light, We Energies: Business Energy Advisor Library



Source: https://www.esource.com/BusinessEnergyAdvisor

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