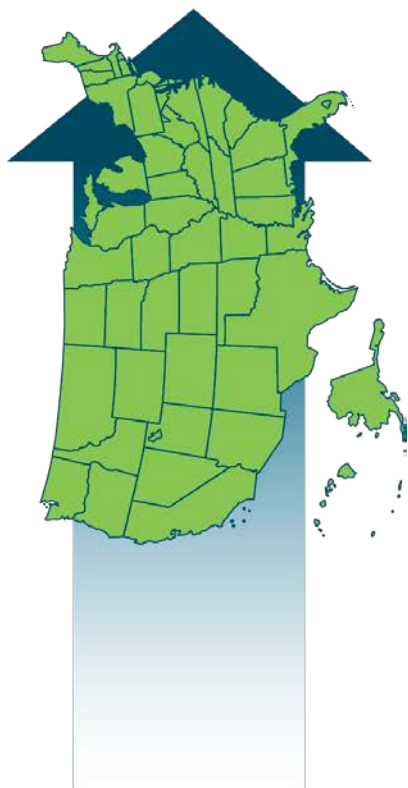


SEE Action

STATE & LOCAL ENERGY EFFICIENCY ACTION NETWORK


SEE Action Guide for States: Energy Efficiency as a Least-Cost Strategy to Reduce Greenhouse Gases and Air Pollution and Meet Energy Needs in the Power Sector

February 2016



The State and Local Energy Efficiency Action Network is a state and local effort facilitated by the federal government that helps states, utilities, and other local stakeholders take energy efficiency to scale and achieve all cost-effective energy efficiency by 2020.

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1. Executive Summary

1.1. How To Use This Guide

This guide is designed to provide information to state decision makers and staff on options to advance energy efficiency through strategies designed or implemented at the state and local levels of government and in the private sector.¹ The information in this guide is intended to be useful to a wide variety of partners and stakeholders involved in energy-related discussions and decision-making at state and local levels. These energy efficiency options, or “pathways” as they are identified in this guide, can assist states in using energy efficiency to meet air pollution reduction and other policy objectives such as energy affordability and reliability.

A pathway is a set of interdependent actions that results in measurable energy savings streams and associated avoided air emissions and other benefits over a period of time. These activities can include state, local, or private sector regulations, policies, programs and other activities. For each of five broad pathways that offer sizable cost-effective energy savings, the guide addresses likely questions policy makers and regulators face when screening for the best opportunities to advance energy efficiency in their state. These screening questions include:

- **Feasibility** – Can the pathway meet the policy goal(s)—and within the required timeframe?
- **Impact** – What scale of impact can be achieved, and how permanent are the results?
- **Responsibility** – Who are the lead entities responsible, and are best practices being followed?
- **Cost** – What is the cost and cost structure of the pathway?
- **Reliability** – Are impacts reliable, and can they be verified and documented?
- **Other considerations** – How can the environment in which the pathway operates support successful outcomes?

The guide also provides sources on where to go for more information to explore the pathways further and what specific benefits they can yield given a state’s unique opportunities.

The pathways discussed in this document do not represent an exhaustive list of options a state might consider. They do represent high-impact strategies that are yielding significant benefits across the country—and in many cases, have been for decades.


Please note this guide does *not* provide guidance on what can and cannot be used as compliance strategies for federal regulations.

1.2. Energy Efficiency Can Reduce CO₂ and Multiple Pollutants for State-Specific Reasons

This guide is useful in a variety of policy contexts. Energy efficiency can be used to help meet state, local, and corporate climate and energy strategies, goals and regulations. It can also be used to comply with state clean air strategies and regulations, as well as federal clean air requirements, such as the National Ambient Air Quality Standards, which regulate ozone, or the Clean Power Plan, which regulates carbon dioxide (CO₂).

Energy efficiency has the advantage of reducing all types of power plant-related emissions simultaneously by avoiding the need to generate electricity in the first place. Therefore, energy efficiency programs can improve air quality by reducing emissions. Whenever households and businesses reduce electricity consumption, somewhere on the grid one or more generators reduce their electric output (all else being equal). Typically, the avoided generation is from higher marginal-cost, fossil fuel-fired power plants, which, depending on the region, can be higher emitting power plants. Thus, avoiding generation from these units is desirable to reduce air pollutant

¹ This guide covers the residential, commercial (including public/institutional) and industrial sectors. It does not include transportation.



emissions. The accumulated benefits of programs such as appliance standards, updated building codes, and more efficient manufacturing have been responsible for significant air quality improvements achieved by the U.S. since the 1970s.²

Energy efficiency programs are central to meeting state objectives for reducing CO₂ emissions from the electric power sector. These programs account for 35% to 70% of power sector reductions in ten states³ with statutory requirements for greenhouse gas reductions. In addition, out of the approximately 30 state-level climate change action plans, energy efficiency programs are a common GHG reduction measure in these plans, and in many cases were among the top five most common measures.⁴

Results from many studies in the U.S. reach the same conclusions: energy efficiency measures are a highly cost-effective means to reduce all pollutants: criteria pollutants, toxic pollutants and greenhouse gas (GHG) emissions.⁵

1.3. Energy Efficiency Is a Good Investment

Energy efficiency is a well-established industry in the U.S. with billions of dollars invested annually through administered energy efficiency services programs, energy savings performance contracting, and other efforts (see section 3.2). These efforts are in turn helping save billions of dollars each year, while also providing reliability, economic and environmental benefits.

Energy efficiency programs are cost-effective. For example, the full cost of saving electricity among U.S. utility efficiency programs across the residential, commercial, industrial, agricultural and low-income sectors was recently estimated at 4.6 cents per kWh, split between the utility and program participants. This compares with an average national electricity price in 2014 of 10.45 cents per kWh.⁶

Energy efficiency programs reduce costs for the utility system from the avoided costs for energy,⁷ generation capacity, and transmission and distribution capacity.⁸ They can also help reduce electricity market prices, reduce disconnections, reduce the number of customers in arrears, improve system reliability and electricity price stability, support local job growth and provide a host of benefits to participants, including non-energy benefits such as increased property values or positive health impacts.

Energy efficiency is playing a significant role in helping meet the energy needs of energy customers throughout the country, with many states incorporating annual energy savings of 1 percent or more into their energy plans and delivery strategies, along with additional policies and programs at the state and local levels.⁹

² Laitner 2009.

³ States with GHG reduction laws include: California, Connecticut, Hawaii, Maine, Maryland, Massachusetts, Minnesota, New Jersey, Oregon, and Washington.

⁴ State climate action plans at http://www.climatestrategies.us/policy_tracker/state/index. Personal communication with Chris James, Regulatory Assistance Project, August 2015.

⁵ Rosenfeld 2008.

⁶ State-by-state average annual rates at: [http://www.eia.gov/electricity/data/browser/#/topic/7?agg=0,1&geo=vvvvvvvvvvo&endsec=v&linechart=ELEC.PRICE.TX-ALL.A~ELEC.PRICE.TX-RES.A~ELEC.PRICE.TX-COM.A~ELEC.PRICE.TX-IND.A&columnchart=ELEC.PRICE.TX-ALL.A~ELEC.PRICE.TX-RES.A~ELEC.PRICE.TX-COM.A~ELEC.PRICE.TX-IND.A&map=ELEC.PRICE.US-ALL.A&freq=A&ctype=linechart<ype=pin&rtype=s&maptype=0&rse=0&pin=.](http://www.eia.gov/electricity/data/browser/#/topic/7?agg=0,1&geo=vvvvvvvvvvo&endsec=v&linechart=ELEC.PRICE.TX-ALL.A~ELEC.PRICE.TX-RES.A~ELEC.PRICE.TX-COM.A~ELEC.PRICE.TX-IND.A&columnchart=ELEC.PRICE.TX-ALL.A~ELEC.PRICE.TX-RES.A~ELEC.PRICE.TX-COM.A~ELEC.PRICE.TX-IND.A&map=ELEC.PRICE.US-ALL.A&freq=A&ctype=linechart<ype=pin&rtype=s&maptype=0&rse=0&pin=)

⁷ Avoided costs of emissions controls are generally considered part of avoided energy costs. The avoided impacts of air emissions that are not controlled are generally captured in tests with a societal perspective—for example, reductions in medical costs and mortality for respiratory ailments and reductions in climate change impacts.

⁸ Neme and Sedano 2012.

⁹ See <http://aceee.org/sites/default/files/publications/researchreports/u1509.pdf>.



1.4. Guide Organization

The guide focuses on five energy-savings pathways, each with distinct strategies. Each of the five pathways includes a featured strategy¹⁰ with a more detailed discussion, including:

- A schematic of **summary answers to the key screening questions** (feasibility, impact, responsibility, cost, reliability and other considerations, as described in section 1.1) and resources for more information
- The **expected range of energy savings** (focusing on electricity where data are available) and avoided GHG emissions from the pathway
- **Evaluation, measurement and verification** (EM&V) approaches for the strategy
- **Requisite policies** to support pathway success
- State, local, and business **case studies** of the pathways in action and their accomplishments

The guide also provides information on tools and resources that can help support success across these pathways and strategies, including:¹¹

- **Methods for estimating and documenting energy savings** drawing from today's mature EM&V industry. This industry includes many professional firms, protocols and guidelines, training and certification programs, regulatory oversight, established conferences, and a rich library of published reports and publicly available data and analyses. Evaluation approaches are becoming increasingly standardized and consistent, with a number of state, regional, and national efforts to define common EM&V procedures and terminology. In fact, independent electricity system operators such as PJM and ISO New England are using energy efficiency as a system resource in their capacity/reliability markets.¹² (See Chapter 2.)
- **Tools for state planning processes** to reduce GHG and other air pollutant emissions in the power sector using cost-effective approaches that meet a variety of policy objectives. (See Appendix A.)
- **Ways to create a sustainable energy efficiency delivery infrastructure** through workforce development—creating in-state jobs and training professionals to design, manage, install, operate and maintain the energy efficiency projects. (See Chapter 3.)
- **Additional considerations to reach policy objectives** such as delivering energy efficiency to low-income communities. (See Chapter 5.)


In order to support power sector planning, this guide presents electricity savings opportunities and impacts wherever existing data sets allow. In some cases, electricity-only information cannot be separated from other fuel types, or the unit of energy used in the data set is not electricity-specific.

The five energy-savings pathways discussed in this guide, and distinct strategies within each pathway, are outlined below. (See Chapter 4.)

¹⁰ The featured strategy is listed first, with the exception of the building energy codes pathway. Code adoption comes before code compliance in practice, and that is the order of presentation in this guide. But code compliance is what generates the electricity savings and therefore is the topic covered in greater depth.

¹¹ Many organizations provide a wide range of resources. For state-focused resources, refer to the SEE Action Network (<http://www.seeaction.energy.gov>), National Association of State Energy Officials (<http://www.naseo.org/> and <http://111d.naseo.org/>), National Association of Regulatory Utility Commissioners (<http://www.naruc.org/>) and National Association of Clean Air Agencies (<http://www.4cleanair.org/>). For regional energy efficiency organizations, see <http://www.neep.org/network/regional-energy-efficiency-organizations-network>. Also see American Council for an Energy-Efficient Economy (<http://aceee.org>), Association of Energy Services Professional (<http://www.aesp.org>), Consortium of Energy Efficiency (<http://www.cee1.org>) and Institute for Market Transformation (<http://www.imt.org>).

¹² See Section 2.5.1 for an extensive list of EM&V resources.

- 
1. **Ratepayer-funded efficiency programs** – Ratepayers, such as utility customers fund programs that promote or directly support the uptake of cost-effective energy efficiency measures in nearly all sectors of the economy. Utilities or third parties administer these programs. Within this pathway, the activities discussed are:
 - a. **Quick Start programs** – These are a set of proven, high-impact, ratepayer-funded energy efficiency initiatives that can be deployed relatively quickly, are comparatively easy to operate, and help build infrastructure for more comprehensive (deep savings) programs to follow.
 - b. **Deep savings programs** – Deep savings programs are longer-term initiatives that aim to acquire hard to reach savings for each project, and those that seek broad savings through outreach to customer segments that are more challenging to engage.
 - c. **Public power programs** – These programs provide services to about a quarter of the U.S. population through community-owned municipal utilities, rural electric cooperatives and people’s utility districts.
 2. **Building energy codes** – State and local building energy codes reduce energy use in new buildings and major renovations by establishing minimum energy efficiency standards for building design, construction and remodeling. Within this pathway, the activities discussed are:
 - a. **Code adoption** – Adoption determines the level of efficiency targeted in commercial and residential buildings. The level depends on which code version is adopted. Codes are updated every three years to keep current with new technologies and market norms.
 - b. **Code compliance** – Compliance means meeting the established building energy requirements and demonstrating that these requirements have been satisfied.
 3. **Local government-led efforts** – Cities and other local governments are poised to reduce electricity use through their role as building and other asset owners, policymakers, taxation authorities and, in some locales, operators of electric utilities. Within this pathway, the activities discussed are:
 - a. **Building performance policies** such as benchmarking and disclosure, energy audits, building rating and retro-commissioning that give building owners, tenants and operators the power to make improvements based on information about how the building is currently using energy.
 - b. **Improving energy efficiency of local government assets** – These include schools, office buildings, and wastewater treatment plants that are directly owned or operated by local governments.
 - c. **Voluntary programs** – Programs such as Property Assessed Clean Energy (PACE) financing, and public-private partnerships or challenges, enable local governments to support energy-saving opportunities across the community.
 4. **State lead-by-example efforts** – States have a broad range of tools they can use to improve the energy efficiency of their own facilities and operations. These improvements directly contribute to reduced air emissions in the power sector and demonstrate successful policies and programs for others to consider, such as owners of commercial buildings in the state. Within this pathway, the activities discussed are:
 - a. **Energy savings performance contracting (ESPC)** – This tool allows entities to implement comprehensive energy-saving projects—and potentially address deferred maintenance needs such as asbestos removal, updating wiring and roof replacement—using private capital. By partnering with an energy services company (ESCO), state agencies can use ESPC to pay for today’s facility upgrades with tomorrow’s energy savings—without tapping into capital budgets. Moreover, state agencies keep all the cost savings when annual savings exceed the amount guaranteed in the performance contract and after the contract period is completed.
 - b. **Building performance and product procurement policies** – These policies reduce energy use and costs for new and existing state-owned buildings and have the added benefit of demonstrating



successful policies and programs for others to consider, such as private sector building owners in the state.

- c. **State equipment efficiency standards** – These standards enable states to set minimum efficiency levels for products that consume significant amounts of energy that are not yet covered by a federal standard, such as computers.
 - d. **Financing access** – Access to low cost financing can overcome the upfront cost barrier of energy efficiency projects, with repayment of borrowed capital offset by energy cost savings. In addition to their own facilities, states can enable access to financing for others, including local governments, school districts, sanitation districts, public hospitals, businesses and consumers.
5. **Large energy users (industry and business)** – Industry and businesses invest in energy-efficient equipment and processes to achieve corporate financial and sustainability goals and could, by themselves, reduce a significant amount of total electricity consumption. Within this pathway, the activities discussed are:
- a. **Strategic energy management** – This term of art refers to systematically and continually improving energy performance and efficiency of facilities and their energy-consuming systems, integrated within an organization’s normal business practice. Participants are generally driven by the business case for energy efficiency: lower operating costs and increased productivity and competitiveness.
 - b. **Combined heat and power (CHP)** – This technology provides two energy services in one energy-efficient step, by generating useful hot water or steam plus electricity from a single system at or near the point of use. Facilities such as hospitals, universities and manufacturing facilities rely on CHP to maintain business continuity, reduce operating costs, improve competitiveness and decrease environmental impacts.
 - c. **ESPC for private commercial buildings** – In addition to its use for institutional and public buildings, the private sector also takes advantage of performance contracting to reduce energy, water, and operation and maintenance costs.

2. Energy Efficiency: An Energy Resource and Emissions Reduction Strategy

2.1. Energy Efficiency Is an Established Energy Resource

Energy efficiency programs have been in place in the U.S. for several decades, and every state has programs in place. In addition, many utilities recognize energy efficiency as an energy resource in the resource plans they develop to guide investment decisions and operational plans.¹³ Nevertheless, the potential of energy efficiency as an energy resource is vast and remains largely untapped.

Energy efficiency potential studies conducted for utility service territories, or at the state or regional level, can provide an estimate of the technical, economic and achievable opportunity for energy, capacity and cost savings for a particular jurisdiction (see Figure 2.1-1). The studies provide a benchmark for goal setting and subsequently provide a yardstick against which to measure actual performance.¹⁴

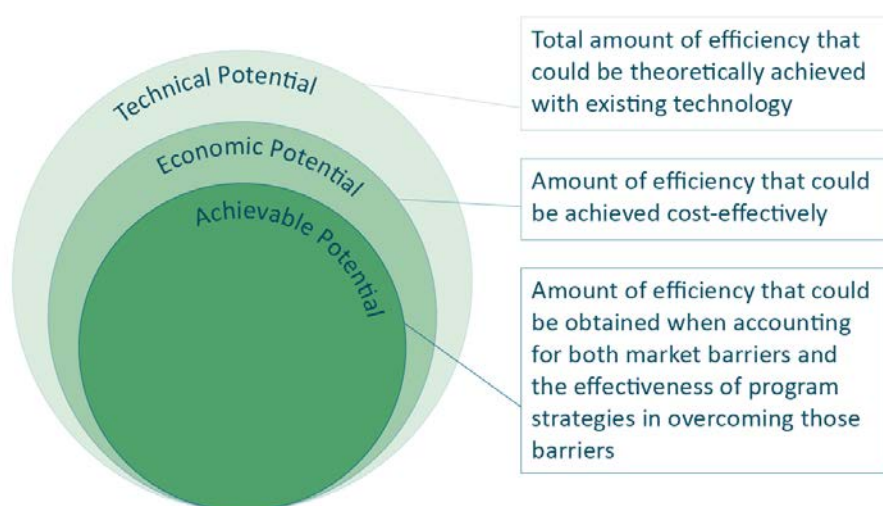


Figure 2.1-1. Energy efficiency potential studies

The energy efficiency industry has established standard protocols and methods for designing, implementing and evaluating programs, and in many places a well-developed delivery infrastructure. Efficiency activities have achieved significant savings over time. Indicators of success include the following:

- **Ratepayer-funded programs** – Nearly a third of states are saving at least 1 percent of electricity each year through programs funded by customers. About another third of states—most relatively new to energy efficiency—are saving between 0.25 percent and 0.75 percent (see Figure 2.1-2). Many states are increasing their efficiency targets as they meet initial goals and are on track to achieve higher savings.¹⁵ Energy efficiency programs funded by customers spent \$6 billion in 2013.¹⁶ *Section 4.2 describes a variety of program options for utility and other ratepayer-funded energy efficiency program administrators.*

¹³ See SEE Action (2011). [Using Integrated Resource Planning to Encourage Investment in Cost-Effective Energy Efficiency](#).

¹⁴ See National Action Plan for Energy Efficiency (2007). *Guide for Conducting Energy Efficiency Potential Studies*. Prepared by Philip Mosenthal and Jeffrey Loiter, Optimal Energy, Inc. http://www.epa.gov/cleanenergy/documents/suca/potential_guide.pdf.

¹⁵ Barbose et al. 2013.

¹⁶ Consortium for Energy Efficiency 2015.

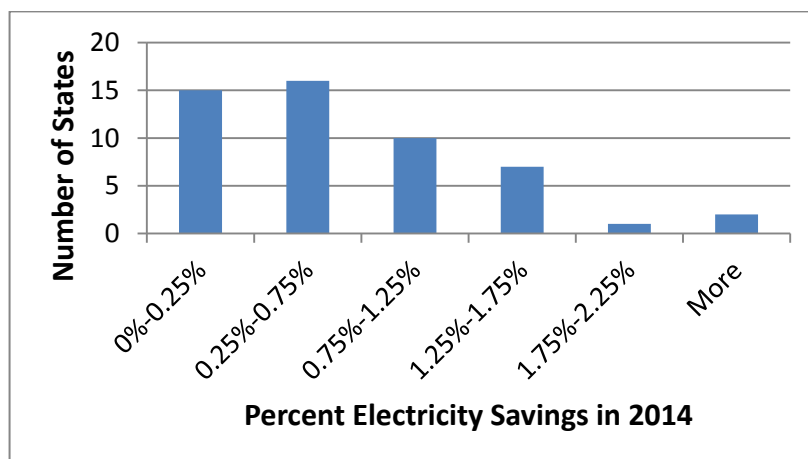


Figure 2.1-2. Annual electricity savings from ratepayer-funded energy efficiency programs¹⁷

- Energy savings performance contracting** – Governments and institutions, as well as businesses, can achieve substantial dollar and energy savings and avoid upfront capital costs by upgrading the energy efficiency of their buildings through the use of energy savings performance contracts with energy services companies (ESCOs).¹⁸ A typical performance contract reduces annual energy use by 15 percent to 30 percent.¹⁹ In 2013, estimated ESCO revenues totaled about \$6.4 billion, with \$71 billion to \$133 billion in remaining investment potential in public and institutional facilities alone.²⁰ In 2012, all active U.S. ESCO industry projects generated an estimated 34 Terawatt-hours of electricity savings—about 2.5 percent of U.S. commercial electricity retail sales.²¹ *Sections 4.5 and 4.6 cover the ESCO industry and performance contracting.*
- Combined heat and power** – CHP currently represents about 8 percent of U.S. generating capacity²²—83.3 gigawatts (GW) at more than 4,200 sites.²³ Together, these installations avoid an estimated 240 million metric tons of CO₂ compared to separate production of heat and electricity.²⁴ *Section 4.6 explores CHP applications for business and industry.*
- Financing** – Energy efficiency financing is available from local, state, federal, and utility-sponsored programs, as well as the private market. According to the National Association of State Energy Officials, over \$2 billion in state energy office administered financing is available for energy efficiency and renewable energy projects in 44 states.²⁵ Qualified energy conservation bonds, a federally supported financing option available to state and local governments, represent an additional \$3.2 billion.²⁶ The bonds can be used for public building energy retrofits, green community programs, rural development,

¹⁷ ACEEE 2015.

¹⁸ Larsen *et al.* 2012.

¹⁹ Patterson and Hessler 2014.

²⁰ Stuart *et al.* 2013.

²¹ Carvallo *et al.* 2015.

²² USDOE and USEPA 2014.


²³ CHP Installation Database developed by ICF International for Oak Ridge National Laboratory and USDOE; March 2014 data. Available at <http://www.eea-inc.com/chpdata/index.html>.

²⁴ USDOE and USEPA 2014.

²⁵ SEE Action and the National Association of State Energy Offices. State Energy Loan Fund Database.

<http://www.naseo.org/state-energy-financing-programs>.

²⁶ Energy Programs Consortium. (2014). Qualified Energy Conservation Bonds. <http://www.naseo.org/Data/Sites/1/epc-qecb-paper-june-2014-.pdf>.



renewable energy projects and mass commuting projects. Just over 30 percent of the \$3.2 billion available has been used in 34 states. The U.S. Department of Agriculture (USDA) offers several low-interest loan programs for businesses and rural electric cooperatives to finance energy efficiency and renewable energy projects. Funding for these programs varies from year to year. In aggregate, energy-related USDA programs offer access to billions of dollars of loans or loan guarantees.²⁷ *Section 4.5 describes state financing tools.*

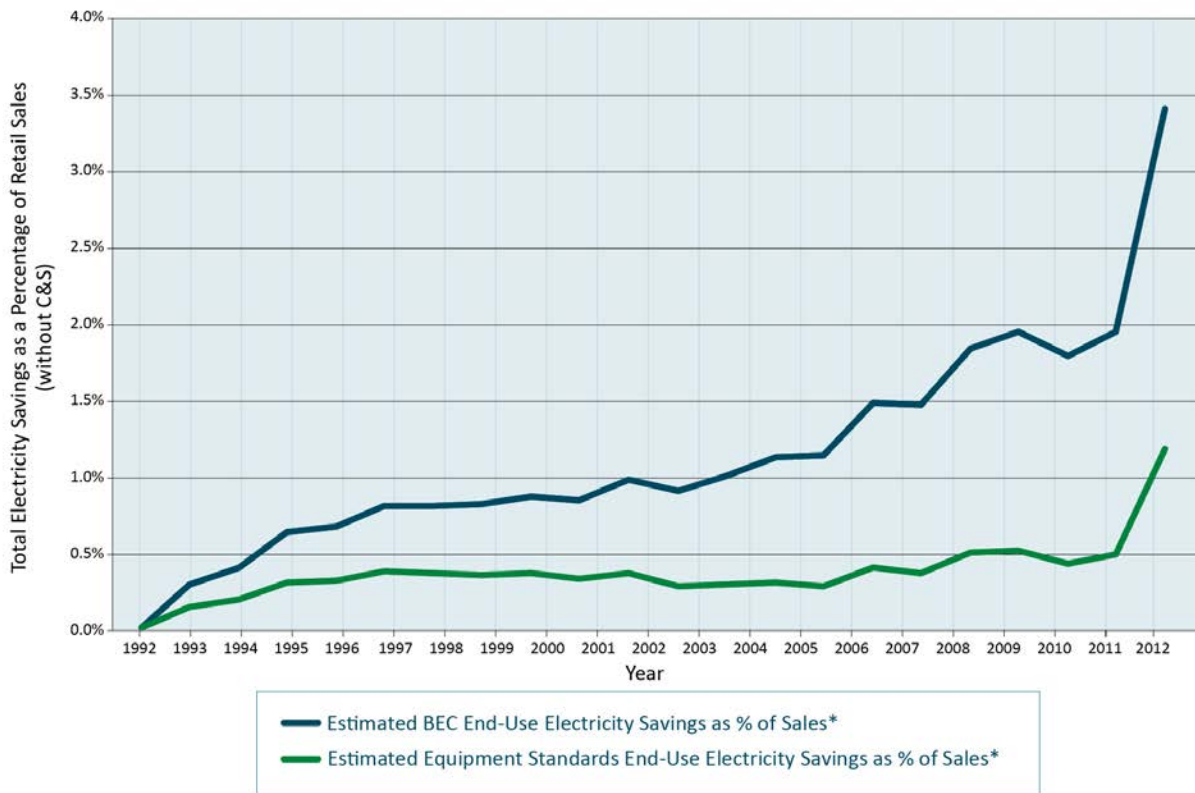
- **Building energy codes and end-use/equipment standards** – Thirteen states have adopted residential building energy codes at least as stringent as the 2012 model code (three states have codes in place that are equivalent to, or are more efficient than, the 2015 model code), and another 22 states have codes as strong as the 2009 model code. Twenty states have adopted commercial building energy codes at least as stringent as the 2010 model code, and another 19 states meet the 2007 model code.²⁸ State standards for end-uses (for example, appliances and lighting) and other energy-consuming equipment also produce electricity savings and often have led to federal standards for those products. Most of the products now covered by national standards were first addressed by state standards.²⁹ By 2012, building energy codes and federal end-use and equipment standards were saving nearly 3.5 percent of electricity sales in the U.S. (see Figure 2.1-3).³⁰ *Section 4.3 explains building energy codes and state equipment efficiency standards.*

²⁷ USDA (2015). All Programs. <http://www.rd.usda.gov/programs-services/all-programs/energy-programs>. See particularly Energy Efficiency and Conservation Loan Program (EECLP), Rural Energy for America Program, and Rural Economic Development Loan and Grant Program. EECLP funding is no longer capped, theoretically opening up approximately \$5 billion for repurposing to energy efficiency financing. Source: Personal communication with Gerry Moore, USDA Rural Utilities Service, December 2015.

²⁸ DOE Building Energy Codes Program, December 2015, <http://www.energycodes.gov/status-state-energy-code-adoption>.

²⁹ <http://www.appliance-standards.org/standard-basics-DOE-state-legislature-product-requirements>

³⁰ Data from Livingston et al. 2013; EIA 2014.



*Baseline sales include retail sales plus, to establish the counterfactual baseline, kilowatt-hours saved through Building Energy Codes (BEC) and federal end-use/equipment standards. Reporting percentages based on retail sales alone would overstate the portion of electricity savings attributed to either policy. Recent updates for codes and standards are leading to significant increases in savings.

Figure 2.1-3. Estimated electricity savings from federal end-use and equipment standards and building energy codes³¹

2.2. Energy Efficiency Saves Money and Is Cost Effective

In addition to saving energy, energy efficiency programs also save money. States generally use one or more standard cost-effectiveness tests to screen specific energy efficiency measures, individual programs or an entire portfolio of programs to ensure these efforts meet cost-effectiveness thresholds. Ratepayer-funded efficiency programs, as well as some state programs such as building energy codes and appliance standards, apply cost-effectiveness tests.


In their simplest form, cost-effectiveness tests evaluate whether the benefits of an investment exceed its costs.³² The tests consider energy efficiency from different points of view, from participants to society as a whole, and consider a wide range of benefits. In addition to standard avoided costs for the utility system (avoided costs for energy,³³ generation capacity, and transmission and distribution capacity³⁴), some tests consider reduced

³¹ Data from Livingston et al. 2013; EIA 2014.

³² National Action Plan for Energy Efficiency 2008.

³³ Avoided costs of emissions controls are generally considered part of avoided energy costs. The avoided impacts of air emissions that are not controlled are generally captured in tests with a societal perspective—for example, reductions in medical costs and mortality for respiratory ailments and reductions in climate change impacts.

³⁴ Neme and Sedano 2012.



electricity market prices, reduced disconnections, collections from customers in arrears, improved system reliability, electricity price stability, local job growth and a host of benefits to participants. Energy efficiency programs also can be screened to account for their full benefits, including non-energy benefits such as increased property values or positive health impacts.³⁵

The full cost of saving electricity among U.S. utility efficiency programs was recently estimated at 4.6 cents per kWh, using a weighted average across programs in the residential, commercial, industrial, agricultural and low income sectors. That includes costs to the utility (or other program administrator), as well as costs to program participants. The utility and program participants split the cost almost right down the middle—on average paying roughly 2.3 cents per kWh each.³⁶ This compares with an average national electricity price in 2014 of 10.45 cents per kWh.³⁷

In regions where new power plants are under consideration—to meet growing electricity demand or to make up for retiring generators or expiring contracts—energy efficiency can defer or reduce the size of new investments in supply, saving utilities and ratepayers money. The estimated U.S. average levelized cost of energy for natural gas-fired combined-cycle power plants—the most common generator built in recent years and planned for the near future—ranges from 6.4 cents to 6.6 cents per kWh according to the U.S. Energy Information Administration and 6.1 cents to 8.7 cents per kWh according to the financial advisory and asset management firm Lazard.³⁸ Even in regions where new generating capacity is not needed, demand-side efficiency avoids energy costs—saving on fuel and other variable costs.

2.3. Energy Efficiency Reduces Multiple Pollutants

Energy efficiency has the advantage of reducing all types of power plant-related emissions simultaneously by avoiding the need to generate electricity in the first place. In recent years, the value of energy efficiency as a cost-effective strategy to reduce air pollutant emissions has grown in importance. Most air pollution control devices are effective at reducing only a subset of the pollutants associated with fossil fuel combustion. Energy efficiency, however, can be used to address air pollution from climate forcers, acidifying substances, eutrophying substances, ozone precursors, and particulate matter or precursors. For example, energy efficiency can reduce ammonia (NH₃), carbon dioxide (CO₂), carbon monoxide (CO), heavy metals (HM), methane (CH₄), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), primary particulate matter (PM), polycyclic aromatic hydrocarbons (PAH), and sulfur dioxide (SO₂).³⁹ With enhanced methods for estimating and determining avoided emissions associated with electricity savings, energy efficiency programs are now being included in air quality improvement plans for a variety of pollutants, including GHG emissions.

While some states were early leaders in recognizing energy efficiency as a multi-pollutant control strategy, other states are just beginning to consider energy efficiency in environmental regulatory programs. Environmental regulatory programs typically mandate specific technologies, practices or policies to reduce emissions of individual pollutants, but can also utilize energy efficiency programs to reduce health risks associated with multimedia (air, water, solid, hazardous waste) discharges.

³⁵ See, for example, <http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf>, <http://www.synapse-energy.com/project/best-practices-screening-energy-efficiency-programs> and <http://www.raponline.org/event/recognizing-the-full-value-of-efficiency-theres-more-layers-in-the-layer-cake-than-many-account>.

³⁶ Hoffman *et al.* 2015. The study determined the average, savings-weighted total cost of saving a kilowatt-hour from 2009 to 2013 in 20 states.

³⁷ State-by-state average annual rates at:

[http://www.eia.gov/electricity/data/browser/#/topic/7?agg=0,1&geo=vvvvvvvvvo&endsec=vg&linechart=ELEC.PRICE.TX-ALL.A~ELEC.PRICE.TX-RES.A~ELEC.PRICE.TX-COM.A~ELEC.PRICE.TX-IND.A&columnchart=ELEC.PRICE.TX-ALL.A~ELEC.PRICE.TX-RES.A~ELEC.PRICE.TX-COM.A~ELEC.PRICE.TX-IND.A&map=ELEC.PRICE.US-ALL.A&freq=A&ctype=linechart<ype=pin&rtype=s&maptype=0&rse=0&pin=.](http://www.eia.gov/electricity/data/browser/#/topic/7?agg=0,1&geo=vvvvvvvvvo&endsec=vg&linechart=ELEC.PRICE.TX-ALL.A~ELEC.PRICE.TX-RES.A~ELEC.PRICE.TX-COM.A~ELEC.PRICE.TX-IND.A&columnchart=ELEC.PRICE.TX-ALL.A~ELEC.PRICE.TX-RES.A~ELEC.PRICE.TX-COM.A~ELEC.PRICE.TX-IND.A&map=ELEC.PRICE.US-ALL.A&freq=A&ctype=linechart<ype=pin&rtype=s&maptype=0&rse=0&pin=)

³⁸ Lazard 2014.

³⁹ RAP 2013a.



2.3.1. Energy Efficiency and Greenhouse Gas Emissions

Electricity generation and power sector emissions are closely linked. Data collected by the U.S. Environmental Protection Agency (EPA) indicate that the electric power sector is a major contributor to air pollutants that contribute to a variety of environmental concerns, including air quality and climate change.⁴⁰ In 2013, for example, fossil-fuel combustion for electricity generation accounted for 31 percent of total GHG emissions in the U.S., which are the pollutants that contribute to climate change.⁴¹

Energy efficiency—reducing electricity consumption at customer sites and consequently demand on power plants—is an effective means of reducing GHG emissions because it reduces the need to combust fossil fuels. Whenever households and businesses reduce electricity consumption, somewhere on the grid one or more generators reduce their electric output (all else being equal). Typically, the avoided generation is from higher marginal-cost, fossil fuel-fired power plants, reducing air pollutant emissions.

Energy efficiency programs are central to meeting state objectives for reducing CO₂ emissions from the electric power sector. These programs account for 35 percent to 70 percent of power sector reductions in ten states⁴² with statutory requirements for greenhouse gas reductions. In addition, out of the approximately 30 state-level climate change action plans, energy efficiency programs are a common GHG reduction measure in these plans, and in many cases were among the top five most common measures.⁴³

Federally, U.S. EPA published the final Clean Power Plan in October 2015. This regulation allows states to use energy efficiency requirements as a compliance option in their state plans to meet the CO₂ emission reduction targets for existing fossil fired EGUs.⁴⁴

2.3.2. Energy Efficiency and Criteria Pollutant Emissions

Energy efficiency programs also reduce criteria air pollutants and improve air quality. The accumulated benefits of programs such as appliance standards, updated building codes, and more efficient manufacturing have been responsible for significant air quality improvements achieved by the U.S. since the 1970s.⁴⁵ One avenue available is quantifying the criteria air pollutant benefits for meeting the National Ambient Air Quality Standards. Under the federal Clean Air Act (CAA), criteria pollutants are regulated through the development of National Ambient Air Quality Standards (NAAQS), which set permissible ambient air concentrations on a pollutant by pollutant basis. States develop pollutant-specific state implementation plans showing how they will lower or maintain air pollutant emissions to meet these standards. States may choose whether they want to include energy efficiency among the strategies in their implementation plans. Implementation plans are needed either as a general plan, if already attaining the NAAQS, to maintain compliance with the NAAQS, or, if not attaining the NAAQS, a specific plan to attain a NAAQS by a future date. EPA encourages state and local governments to use energy efficiency as a way to meet the NAAQS. In 2012, EPA released a Roadmap for Incorporating Energy Efficiency and Renewable Energy Programs and Policies in State Implementation Plans.⁴⁶ EPA also promotes voluntary efforts to reduce criteria air

⁴⁰ See, for example, EPA's National Emissions Inventory Air Pollutant Emissions Trends Data (<http://www.epa.gov/ttnchie1/trends/>) and mercury rule for electric generating units (EPA 2012). 40 CFR Parts 60 and 63 National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Final Rule. Federal Register 77, no. 32 (Feb. 16, 2012): 9310.

⁴¹ U.S. EPA (2015). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2013*. EPA 430-R-15-004. April. <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>.


⁴² States with GHG reduction laws include: California, Connecticut, Hawaii, Maine, Maryland, Massachusetts, Minnesota, New Jersey, Oregon, and Washington.

⁴³ State climate action plans at http://www.climatestrategies.us/policy_tracker/state/index. Personal communication with Chris James, Regulatory Assistance Project, August 2015.

⁴⁴ U.S. EPA Final Clean Power Plan available online at

⁴⁵ Laitner 2009.

⁴⁶ For more information see <http://epa.gov/airquality/eere/index.html>.



pollutants to help states keep their air clean and avoid non-attainment designations through their Ozone Advance and PM Advance Programs.⁴⁷

2.3.3. Energy Efficiency and Multi-Pollutant Benefits

Results from many studies reach the same conclusion: energy efficiency measures are highly cost-effective means to reduce all pollutants: criteria pollutants, toxic pollutants and GHG emissions.⁴⁸

Recent data demonstrate that energy efficiency has helped to sustain long-term air quality improvement, maintain electricity reliability, and protect consumers and businesses from higher energy bills, as demonstrated by the following examples:

- **Minnesota** – Xcel Energy’s energy efficiency programs have avoided construction of 2,500 MW of new power plants since 1992, avoided emissions of over 11,000 tons of oxides of nitrogen (NO_x),⁴⁹ and avoided an economic burden of nearly \$2 billion.⁵⁰
- **California** – Energy efficiency programs in 2010-11 saved 5,900 GWh of energy and avoided the construction of two power plants,⁵¹ saving an estimated \$590 million in capital costs.⁵² The state has avoided the construction of about 40 power plants and their associated emissions since the late 1970s.⁵³
- **Maryland** – The state’s energy efficiency and renewable energy programs provide about 0.60 parts per billion (ppb) reduction to ozone concentrations—an analysis based on programs that are not yet fully mature. Maryland continues to expand its energy efficiency programs under the EmPOWER Maryland Energy Efficiency Act, with further air quality benefits expected to accrue.⁵⁴ EmPOWER is also a key strategy in Maryland’s Greenhouse Gas Reduction Plan.⁵⁵

The energy savings and avoided emissions associated with energy efficiency measures are not limited to savings at the end user’s site. The average fossil-fueled power plant in the U.S. is about 32 percent efficient thermally, meaning that about two-thirds of the fuel is not converted to electricity.⁵⁶ Additional losses occur during the transmission and distribution (T&D) of electricity. The Energy Information Administration estimates average T&D losses to be 6 percent,⁵⁷ though losses as high as 20 percent are possible during peak periods of electricity demand.⁵⁸ Thus, eliminating the consumption of one unit of electricity (site savings) can yield savings of several equivalent units of fuel consumption (source savings) and avoid the emissions associated with that consumption.⁵⁹

⁴⁷ For more information see <http://www.epa.gov/ozoneadvance/>.

⁴⁸ Rosenfeld 2008.

⁴⁹ Xcel Energy 2013.

⁵⁰ National Research Council 2010.

⁵¹ Smart Energy Universe 2014. Assumes that natural gas combined-cycle plants would have been constructed at a levelized cost of \$100/MWh. See <http://aceee.org/files/proceedings/2014/data/papers/8-212.pdf>.

⁵² Assumes that natural gas combined-cycle plants would have been constructed at a levelized cost of \$100/MWh (Lazard 2008).

⁵³ ASE 2013.

⁵⁴ Aburn 2013.


⁵⁵ <http://climatechange.maryland.gov/plan/>

⁵⁶ Laitner 2013.

⁵⁷ EIA 2015. Data are average for the period 1990 to 2012.

⁵⁸ See www.raonline.org/document/download/id/4537.

⁵⁹ This description does not apply to combined heat and power (CHP) applications, which can be as high as 90 percent thermally efficient. CHP applications match power generation to on-site electricity and steam (or heat) demand.



Addressing air quality from a multi-pollutant perspective is not a new idea. Several papers and books have been written⁶⁰ emphasizing the importance and effectiveness of adopting multi-pollutant approaches. Results from economic modeling also demonstrate that reducing multiple air pollutants at the beginning of energy manufacturing processes is far more cost-effective than serial, pollutant-specific efforts focused at the end. Recent efforts suggest that emissions of multiple power sector pollutants can be addressed in a manner similar to the way resource adequacy is practiced in many jurisdictions—through an integrated resource planning process.⁶¹ However adopted, energy efficiency can play an important role in any concerted effort to cost-effectively achieve reductions in emissions of multiple pollutants simultaneously.⁶²

2.4. Documenting Energy Savings and Emissions Reductions

Approaches to determining energy savings or avoided emissions vary depending on the goals and requirements of a state’s particular energy, climate and air quality policies.

However, certain concepts are fundamental to the topic of evaluation, measurement and verification (EM&V) for end-use energy efficiency. This section summarizes key points about documenting energy savings and emissions reductions and describes resource documents and methods on these topics.

2.4.1. Energy Efficiency EM&V Has Been Implemented for Decades

End-use energy efficiency emerged as part of the nation’s energy strategy in the 1970s.⁶³ Since then, efforts to document the impacts of energy efficiency actions have been critical to their success, credibility and expansion. These efforts have evolved over the four decades of documenting efficiency savings for state PUC oversight of programs using billions of dollars of utility customer funds as well as, over the same period of time, for energy savings performance contracts implemented by ESCOs (as described above). Thus, there is now a mature EM&V industry that determines savings for these ratepayer-funded customer funded energy efficiency programs as well as for performance contracts. This industry includes many professional firms, protocols and guidelines, training and certification programs, regulatory oversight, established conferences, and a rich library of published reports and publicly available data and analyses.⁶⁴ Evaluation approaches are becoming increasingly standardized and consistent, with a number of state, regional, and national efforts to define common EM&V procedures and terminology. In fact, independent electricity system operators such as PJM and ISO New England use current EM&V methods as the basis for including energy efficiency as a system resource in their capacity/reliability markets. In addition, state and federal efforts are providing experience and standardized approaches for documenting the impacts of virtually all energy efficiency strategies. These approaches are referenced throughout this guide.

2.4.2. Estimating and Determining Energy Savings

This section covers concepts and resource documents associated with estimating and documenting energy savings.

2.4.2.1 Estimating a Counterfactual Baseline

Regardless of how energy efficiency savings are determined, they are estimates, because it is impossible to definitively measure something that does not exist—energy that was not used. In general, savings are determined by comparing energy consumption after an efficiency action is taken (the “reporting period”) with what is assumed

⁶⁰ National Research Council 2004.

⁶¹ RAP 2013b.

⁶² EPA Guide to Action http://www3.epa.gov/statelocalclimate/documents/pdf/guide_action_full.pdf

⁶³ National Energy Program Fact Sheet on the President’s Program, April 20, 1977.

⁶⁴ The SEE Action Network (<https://www4.eere.energy.gov/seeaction/>) and other organizations provide a wide range of resources. For example, see American Council for an Energy-Efficient Economy (<http://aceee.org>), Association of Energy Services Professional (<http://www.aesp.org>), Consortium for Energy Efficiency (<http://www.cee1.org>) and Institute for Market Transformation (<http://www.imt.org>).

to be the energy consumption in the absence of the action (the “counterfactual” scenario, or the baseline). Thus, savings estimates use baseline assumptions, which by their nature are estimated with varying degrees of accuracy.

Figure 2.4-1 illustrates this concept.

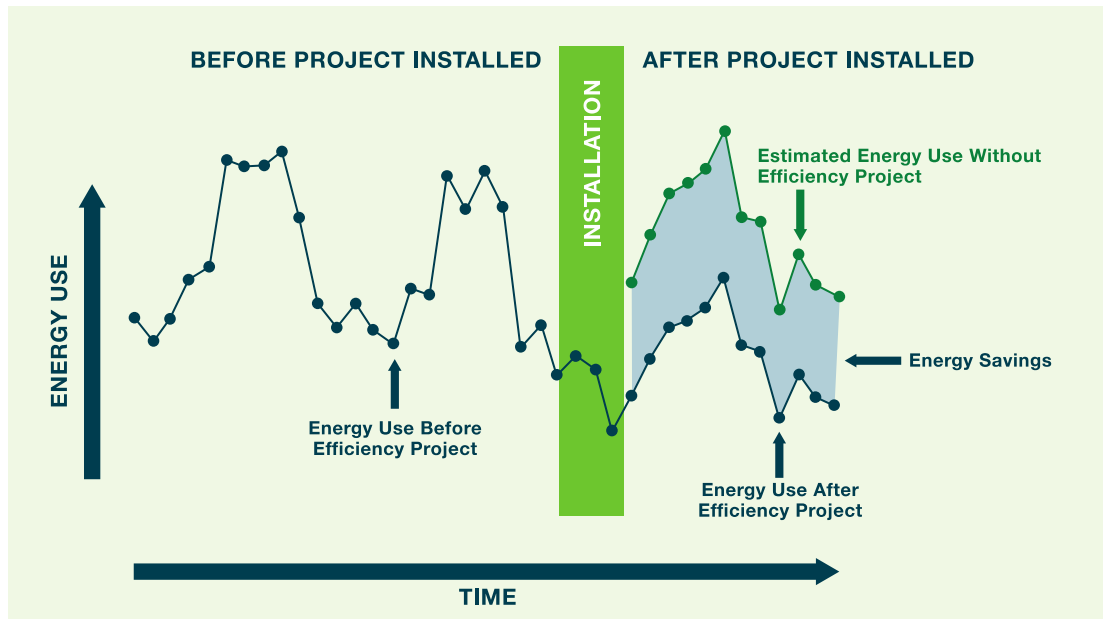


Figure 2.4.2-1. Energy consumption before, during and after a project is implemented⁶⁵

Conceptually, estimating energy savings is similar to what air regulators do to estimate the emissions associated with mobile sources. For mobile sources, emission reductions are estimated by: (a) confirming that the emissions controls are installed and the rate of vehicle emissions (e.g., grams per mile) and (b) developing assumptions about baseline vehicle emissions rates (without the controls) and important variables that determine total emissions reductions (e.g., vehicle miles traveled). This is analogous to estimating energy savings in buildings, which are based on: (a) confirming that the energy efficiency measures are installed and the rate of energy consumption (e.g., kWh per month) and (b) developing assumptions about baseline energy use (without the efficiency measures) and important variables that determine total energy savings (e.g., facility operating hours and weather).


2.4.2.2 Current EM&V Practices

The majority of industry guidance and protocols on documenting savings from energy efficiency programs in the U.S. has been driven by state public utility commission (PUC) requirements for programs funded by utility customers. Typically, annual energy savings reports⁶⁶ are prepared based on requirements established by the state PUC. The reports are submitted for PUC review and approval. They also are used to assess energy efficiency program performance and in utility resource planning.

According to a recent survey, most states (79 percent) rely on independent consultants and contractors to conduct evaluations for ratepayer-funded programs, while some states (21 percent) use utility or government

⁶⁵ SEE Action Network 2012.

⁶⁶ Energy savings reports are typically prepared as part of *impact evaluations*. Impact evaluations are assessments that determine and document the direct and indirect benefits of an energy efficiency program.



agency staff.⁶⁷ Also, EM&V budgets for these programs vary significantly between states, but a typical range is from 3 percent to 6 percent of total energy efficiency program expenditures. One report put the average EM&V budget in 2011 at about 3.6 percent of program expenditures.⁶⁸ As the role of energy efficiency expands as both an energy resource and emissions reduction strategy, states may require additional EM&V. However, advances in EM&V approaches and technologies hold great promise for reducing costs and improving the accuracy of savings determination.

Three industry-standard practice categories of EM&V approaches for quantifying energy savings are *deemed savings*, *project-based measurement and verification (M&V)*, and *comparison-group methods*. Selecting an approach or combination of approaches, involves consideration of factors such as objectives of the energy efficiency activity being evaluated, the scale of the activity, and evaluation budget and resources. Project-based M&V and deemed savings are commonly used for determining savings from individual energy efficiency measures and projects. By contrast, comparison-group methods are usually only used to estimate savings from EE programs.

For well-known and established efficiency measures is the use of “deemed” savings values and calculations, also called stipulated savings values, is a very common approach.⁶⁹ Deemed savings values are estimates of energy or demand savings for a single unit of an installed energy efficiency measure that: (1) have been developed from data sources (such as prior metering studies) and analytical methods that are widely considered acceptable for the measure and purpose and (2) are applicable to the situation being evaluated. Using deemed savings involves multiplying the number of installed measures by the deemed savings per measure.

The deemed savings approach is common because it significantly reduces evaluation costs and the time it takes to receive evaluation results. The previously referenced survey found that nearly all states with established utility commission EM&V oversight (36 states, 86 percent) use some type of deemed values in their utility program evaluations.

Deemed savings values and deemed savings calculations are often documented in databases known as technical reference manuals (TRMs). About 20 states’ utility programs have their own formal TRMs or use regional TRMs that provide deemed savings values that are applicable to their jurisdictions. The SEE Action Network’s EM&V

SOUND APPROACHES TO EM&V

EM&V practices vary, however, sound approaches to any type of EM&V include at least the following:


- Savings should be determined on an ex-post basis (based on actual results, not forecasts) using well-established and credible protocols
- Savings should not be determined by simply comparing energy use before and after an energy efficiency action is taken; important independent variables, for example weather, should be taken into account to isolate the energy savings that result from the energy efficiency activity
- The persistence of savings should be addressed
- Savings values should be confirmed by independent third parties
- Assumptions, particularly concerning baselines, as well the reliability and accuracy of quantified savings should be documented

Further information on EM&V practices and approaches can be found on the SEE Action EM&V portal:
<https://www4.eere.energy.gov/seeaction/evaluation-measurement-and-verification-resource-portal>.

⁶⁷ Kushler, M., *et al.* 2012.

⁶⁸ Wallace and Forster 2012.

⁶⁹ Efficiency’s deemed savings values can be compared with AP-42 emission factors in that both are developed and used in situations where well-documented values/factors provide sufficient reliability and certainty for regulatory purposes.



portal includes a list of TRMs, most of which have been approved by a state agency, as well as a discussion of options for developing regional TRMs.⁷⁰

2.4.2.3 Common EM&V Protocols

Numerous EM&V guidelines and protocols have been developed over the four-decade history of energy efficiency programs. Some of these documents have been developed by federal agencies, state PUCs and state energy offices that have oversight responsibility for these programs. Other documents have been developed by national and international efficiency industry groups for the purpose of bringing consistency to EM&V practices. These documents are now in wide use and provide the benefits of establishing minimum requirements and best practices for the conduct of EM&V, as well as protocols providing specific EM&V requirements that can be referenced in air quality program regulations.

Table 2.4-2 describes common protocols and guidelines for EM&V for energy efficiency programs. While some resources were created for a specific purpose, in practice they may be used for additional applications.

⁷⁰ SEE Action Network 2011.

Table 2.4.2-1. Common End-Use Efficiency EM&V Protocols and Guidelines

Protocol/Guideline	Sponsoring Organization	Focus on Programs, Projects or Both ⁷¹	Website	Summary
Uniform Methods Project (UMP)	U. S. Department of Energy (DOE)	Both	http://energy.gov/eere/about-us/ump-protocols	<p>Describes protocols that are based on commonly accepted methods for a core set of widely deployed energy efficiency measures. The UMP currently covers these efficiency project and program types (but is adding more):</p> <ul style="list-style-type: none"> • Commercial and industrial lighting, lighting controls, chillers, new construction projects, retro-commissioning, chillers, variable frequency drives, HVAC controls, data centers and compressed air. • Residential furnaces and boilers, lighting, behavior programs, and refrigerators. • Combined commercial and residential HVAC, efficiency upgrades and whole building projects.
Energy Efficiency Program Impact Evaluation Guide	SEE Action Network, facilitated by DOE and EPA	Both	www.epa.gov/eeactionplan	<p>Describes common terminology, structures, and approaches used for determining energy savings as well as avoided emissions and other non-energy benefits resulting from facility (non-transportation) energy efficiency programs. It provides context, planning guidance, and discussion of issues that determine the most appropriate evaluation objectives and best practices approaches for different efficiency portfolios.</p>
Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans	EPA	Both	http://www.epa.gov/airquality/eere/pdfs/EEREmanual.pdf	<p>Provides guidance on incorporating energy efficiency and renewable energy policies and programs into State and Tribal Implementation Plans.</p>

⁷¹ *Programs* are activities, strategies, or approaches undertaken by a state, utility, contractor, private company or other entity that directly result in efficiency-induced energy savings. *Projects* are activities involving one or more energy efficiency measures installed at a single facility or site.



NEEP Regional-Common EM&V Methods and Savings Assumptions Guidelines	Northeast Energy Efficiency Partnership	Both	http://www.neep.org/regional-emv-methods-and-savings-assumptions-guidelines-2010	Provides methods to consider in determining gross energy and demand savings and savings assumptions for a priority set of energy efficiency program/project types or measures
<i>California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals</i>	California Public Utilities Commission	Programs	http://www.calmac.org/publications/EvaluatorsProtocols%5FFinal%5FAdoptedviaRuling%5F06%2D19%2D2006%2Epdf	Guides the efforts associated with conducting evaluations of California's energy efficiency programs and program portfolios
International Performance Measurement and Verification Protocol (IPMVP)	Efficiency Evaluation Organization	Projects	www.evo-world.org	Provides an overview of current best practices for determining savings from energy efficiency projects and measures. The IPMVP provides a framework and definitions that can help practitioners develop M&V plans for their projects.
FEMP M&V Guidelines	DOE Federal Energy Management Program	Projects	http://mnv.lbl.gov/keyMnVDocs	Provides guidelines and methods for documenting and verifying the savings associated with federal agency performance contracts; includes procedures and guidelines for quantifying the savings resulting from energy efficiency
ASHRAE Guideline 14, Measurement of Energy and Demand Savings	American Society of Heating, Refrigerating, and Air-Conditioning Engineers	Projects	www.ashrae.org	ASHRAE is the professional engineering society that has been the most involved in writing guidelines and standards associated with energy efficiency. Compared with the FEMP M&V Guidelines and the IPMVP, Guideline 14 is a more detailed technical document that addresses the analyses, statistics, and physical measurement of energy use for determining energy savings.
Regional Technical Forum (RTF)	Northwest Power and Conservation Council	Projects	http://rtf.nwcouncil.org	The RTF is an advisory committee established to develop standards to verify and evaluate the savings from a wide range of energy efficiency and conservation measures. The RTF maintains an extensive and well documented database of deemed savings values.



Superior Energy Performance Measurement and Verification Protocol for Industry	DOE	Projects	http://www.energy.gov/eere/amo/downloads/superior-energy-performance-measurement-and-verification-protocol-industry	Defines the procedures that will be used to confirm conformance with the energy performance level requirements of the Superior Energy Performance Program.
ISO-NE Measurement and Verification of Demand Reduction Value from Demand Resources - Manual M-MVDR	Independent System Operator – New England (regional transmission organization)	Projects	http://www.iso-ne.com/participate/rules-procedures/manuals	Provides guidance and required criteria for the measurement and verification of performance of Demand Resources participating in the wholesale electric markets administered by the ISO
PJM Manual 18B: Energy Efficiency Measurement & Verification	PJM Interconnection (regional transmission organization)	Projects	https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB8QFjAA&url=https%3A%2F%2Fwww.pjm.com%2F~%2Fmedia%2Fdocuments%2Fmanuals%2Fm18b.ashx&ei=m9xHVceiEMvJtQXviYDoDw&usg=AFQjCNEQb0Z65Y_2ESjIdAP10sPjZb94Mw&sig2=Ydqecugs2PPnuJTwxmtPlw&bvm=bv.92291466,d.b2w	Provides guidance on measurement and verification of the demand reduction value of energy efficiency resources

2.4.3. Estimating and Determining Avoided Emissions

Avoided emissions from energy efficiency measures can be derived from estimates of the associated energy savings. Consequently, a key consideration when determining avoided emissions from energy efficiency is that the timing and location of energy savings determines which electric generating units' (EGU) output is displaced.

- **Timing** – Which individual EGUs operate on the electric grid varies by season, by weekday versus weekend, and by time of day. Thus, the timing of the energy savings affects which EGUs reduce output and emissions.
- **Location** – Where on the grid the efficiency savings take place, and which EGUs serve that portion of the grid, also affect which EGUs' output and emissions are displaced by efficiency actions. Identical efficiency projects in different parts of a state can have different emissions.

While estimating avoided emissions from energy efficiency can be complex, air regulators can use a number of established analytical approaches that account for timing and location to estimate avoided emissions from energy savings data. There are three widely used approaches:


1. **Average emissions approaches** use an emission factor to estimate avoided emissions based on the average emissions resulting from one unit of energy consumption. The annual emissions of all of the generators operating within a defined geographic area are divided by the aggregated annual net generation within the same area to get a "system average" emission rate. EPA's Emissions & Generation Resource Integrated Database (eGRID)⁷² provides such emission rate data for nitrogen oxides, sulfur dioxide, mercury and GHG for 26 subregions of the U.S.
2. **Marginal emissions approaches** estimate avoided emissions by using the *actual* emissions rates of specific EGUs that are likely to operate less when the energy savings occur, based on historical data. EPA has developed the AVERT model⁷³ to assist in estimating emissions using this method.
3. **Dispatch modeling approaches** use sophisticated computer algorithms and software to simulate how power plants and transmission systems are likely to operate under future conditions. Instead of assuming that future behavior will match historical behavior, these models are driven by input assumptions about future fuel prices, unit operating costs, energy demand, etc. Because these models can forecast the output of each generator on the system, and each generator's emissions rates are known, these models also can be used to project emissions. By modeling two scenarios—one including the impacts of energy efficiency policies and programs, and one without those impacts—an analyst using such a model can develop estimates of avoided emissions.

AVOIDED EMISSIONS VALUES AND THE CLEAN POWER PLAN

Avoided emissions values may not always be needed to determine compliance with air quality regulations. More likely, a state will not need to calculate avoided emissions values for compliance under the Clean Power Plan. However, there are other reasons (e.g., for planning purposes for mass-based state plans) a state could be interested in this calculation. In some situations, documenting the efficiency actions—or the energy savings—is all that is required to show compliance with the air emissions initiative or regulation and to get the emissions accounting correct. The rate-based approach in the Clean Power Plan provides for crediting of energy efficiency savings with the calculation of Emissions Rate Credits, which are defined and determined in units of energy (MWh).

⁷² See www.epa.gov/egrid/.

⁷³ See <http://www.epa.gov/avert/>.



Appendix A of this guide describes several tools for calculating impacts of energy efficiency programs, including avoided emissions and electricity savings, including EPA's *Assessing the Multiple Benefits of Clean Energy: A Resource for States*, which provides an analytical framework for projecting potential emissions and other impacts from energy efficiency and includes tips on tools and approaches to use, what to consider when calculating emissions impacts, and examples from state and local governments.⁷⁴ In 2012, EPA published a roadmap for energy efficiency and renewable energy⁷⁵ as a subsequent resource to address some of the issues associated with determining avoided emissions, such as the difficulty in tracing emissions avoided through energy efficiency back to specific EGUs, and to increase uptake of energy efficiency and renewable energy as emissions control strategies. Chapter 6 of SEE Action Network's *Energy Efficiency Program Impact Evaluation Guide* also provides guidance for estimating avoided emissions from energy efficiency.⁷⁶

⁷⁴ *Assessing the Multiple Benefits of Clean Energy: A Resource For States*, U.S. EPA, 2011
<http://www3.epa.gov/statelocalclimate/resources/benefits.html>

⁷⁵ EPA 2012.

⁷⁶ SEE Action 2013.



3. Developing a State Energy Efficiency Portfolio: Practical Considerations

3.1. Working Across State Agencies, With Local Governments and the Private Sector, and Regionally

While some state air regulators have had experience using energy efficiency in air quality planning, most of the states' deep knowledge about energy efficiency programs resides in agencies beyond the environmental protection departments. The public utility commission (PUC) and state energy office (SEO) have experience and staff knowledgeable in the areas of energy efficiency planning, program design, implementation and evaluation.

States are increasing the coordination across agencies in order to meet multiple policies and regulations at least cost and to take advantage of the many benefits of energy efficiency, including reducing energy costs, avoiding multiple air pollutants simultaneously, and developing local jobs that can't be exported.

In order to include energy efficiency programs in state plans to reduce air pollution, air quality agencies will need to engage—in some jurisdictions, for the first time—in certain energy efficiency program areas, such as approving multi-year program portfolios and establishing evaluation, measurement and verification processes. In a few areas, state air regulators will have primary responsibility, including:

- Establishing potential avoided emissions from energy efficiency programs as real, surplus, verifiable, quantifiable and enforceable
- Approving regulations for quantifying and crediting avoided emissions
- Defining energy savings inputs for emissions modeling
- Setting protocols for converting energy savings into emission reductions

In most other aspects of energy efficiency programs, however, air regulators will simply provide input for consideration by the lead agency (PUC or SEO).

Existing as well as new energy efficiency programs can contribute to the portfolio of air emissions reduction programs that are included in state plans to reduce air pollution. The state air agency, PUC, and SEO can work together to make any changes that may be needed to adapt programs to meet air quality requirements and develop standardized data and a robust data collection and reporting process.

States can begin by taking stock of data available through a variety of state, regional, federal, and other public and private sources.

State partnerships with local government initiatives (see Section 4.3.2 of this guide), voluntary business and industry initiatives (Section 4.3.4), ratepayer-funded programs (Section 4.2), the energy efficiency industry, local and regional energy efficiency organizations, and other stakeholders improve coordination and may provide support for state, private sector or nonprofit entities to aggregate energy savings for emissions reduction strategies.

Throughout the U.S. are long-standing and relatively new organizations addressing a variety of regional electricity matters, such as energy efficiency market transformation activities, GHG and other air quality initiatives, resource adequacy and transmission planning.⁷⁷ In these and other regional forums, states are working collaboratively to consider ways to work together to achieve electricity savings and GHG emission reductions at least cost.

⁷⁷ For example, the Northwest Energy Efficiency Alliance, Northwest Planning and Conservation Council, Committee for Regional Electric Power Coordination, Eastern Interconnection Planning Collaborative and the New England States Committee on Electricity.



3.2. Workforce Development: Building a Sustainable Energy Efficiency Delivery Infrastructure

Beyond establishing policies, regulations and programs through one or more energy efficiency pathways, several forms of infrastructure support need to be in place to deliver efficiency benefits successfully and on an ongoing basis. For example, consumers need to demand energy efficiency services and products, and qualified contractors and retailers need to be available to provide them.

Workforce training and development efforts are designed to provide the necessary skills and labor base to ensure the delivery of planned energy savings (see text box). For energy-efficient strategies to realize their full potential, there must be adequately trained professionals to design, manage, install, operate and maintain them.⁷⁸ A large and growing number of energy efficiency programs and policies nationwide have embedded workforce quality requirements to ensure high quality, persistent savings through the energy efficiency delivery process. The infrastructure of professional trainings and certifications to develop skilled workers has already been developed and can be leveraged for greater success in achieving program and policy goals.

The energy efficiency workforce is diverse. Energy efficiency workforce services can be categorized at a high level into five types:⁷⁹

1. **Planning and project management** is conducted by program administrators, federal and state efficiency staff, implementation contractors, technical support service providers and energy managers.
2. **Consulting and energy advisory services** are provided by design and engineering firms, implementation contractors, technical support service providers, energy services companies (ESCOs) and energy managers.
3. **Construction and installation** is done by design and engineering firms, building and construction firms, insulation firms, technical support service providers, ESCOs and local weatherization agencies.
4. **Evaluation, measurement and verification** are performed by program administrators, implementation contractors, technical support service providers, ESCOs, energy managers and engineering firms.
5. **Operations and maintenance** is managed by building operators and facilities staff.⁸⁰

Most spending in the energy efficiency services sector goes to insulation jobs (including envelope insulation to meet building energy codes and mechanical insulation to optimize equipment performance and achieve energy savings), work by ESCOs (including energy savings performance contracting), and utility ratepayer-funded activities and associated market activity. For every million dollars spent on these activities nationally, Lawrence Berkeley National Laboratory (LBNL) estimated the resulting person-years of employment (PYE)⁸¹ required is 8.9 PYE for insulation, 2.5 PYE for ESCO work, and 6.2 PYE for ratepayer-funded efficiency activities and associated market activity. Depending on the level of spending, LBNL projected that job growth in the U.S. energy efficiency services sector would double in a low-growth scenario, and increase by four-fold in a high-growth scenario (deemed to be most likely), between 2008 and 2020.^{82,83} Another study by Pacific Northwest National Laboratory found that

⁷⁸ For an analysis of training and education needs to support expected growth in the energy efficiency services workforce, see Goldman, *et al.* 2010a.


⁷⁹ Goldman *et al.* 2010b.

⁸⁰ For more on Building Operator Certification, see <http://www.theboc.info/>.

⁸¹ One PYE equals one person working full-time for a year.

⁸² Goldman *et al.* 2010b.

⁸³ See Anderson *et al.* 2014 for a literature review and analysis of employment impacts in 2030 for scenarios achieving 10 percent and 15 percent electricity savings in the U.S., compared to 2015.



reducing energy expenditures generated a net gain of an estimated 8 jobs per million dollars of consumer bill savings and 11 jobs per million dollars of investment in energy efficiency.⁸⁴

There are a number of paths to building a qualified workforce for the energy efficiency services sector, such as state requirements for certifications for energy efficiency service jobs and community college workforce training and education in the building trades. One example is the Heating, Ventilation, Air Conditioning and Refrigeration (HVACR) program of study at the College of DuPage in Illinois,⁸⁵ which recognizes that the HVACR industry is among the top 30 growth occupations in the U.S. Its graduates become self-employed business owners or are in demand as contractors and building engineers by utility and supply chain companies, as well as governmental organizations.

The most common workforce development pathways into the energy efficiency industry are as follows:

- Apprenticeship programs (union or non-union) in the building trades
- Community college career-technical education programs
- Industry training and certification programs (e.g., Building Performance Institute, International Facility Management Association)
- Four-year degree programs (e.g., for architects and engineers)

Government and industry together develop national skill standards. Three U.S. DOE initiatives, working closely with industry partners, provide energy efficiency work quality and certification guidelines for the residential, commercial and industrial sectors:

- **Weatherization Assistance Program’s Guidelines for Home Energy Professionals** – These include Standard Work Specifications that define acceptable outcomes for home energy upgrades and Home Energy Professional Certifications for workers that pass an exam to demonstrate comprehensive knowledge and technical proficiency.⁸⁶
- **Better Buildings Workforce Guidelines** – These voluntary national guidelines are designed to improve the quality and consistency of commercial building workforce credentials for four occupations: building energy auditor, building commissioning professional, building operations professional and energy manager.⁸⁷
- **Superior Energy Performance Workforce Certification** – To teach the broad range of skills required to capture and sustain energy savings for industrial plants, the Superior Energy Performance program requires contractors working on the projects to be certified through the Certified Practitioner in Energy

WORKFORCE TRAINING


Developing a qualified workforce to deliver electricity savings through energy efficiency offers the opportunity to create in-state jobs through specialized training. Training prepares a state for the successful implementation of an energy efficiency industry and for top quality execution of efficiency projects. Many community colleges offer HVAC, electrical, and other building and construction-related education that could include training on energy efficiency aspects of these fields. A growing number of technical colleges are increasingly focused on adding efficiency-related curriculum. Energy efficiency also can be integrated into coursework at universities for building engineers and building scientists.

⁸⁴ PNNL’s report, Assessing National Employment Impacts of Investment in Residential and Commercial Sector Energy Efficiency. http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-23402.pdf

⁸⁵ <http://www.cod.edu/programs/hvacr/index.aspx>.

⁸⁶ EERE 2015a.

⁸⁷ EERE 2015b.



Management Systems (CP EnMS) program. The program includes energy efficiency and continual business improvement skills.⁸⁸

States interested in understanding current and future qualifications of the workforce delivering energy efficiency in their state can ask program and government administrators the following questions:

- What certifications or licenses are required for workers to perform energy efficiency work?
- Have publicly-supported training programs (e.g., community colleges) been aligned to meet the growing demand for energy efficiency job skills?
- Is the jurisdiction working with its state and local chapters of national industry associations to ensure they are helping to develop a pipeline of skilled workers through training and certifications for the energy efficiency job needs of the state?
- Are national or state quality installation standards (e.g., electrical, mechanical, or HVAC codes and industry technical standards) required by the state, at the local level or by individual energy efficiency programs?
- Is there an inspection or quality assurance system in place to review the quality of work once the energy efficiency measures have been installed?
- Is there a feedback mechanism in place to identify and address work quality problems that are identified through the quality assurance process?

States can assess both existing workforce capacity and future workforce demand from an expanding energy efficiency services sector. There are three ways to estimate the number of jobs needed for this sector:

1. Collecting real-time labor market information
2. Conducting employer surveys
3. Projecting future labor demand based on estimated increased activity in the energy services sector

Existing jobs in the sector may require training for practitioners to upgrade their skills. For example, heating, ventilating and air conditioning contractors may need to learn how to properly install new types of high efficiency equipment. Other job categories are specific to the energy efficiency services sector—for example, home energy modeling—and may be new to contractors in a state with a nascent energy efficiency industry.

It takes time to identify projected workforce needs and recruit and train qualified contractors. States that want to ramp up energy efficiency activities should consider workforce issues early in the process.

⁸⁸ EERE 2015c.

4. Options to Cost-Effectively Achieve Energy Efficiency Goals

4.1. Introduction – The Pathways Concept

States have many options to cost-effectively achieve energy efficiency goals. This guide refers to these options as **pathways**.

A pathway is a set of interdependent activities that results in specific energy savings streams and avoided air emissions over a period of time (as well as achieving other objectives such as job growth). For example, the building energy codes pathway includes state adoption of a specific code, training for design and construction professionals on how to comply with the code, installation of the efficiency measures specified by the code, and enforcement of the code by local officials. These activities can take the form of policies, regulations, programs or projects, familiar tools to state officials. Activities that make up a pathway are overseen by one or more responsible entities, occur in a specific timing sequence, and can be supported for success through common infrastructure elements such as marketing strategies and workforce development.

Table 4.1-1. State Toolbox: Activities That Define a Pathway

Tool	Definition	Building Energy Codes Example
Policies	Objectives, criteria or courses of action established by governors, mayors, legislatures, city councils, and agencies of state or local governments as well as by businesses	A uniform building energy code adopted by the state legislature, and authorization for a stakeholder group to develop code updates on a regular cycle (or the legislature's requirement that the state continually adopt the most current version of the International Energy Conservation Code within a year of publication)
Regulations	Rules established by local or state agencies to implement policies by prescribing or proscribing conduct by those subject to the regulation	Specific code requirements established by the designated state agency
Programs	Activities, strategies, or approaches undertaken by a state, utility, contractor, private company or other entity that directly result in efficiency-induced energy savings	Training for local code officials, designers, builders and contractors to improve compliance with code requirements, provided by the state energy office and local utilities
Projects	Activities involving one or more energy efficiency measures installed at a single facility or site	A home that complies with the state's energy code

Policies and regulations alone do not necessarily result in energy savings. Programs, and the efficiency projects they support, are the vehicles by which policies and regulations are implemented, energy savings are delivered, and the level at which these savings typically are determined or quantified.

Pathways can be combined into a state **portfolio** designed to obtain a specified level of energy savings or emissions reductions. Pathways can be thought of as discrete wedges, each delivering a portion of an overarching energy savings or emissions reduction goal, which can be stacked to achieve the goal in its entirety. In other words, a state's portfolio of multiple energy efficiency pathways is designed to reach the goal. Some pathways overlap or interact with one another. For example, ratepayer-funded programs (see Section 4.2 of this guide) may support

building energy codes (Section 4.3) or voluntary business and industry initiatives (Section 4.6) by providing financial incentives, training and technical assistance.

States can choose among a myriad of potential portfolios by combining pathways in different ways. Variations in portfolios also can come from adjusting the level of energy savings or emissions reductions each pathway contributes to the overall target.

This guide discusses five pathways:

1. **Ratepayer-funded efficiency programs**, such as those delivered by investor- and publicly-owned utilities and third-party energy efficiency administrators
2. **Building energy codes**, including code adoption and compliance
3. **Local government-led efforts**, such as benchmarking and disclosing building energy use
4. **State lead-by-example activities**, including energy savings performance contracting
5. **Voluntary efforts by large commercial and industrial energy users**, including strategic energy management and combined heat and power systems

These pathways are exemplary of the types of energy efficiency strategies states use. They do not represent an exhaustive list of options a state might consider. While states can learn from each other’s experiences, each state tailors its solutions based on its own characteristics and objectives.

In selecting which pathways to pursue, states and local jurisdictions consider factors such as:

- **Feasibility** – Can the pathway meet the policy goal(s)—and within the required timeframe?
- **Impact** – What scale of impact can be achieved, and how permanent are the results?
- **Responsibility** – Who are the lead entities responsible, and are best practices being followed?
- **Cost** – What is the cost and cost structure of the pathway?
- **Reliability** – Are impacts reliable, and can they be verified and documented?
 - A related question is persistence of savings. As an example, Table 4.1-2 shows the range in lifetimes for energy efficiency programs funded by utility customers, along with the sample size (i.e., number of years of program data).

Table 4.1-2. National- and Sector-Level Lifetimes for Utility Customer-Funded Energy Efficiency Programs⁸⁹

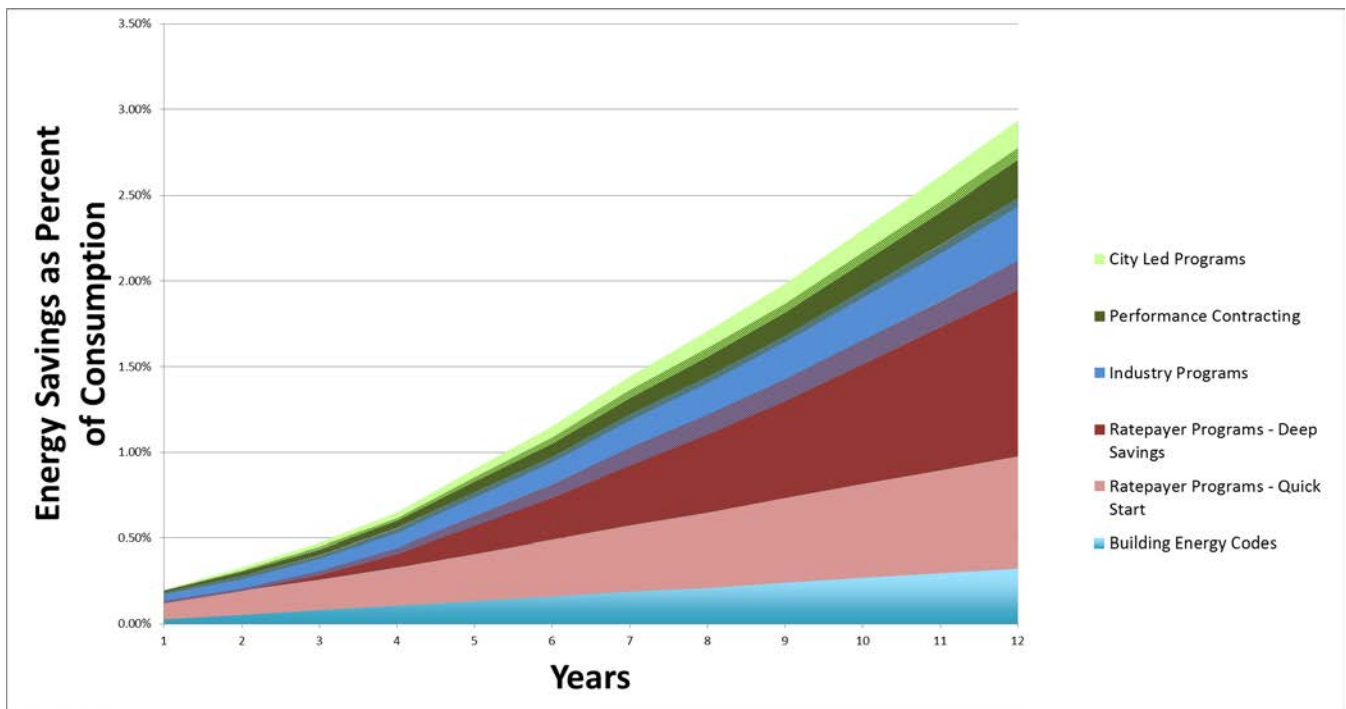
Sector	Simple Average (years)	1st Quartile (years)	Median (years)	3rd Quartile (years)	Number of program years of data used to derive lifetime
National/Portfolio	13	9	12	15	1,647
Commercial & Industrial	12	10	13	15	813
Residential	13	7	11	16	608
Low Income	13	8	12	16	93

⁸⁹ Hoffman et al. 2015. The interquartile range is the middle 50 percent of values.

- **Other considerations** – The environment that the pathway operates in should support successful performance. Other considerations for pathway selection include:
 - Is the necessary policy framework in place?
 - Is an appropriate administrative structure in place?
 - Is the workforce that will deliver the pathway’s results at the needed scale and skill level?
 - Is market readiness well understood to inform pathway design—e.g., evaluation of energy efficiency potential, availability of various market actors (e.g., contractors, retailers, distributors and manufacturers), characteristics and opportunities of target market sectors (e.g., residential, commercial, industrial, public), and barriers and ways to overcome them?

These screening questions are discussed in detail for each pathway this guide covers.


State or local governments can select one or more pathways to meet their policy objectives. Most jurisdictions select multiple pathways to cover a range of objectives and markets. Figure 4.1-1 shows how an illustrative combination of pathways, combined into a portfolio at the state level, builds savings over time to meet overall policy objectives—in this case, an energy savings target expressed as a percent of state electricity consumption.



This hypothetical state-level energy efficiency strategy portfolio contains several pathways that stack and expand over time to achieve a desired level of energy savings in a specified year. Some strategies overlap with others – for example industrial energy efficiency can be captured in both voluntary efforts by industrial customers as well as ratepayer-funded programs. In this illustration, such overlap is depicted by crosshatch.

Figure 4.1-1. Illustrative example of a state-level portfolio of pathways with increasing total savings over time

Portfolios are dynamic over time. They can be modified in response to their success rate and to adapt to new opportunities and challenges. Changing and even adding pathways also can occur as states gain more experience and the underlying energy efficiency infrastructure matures (e.g., more energy efficiency contractors are available and consumers are more aware of energy-saving opportunities).



Additional pathways discussed in this chapter can be combined in various other ways (and with pathways not covered by this guide) to achieve a state’s targeted electricity savings and emissions reductions over time.

There are many reasons why a state might introduce a new pathway partway through the implementation period of an overall portfolio strategy. For example, a state may begin the period accruing savings from programs already running, while simultaneously building new programs to launch after they are implementation-ready.



4.2. Ratepayer-Funded Efficiency Programs

Ratepayers fund programs that promote or directly support the uptake of cost-effective energy efficiency measures in nearly all sectors of the economy—residential, commercial, industrial, agricultural and public facilities.⁹⁰ Utilities or third parties administer these programs.⁹¹

Ratepayer-funded efficiency programs typically generate a significant portion of a state’s electricity savings. For example, during the period 2008 to 2013, ratepayer-funded programs in Northwest states accounted for about three-quarters of the region’s end-use electric efficiency savings.⁹² In terms of overall electricity sales, net savings from ratepayer-funded efficiency programs represented 0.69 percent of U.S. retail electricity sales in 2014, with some states achieving savings over 2 percent.⁹³

Natural gas ratepayers fund efficiency programs also reduce greenhouse gas emissions and may have impacts on electricity use. Natural gas efficiency programs that pursue a whole house/whole building approach may be a source for electricity savings because the building shell measures that are implemented create energy savings for both fuels. If integrated with electricity efficiency programs, natural gas efficiency programs could increase participation and cost-effectiveness. States may want to consider whether and how these programs should be taken into account in planning for electricity savings.

This chapter provides examples of ratepayer-funded programs. Appendix B illustrates the full variety of programs states and utilities can choose from to serve each market sector.

For the purposes of this guide, we define two categories of program portfolios—Quick Start programs and Deep Savings programs (see Table 4.2-1). They are primarily differentiated by:

- *Speed to implement:* Quick Start programs—a term used by states implementing them—can be set up relatively quickly to begin accruing savings sooner. Although some Deep Savings programs can be set up quickly, most require a longer time investment.
- *Ease of operation:* Compared to Deep Savings programs, Quick Start programs are fairly easy to operate from the perspective of the utility regulator and program administrator and easy to navigate by participants. Deep Savings programs can be more complicated. For example, some programs focus on hard to reach sectors like small businesses.
- *Depth and breadth of savings:* Quick Start programs tend to focus on “low hanging fruit”—least-cost savings that can be acquired from many projects, aggregating to significant total program savings. Deep Savings programs tend to be more comprehensive in scope.

⁹⁰ Utility ratepayer-funded efficiency programs do not generally impact the transportation sector. Some jurisdictions allow industrial customers to opt out of contributing to or participating in programs.

⁹¹ A variety of entities administer ratepayer-funded programs, including utilities, state energy offices and third parties (such as for-profit and not-for-profit organizations, state agencies, local governments and regional organizations). Utility-administered programs are the most common across the country. For simplicity’s sake, this section refers to utility-administered programs funded by their customers, but the reader should recognize the suite of program administrators implied.

⁹² Using data for a 2014 presentation by Eckman and Grist. Not including market transformation programs, which in the Northwest include ratepayer-funded activities by the Northwest Energy Efficiency Alliance that produce 20 percent of the region’s electricity savings and pave the way for additional savings from utility- and third party-administered programs.

⁹³ American Council for an Energy Efficient Economy (ACEEE) 2015. These are new electricity savings with free rider and spillover effects taken into account. The median savings value for states was 0.56 percent of retail electricity sales.




Table 4.2-1. Relative Characteristics of Quick Start and Deep Savings Programs

	Quick Start Programs	Deep Savings Programs
Time to first energy savings	Shorter	Longer
Ease of operation	More straightforward	More complicated
Depth and breadth of savings	More focus on quantity of projects and participants	More focus on depth (more savings per project for longer periods of time)

States that started with Quick Start programs can incorporate Deep Savings programs in their portfolios once much of the low hanging fruit is captured or program administrators gain sufficient experience and confidence. It takes time to develop the supportive energy efficiency infrastructure and customer base for Deep Savings programs to be successful in realizing planned savings. All states have a unique market context and start from different levels of experience given their energy efficiency program portfolios (both ratepayer-funded programs and others). Implementing both Quick Start and Deep Savings programs will achieve higher levels of savings.

As energy efficiency programs evolve over time, so do Quick Start programs. In five to 10 years, examples of Quick Start programs may be different from the ones given here. For example, changes in state building energy codes and federal appliance standards affect baseline electricity use and change the potential for energy savings from utility programs in the short run.⁹⁴ Ratepayer-funded programs change in response. The recent strengthening of federal lighting standards, for example, may alter the economics of some ratepayer-funded lighting programs and cause a shift in funding to other programs.

⁹⁴ IEE 2011.

INNOVATIVE APPROACHES TO INCREASE ELECTRICITY SAVINGS

Building on experience, states are exploring new ways to increase the level of cost-effective energy savings through innovative approaches to ratepayer-funded programs:

- **Define savings goals for the long term** – Savings goals for ratepayer-funded energy efficiency programs are typically defined as the amount of first-year savings. That encourages utilities to invest in energy efficiency measures that have a low cost per unit of first-year savings, even when other measures provide far more value over their lifetime. Some jurisdictions, such as Michigan and Wisconsin, have redefined their energy efficiency goals to better address long-term objectives, such as stating goals in terms of lifetime energy savings or equivalent.⁹⁵
 - **Account management model** – Utilities that have achieved high levels of electricity savings have dedicated staff who develop relationships with large commercial and industrial customers, constantly work with them on operational efficiency improvements, understand their capital investment cycle, and help them develop comprehensive, long-term plans to improve energy efficiency.
 - **Invest in emerging technology** – For example, light-emitting diode (LED) technology has advanced rapidly in recent years in both the residential and commercial sectors. Residential LEDs use at least 75 percent less energy, and last 25 times longer, than comparable incandescent bulbs. By 2027, widespread use of LEDs could save about 348 TWh (compared to no LED use) of electricity.⁹⁶
 - **Intelligent efficiency** – Information and communication technology and user access to real-time information enable a systems-based, holistic approach to energy savings.⁹⁷ For example, the New York State Energy Research and Development Authority offers incentives for installing information-gathering technologies that provide critical data to monitor and adjust building operation. Incentives are available for systems that provide ongoing optimization and monitoring, going beyond traditional occupancy and motion sensors.⁹⁸
- Conservation voltage reduction**⁹⁹ – The distribution lines that deliver energy to homes and businesses typically lose 3 percent to 7 percent of the electricity they carry.¹⁰⁰ Utilities can reduce line losses by operating the distribution system in the lower portion of the acceptable voltage range. Reducing electric service voltage also reduces the energy consumption of some consumer equipment without affecting service. In fact, according to research by the Northwest Energy Efficiency Alliance and the Electric Power Research Institute (EPRI), most of the energy savings potential may be on the customer side.

⁹⁵ Optimal Energy and Energy Futures Group, “Alternative Michigan Energy Savings Goals to Promote Longer Term Savings and Address Small Utility Challenges,” prepared for the Michigan Public Service Commission, Sept. 13, 2013. http://www.dleg.state.mi.us/mpsc/electric/workgroups/progdesign/final_phase1_report.pdf.

⁹⁶ <http://energy.gov/energysaver/articles/led-lighting>.

⁹⁷ Elliott, R. Neal, Maggie Molina, and Dan Trombley. 2012. *A Defining Framework for Intelligent Efficiency*. American Council for an Energy-Efficient Economy. <http://aceee.org/research-report/e125>.

⁹⁸ <http://www.nyserda.ny.gov/All-Programs/Programs/Existing-Facilities-Program/Monitoring-Based-Commissioning-Incentives>.

⁹⁹ Lisa Schwartz (principal author), Regulatory Assistance Project, and William Steinhurst, Synapse Energy Economics, Inc., *Is It Smart if It's Not Clean? Part 1: Strategies for Utility Distribution Systems*, May 2010, http://www.raponline.org/docs/RAP_Schwartz_SmartGrid_IsItSmart_PartOne_2010_05.pdf.

¹⁰⁰ EPRI, “Green Circuit Field Demonstrations,” March 2008, at <http://mydocs.epri.com/docs/public/00000000001016520.pdf>.

- **Cross-Fuel Coordination, Natural Gas Direct Use and Thermal End-Use Electrification** – Typically, ratepayer-funded energy efficiency programs are designed and delivered one fuel at a time—electricity or natural gas only. States can support opportunities for cross-fuel coordination to deliver energy and dollar savings at lower cost to utilities and consumers while improving customer satisfaction.¹⁰¹ As states look ahead to meeting policy targets in the coming decades, they will likely continue to consider approaches to optimize the installation of higher efficiency equipment and lower overall energy use and costs. States may explore the energy savings and emissions reductions potential of both electric-to-gas and gas-to-electric fuel switching in the context of the primary fuel input composition of their electric grid mix, whether specific fuel-switching practices are explicitly prohibited by state law, and what the anticipated impact of these programs are in state. Currently, both fuel-switching approaches are in use by states, with existing programs primarily focused on electric-to-natural gas conversions, including a handful of states that employ these measures as part of their electric demand-side management strategies. However, as new technologies come on line and renewable and other non-fossil fuels increasingly contribute to the grid mix, natural gas-to-electric incentives may play a larger role.¹⁰²
- **Upstream incentives for energy-efficient products** – Providing rebates to distributors of energy-efficient products instead of end-use customers, for example, may increase participation rates and lower program costs.
- **Resetting the balance between regulation and markets** – In its Reforming the Energy Vision proceeding, the New York Public Service Commission is considering ways to reduce reliance on deterministic savings targets and increase reliance on a value-based approach to stimulate energy efficiency.¹⁰³ The end state would rely on a new market regime enabled by utilities, a new ratemaking process that takes away bias toward capital expenses compared with operating expenses (for example, promoting energy efficiency as a “non-wires alternative” to system needs), and longer term rate plans that allow more flexibility for utility planning and innovation, new enterprise-wide performance standards for utilities, revised delivery rates that better signal value to customers and aggregators, and a distribution system planning process that reveals locational and temporal system values using a new benefit/cost regime that better reflects long term system and societal values. In addition, the New York State Energy Research and Development Authority and its Green Bank are being redesigned to complement these efforts.

4.2.1. Requisite Policies


All types of utilities, investor-owned, municipal and cooperatives, offer ratepayer-funded energy efficiency programs. For a regulated utility, Quick Start and Deep Savings programs can be initiated by the utility filing a tariff for approval by a state public utility commission. Or the commission, on its own motion, may direct a regulated utility to file an energy efficiency program, to evaluate energy efficiency programs as part of a planning effort to meet forecasted energy demand (integrated resource planning) or a separate stakeholder process. The commission may set requirements for individual Quick Start programs or a portfolio of programs, including administration, customer classes and end uses served, screening criteria, costs and utility cost recovery.

Public power utilities that are not subject to rate regulation by a state commission adopt energy efficiency programs through their local government or member-elected boards. In some states, legislation may provide an

¹⁰¹ Nowak, S., M. Kushler, and P. Witte. 2014. “Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs.” American Council for an Energy-Efficient Economy. <http://www.aceee.org/sites/default/files/publications/researchreports/u1406.pdf>.

¹⁰² See, for example, https://www.aga.org/sites/default/files/dispatching_direct_use_-_achieving_greenhouse_gas_reductions_the_use_of_natural_gas_in_homes_and_businesses.pdf; <http://www.energy.ri.gov/documents/siri/Systems%20Integration%20Rhode%20Island%20DRAFT%20Vision%20Document%202015.11.19%20FINAL.pdf>.

¹⁰³ New York PSC, Case 14-M-0101 – Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision.



impetus for adopting or expanding energy efficiency programs. Legislation may cover all types of utilities in the state or only regulated utilities. Laws may be in the form of voluntary energy efficiency goals, integrated resource planning requirements,¹⁰⁴ Energy Efficiency Resource Standards¹⁰⁵ or other energy efficiency obligations.

Implementing policies, regulations and programs to promote energy-efficient equipment can help states achieve energy savings and emissions reduction goals. However, policymakers and regulators also can consider initiatives that provide incentives for operations and maintenance and other process improvements to improve energy efficiency and reduce air emissions.

UTILITY REGULATION AND PRACTICES

State regulatory commissions, which oversee investor-owned utilities,¹⁰⁶ and the boards of publicly owned utilities, have opportunities to establish regulations and practices that encourage efficient use of energy, including the following:

- Set energy savings targets for utilities¹⁰⁷
- Invest in the complete set of available cost effective energy efficiency resources¹⁰⁸
- Design utility customer rate structures to encourage, or at least not discourage, efficient use of electricity
- Create stable funding for energy efficiency programs through a public benefits fund, a charge on customers' bills on electricity consumption
- Provide utilities with timely recovery of their direct costs for energy efficiency programs and consider utility performance incentives that encourage utility investment in energy efficiency, such as allowing a return on investment for energy efficiency programs, similar to that for supply-side resources, that meet performance standards¹⁰⁹
- Consider decoupling—a ratemaking mechanism that breaks the link between how much energy a utility delivers and the revenue it collects, thereby removing the disincentive for utilities to promote efficiency—or a lost revenue adjustment mechanism that adjusts rates so the utility can recover revenues reduced specifically as a result of energy efficiency programs
- Use integrated resource planning to prioritize cost-effective demand-side resources as the first elements of a portfolio of resources to meet customers' electricity requirements
- Instead of allowing large industrial customers to opt out of paying for utility programs that acquire cost-effective energy efficiency resources benefiting all customers, instituting well-designed “self-direct” programs can facilitate cost-effective efficiency investments in industrial facilities.¹¹⁰

¹⁰⁴ For examples, see Wilson and Biewald.

¹⁰⁵ See ACEEE 2014. PUCs also may adopt energy savings targets—either specific savings levels or a standard that regulated utilities adopt all cost-effective energy efficiency measures.

¹⁰⁶ In some states, utility commissions also have oversight responsibilities for rural electric cooperatives.

¹⁰⁷ See SEE Action's guide to *Setting Energy Savings Targets for Utilities* <https://www4.eere.energy.gov/seeaction/publication/setting-energy-savings-targets-utilities>.

¹⁰⁸ See <http://aceee.org/files/proceedings/2014/data/papers/8-377.pdf>.

¹⁰⁹ For more information, see the National Action Plan for Energy Efficiency report on aligning utility incentives: <http://www2.epa.gov/sites/production/files/2015-08/documents/incentives.pdf>.

¹¹⁰ Qualifying industrial customers can “self-direct” the fees toward energy efficiency investments in their own facilities, instead of paying into an aggregated pool of funds the utility collects to fund all energy efficiency programs. In contrast to jurisdictions that allow industrial customers to opt out of paying for energy efficiency altogether, under a self-direct paradigm, industrial customers can choose to pay the fees to the utility or spend the fees in their own facilities to achieve energy savings. Refer to SEE Action's report, *Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector* https://www4.eere.energy.gov/seeaction/system/files/documents/industrial_energy_efficiency.pdf.

RATEPAYER-FUNDED PROGRAMS FOR LARGE CUSTOMERS^{111,112}

Many utilities offer energy efficiency incentive programs for large commercial and industrial (C&I) customers. Programs can be categorized as three types:

- **Prescriptive programs** that encourage the purchase and installation of pre-approved efficiency measures
- **New construction programs** that offer incentives for new facilities to exceed state energy code or meet certification levels like ENERGY STAR or LEED
- **Custom programs** that offer site-specific energy assessments, identify savings opportunities and provide rebates for installing multiple efficiency measures that are unique to the facility, including both capital investments as well as operational improvements

Prescriptive programs can be started relatively quickly and easily. New construction and custom programs can achieve deep savings.

Both large C&I prescriptive programs include measures such as lighting and heating, ventilation and air-conditioning equipment upgrades. Commercial prescriptive programs may also include commercial-oriented measures such as office equipment or refrigerated display cases for grocery stores. Similarly, industrial prescriptive programs may also include process-oriented measures like motors or industrial compressors.

Custom programs for both sectors could include audits, commissioning or retro-commissioning (i.e., optimizing energy systems so that they run as efficiently as possible), and site-specific energy improvements. Some industrial custom programs may be intended for specific customers, such as data centers or refrigerated warehouses. Custom programs also may include Strategic Energy Management initiatives (see Section 4.3.4.1). Some utilities and other program administrators are participating in DOE's Superior Energy Performance program:¹¹³ Bonneville Power Association (Northwest states), Efficiency VT (VT), Focus on Energy (WI) and Eversource (CT, MA, NH). Other utilities are offering other forms of Strategic Energy Management: Consumers Energy (MI), Energy Trust of Oregon (OR), MidAmerican Energy (IA), National Grid (MA, NY, RI), Puget Sound Energy (WA), Snohomish County PUD (WA), Xcel Energy (CO and MN), Rocky Mountain Power (ID, UT, WY) and American Electric Power (multiple states in the Midwest and Southeast).¹¹⁴

In addition to ratepayer-funded programs, business and industry take advantage of several other pathways to use electricity more efficiently, reduce operating costs and achieve corporate sustainability goals. Section 4.3.4 discusses some of these voluntary pathways.

4.2.2. Quick Start Programs


Quick Start programs are a set of proven, high-impact, ratepayer-funded energy efficiency initiatives that can be deployed relatively quickly, are comparatively easy to operate, and help build infrastructure for more comprehensive (Deep Savings) programs to follow. Quick Start programs have a track record of success in realizing near-term energy savings, with significant savings possible within a year of initiation. These programs are intended

¹¹¹ Hoffman, *et al.* 2013.

¹¹² See also *Sustained Energy Savings Achieved Through Successful Industrial Customer Interaction With Ratepayer Programs: Case Studies*: <https://www4.eere.energy.gov/seeaction/publication/sustained-energy-savings-achieved-through-successful-industrial-customer-interaction>.

¹¹³ DOE offers an Accelerator program to assist utilities and third-party program administrators with the Superior Energy Performance program: <http://www1.eere.energy.gov/buildings/betterbuildings/accelerators/isep.html>. See Section 4.3.4.1 for more information.

¹¹⁴ DOE, personal communication, Aug. 13, 2015.



to be simple from regulatory, program administration and consumer perspectives. Another advantage of Quick Start programs is their simplicity of design, resulting in relatively low operating costs and simple savings documentation.¹¹⁵

Utilities have been implementing these types of programs for more than 30 years. States that begin or expand Quick Start programs can benefit from other states' experience: building on those states' established performance benchmarks, staffing needs analysis, program design templates, training materials, EM&V approaches, marketing efforts and lessons learned.

In regions with a limited energy efficiency industry, Quick Start programs can help program administrators, contractors, engineers, distributors and other stakeholders develop experience and expertise. They build a base for continuing and expanding efficiency efforts, as well as generating jobs and local economic development. Importantly, early Quick Start programs can provide a "proof of concept" for the ratepayer-funded efficiency programs pathway—demonstrating that energy efficiency programs credibly and reliably deliver what they promised.

Other advantages of Quick Start portfolios are training for contractors and trade allies, and development of an energy efficiency infrastructure that can support more complex, comprehensive deep savings programs and non-energy benefits. Non-energy benefits, or co-benefits, include energy reliability, job creation, increased consumer comfort, health benefits, improved safety and higher productivity.

Between 2009 and 2013, the average total cost of energy efficiency programs across the U.S. was 4.6¢/kWh. For residential consumer product rebates, a common Quick Start program, total cost was 2.1¢/kWh saved.¹¹⁶ Table 4.2-2 provides example Quick Start programs.

¹¹⁵ See the Southeastern Energy Efficiency Alliance's [Energy Efficiency Quick Start Programs: A Guide to Best Practices](#).

¹¹⁶ Hoffman *et al.* 2015.

Table 4.2-2. Example Quick Start Programs¹¹⁷

Quick Start Programs	
ENERGY STAR®-Labeled Products	Through appliance and equipment retailers, offers rebates on a variety of products that meet ENERGY STAR® efficiency standards
Energy Audit and Direct Install	Offers discounted or free basic (i.e., non-comprehensive) home energy audits and low cost, direct install efficiency measures such as high efficiency light bulbs or programmable thermostats
Residential Efficient Heating and Cooling	Gives incentives and training to contractors to increase sales of efficient heating and cooling systems and to increase efficiency through tune-ups of existing units and quality installation of new units as well as offering incentives directly to retailers and utility customers
Appliance Recycling Programs	Offers cash incentives to customers for surrendering their old appliances to be recycled; includes free transport and recycling of old units such as refrigerators
Non-residential Prescriptive Programs	Provides incentives for commercial, agricultural and industrial businesses to implement basic efficiency upgrades with proven savings (e.g., lighting, heating and cooling systems, refrigeration)
Non-residential Retro-commissioning	Offers incentives to building owners to systematically tune up the building's energy consuming systems to optimize operation
Commercial and Industrial (C&I) Custom Programs	Provides audits, feasibility study funding, and training in best practices and incentives for custom efficiency projects
Non-residential Benchmarking and Performance	Monitors and analyses a building's energy performance to recommend efficiency upgrades
Non-residential On-Site Energy Manager	Provides trained staff to businesses to assess a building's energy consumption and work with building operators to cut energy consumption and costs

4.2.2.1 Case Studies

Arkansas – In January 2007, the Arkansas Public Service Commission (PSC) approved the Commission's Rules for Conservation and Energy Efficiency Programs. These rules require regulated utilities to propose and administer ratepayer-funded Quick Start and pilot programs.¹¹⁸ The PSC approved initial utility portfolios in summer 2007. In 2010, the Commission established a statewide, annual energy efficiency target. The target originally was set at 0.25 percent of 2010 retail electricity sales, to be ramped up to 0.75 percent by 2013.¹¹⁹ In 2013, the Commission set the goal for 2015 at 0.9 percent of 2014 sales.¹²⁰


Entergy Arkansas, Inc., a regulated investor-owned utility, is the largest electric utility (by kilowatt-hour sales) in Arkansas. Entergy began to implement PSC-approved energy efficiency programs at the end of 2007. The bulk of Entergy's and other Arkansas regulated utilities' programs began in 2008. The utilities' energy efficiency portfolios include a number of programs, most of which fit under the descriptions of Quick Start programs listed above. The

¹¹⁷ Adapted from National Action Plan for Energy Efficiency 2009.

¹¹⁸ Arkansas Public Service Commission, May 20, 2014. The PSC defines Quick Start programs as "programs that are limited in nature and that in other jurisdictions have been shown to have a high probability of providing aggregate ratepayer benefits to the majority of utility customers." The Commission defined pilot programs as those that "include specific questions that the pilot will address."

¹¹⁹ Arkansas Public Service Commission, Dec. 10, 2010.

¹²⁰ Arkansas Public Service Commission, Sept. 9, 2013.



PSC directed the utilities to include programs for all customer classes and choose programs from various categories.¹²¹ The 2008 Program Year portfolio included energy audit and incentive programs for commercial and industrial customers, air-conditioning tune-ups for residential customers and small businesses, rebates for compact fluorescent lights, a home energy improvement program, and information and training.¹²²

Although the Commission generally requires energy efficiency programs to be screened using each of the cost-effectiveness tests outlined in the California Standard Practice Manual, the Commission exempted the Quick Start programs.¹²³ The Commission ordered utilities to choose Quick Start or pilot programs for immediate implementation and file comprehensive portfolio plans by 2009 to begin in the 2010 program year.

The Quick Start programs started just as the economic recession began. Even so, the programs achieved significant savings. From 2008 through 2010, the first three years of the programs, actual savings exceeded projections.¹²⁴

Mississippi and Louisiana – Mississippi and Louisiana are following on Arkansas’ success. The Public Service Commissions in both states implemented rules based closely on Arkansas’ Conservation and Energy Efficiency Rules. Utilities began putting their Quick Start portfolios into action in October 2014 in Louisiana and in November 2014 in Mississippi.

In Mississippi, the PSC required that utilities choose programs they can implement in four months. Also following on Arkansas’ example, the Mississippi PSC required both electric and gas utilities to file plans for comprehensive energy efficiency portfolios and committed to setting an efficiency target (EERS) no later than three years after the approval of their Quick Start portfolios.

Louisiana also followed the Arkansas model, but the Louisiana PSC amended its rules to make participation optional for utilities under its jurisdiction.¹²⁵ As a consequence, rural electric cooperatives and natural gas utilities have opted out,¹²⁶ missing opportunities for consumer savings.

Georgia – The single investor-owned utility in Georgia, Georgia Power, has a demand-side management plan largely comprised of Quick Start programs. The programs began in 2010. Residential offerings include behavioral programs, rebate programs for efficient lighting and appliances, a refrigerator replacement program, and a program that identifies and installs energy conservation measures for existing water heating systems. The utility also offers custom and prescriptive programs for commercial customers.¹²⁷

4.2.2.2 EM&V

Quick Start programs are relatively common and have been implemented for many decades. Thus, the EM&V approaches used to document their impacts are generally well established and widely used. These approaches are defined in several industry-standard EM&V protocols and guidelines, the SEE Action *Energy Efficiency Program Impact Evaluation Guide*¹²⁸ and DOE’s Uniform Methods Project.¹²⁹

¹²¹ Arkansas Public Service Commission, May 2014.

¹²² Entergy Arkansas, Inc., April 1, 2009.

¹²³ The tests are the Participant Cost Test, the Ratepayer Impact Measure, the Total Resource Cost test and the Program Administrator Cost test. (CPUC 2001, National Action Plan for Energy Efficiency 2008)

¹²⁴ Source: LBNL’s calculations, based on Arkansas PSC’s Energy Efficiency Annual Report Workbooks for Southwestern Electric Power Company, Oklahoma Gas & Electric (Arkansas), Entergy Arkansas Inc. and The Empire District Electric Company.


¹²⁵ Louisiana PSC, Sept. 20, 2013.

¹²⁶ Personal communication with Brent Bailey, State Activities Coordinator at 25x’25, November 2014.

¹²⁷ Georgia Power Company 2013.

¹²⁸ State and Local Energy Efficiency (SEE) Action Network 2012.

¹²⁹ Under the Uniform Methods Project, DOE is developing a framework and a set of protocols for determining energy savings from specific energy efficiency measures and programs. The protocols provide a straightforward method for evaluating gross energy savings for common



As discussed in Chapter 3, there is no direct way of measuring energy savings, because one cannot measure the absence of energy use. However, savings can be estimated accurately, and these estimates are accepted by a wide variety of state agencies for utility cost recovery and by independent system operators for grid reliability purposes. There are three commonly used approaches for savings determination for Quick Start and other types of utility ratepayer-funded programs:

1. Project-based measurement and verification
2. Comparison-group methods
3. Deemed savings

While deemed savings is currently the most commonly used approach, it is not available for all energy efficiency measures and applications.¹³⁰ Deemed savings are an *estimate* of energy savings that are: (1) developed from data sources and analytical methods widely considered acceptable for the measure and purpose and (2) applicable to the situation being evaluated. Deemed savings are applied only to a single unit of an installed energy efficiency measure. Properly applied, deemed savings can actually improve the reliability of *average* savings estimates—in other words, savings across all projects, rather than for an individual project—and reduce ESPC transaction costs by providing certainty without ongoing EM&V.

4.2.2.3 Expected Range of Energy Savings and Emissions Reductions

In 2012, Georgia Power's Quick Start programs saved about 0.25 percent of the utility's total retail electricity sales. Similarly, in the first three years of Arkansas' Quick Start initiative (2008 through 2010), Quick Start portfolio savings represented about 0.2 percent to 0.4 percent of total retail energy sales of utilities running the programs. For the three years, actual savings in Arkansas were nearly 50 percent greater than projected savings. These examples show that Quick Start programs can achieve significant savings even in their first few years.

The expected range of emissions reductions¹³¹ from Quick Start programs depends on which EGUs' output is displaced by the demand-side efficiency actions. Quick Start efficiency programs primarily affect the dispatch of existing non-baseload generators, including load-following and peaking plants. On average for the entire country, these non-baseload generators emit at levels about 25 percent higher than the average emissions rate from all generation. What this means is that a 0.4 percent reduction in annual retail energy sales, as in the case of Arkansas' Quick Start programs, might reduce annual CO₂ emissions by 0.5 percent (25 percent higher than 0.4 percent) on average if such programs are applied throughout the U.S. However, that's a national average. The difference between non-baseload emissions rates and average emissions rates varies. In a few exception-to-the-rule regions, non-baseload generators emit CO₂ at rates that are *lower* than average.¹³²

Importantly, the location of the emissions reductions is not limited to the state in which the efficiency programs are implemented, except in states that have an isolated electric grid (Alaska, Hawaii and Texas). Some emissions reductions likely occur at generators in adjacent states that serve in-state load through the interstate transmission.

residential and commercial measures offered by ratepayer-funded initiatives in the U.S. They represent a refinement of the body of knowledge supporting energy efficiency EM&V activities. Technical experts wrote the protocols and industry experts reviewed them.

<http://energy.gov/eere/about-us/initiatives-and-projects/uniform-methods-project-determining-energy-efficiency-progr-0>

¹³⁰ SEE Action Network 2012.

¹³¹ Emissions reductions compared to what would happen in the absence of the energy efficiency programs. If annual load growth (in MWh) increases—despite the energy savings achieved through efficiency programs—absolute emissions levels (in tons) could increase, but less than would have happened otherwise.

¹³² Coincidentally, the western portion of Arkansas falls within one of those exception-to-the-rule regions while the eastern portion of Arkansas is closer to the national average. This means that the 0.4 percent savings in Arkansas probably resulted in less than 0.5 percent emissions reductions, closer to 0.4 percent emissions reductions in fact. The details of this calculation are not important, but the fact that results vary regionally is.

Quick Start Programs A set of proven, high-impact ratepayer-funded energy efficiency programs that can be deployed quickly, are easy to operate, and help build infrastructure for more comprehensive programs to follow.

Screening Questions	Quick Answers	Resources: Documented State Experience or Recommended Practice
<p>FEASIBILITY Can Quick Start programs help achieve GHG and criteria air pollutant reductions in the required time frame?</p>	<ul style="list-style-type: none"> • Yes. They reduce the amount of electricity generated, and fossil fuel consumed, at EGUs. Reduced energy demand yields emissions reductions. 	<ul style="list-style-type: none"> • States’ Perspectives on EPA’s Roadmap to Incorporate Energy Efficiency/Renewable Energy in NAAQS State Implementation Plans: Three Case Studies (NESCAUM) • Efficiency Power Plant Tool (RAP)
<p>IMPACT What energy savings and emission reductions can Quick Start programs achieve, and are the savings permanent?</p>	<ul style="list-style-type: none"> • Potential energy savings are about ½% per year of state retail electricity sales. • Resulting emission reductions vary with amount and timing of energy savings and EGU emission profiles. Values can be determined with simple estimates or detailed modeling. • Established savings lifetimes range from a few years to decades, based on measure life and replacement assumptions. 	<ul style="list-style-type: none"> • Utility regulatory filings and commission orders (AR, LA, MS) • Rapid Deployment Energy Efficiency Toolkit (National Action Plan) • Setting Energy Savings Targets for Utilities (SEE Action) • Quantifying the Air Quality Impacts of Energy Efficiency Policies and Programs (RAP)
<p>RESPONSIBILITY Who is responsible for administering and implementing Quick Start programs, and what are the best practices?</p>	<ul style="list-style-type: none"> • Utilities or third-party administrators run Quick Start programs. • Governing boards oversee programs by municipal utilities, rural electric coops, and people’s utility districts. State public utility commissions oversee programs by investor-owned utilities and third-party administrators. • Many states have long experience with Quick Start programs, and best practices have been well documented. 	<ul style="list-style-type: none"> • Utility regulatory filings and commission orders (AR, LA, MS) • RDEE Toolkit • Who Should Deliver Ratepayer-Funded Energy Efficiency? (RAP)
<p>COST What is the cost structure of Quick Start programs, and how much do they cost?</p>	<ul style="list-style-type: none"> • Utility ratepayers fund Quick Start programs. Cost-effectiveness and other criteria determine program selection. • The savings-weighted total resource cost for all efficiency programs in the U.S. is well below the cost of most generating resources. For residential consumer product rebates, a common Quick Start program, total cost is 2.2¢/kWh saved. 	<ul style="list-style-type: none"> • Cost of Saved Energy Studies (LBNL) • RDEE Toolkit (DOE)
<p>RELIABILITY How can I document the energy impacts of Quick Start programs?</p>	<ul style="list-style-type: none"> • Quick Start energy savings are documented with well-established EM&V processes. A rough estimate of EM&V cost is 3% to 6% of energy efficiency program cost. EM&V costs for Quick Start programs tend to be low. 	<ul style="list-style-type: none"> • Uniform Methods Project (DOE) • Energy Efficiency Program Impact Evaluation Guide (SEE Action) • Setting Energy Savings Targets for Utilities (SEE Action)
<p>OTHER CONSIDERATIONS What are other considerations for successful delivery of energy savings from Quick Start programs?</p>	<ul style="list-style-type: none"> • The established framework for energy efficiency and utility resource planning • Existing administrative structure for efficiency programs and EM&V • Training for contractors and trade allies • Planning to evolve to programs that achieve additional savings • Co-benefits (e.g., job creation, comfort, health, safety, productivity) 	<ul style="list-style-type: none"> • Using Integrated Resource Planning to Encourage Investment in Cost-Effective Energy Efficiency Measures • Better Buildings Commercial Workforce Guidelines (DOE) • Residential Standard Workforce Specifications (DOE)



4.2.3. Deep Savings Programs

Deep Savings programs funded by utility customers are long-term initiatives that target significant energy savings—both projects that aim to acquire hard to reach and “deep” savings for each project, and those that seek “broad” savings through outreach to customer segments that are more challenging to engage. States with a well-developed energy efficiency infrastructure—utilities or third-party program administrators with strong knowledge and experience and a mature energy efficiency industry (contractors, engineers, distributors, etc.)—can add these programs to an existing efficiency portfolio to achieve higher total energy savings.

To get substantial uptake of program offerings requires sophistication for program administrators (in program implementation), for energy efficiency providers (in design, installation and maintenance of efficiency measures) and for consumers (in their decision-making on program participation and purchase of energy efficiency products and services).

Programs that achieve deep savings tend to focus on multi-measure, comprehensive projects, like whole-home retrofits; improvements that involve significant efficiency gains—for example, going from an 11 SEER to a 15 SEER-rated central air conditioner; upgrades that require large investments, such as replacing a central air conditioner; improvements to the building shell (e.g., insulation, air sealing, high-efficiency windows); or penetrating consumer sectors that are normally difficult to reach, such as small businesses.¹³³

The focus on more ambitious savings opportunities can make these programs more challenging—for example, convincing a customer to invest in a several thousand dollar, whole-home retrofit compared to simply buying high-efficiency light bulbs. Building a supportive energy efficiency infrastructure also may take time to develop.

Examples of Deep Savings programs include:

- Home Performance with Energy Star®, a full home retrofit program
- Energy Star® certified new homes, with energy savings of up to 30 percent compared to typical new homes¹³⁴
- Central air conditioner and heat pump retirement programs
- Replacement of electric resistance water heaters with heat pump water heaters
- Proper installation of heating, ventilation and air conditioning units in existing homes
- Programs that include duct sealing, and insulation and air sealing for the attic

Two important considerations for Deep Savings programs are:


- **Payback period** – Participants prefer shorter times to recover their investments.
- **Cost-effectiveness** – Program administrators typically must demonstrate to the state regulatory commission, city council or rural cooperative board that a measure, program or portfolio is cost effective. A key aspect of comprehensive energy efficiency programs is that measures with long paybacks and short paybacks can be included in the same package. Thus, the payback for the entire project must pass the required cost-effectiveness test and be attractive to customers.

4.2.3.1 Case Studies

New Jersey – New Jersey illustrates how states progress beyond Quick Start programs, with a mature energy efficiency infrastructure that can support programs that achieve higher levels of savings. The New Jersey Board of

¹³³ SEER is the Seasonal Energy Efficiency Ratio, a measure of an air conditioner’s cooling output per unit of energy used.

¹³⁴ See http://www.energystar.gov/index.cfm?c=new_homes.hm_index.



Public Utilities, through its Clean Energy Program, offers a portfolio of energy efficiency programs that includes a number of Deep Savings programs, including some that are coordinated with companion utility efficiency programs:¹³⁵

- *Home Performance with ENERGY STAR®* – Participants receive significant incentives and discounted financing for whole-home retrofits performed by certified contractors, plus an energy efficiency plan with recommended measures, costs and an analysis of their payback.¹³⁶
- *WARMAvantage* – Participants receive rebates for new or replacement high efficiency furnaces, boilers and water heaters with proper installation.
- *COOLAvantage* – Participants receive rebates for new or replacement high efficiency central air-conditioners, ductless mini-split systems, heat pumps and geothermal heat pumps with proper installation.
- *Pay for Performance* – Commercial and industrial customers can participate in this comprehensive energy efficiency program that provides incentives towards whole-building energy improvements for both existing buildings and new construction.

Oklahoma – Utilities in Oklahoma gained experience with energy efficiency through Quick Start programs, helping to develop a mature energy efficiency infrastructure to support programs that achieve higher levels of savings. For example, Public Service Company of Oklahoma, an investor-owned utility with more than 460,000 residential customers, has implemented the Home Performance with ENERGY STAR® Multiple Upgrades program, which provides training and incentives for comprehensive upgrades to building envelope and HVAC equipment in existing homes.¹³⁷ It also focuses on quality installation of equipment. The program includes an audit to help homeowners identify potential efficiency upgrades and works towards a permanent transformation of customer behavior and awareness of energy savings and efficient technologies.¹³⁸

Texas – Entergy Texas, an investor-owned utility with 370,000 residential customers, has also implemented the Home Performance with ENERGY STAR® program and had success in achieving deep savings from participating projects.¹³⁹ Like Public Service Company of Oklahoma, Entergy's objective for the program is to motivate homeowners to take a comprehensive, whole-house approach to reducing energy consumption. To maximize savings per project, Entergy targets high energy-use customers and homes built before 2002. In 2014, the average project undertaken through the program saved over 9 MWh per year.¹⁴⁰

4.2.3.2 Expected Range of Energy Savings and Emissions Reductions

Electricity savings vary based on type of program, market sector, incentives provided, level of participation, climate and other factors. As one example, in 2014, Public Service Company of Oklahoma's Home Performance with ENERGY STAR® program saved nearly 5,800 MWh from over 1,800 projects.¹⁴¹ That's equal to about 0.4 percent of the utility's retail sales that year. Using non-baseload emissions factors from eGRID specific to the region that includes Oklahoma—5,800 MWh of energy savings translates into 4,390 avoided tons of CO₂ emissions in 2014. In

¹³⁵ NJ Clean Energy Program 2015a and 2015b.

¹³⁶ BPU 2015.


¹³⁷ EIA 2015.

¹³⁸ DOE 2015a.

¹³⁹ EIA 2015.

¹⁴⁰ DOE 2015b.

¹⁴¹ DOE 2015a.



the case of this utility, a 0.4 percent reduction in retail sales leads to a comparable 0.4 percent reduction in CO₂ emissions.¹⁴²

4.2.4. Public Power Programs

Municipal utilities, rural electric cooperatives and people's utility districts provide power to about a quarter of the U.S. population. The local government or an elected board provides oversight.¹⁴³ These utilities offer the same kind of programs discussed earlier in this chapter to promote energy efficiency. Following are examples.

4.2.4.1 Case Studies

Tennessee – The Tennessee Valley Authority (TVA) is a federally owned corporation that supplies electricity, through 155 member distribution local power companies, to nine million customers in seven states in the Southeast.¹⁴⁴ Cooperative and municipal utilities that buy electricity from TVA can participate in its ENERGY STAR® for Manufactured Homes Program. The program offsets the incremental cost of upgrading from a manufactured home that meets U.S. Department of Housing and Urban Development (HUD) standards to an ENERGY STAR®-certified home (\$1,400).¹⁴⁵ Manufactured homes that participate in the program must be furnished with all-electric, efficient heat pumps for heating and cooling. Other features include energy-efficient lighting, appliances and windows, as well as better insulation and air sealing. ENERGY STAR®-certified manufactured homes use approximately 12,000 kWh less per year than baseline models.¹⁴⁶ In Tennessee alone, 1,000 manufactured homes were sold through the program in 2014—more than half of the manufactured housing units shipped to the state that year—saving nearly 12 million kWh annually.¹⁴⁷ That's enough energy to power about 1,000 homes each year in TVA's service area. In addition, households in ENERGY STAR® manufactured homes save between \$50 and \$75 on their energy bills each month.

Indiana – Hoosier Energy is a generation and transmission cooperative serving 48 counties in central and southern Indiana.^{148,149} Hoosier has a full energy efficiency portfolio that includes programs for residential, commercial and industrial customers. Residential programs span both retrofit and energy-efficient new construction (the Touchstone Energy Homes program). Started as a pilot in 2010, Hoosier's Appliance Recycling program offers customers \$50 to replace their old (inefficient), working refrigerator or freezer with a new, more efficient one.¹⁵⁰ In 2014, the program replaced 952 refrigerators and freezers and saved 981 MWh. Altogether, Hoosier's energy efficiency programs saved over 25,000 MWh in 2014, about 0.35 percent of its residential retail sales.^{151,152}

¹⁴² Non-baseload emission rates are a proxy for marginal emission rates and are therefore a better indicator of the emission reductions from energy efficiency programs. The eGRID non-baseload emissions rate for the Southwest Power Pool South Region, which includes all of Oklahoma, is 1,513.73 lb CO₂/MWh. Oklahoma, like western Arkansas, is in one of the few exception-to-the-rule regions of the country where non-baseload emissions rates are not higher than the average emissions rate for all generation. This is why the 0.4 percent energy savings translates into 0.4 percent emissions reductions rather than 0.5 percent, as would be the case on average nationally. The results presented here are a rough estimate of avoided emissions for illustrative purposes. Other methods of calculating avoided emissions are described in Section 3.5.2.

¹⁴³ RAP 2011.

¹⁴⁴ TVA 2015.

¹⁴⁵ Manufactured homes must comply with HUD building codes, not with state building codes (see http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/ramh/mhs/faq). Under the Energy Independence and Security Act of 2007, DOE develops and publishes energy standards for manufactured housing (see <https://www.federalregister.gov/regulations/1904-AC11/energy-efficiency-standards-for-manufactured-housing->).

¹⁴⁶ HUD requires that manufactured homes leave the factory with a heating system. This is most often achieved by installing electric resistance strip heat. When calculating electricity savings for ENERGY STAR® manufactured homes, the baseline home contains resistance strip heat.


¹⁴⁷ U.S. Census Bureau 2015.

¹⁴⁸ Hoosier Energy 2015a.

¹⁴⁹ Hoosier Energy also serves one cooperative in southeastern Illinois.

¹⁵⁰ Hoosier Energy 2015b.

¹⁵¹ Hoosier Energy n.d.



Ohio – American Municipal Power (AMP) supplies wholesale power and services for 132 members in nine states. In 2011, AMP arranged for its member companies to begin participating in a third party-run energy efficiency program called Efficiency Smart Savings. The program offers households rebates for efficient lighting and efficient appliances and incentives for appliance recycling; it offers midsize businesses rebates on more than 90 common energy efficiency measures; and it offers large commercial and industrial businesses customized engineering services and technical assistance for efficiency projects. One of AMP’s members, Bowling Green Municipal Utilities, saved an average of more than 1 percent of retail sales each year—over 250 percent of the savings target—through the program from 2011 to 2013.^{153,154}

Vermont – The City of Burlington’s Electric Department has run a suite of energy efficiency programs for more than two decades. The programs provide technical assistance and financial incentives to help builders incorporate the most efficient products and systems into new residential and commercial buildings; technical assistance and rebates for equipment replacement in existing facilities; incentives to increase sales of ENERGY STAR®-qualified residential products; and incentives to improve heating systems in residential and commercial buildings, including Home Performance with ENERGY STAR®. In 2013, these programs saved more than 7,000 MWh—over 2 percent of the utility’s retail sales.¹⁵⁵

Texas – Austin Energy is another municipal utility with a broad portfolio of energy efficiency programs. Commercial customers can receive rebates for efficient appliances and equipment, efficient building upgrades and new construction, high efficiency cooling and heating systems, high efficiency lighting, and customized technologies. Multifamily customers can receive incentives for customized upgrades, efficient appliances and equipment, heating and cooling systems, and high efficiency lighting. Residential programs include incentives for heating and cooling systems, appliances and equipment, building envelope upgrades. Under DOE’s Home Performance with ENERGY STAR® program, customers receive up to \$2,000 in rebates for comprehensive home improvements. In 2013, this single program saved Austin Energy nearly 4,800 MWh, more than 0.1 percent of its 2012 residential sales.¹⁵⁶

¹⁵² EIA 2015.

¹⁵³ Based on 2013 retail sales.

¹⁵⁴ EIA 2015; LBNL personal communications with American Public Power Association (APPA) (March 23-27, 2015).

¹⁵⁵ BED n.d. EIA 2015.

¹⁵⁶ Austin Energy 2014.



4.3. Building Energy Codes

Buildings use about 41 percent of total energy and 72 percent of electricity consumed in the U.S.¹⁵⁷ State and local building energy codes—a subset of legal requirements known as building codes—reduce energy use in new buildings and major renovations by establishing minimum energy efficiency standards for building design, construction and remodeling.

Because the incremental cost of efficiency upgrades is lowest during design and construction, it is much more cost-effective to require upgrades through energy codes than for building owners to make efficiency retrofits after construction is completed. Over 80 percent of states in the U.S. have statewide building energy codes of varying stringencies.

Energy codes address areas of construction such as wall and ceiling insulation; window and door specifications; efficiency of heating, ventilating and air-conditioning equipment; and lighting fixtures. There are two model codes—templates that jurisdictions may adopt with or without changes—for the design and construction of new buildings: the *International Energy Conservation Code® (IECC)* and the *ANSI/ASHRAE/IESNA Standard 90.1 Energy Standard for Buildings except Low-Rise Residential Buildings*.¹⁵⁸ The IECC addresses all residential and commercial buildings. ASHRAE 90.1 covers commercial buildings.¹⁵⁹ The IECC adopted ASHRAE Standard 90.1 by reference; that is, compliance with ASHRAE Standard 90.1 qualifies as compliance with IECC for commercial buildings.^{160,161}

The IECC and ASHRAE 90.1 codes are updated every three years to keep them current with new technology and market norms.^{162,163} Interested stakeholders develop code changes by submitting proposals to a process managed by the International Codes Council and ASHRAE.¹⁶⁴

In recent years, building energy codes have become significantly more efficient. The 2009 IECC, for example, reduces allowed consumption by 14 percent compared to the 2006 IECC, and the 2012 IECC reduces consumption 24 percent compared to the 2009 IECC (see Figure 4.3.1-1). In May 2015, DOE estimated that the new code will save 0.98 percent of household energy use compared to houses built to the 2012 IECC.¹⁶⁵

¹⁵⁷ PNNL 2014.

¹⁵⁸ DOE is required by law to establish mandatory energy efficiency requirements for new federal buildings and to develop energy efficiency standards for manufactured homes. Federal law also requires that DOE publish determinations as to whether new editions of ASHRAE Standard 90.1 and the IECC would improve energy efficiency. In response, DOE's Building Energy Codes Program (BECP) undertakes rulemaking processes to facilitate full disclosure of DOE's analysis including development of methodologies, to solicit public input and to publish final rules.

¹⁵⁹ Defined as buildings other than single-family dwellings and multi-family buildings three stories or less above grade.

¹⁶⁰ DOE 2010.

¹⁶¹ The current model code versions are ANSI/ASHRAE/IES Standard 90.1-2013–Energy Standard for Buildings Except Low-Rise Residential Buildings and the 2012 International Energy Conservation Code®.

¹⁶³ BECP 2015.

¹⁶³ BECP 2015.

¹⁶⁴ BCAP 2010.

¹⁶⁴ BCAP 2010.

¹⁶⁵ <http://www.energycodes.gov/determinations>.

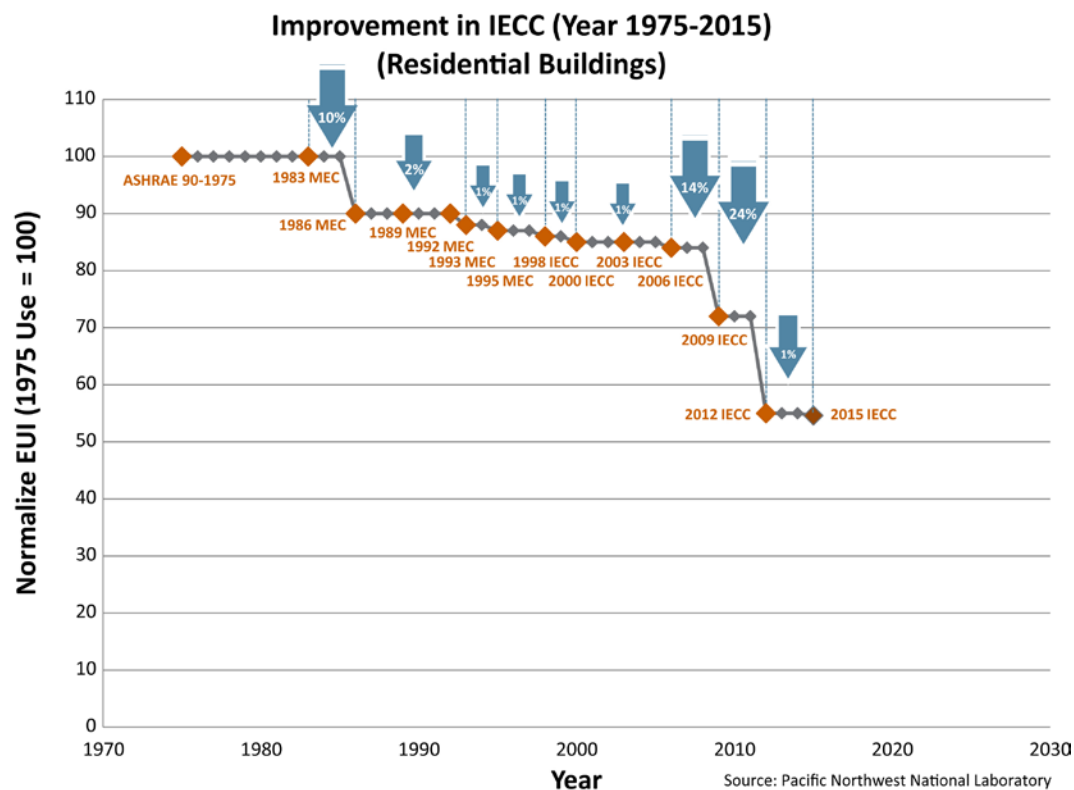


Figure 4.3-1. Improvement in IECC model codes 1975–2015¹⁶⁶

The number of new building starts in a given year is small compared to the existing building stock. However, savings from energy codes grow each year as more buildings are built or undergo major renovation. For example, the state of Washington adopted mandatory building energy codes in 1990. The Washington Department of Commerce estimates that, by 2030, those codes will have directly affected half of all buildings in the state.¹⁶⁷ Thus, energy savings from introducing or strengthening building energy codes have a long-term impact. They also have a long-term impact on emissions reductions. In fact, Texas includes its state building energy codes in its state implementation plan for compliance with EPA regulations on NO_x emissions.¹⁶⁸

Depending on the locale, either states or local governments—or both—are responsible for adopting and enforcing building energy codes.¹⁶⁹

Two main steps are needed to successfully implement building energy codes:


- **Code adoption.** Code adoption is the process of formally putting codes in place in a legal and regulatory framework and updating them over time. To achieve the most energy savings, states can adopt the most current model code (the current version of the IECC) and amend model codes to make them stronger.
- **Code enforcement and compliance.** Code enforcement is generally carried out by local governments who send inspectors to check building construction sites and review building plans. Code compliance refers to

¹⁶⁶ Pacific Northwest National Laboratory.

¹⁶⁷ Washington State Department of Commerce 2014.

¹⁶⁸ Prindle 2014, SPEER 2015. For more information see EPA 2004.

¹⁶⁹ See <http://www.energycodes.gov/#> to look up who is responsible for adopting and enforcing building energy codes in each state.



meeting the requirements specified by the code and demonstrating that the requirements have been met. It is through code compliance that actual energy savings are achieved. Code compliance rates measure how well building projects conform to code obligations.

Some utilities provide training and education on updated codes and code compliance. Some also offer financial incentives to cover a portion of project costs as a way to encourage better compliance.¹⁷⁰ Although code compliance activities have high energy-savings potential, they are often underfunded.¹⁷¹ In Illinois, the CANDI¹⁷² program engages the five largest utilities to support code compliance efforts.¹⁷³ CANDI established a statewide code compliance collaborative, a comprehensive training program and an equipment leasing program.¹⁷⁴ The program also provides administrative support to local governments, produces and circulates educational materials, and facilitates third-party inspections and reviews of plans.¹⁷⁵

4.3.1. Code Adoption

Codes may be adopted through state legislation or, where allowed, action by local governments (county or city council).¹⁷⁶ Most state legislatures have granted a state agency the power to update codes through an administrative rulemaking process. Commonly, the code adoption process evolves through a combination of these elements.¹⁷⁷

To determine the most effective course of action, decision makers must understand how current building energy codes in the state compare to energy efficiency practices in the residential and commercial new construction and renovation market.

Building energy codes vary widely across the U.S. and, in some cases, within a state (see Figures 4.3.1-2 and 4.3.1-3). Only a minority of states has adopted the latest IECC or ASHRAE model codes, leaving most states with an opportunity to adopt more stringent building energy codes. The following case studies illustrate some best practices for code adoption, including the adoption of “stretch codes,” which exceed model codes. For example, in 2011, North Carolina added the voluntary High Efficiency Residential Option (HERO) Appendix to its code legislation. HERO achieved a 30 percent added energy savings compared to the state’s then current building energy codes.¹⁷⁸

¹⁷⁰ For more information on how utilities can support building energy code adoption and compliance, see the report, “Attributing Building Energy Code Savings to Energy Efficiency Programs.” <http://www.neep.org/file/1047/download?token=Pdo-mTG4>.

¹⁷¹ MEEA 2015.

¹⁷² CANDI is an acronym for the participating government agencies and investor-owned utilities that participate.

¹⁷³ Prindle 2014.

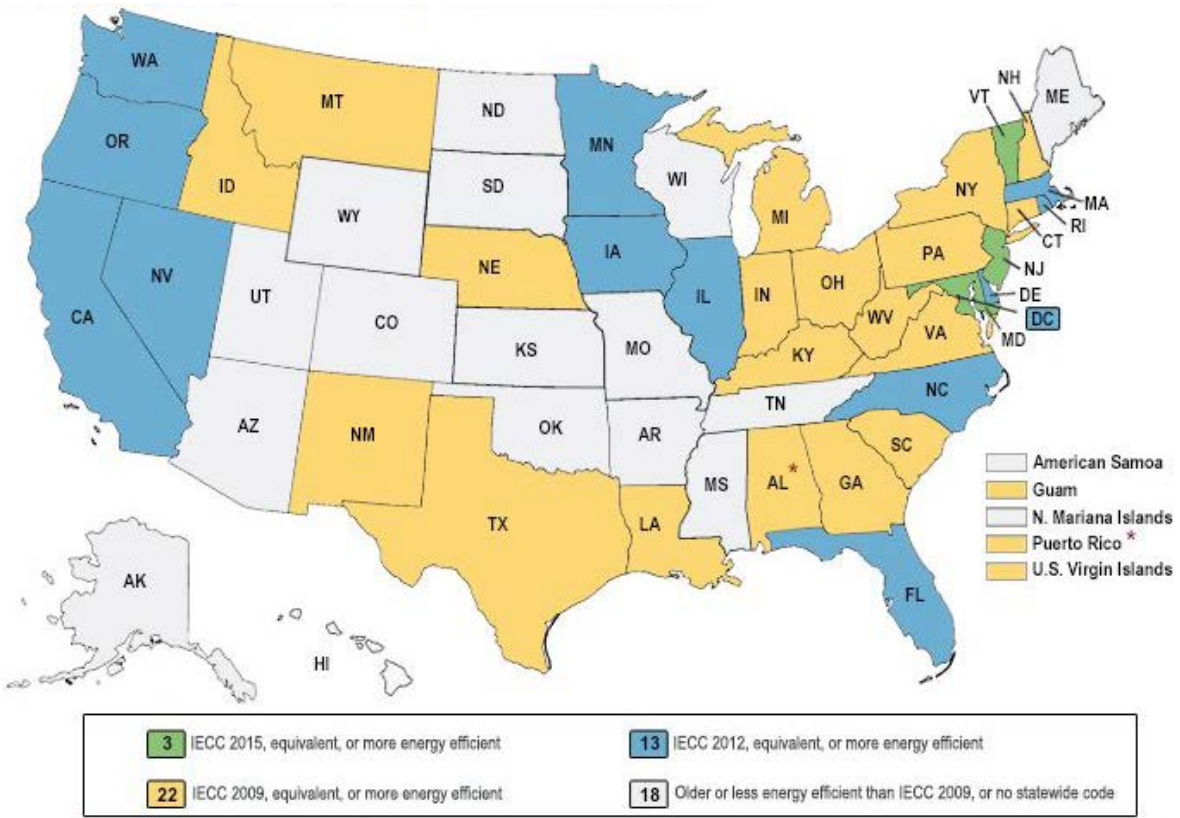
¹⁷⁴ *Ibid.*

¹⁷⁵ *Ibid.*

¹⁷⁶ In some states, local governments are responsible for code adoption and enforcement. See <http://energycodesocean.org/policy-action-toolkit-home-rule-states>.

¹⁷⁷ BCAP 2014b.

¹⁷⁸ For more on North Carolina’s codes see: <http://energycodesocean.org/state-country/north-carolina>.



As of November 2015

Figure 4.3.1-1. Current residential building energy code adoption status¹⁷⁹

¹⁷⁹ DOE Building Energy Codes Program, December 2015, <http://www.energycodes.gov/status-state-energy-code-adoption>.

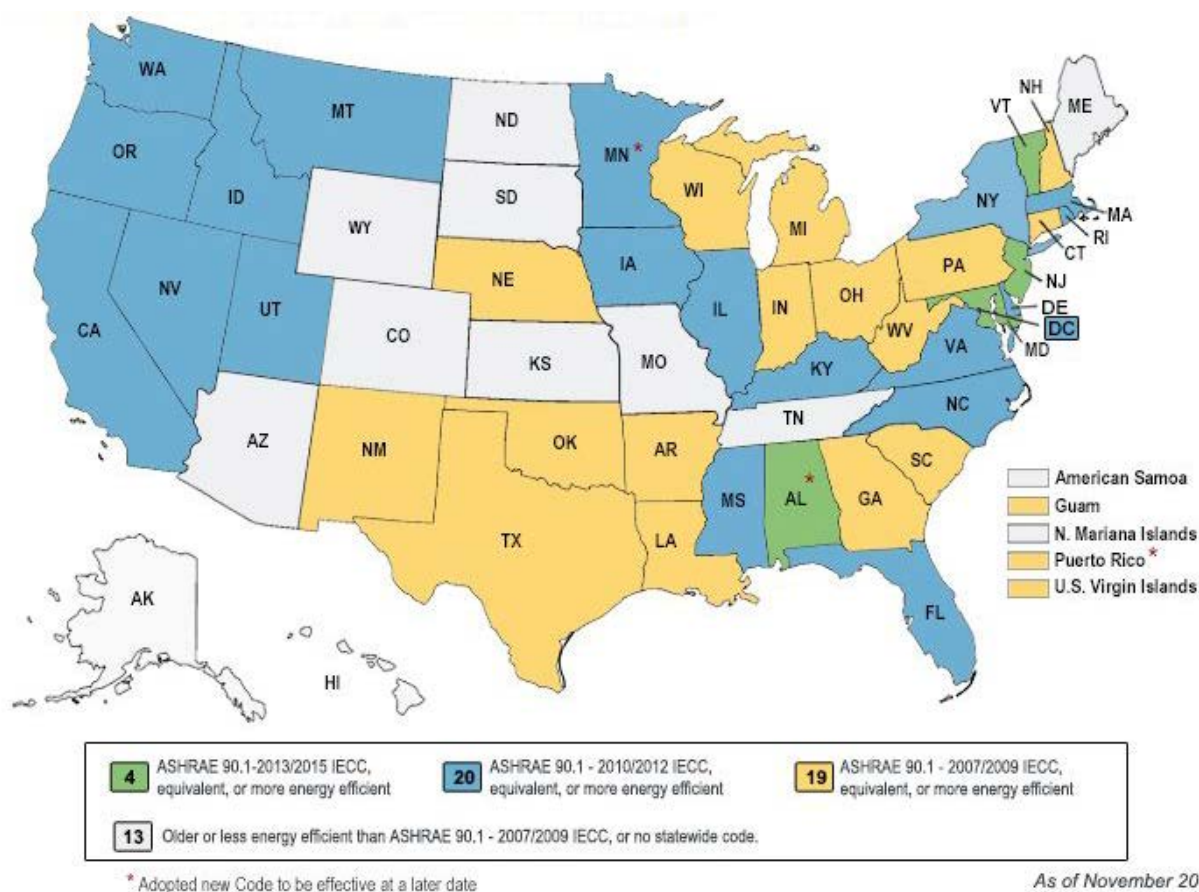


Figure 4.3.1-2. Current commercial building energy code adoption status¹⁸⁰

4.3.1.1 Case Studies

Maryland – In 2009, Maryland passed legislation that mandates the state adopt the most current version of the International Energy Conservation Code (IECC) within a year of publication and must implement the new code within six months of adoption.^{181,182} The IECC is updated every three years, giving Maryland an effective three-year trigger for adopting new building energy codes. Local jurisdictions, which implement and enforce codes in the state, may amend the state-adopted code to strengthen it but are prohibited from weakening it.

Illinois – Illinois also requires state adoption of the current IECC within a year of publication and implementation within six months of adoption.¹⁸³ Local governments are allowed to amend commercial codes to make them more stringent but cannot amend residential codes to make them more or less stringent.¹⁸⁴ Illinois' Capital Development Board, the agency responsible for adopting building energy codes, created a stakeholder group, the Illinois Energy Conservation Advisory Council, to solicit input on building codes from building trade representatives, design and construction professionals, code administrators and other interested parties.


¹⁸⁰ Ibid.

¹⁸¹ Maryland General Assembly 2009.

¹⁸² Bowles 2012.

¹⁸³ Illinois General Assembly 2009.

¹⁸⁴ Illinois Department of Commerce and Economic Opportunity 2014.



Massachusetts – In May 2009, the Massachusetts Board of Building Regulations and Standards adopted the Massachusetts “stretch” energy code. The stretch code calls for a 20 percent improvement in building energy performance based on the Home Energy Rating System (HERS). The stretch code applies to new and existing residential buildings under three stories, and to new commercial buildings and additions over 5,000 square feet. Local governments can adopt the stretch code if they are interested in pushing efficiency standards beyond the state baseline code.¹⁸⁵

4.3.2. Code Compliance

Code compliance means meeting the established building energy requirements and demonstrating that these requirements have been satisfied. The builder or contractor is responsible for both of these tasks.

There are two basic ways to comply with building energy codes.¹⁸⁶ The first, most commonly used, method is the prescriptive approach. Under this approach, the code stipulates the stringency of the materials and equipment the builder must use. A tradeoff under this approach may allow deviations from prescriptive requirements by substituting more stringent measures in other areas. The second approach is based on performance. In this case, the code allocates a total allowable energy use for a building, and the builder can choose the materials and equipment that will meet this target in a modeling simulation.¹⁸⁷

The main cost impacts of building energy codes are increased construction costs, which ultimately fall on building owners. Incentives provided by utilities subsidize compliance costs in some locales. Utilities also may advocate for strengthened codes—provided they receive energy savings credit for their efforts—as well as training and education for designers, contractors, officials and others responsible for code compliance.¹⁸⁸ Enforcement of codes by state or local jurisdictions is funded through fees on building plan reviews and inspections paid by building developers and owners.

Just as adoption varies widely across the country, so do compliance rates. There are a number of questions related to measuring them.

First, compliance can be defined in different ways so what is measured may not be comparable from study to study. Second is the question of what to measure—adherence to the letter of the code or the energy consumption impacts of the parts of the code that have been followed. Evaluators at the Northwest Energy Efficiency Alliance (NEEA),¹⁸⁹ for example, measure compliance rates using three methodologies to capture both of these components:

1. A “checklist” approach gives a project credit for each code requirement it meets.
2. A “modified checklist” weights code requirements with greater energy savings impacts more heavily than those with lower energy savings.¹⁹⁰
3. An “energy consumption” approach compares a building’s actual energy use to its estimated use assuming full code compliance.

¹⁸⁵ State of Massachusetts n.d.


¹⁸⁶ The various paths are written into the code. Builders decide which compliance method they will use.

¹⁸⁷ BCAP 2014a.

¹⁸⁸ Unless explicitly addressed, adopting more stringent codes erodes the utility’s ability to claim credit for energy savings for traditional ratepayer-funded programs.

¹⁸⁹ The Alliance includes more than 140 Northwest utilities and energy efficiency organizations that work at a regional level to accelerate the adoption of energy-efficient products, services and practices.

¹⁹⁰ For example, posting a description of the energy features on the building’s electricity panel may be important from a procedural perspective but it does not contribute to energy savings directly. (NEEA 2014)



Third is local variability: “the energy code is effectively implemented at the local jurisdiction level (county or city) where building construction and permitting take place.”¹⁹¹ How can a top down assessment of code programs capture this local variability in terms of compliance and what is being measured?

NEEA conducted code compliance studies for the four states it serves and found the following compliance rates for residential new construction.¹⁹²

Table 4.3.2-1. Residential New Construction Compliance Rates by State

State	Compliance Rate
Idaho	90%
Montana	60.5%
Oregon	91%
Washington	96%

Source: Cadmus 2012, 2013a, 2013b and 2014.

NEEA tailored the compliance measurement approaches listed above for each state to take into account differences in code requirements. No uniform methodology for measuring compliance rates exists, and there is no national repository of compliance rate data. However, DOE is currently developing a uniform methodology that states can use to evaluate energy savings levels and compliance rates with building energy codes.

States can take the following actions to improve enforcement of adopted codes and increase compliance rates:^{193, 194}

- Provide adequate funding for code compliance activities.¹⁹⁵ For example, the state of Washington provides stable funding for building energy code activities including compliance.¹⁹⁶
- Measure compliance rates every three to five years using statistically valid methodologies. NEEA has conducted compliance rate studies for Idaho, Montana, Oregon, and Washington and plans follow-up studies.
- Offer comprehensive education and training for designers, builders and others that need to comply with codes and for officials designated to adopt and enforce them, with support from utilities, including:
 - The value and importance of building energy codes for building owners and tenants and for achieving state energy efficiency and air quality goals
 - Code updates as well as topics targeted for the specific audience (e.g., building designers, heating subcontractors), integrating site visits and hands-on training
 - Ongoing technical assistance resources that are well-publicized, timely and dependable

¹⁹¹ PNNL 2014.

¹⁹² Listed rates are based on a “checklist” or modified checklist methodology. See Cadmus 2012, 2013a, 2013b and 2014. Cadmus has done similar studies in California.

¹⁹³ Cohan 2012.

¹⁹⁴ Also see DOE’s [Achieving Energy Savings and Emission Reductions from Building Energy Codes: A Primer for State Planning](#) and region-specific guides to success with energy codes: <http://www.successwithenergycode.com/index.php>.

¹⁹⁵ Providing sufficient funding for code education and training is likely to be a highly cost effective way to save energy in states with robust building energy codes. (Cohan 2012)

¹⁹⁶ Cohan 2015.

- For example, Nebraska offers customized training for designers, builders and others focusing on a number of specific topics such as REScheck and COMcheck (see below). The state energy office also provides customized, localized, one-on-one technical assistance for local governments.¹⁹⁷
- Provide readily accessible tools and materials to assist with compliance, such as templates for submittals, calculation and sizing spreadsheets, and guides such as those available through REScheck™ and COMcheck™.¹⁹⁸ REScheck helps builders, designers and contractors ascertain whether their residential projects meet building energy codes and allows officials to quickly and easily determine if codes have been met for each project. COMcheck does the same for commercial projects.
- Organize stakeholder collaborative groups to assist in adopting, implementing and enforcing codes. For example, the Illinois Energy Conservation Advisory Council, a stakeholder group, advises the agency that oversees the state's energy code.¹⁹⁹

It is through code compliance that actual energy savings are achieved. States can improve enforcement of adopted codes and increase compliance rates by providing adequate funding for code compliance, by measuring compliance every three to five years, by offering comprehensive code education and training, by providing readily accessible tools, materials and guides, and by organizing stakeholder collaboratives to support compliance activities.

4.3.2.1 Case Study

Washington – The state of Washington first established building energy codes in the 1970s and adopted a mandatory statewide code in 1990. A 2009 state law requires the Washington State Building Code Council (the state agency designated to establish minimum building, mechanical, fire, plumbing and energy code requirements) to develop energy codes that achieve a 70 percent reduction in building energy use by 2030, compared to the state's 2006 energy code.²⁰⁰

The state's efforts towards code compliance include the following:²⁰¹

- Washington's 2011 strategic plan for buildings²⁰² calls for the state to develop and implement a field evaluation protocol to document a 90 percent code compliance rate before 2016. Compliance studies in 2008 for commercial buildings found a 94 percent compliance rate. A new evaluation is underway. A 2013 NEEA study for residential buildings found a 96 percent compliance rate.
- The state works collaboratively with other Northwest states and regional groups (e.g., NEEA, Northwest Energy Efficiency Council, a trade association, and the Northwest Energy Code Group²⁰³) to share experiences on code enforcement issues and best practices for code training and education.
- Washington State University Extension Energy Program provides training and ongoing support for the residential building code. The Northwest Energy Efficiency Council provides support for the commercial building sector. The Washington Association of Building Officials, Building Industry Association of

¹⁹⁷ ACEEE 2015.

¹⁹⁸ See <http://www.energycodes.gov/software-and-web-tools>.


¹⁹⁹ OCEAN 2015.

²⁰⁰ Washington Department of Commerce 2014.

²⁰¹ ACEEE 2014.

²⁰² See <http://www.commerce.wa.gov/Documents/EO-2011-Strategic-Plan-for-Buildings.pdf>.

²⁰³ The Northwest Energy Code Group is organized through the Northwest Energy Efficiency Alliance.



Washington, homebuilder associations and private businesses offer additional training opportunities. Educational activities include field training and targeted training in specific sections of the code.

- Electric utilities in the state provide funding and help with outreach for code education and training and provide incentives for new buildings and renovation projects that exceed code standards to encourage next steps in cost-effective, energy-efficient construction practices.
- The Washington State Building Code Council is considering moving to an outcome-based code structure. Under this approach, actual energy consumption of the occupied building—based on energy bill data—must be lower than a predetermined energy use target for the specific building occupancy in order to comply.²⁰⁴

A recent report for NEEA estimates that, between 2015 and 2024, energy savings from nonresidential building energy code changes adopted by the state of Washington between February 2011 and January 2015 will average 11,341 MWh per year. This is equal to 0.45 kWh saved per square foot each year.²⁰⁵

4.3.2.2 EM&V

Two metrics are typically used to quantify the savings attributed to building energy code adoption and compliance:

- **Projected savings** – the savings estimated to occur as a result of new or updated building codes. These savings are based on assumptions about the efficiency of existing building stock, the effect of the new/updated code on building energy efficiency, projections of how much building square footage will be affected (e.g., projections of new construction rates) and assumptions about the percent of code compliance.
- **Evaluated savings** – the documented savings based on actual or modeled values (or both) for each of the factors used to prepare projected savings values, such as actual compliance rates and new construction rates.

For purposes of environmental compliance, documenting impacts with evaluated, versus projected, savings is usually preferable.

Quantifying projected and evaluated savings is typically accomplished by independent evaluators through a combination of surveys of contractors and construction activity, inspections of buildings, review of energy bills and computer simulations of building energy use. There is substantial experience associated with the projected-savings method. Each state's procedures for adopting energy code include an assessment of potential impacts. There also is some experience applying evaluated-savings methods to energy codes. For example, California has an impact evaluation protocol for assessing both building energy codes and product standards. The state has gone through a few multi-year cycles of determining evaluated savings.^{206,207} In addition, DOE has developed procedures

²⁰⁴ Under the state's current performance-based compliance method, the applicant's proposed design meets energy code if the required computer model simulation demonstrates that the building will use less energy than a building of similar design incorporating code-required construction elements.

²⁰⁵ NEEA 2014.

²⁰⁶ *Attributing Building Energy Code Savings to Energy Efficiency Programs*, IEE/IMT/NEEP Report, February 2013. Prepared by The Cadmus Group, Inc., Energy Futures Group NMR Group, Inc. Optimal Energy.

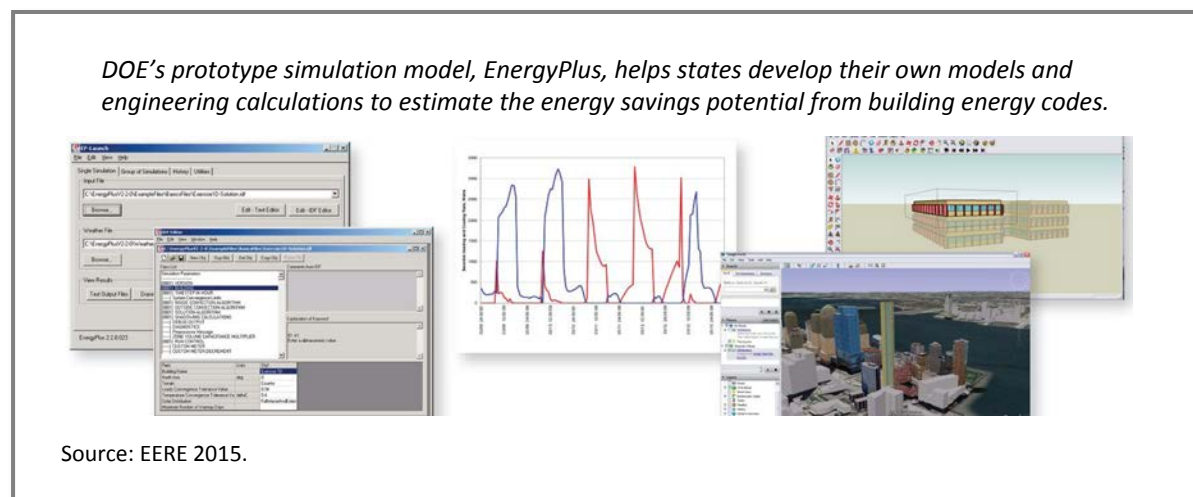
²⁰⁷ *California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals, Codes and Standards and Compliance Enhancement Evaluation Protocol*, April 2006. Prepared for the California Public Utilities Commission by The TecMarket Works Team. *Statewide Codes and Standards Program Impact Evaluation Report For Program Years 2010-2012*. August 2014. Prepared for California Public Utilities Commission Prepared by Cadmus, Energy Services Division and DNV GL.

and templates for assessing building energy code compliance and is conducting a pilot program that involves assessing evaluated savings.^{208,209}

4.3.2.3 Expected Range of Energy Savings and Emissions Reductions

Building energy codes have a large potential to save energy through the adoption of increasingly stringent codes and through raising compliance rates after codes have been adopted. In 2012, the U.S. saved an estimated 40 billion kWh of electricity and avoided 36 million metric tons of CO₂ emissions through building energy codes.²¹⁰ Between 2013 and 2040, if current trends in adoption and compliance continue, the cumulative electricity savings from codes is estimated to be 3,643 billion kWh with 3,178 million metric tons of avoided CO₂.²¹¹

A 2014 Pacific Northwest National Laboratory study estimates that, in 2030, code development, adoption and compliance efforts could reduce residential electricity consumption in the U.S. by more than 4 percent and commercial sector consumption by nearly 9.5 percent, compared to 2012.^{212,213}



DOE's prototype simulation model, EnergyPlus, helps states develop their own models and engineering calculations to estimate the energy savings potential from building energy codes.²¹⁴

Reducing future demand for electricity indirectly results in emissions reductions at fossil-fueled electric generating units (EGUs), compared to what would happen in the absence of the codes. Building energy codes also frequently result in direct emissions reductions associated with on-site combustion of heating fuels, typically natural gas.

²⁰⁸ DOE is determining projected and evaluated savings through field-based research on a statistically valid sample representing all buildings constructed under the code being studied. Data from the studies will be used to create computer simulations of as-built annual building energy use and compared to simulations representing "to code" energy use. See Achieving Energy Savings and Emission Reductions from Building Energy Codes: A Primer for State Planning (<https://www.energycodes.gov/achieving-energy-savings-and-emission-reductions-building-energy-codes-primer-state-planning>) and the Funding Opportunity Announcement, "Strategies to Increase Residential Energy Code Compliance Rates and Measure Results." (<https://www.energycodes.gov/funding-opportunity-doe-building-energy-codes-program-strategies-increase-residential-building>)

²⁰⁹ PNNL 2014.


²¹⁰ Cohan 2015.

²¹¹ *Ibid.*

²¹² PNNL 2014.

²¹³ EIA 2014.

²¹⁴ www.energycodes.gov/commercial-prototype-building-models.



As with other types of energy efficiency policies and programs, the expected emissions reductions associated with reduced electricity usage depend in part on which EGUs' output is displaced, and that will vary based on the timing and location of energy savings (see Section 3.5.2).²¹⁵

Building energy codes primarily affect the future energy use of buildings not yet built.²¹⁶ Buildings may last a hundred years or longer. This has ramifications for the various methods (described in Section 3.5.2) for estimating the emissions reductions associated with electric energy savings. The emissions factors in EPA's eGRID database²¹⁷ are based on historical generation mixes and emissions rates, currently from the year 2012. These emissions factors are of limited value for medium- and longer-term projections of avoided emissions given ongoing changes in generation portfolios, though they could be used to estimate the short-term impacts of building energy codes over the next five years or so.²¹⁸ EPA's AVERT tool and other marginal emissions methods based on historic data are similarly challenged in estimating long-term emissions reductions, because changes in the generation portfolio also affect which EGUs are economically dispatched.²¹⁹

One alternative is to assume that building codes will primarily displace or defer the need for new EGUs and to use the typical emissions rate of a new natural-gas fired combined-cycle EGU (or some other surrogate EGU technology) to estimate avoided emissions. This approach is much less commonly used than eGRID emissions factors, but gaining attention.²²⁰

Modeling alternatives also are available, as described in Section 3.5.2. For example, a 2014 Pacific Northwest National Laboratory (PNNL) study estimated the difference in future energy consumption and emissions between a base-case building codes scenario and a model building codes scenario based on expected triennial updates to the IECC model code. The base case assumes every state preserves whatever state energy code was in place in 2013 and compliance rates match historic/realistic levels. The model energy codes scenario assumes every state adopts updated model codes in the year immediately following their publication and compliance rates are 100 percent. PNNL then used a computer model to estimate that under the model building codes scenario, U.S. CO₂ emissions would be 461 million metric tons lower in the year 2040, and the cumulative reduction in CO₂ emissions for the years 2013 through 2040 would equal 6,189 million metric tons.²²¹

A spreadsheet tool for estimating energy savings and avoided emissions from building energy codes is available on DOE's website at <http://www.energycodes.gov/resource-center/utility-savings-estimators>. This tool uses the same methodology as the PNNL study²²² and allows users to develop state-level estimates of building code impacts using default values or user-defined inputs.

²¹⁵ The direct emissions reductions associated with reduced on-site combustion of heating fuels, however, do not vary with time or location but instead depend entirely on the type of fuel burned and the characteristics of the combustion equipment. EPA publishes standard emissions factors for such combustion equipment in a document called AP-42, *Compilation of Air Pollutant Emission Factors*, available at <http://www.epa.gov/ttnchie1/ap42/>.

²¹⁶ Impact on existing residential buildings is minimal. Although the impact on existing commercial buildings may be large, the exact magnitude is uncertain.

²¹⁷ The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the U.S.

²¹⁸ EPA periodically updates the eGRID database. The most recently updated data should always be used.

²¹⁹ In fact, EPA specifically advises that AVERT "should not be used to examine the emission impacts of major fleet adjustments or changes extending further than five years from the baseline year."

²²⁰ For one example, refer to a paper written by staff at the California Energy Commission, available at http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/General/2013_Initial_Study_Air_and_Water_Emission_Factors.pdf.

²²¹ PNNL (March 2014). "Building Energy Codes Program: National Benefits Assessment, 1992-2040." Prepared by O.V. Livingston, P.C. Cole, D.B. Elliott and R. Bartlett for the Department of Energy. PNNL-22610 Rev 1. https://www.energycodes.gov/sites/default/files/documents/BenefitsReport_Final_March20142.pdf.

²²² A full explanation of this methodology is available at: http://efficiency.lbl.gov/sites/all/files/lbnl6025e_ffc.pdf.

Building Energy Codes Building energy codes are state and local regulations that establish minimum energy efficiency standards for building design, construction, and renovation.

Screening Questions	Quick Answers	Resources: Documented State Experience or Recommended Practice
<p>FEASIBILITY Can building energy code adoption and compliance help achieve GHG and criteria air pollutant reductions in the required time frame?</p>	<ul style="list-style-type: none"> • Yes. They reduce the amount of electricity generated, and fossil fuel consumed, at EGUs. Reduced energy demand yields emissions reductions. 	<ul style="list-style-type: none"> • Efficiency Power Plant Tool (RAP) • Building Codes Assistant Project (BCAP) • DOE Building Energy Codes Program (BECP) and “Select the Appropriate Code for Adoption”
<p>IMPACT What energy savings and emission reductions can building energy codes achieve, and are the savings permanent?</p>	<ul style="list-style-type: none"> • Compliance with robust energy codes permanently decreases a building’s energy consumption for the life of the measures. • DOE’s prototype simulation model, EnergyPlus, helps states develop their own models and engineering calculations. • Resulting emissions reductions vary with amount and timing of energy savings and EGU emission profiles. Values can be determined with simple estimates or detailed modeling. 	<ul style="list-style-type: none"> • <i>Building Energy Codes Program: National Benefits Assessment, 1992-2040</i> (Pacific Northwest National Laboratory) • DOE’s EnergyPlus: Building Energy Codes Program’s Commercial Prototype Building Models
<p>RESPONSIBILITY Who is responsible for administering and implementing energy codes, and what are the best practices?</p>	<ul style="list-style-type: none"> • The designated state agency, local government agencies, or both are responsible for code development, adoption, and enforcement. • Building designers, builders, and building owners are responsible for implementing the code requirements. 	<ul style="list-style-type: none"> • DOE Building Energy Codes Program on development, adoption, and compliance • ACEEE State and Local Policy Database: Compliance • Online Code Environment & Advocacy Network: Code Development • Responsible Energy Codes Alliance: IECC Compliance Guides
<p>COST What is the cost structure of energy code programs, and how much do they cost?</p>	<ul style="list-style-type: none"> • Building developers or owners pay for energy efficiency upgrades required by the code. • Fees for building plan reviews and inspections pay for code enforcement. • Utilities may provide incentives for certain code measures and help fund education and training. 	<ul style="list-style-type: none"> • “The Cost of Enforcing Building Energy Codes: Phase 1” • Online Code Environment & Advocacy Network – Incremental Cost Analysis • DOE’s <i>National Energy and Cost Savings (Residential)</i> • DOE’s <i>National Cost-effectiveness of ASHRAE Standard 90.1-2010 Compared to ASHRAE Standard 90.1-2007 (Commercial)</i>
<p>RELIABILITY How can I document the energy impacts of building energy codes?</p>	<ul style="list-style-type: none"> • Independent evaluators assess savings through surveys of construction activity, inspections, review of energy bills, and computer simulations. Guidelines have been developed for these evaluations. • Several states and some local governments have evaluated code compliance. • DOE is developing a methodology to measure compliance impacts (expected 2015-2016). • ACEEE has created a guide to help states document emissions reductions from energy efficiency codes. 	<ul style="list-style-type: none"> • Compliance evaluations: ID, MT, OR, WA REScheck and COMcheck tools <i>ACEEE Template for Including Building Energy Codes in State Compliance Plans</i>
<p>Other Considerations What are other considerations for successful delivery of energy savings from codes programs?</p>	<ul style="list-style-type: none"> • Adequate funding for code compliance activities • Measuring compliance rates every 3 to 5 years • Education and training for the building industry • Adopting current versions of foundational model building energy codes – International Energy Conservation Code® and ANSI/ASHRAE/IESNA Standard 90.1 	<ul style="list-style-type: none"> • <i>A Comprehensive Approach to Energy Code Compliance</i> • International Code Council (ICC – publisher of the IECC), ASHRAE • Responsible Energy Codes Alliance: IECC Compliance Guides • <i>Navigating the Clean Power Plan (ACEEE)</i>



4.4. Local Government-Led Efforts

Cities and other local governments are poised to reduce electricity use and therefore EGU emissions through their role as building/asset owners, policymakers, taxation authorities and, in some locales, operators of electric utilities. Many cities have set reduction goals for carbon dioxide emissions. Local governments are trailblazers that test and refine policies and programs that later may be adopted statewide. Local building energy efficiency efforts can be broadly categorized as:

- Policies and programs that encourage energy savings by residents and businesses, including:
 - Building performance policies for residential and commercial buildings
 - Voluntary programs such as private sector challenges and energy project financing
- “Lead by example” activities focused on saving energy in local government-controlled assets

This chapter discusses both approaches.²²³ Note that these approaches interact to support each other. For example, building performance policies and private sector challenges may reveal opportunities for energy efficiency upgrades, which could be paid for using local-government supported financing offerings.

While the focus here is on local government activities, states can support these efforts in many ways. For example, states can offer building code compliance training or can establish “reach” or “stretch” codes to make it easy for local jurisdictions and builders to voluntarily go beyond standard building energy codes.²²⁴ States can offer attractive financing or tax credits to address upfront costs of energy efficiency upgrades or can establish and convene networks to support local government energy topics. Where Property Assessed Clean Energy (PACE)-enabling legislation is not yet in place, states can enact it to allow local governments to offer this type of financing (discussed later in this section).

4.4.1. Building Performance Policies

Because of the large potential for energy efficiency in buildings, a focus on this sector is key to achieving significant energy savings and associated greenhouse gas reductions.

Improvements in building technologies—including efficient lighting, advanced building controls, efficient appliances, whole-building design and efficient construction practices—have made it possible to build and operate more efficient and better-performing buildings than ever before. Building energy codes address consumption in new buildings and, in some cases, major renovations by specifying energy performance requirements.

However, the energy performance levels that buildings achieve when they are first built often degrade over time due to declining equipment performance or changing building use or operation. Consequently, building energy codes do not usually address the full potential for improving energy performance over a building’s lifetime. Building performance policies address this gap by giving building owners, tenants and operators the power to act based on information about how the building is currently using energy. While these policies include a range of strategies, we focus on four primary types of policies in Table 4.4.1-1.²²⁵

²²³ The *Clean Energy Lead by Example Guide: Strategies, Resources, and Action Steps for State Programs* (June 2009) discusses internally focused efforts in detail: <http://www.epa.gov/statelocalclimate/resources/example.html>.

²²⁴ Reach codes adopt components of the most recent version of the International Energy Conservation Code or utility ratepayer-funded programs that encourage higher levels of energy efficiency in construction and renovation. Reach codes have the familiar structure of mandatory codes, and building inspectors are trained to verify compliance.

²²⁵ SEE Action Network’s *Greater Energy Savings through Building Energy Performance Policy* provides examples of other building performance policies: https://www4.eere.energy.gov/seeaction/sites/default/files/pdfs/building_energy.pdf.

Table 4.4.1-1. Sample of Building Performance Policies

Type of Policy	Buildings Covered	Sectors Affected	Summary
Ongoing energy benchmarking and transparency	Buildings over a certain square footage (varies by jurisdiction)	Primarily commercial, large multifamily, municipal	<p>Benchmarking involves compiling building energy consumption data²²⁶ and calculating summary metrics that can be compared to peer buildings or the same building’s historical consumption.</p> <p>Building owners provide results, typically annually, to a designated government agency. Results are often disclosed to the public to make energy performance of buildings transparent, encourage steps to improve performance over time, and enable the real estate market to reward high-performing buildings.</p>
Ongoing energy audits	Buildings over a certain square footage (varies by jurisdiction)	Primarily commercial, large multifamily, municipal	<p>Audits are on-site evaluations of a building’s major energy-consuming systems conducted by a certified professional.</p> <p>Audits identify opportunities to improve efficiency and reduce energy bills and provide a roadmap for property owners to improve performance.</p> <p>Some jurisdictions offer technical or financial support for audits.</p>
Periodic retro-commissioning	Buildings over a certain square footage (varies by jurisdiction)	Primarily commercial, large multifamily, municipal	<p>Retro-commissioning is a structured process, conducted by a certified professional, to systematically examine a building’s major energy-consuming systems and identify and correct sub-optimal performance.</p> <p>Retro-commissioning can lead to improved building performance through low- or no-cost measures.</p> <p>Some jurisdictions require that large buildings periodically undergo retro-commissioning to ensure ongoing efficient performance.</p>
Point of sale energy disclosure or upgrade	Commercial, owner-occupied residential (varies by jurisdiction)	All	<p>Point of sale policies encourage or require sellers to: (1) provide potential buyers with information about the energy performance of the property for sale or (2) complete basic upgrades to demonstrate compliance with a local energy ordinance at the time of sale or major renovation.</p> <p>Trained and certified property assessors ensure accuracy of the information.</p>

²²⁶ EERE 2014a.

Figure 4.4.1-1 shows the interaction among building performance policies. While it describes a general sequencing of policy implementation and activity, jurisdictions may stray from the sequence presented in this illustration.

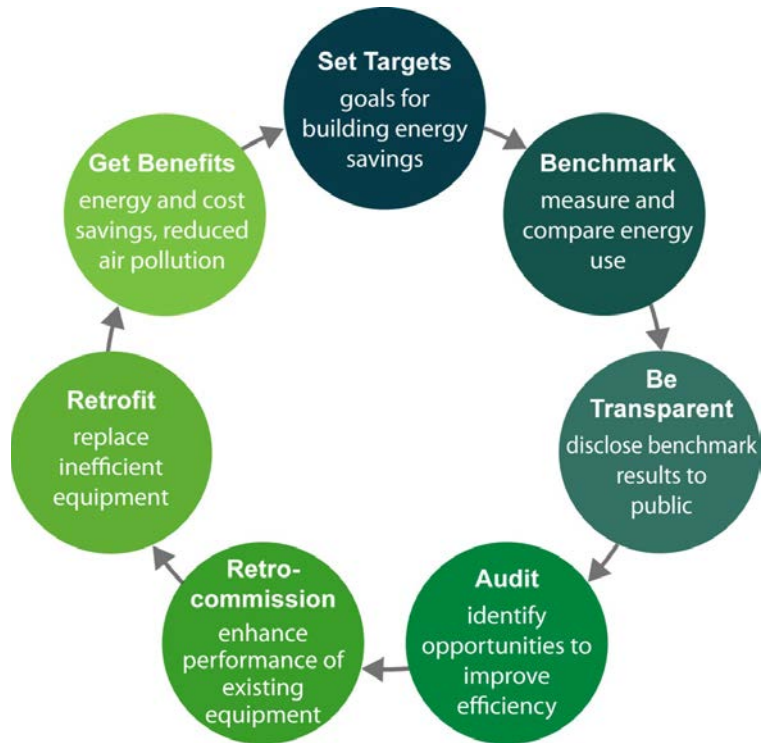


Figure 4.4.1-1. Building performance policies interaction

4.4.1.1 Case Studies

Many states and municipalities have adopted benchmarking or transparency policies (see Figure 4.4.1-2). Several municipalities also require energy assessments; corrective actions (retro-commissioning); and point of sale disclosure, upgrades or both. Following are examples of established building performance programs that illustrate the range of implementation options.

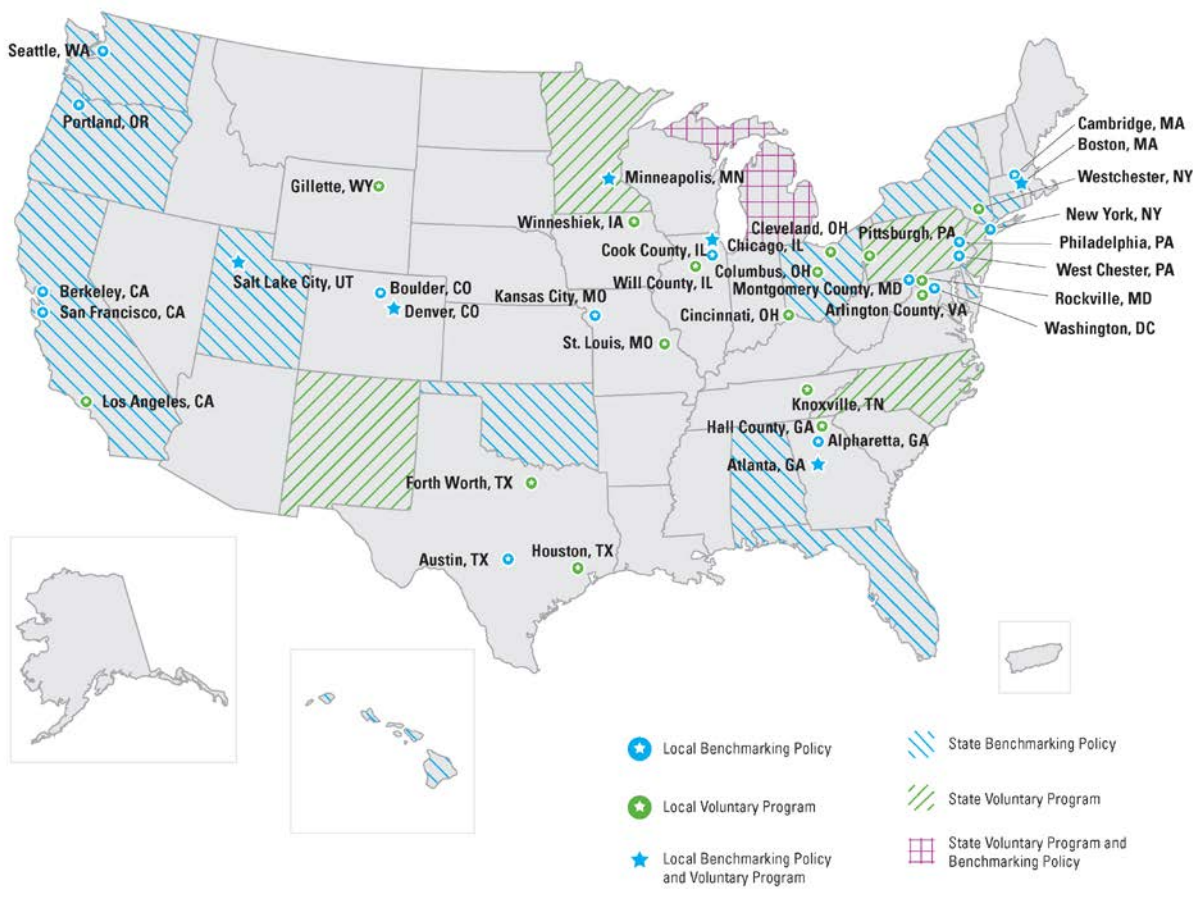


Figure 4.4.1-2. State and local benchmarking policies and voluntary programs²²⁷

²²⁷ <http://www.energystar.gov/buildings/program-administrators/state-and-local-governments>.

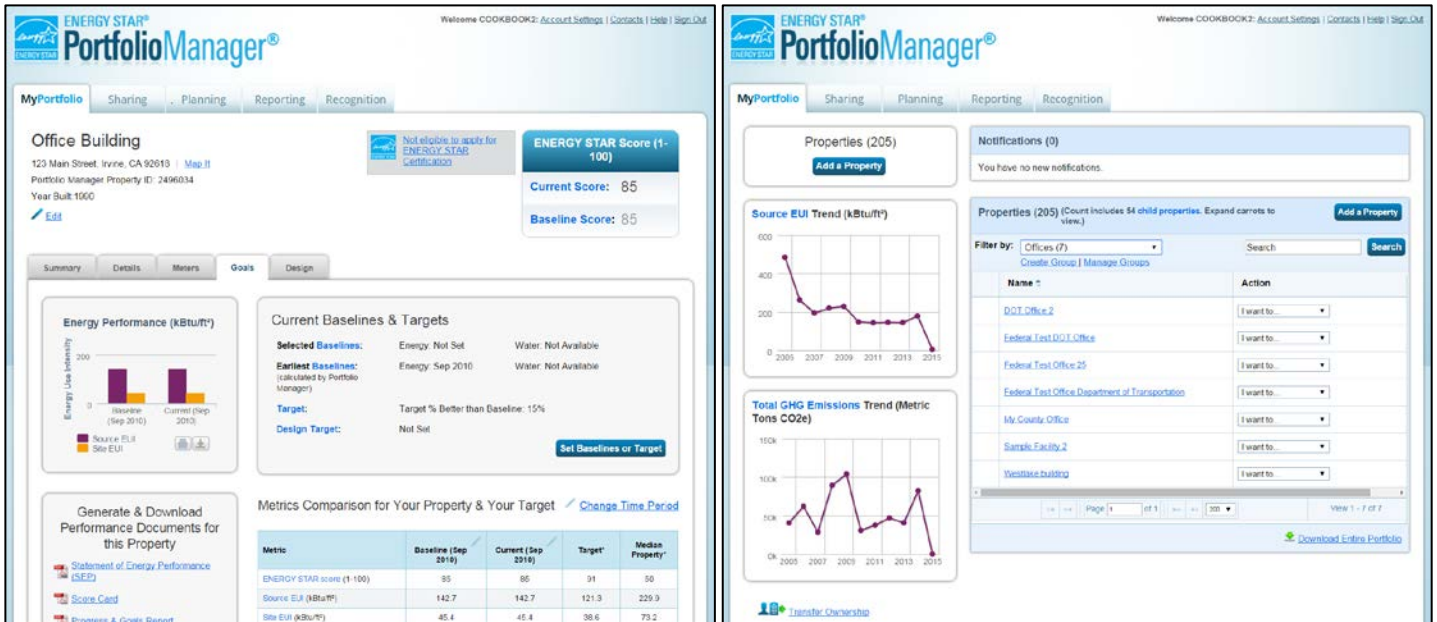


Figure 4.4.1-3. Sample of Portfolio Manager views²²⁸

Ongoing Mandatory Energy Efficiency Benchmarking, Disclosure and Transparency^{229,230}

The following policies use EPA’s ENERGY STAR Portfolio Manager to benchmark energy use (see Figure 4.4.1-3).²³¹

Minneapolis’ Commercial Building Rating and Disclosure Ordinance. In February 2013, Minneapolis passed an ordinance requiring commercial buildings (50,000 square feet and over) and municipal buildings (25,000 square feet and over) to benchmark their energy consumption data and provide it to the city. Starting in 2016, the city will share all benchmarked data publicly and will issue violations and potentially fines to non-compliant property owners. The policy will affect nearly 1,050 buildings that, combined, account for more than half of the city’s total energy use.²³² The city expects that consistent information on how buildings compare to their peers will promote energy efficiency actions.²³³

New York City Local Law 84. In 2009, New York City passed a law requiring commercial and residential buildings that are 50,000 square feet or larger and municipal buildings 10,000 square feet or larger to benchmark energy and water usage annually.^{234,235} The city shares energy usage data publicly. During the first two years of the policy’s implementation (2010 to 2012), covered buildings reduced energy use by 4 percent (12,402,827 million

²²⁸ <http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager>.

²²⁹ The Natural Resources Defense Council and the Institute for Market Transformation’s City Energy Project supports cities in designing these types of policies and programs. For more information, see <http://www.cityenergyproject.org/>.

²³⁰ While not a local program, California enacted AB 802 in October 2015 to make it easier for property owners to get timely energy data. Replacing prior law (AB 1103) governing energy disclosure to property owners, AB 802 requires utilities to share 12 months of data with requesting commercial and multifamily properties of 50,000 square feet or greater within four weeks of the request. AB 802 takes effect on Jan. 1, 2017. For more information, see http://www.allenmatkins.com/Publications/Legal-Alerts/2015/10/23_10_2015-New-Legislation-to-Replace-Existing-Energy-Use-Disclosure-Law.aspx.


²³¹ See <http://www.energystar.gov/buildings/program-administrators/state-and-local-governments/policies>.

²³² City of Minneapolis 2013.

²³³ See <http://www.ci.minneapolis.mn.us/environment/energy/>.

²³⁴ NYC 2014a.

²³⁵ New York City property owners also use the ENERGY STAR® Portfolio Manager tool to benchmark and share data.



Btu), saved \$138 million in energy costs, and reduced greenhouse gas emissions by 7 percent. In the four years since the policy's adoption, the city has seen a 5.7 percent decrease in energy usage in covered buildings. While these are gross reductions and not all attributable to benchmarking, they are indicative of what a well-designed building performance program could achieve.²³⁶

Montgomery County, Maryland. Montgomery County was the first county to enact mandatory benchmarking and disclosure, in 2014. The policy applies in three stages. First, government buildings over 50,000 square feet must benchmark. Next, commercial buildings over 250,000 square feet must benchmark. Finally, all buildings over 50,000 square feet must benchmark. The policy will apply to nearly 1,000 buildings. The county established work groups of government agencies, private firms and organizations representing the energy services sector to help clarify program requirements and establish a network of ambassadors.

Energy Efficiency Disclosure or Upgrade at Point of Sale

Austin's Energy Conservation Audit and Disclosure Ordinance targets owner-occupied residential properties. Before selling a home, homeowners whose properties are at least 10 years old must conduct and disclose the results of a home energy audit to prospective buyers. Penalties for non-compliance are up to \$2,000. Multifamily property owners (five units or more) must also conduct an energy assessment when the building turns 10 years old and every 10 years thereafter. Audit results must be displayed and shared with current and prospective tenants.²³⁷

Berkeley's Residential Energy Conservation Ordinance requires all homes for sale or undergoing major remodeling to demonstrate completion of 11 prescriptive energy efficiency measures (e.g., low flow toilets, weather-stripping, ceiling insulation measures).²³⁸ Established in 1987, the cost of complying with these responsibilities is capped at 0.75 percent of home value to protect owners from undue financial burden. Berkeley's Commercial Energy Conservation Ordinance requires a different set of prescriptive measures during transfer or sale for commercial buildings.²³⁹ The Berkeley City Council recently requested an evaluation of its residential and commercial point of sale upgrade programs. The evaluation will offer insight into the energy, natural gas and water savings attributable to these programs.²⁴⁰

Beginning in December 2015, Berkeley's Residential and Commercial Conservation Ordinances will be replaced by a single **Building Energy Saving Ordinance**, which requires both time of sale upgrades and periodic submission (every five to 10 years) of an energy assessment report and ENERGY STAR Portfolio Manager score. Requirements vary by building size and type, but all buildings will eventually be covered by the ordinance.²⁴¹

Energy Assessments

San Francisco's 2011 Existing Commercial Building Energy Performance Ordinance requires owners of nonresidential buildings in the city (10,000 square feet or greater) to annually measure and disclose energy performance.²⁴² The ordinance also mandates periodic, comprehensive energy assessments, at the owners' expense, that give property owners: (1) information on available retro-commissioning or retrofit options for the building, (2) an estimate of each measure's cost and energy savings potential and (3) a consolidated list of all cost-effective measures available to the owner.^{243,244}

²³⁶ NYC 2014a and [personal communication with DOE](#).

²³⁷ City of Austin 2013.

²³⁸ City of Berkeley 2008.


²³⁹ City of Berkeley 2010.

²⁴⁰ See <http://www.ci.berkeley.ca.us/EnergyOrdinanceUpdate/>.

²⁴¹ See http://www.cityofberkeley.info/Clerk/City_Council/2015/03_Mar/Documents/2015-03-10_Item_01_Ordinance_7397.aspx.

²⁴² The San Francisco Department of Environment determines the specific timeline.

²⁴³ City of San Francisco 2014.



Boston’s 2013 Building Energy Reporting and Disclosure Ordinance requires municipal, commercial and, starting in 2017, residential buildings with 35 units or more or 35,000 square feet or greater to benchmark and disclose energy consumption. In addition, every five years building owners must conduct a comprehensive energy assessment or take an “energy action” which can include a major investment in energy efficiency, creation of an energy management plan, retro-commissioning of energy systems, or other equivalent actions.²⁴⁵

Retro-Commissioning

In addition to benchmarking and disclosure (Local Law 84), **New York City Local Law 87** requires owners of large buildings (over 50,000 square feet) to conduct retro-commissioning and an energy audit every 10 years. Retro-commissioning must cover three broad areas: operating protocols and calibration; repair and cleaning; and training and documentation.²⁴⁶ By requiring properties to collect and then act on energy usage information, New York City hopes to optimize the energy performance of its buildings.

4.4.1.2 Expected Range of Energy Savings and Emissions Reductions

Realized energy savings vary based on the specific building performance policies enacted. For example, some policies simply make energy performance visible whereas others require building owners to use that information to act to reduce energy use. Following are savings ranges for two strategies:

- **Benchmarking.** An analysis of more than 35,000 buildings that benchmarked their energy use consistently over a four-year period in EPA’s ENERGY STAR ENERGY STAR Portfolio Manager found annual average, weather-normalized energy savings of 2.4 percent.^{247,248}
- **Retro-commissioning.** A study of over 600 retro-commissioning projects in commercial buildings found average whole building energy savings of 16 percent. The study also found encouraging rates of “persistence.” Energy savings after four years had declined only 10 percent on average with electricity savings declining less than other types of energy savings (e.g., central hot or chilled water).²⁴⁹

The expected emissions reductions associated with reduced electricity usage in any given building subject to building performance policies depends on: (1) how much energy the building consumes (current performance as a result of policy/program intervention), (2) how much energy would have been consumed absent the building performance policy (business-as-usual counterfactual to #1) and (3) what fuel sources are used (e.g., electricity, natural gas). Emission reductions from electricity also depend on the timing and location of energy savings. The emissions characteristics of the generation portfolio and the EGUs that operate on the margin (and whose output would be reduced with a reduction in electricity consumption) vary by region and each hour of the year (see Section 3.5).

Given these caveats, Table 4.4.1-2 illustrates estimated CO₂ emissions reductions from benchmarking and retro-commissioning for a hypothetical average commercial building (e.g., 15,000 square feet operating approximately 60 hours per week).²⁵⁰ Table 4.4.1-2 shows the process of: (1) estimating baseline electricity consumption, (2) making assumptions, drawn from the studies presented above, of savings potential in percentage of baseline terms, (3) calculating expected electricity savings per year, compared to a baseline, (4) locating an “emissions factor” that converts electricity saved into emissions avoided and (5) calculating emissions reductions per year. The

²⁴⁴ Cost-effective is defined as items with a five-year simple payback or less, items with a positive net present value, or a combination of both.

²⁴⁵ City of Boston 2013. For more information and to view disclosed data, see <http://berdo.greenovateboston.org/>.

²⁴⁶ New York City 2014b.

²⁴⁷ ENERGY STAR 2012.

²⁴⁸ While these savings are not attributable solely to benchmarking, this analysis indicates that benchmarking can lead to significant savings.

²⁴⁹ Mills 2009.

²⁵⁰ Energy demands of commercial customers vary greatly. The average numbers used here are for illustrative purposes and are drawn from EIA data and the EIA’s Commercial Building Energy Consumption Survey.

full emissions impact of a building performance policy will depend on the number of buildings affected, their geographic location, specific energy savings, and which fuels are saved (electricity, natural gas and other fuels).

Table 4.4.1-2. Illustrative Emissions Savings Potential from Benchmarking and Retro-Commissioning for a Hypothetical Average Commercial Building

	(1) Baseline Consumption Assumptions	(2) Reduction Assumptions	(3) Energy Savings [1*2]	(4) Emissions Factor	(5) Emissions Reduction per Year [3*4]
Benchmarking	75 MWh/year (electricity)	2.4% energy (assuming all electric)	2 MWh/year	1,520 pounds CO ₂ per MWh ²⁵¹	3,000 pounds (1.5 short tons) CO ₂
Retro-commissioning	75 MWh/year (electricity)	10% electricity	7.5 MWh/year	1,520 pounds CO ₂ per MWh	11,400 pounds (5.7 short tons) CO ₂

Note: Estimates for planning purposes should be based on the actual mix of buildings in a locality.

²⁵¹ 2010 average non-baseload CO₂ emissions factor from EPA's eGRID database: <http://www.epa.gov/cleanenergy/energy-resources/egrid/>. This number is steadily declining with time as more low-emitting EGUs are added to the generation portfolio.

Building Performance Policies Building performance policies set targets for building energy use and provide information to building owners, tenants, and operators over the building's lifetime.

Screening Questions	Quick Answers	Resources: Documented State Experience or Recommended Practice
<p>FEASIBILITY</p> <p>Can building performance policies help achieve GHG and criteria air pollutant reductions in the required time frame?</p>	<ul style="list-style-type: none"> • Yes. These policies can reduce the amount of electricity generated, and fossil fuel consumed, at EGUs. Reduced energy demand yields emissions reductions. 	<ul style="list-style-type: none"> • Greater Energy Savings through Building Energy Performance Policy (SEE Action) • Energy Performance Certification of Buildings: A Policy Tool to Improve Energy Efficiency (IEA)
<p>IMPACT</p> <p>What energy savings and emission reductions can building performance policies achieve, and are the savings permanent?</p>	<ul style="list-style-type: none"> • Potential energy savings from benchmarking and transparency may be as high as 2.5% annually per building. • More active policies, such as mandatory retro-commissioning, may yield electricity savings of 5% to 15% per building. • Resulting emission reductions vary with the amount and timing of energy savings and EGU emission profiles. Values can be determined with simple estimates or detailed modeling. • Savings lifetimes range from a few years to decades, based on measure life, occupant behavior, and replacement assumptions. 	<ul style="list-style-type: none"> • Benchmarking and Disclosure Evaluation Handbook (DOE) • ENERGY STAR Portfolio Manager Data Trends (EPA) • The Cost Effectiveness of Commercial Building Commissioning (LBNL)
<p>RESPONSIBILITY</p> <p>Who is responsible for administering and implementing building performance policies, and what are the best practices?</p>	<ul style="list-style-type: none"> • Municipal governments typically lead these efforts. • City councils approve ordinances that enact these policies. • Local jurisdictions share and document best practices in peer exchange forums. 	<ul style="list-style-type: none"> • SEE Action Residential Retrofit or Commercial Buildings Working Groups • Global Building Performance Network • BuildingRating.org • Institute for Market Transformation
<p>COST</p> <p>What is the cost structure of building performance policies, and how much do they cost?</p>	<ul style="list-style-type: none"> • Building owners bear the costs of complying with building performance policies, although municipalities may offer small incentives or technical assistance from public funds. • Some jurisdictions cap total cost of compliance at less than 1% of property value for residential buildings and 1% of property value for commercial buildings. 	<ul style="list-style-type: none"> • New York Local Law 84 and 87 • City of Berkeley (CA) Residential and Commercial Energy Conservation Ordinances
<p>RELIABILITY</p> <p>How can I document the energy impacts of building performance policies?</p>	<ul style="list-style-type: none"> • Performance policies that involve energy saving actions, such as retro-commissioning have established EM&V guidelines. EM&V guidelines also exist for specific measures building owners take in response to other policies, such as audit requirements that provide information and drive demand for efficiency actions. 	<ul style="list-style-type: none"> • Energy Efficiency Program Impact Evaluation Guide (SEE Action)
<p>OTHER CONSIDERATIONS</p> <p>What are other considerations for successful delivery of energy savings from building performance policies?</p>	<ul style="list-style-type: none"> • Existing statewide energy codes and performance policies • Existing administrative structures for documenting savings • Training for auditors, contractors, and trade allies • Enforcement options and infrastructure • Utility assisting in data access 	<ul style="list-style-type: none"> • Building Energy Codes Program (DOE) • ENERGY STAR Portfolio Manager (EPA) • Better Buildings Commercial Workforce Guidelines (DOE) • Residential Standard Workforce Specifications (DOE)

4.4.2. Voluntary Programs

Due to their roles as asset owners, taxation authorities, and conveners of stakeholders, municipal governments are potential leaders to launch voluntary energy efficiency programs such as:

- **Commercial Property Assessed Clean Energy (PACE) financing.**²⁵² PACE programs use local governments' special property assessment authority to finance clean energy projects. In the 31 states or districts where PACE enabling legislation is in place, municipalities may use special assessments to finance energy efficiency, renewable energy and other improvements on private property (see Figure 4.4.2-1).²⁵³ Assessments are paid back over time through property tax bills. PACE financing may be used to invest in energy efficiency improvements for residential or nonresidential structures. Multiple municipalities have completed PACE projects, including Toledo, Ohio; several cities in Connecticut; several cities in Michigan; several jurisdictions in California including the Western Riverside Council of Governments; several cities in Florida, Utah, several cities in New York, several cities in Missouri, and Milwaukee, Wisconsin.
- **Private sector partnerships, challenges and commitments.** Many municipalities have taken leadership action on greenhouse gas emissions and energy efficiency to set a target or goal and then develop a plan to meet it, often with communitywide input. Some have formalized their commitments by developing a city energy or sustainability plan such as the City of Atlanta Mayor's Office of Sustainability Power to Change Plan²⁵⁴ or by joining groups such as the White House's Climate Action Champions,²⁵⁵ U.S. Conference of Mayors' Climate Protection Agreement, Resilient Communities for America,²⁵⁶ DOE's Better Buildings Challenge, EPA's Community Energy Challenge, District 2030,²⁵⁷ or the newly announced Compact of Mayors²⁵⁸ and Mayors' National Climate Action Agenda.²⁵⁹ Over a thousand municipalities have joined the U.S. Conference of Mayors commitment alone, representing all 50 states and a population of nearly 89 million. These national commitments establish platforms for local governments to share best practices, engage the private sector and aggregate their impact. Some leading municipalities are using their convening and recognition powers to actively encourage and reward private sector commitments and to track progress over time.
- **ENERGY STAR.** Through ENERGY STAR, EPA offers local governments a proven platform for saving energy, including off-the-shelf resources that can be tailored to meet local goals. A key resource is the Guidelines for Energy Management.²⁶⁰ More than 400 local governments are ENERGY STAR partners.²⁶¹

²⁵² Residential PACE programs continue to face challenges and are not discussed in this chapter. As of this writing, the White House and the Federal Housing Administration are exploring the concept of contractually subordinated assessments as one possible solution. For more information on residential PACE, see www.pacenow.org or <https://www.whitehouse.gov/the-press-office/2015/08/24/fact-sheet-president-obama-announces-new-actions-bring-renewable-energy>.

²⁵³ NCSL 2014.

²⁵⁴ <http://p2catl.com/wp-content/uploads/2014/07/Power-to-Change-Plan-2014.pdf>.

²⁵⁵ See <http://energy.gov/epa/climate-action-champions>.

²⁵⁶ See <http://www.resilientamerica.org/wp-content/uploads/2013/09/RC4A-Agreement-9.13.13-1.pdf> for more information on Resilient Communities for America.


²⁵⁷ <http://www.2030districts.org/>.

²⁵⁸ See <http://www.compactofmayors.org/> for more information on the Compact of Mayors.

²⁵⁹ See <http://www.usmayors.org/climateprotection/revise/> for information on the US Mayors' Climate Protection Agreement, <https://www4.eere.energy.gov/challenge/> for information on the Better Buildings Challenge, <http://www.epa.gov/region1/eco/energy/mitigation-efforts-epane.html> for information on the New England Community Energy Challenge, and <http://www.houstontx.gov/mayor/press/20140922.html> for details on the Mayors National Climate Action Agenda.

²⁶⁰ See <http://www.energystar.gov/buildings/about-us/how-can-we-help-you/build-energy-program/guidelines>.

²⁶¹ Energy Star 2014. For a list of local government partners, see <https://www.energystar.gov/buildings/about-us/energy-star-partners/list-energy-star-partners>.



projects, making it too early to estimate ultimate participation rates and measure mixes.²⁶⁷ As these programs mature, it will become possible to estimate their savings potential.

- **Energy efficiency challenges for commercial buildings.** Participants in voluntary challenges are free to choose energy savings strategies that work best for them. Thus, realized savings varies from program to program. In Atlanta, Better Buildings Challenge participants reduce energy use 2.5 percent per year—indicative of potential savings rates. Better Buildings Challenge participants in other cities have reported cumulative energy savings as high as 10 percent per year, but this is not typical.²⁶⁸

4.4.2.3 EM&V

Implementing programs such as retro-commissioning, and making new and existing local government facilities more energy-efficient, directly result in energy savings that can be evaluated using established methods. Building performance policies and programs such as benchmarking, disclosure, and audit mandates also lead to energy savings when building operators take action based on the performance information made available by them. However, it is difficult to separate the energy savings attributable to these policies from other factors that can drive demand for efficiency actions, such as energy efficiency rebate programs and existing policies. New methods to evaluate the impacts of benchmarking and transparency policies are now being piloted by a few jurisdictions.²⁶⁹

Impact Evaluations for Commissioning and Retro-Commissioning

There are established methods to determine the energy savings impacts of both building commissioning and retro-commissioning activities.²⁷⁰ Commissioning savings are usually determined on a project-by-project basis—for each project, not just a sample subset of projects. Measurement and verification (M&V) approaches for these activities are defined by the International Performance Measurement and Verification Protocol (IPMVP) and are well established and widely recognized. These approaches involve retrofit isolation metering, analyzing the entire facility's energy bills, calibrated simulation of the entire facility, or some combination of all of these methods. Building from the general approaches defined in the IPMVP, the DOE's Uniform Methods Project²⁷¹ provides more detailed protocols for quantifying the energy savings from specific efficiency activities, including retro-commissioning.²⁷²

Impact Evaluations for New Buildings and Retrofits

Local governments can: (1) establish efficiency requirements for new buildings (and renovations) that exceed common practice, (2) retrofit existing government buildings for improved efficiency or (3) do both. Energy savings from building-specific construction and retrofit actions have been evaluated for decades, using well-established guidelines and protocols.²⁷³ Savings from public building efficiency activities are typically determined on a project-by-project basis. Thus, EM&V options defined by the IPMVP are applicable. In addition, deemed (stipulated) savings values and calculations²⁷⁴ can also be used to quantify savings for specific, common efficiency measures

²⁶⁷ See www.pacenow.org for more information on current PACE programs and projects.

²⁶⁸ See <https://www4.eere.energy.gov/challenge/partners/better-buildings/> for details on results to date. Annual reductions vary due to different baseline years.

²⁶⁹ For an example of a study estimating energy savings from benchmarking, see http://www.energystar.gov/ia/business/downloads/datatrends/DataTrends_Savings_20121002.pdf?3d9b-91a5


²⁷⁰ Savings vary by types of building equipment, systems and controls that are addressed in the commissioning process.

²⁷¹ [EERE 2014b.](#)

²⁷² [NREL 2014.](#)

²⁷³ Section 3.5.1 of this guide references these documents.

²⁷⁴ *Deemed savings* are estimates of energy savings for a single unit of an installed energy efficiency measure that: (1) has been developed from data sources and analytical methods that are widely considered acceptable for the measure and purpose and (2) is applicable to the situation being evaluated. Similarly, *deemed savings calculations* are standardized savings algorithms that use stipulated or project-specific values—or both—as inputs for determining savings.



that are components of an overall project, such as replacing incandescent lamps with LEDs or installing more efficient motors. For new construction, savings are typically quantified by comparing the energy use of the new building with estimated energy use, as determined by calibrated simulation models, if the building had been constructed only to common practices.

Impact Evaluations for Benchmarking and Transparency Policies

DOE's *Benchmarking and Transparency Policy and Program Impact Evaluation Handbook*²⁷⁵ describes methodologies to determine the energy and non-energy benefits²⁷⁶ (including GHG gas emissions reductions) of benchmarking and transparency policies, as well as a strategic planning framework for designing and implementing the policies. The handbook's recommended methods for estimating the energy impacts from benchmarking and transparency policies rely on direct measurement of the year-to-year changes in facility energy consumption through tracking tools such as ENERGY STAR Portfolio Manager. This is intended to be a streamlined approach that requires minor adjustments from the processes that jurisdictions already are using in their data collection efforts. The evaluation methodologies are based on IPMVP and the Uniform Methods Project.

DOE is partnering with New York City and Seattle to pilot the handbook's methodologies. Impact evaluation reports for these two jurisdictions will be available in 2015.

4.4.3. Improving Energy Efficiency of Local Government Facilities

Local governments can reduce GHG emissions directly by establishing policies and completing projects that improve energy efficiency of locally owned or operated assets. Municipal and county governments own, operate, or are responsible for a large number and variety of assets, such as schools, hospitals, office buildings, maintenance facilities, streetlights and traffic signals, and wastewater treatment plants. Improving energy efficiency of these assets may be an easy starting point for jurisdictions that want to improve energy efficiency in their locale, due to a high degree of control and influence. Efficiency upgrades not only reduce energy expense to the local government—up to 10 percent of total local government expenditures—they also lead by example and help create local markets for businesses that provide energy efficiency products and services, while reducing local air pollutants including GHG emissions.²⁷⁷

A staged approach to addressing cost-effective efficiency upgrades of municipal assets—one that gradually moves from shorter-term payback projects to longer-term activities with more significant benefits—may yield greater overall energy savings and can increase opportunities for learning and continuous improvement. Local governments can use energy savings performance contracting to implement projects (see Section 4.3.3.1).

4.4.3.1 Case Study

Virginia – Since the mid-1990s, Arlington County, Virginia, has focused on energy efficiency to improve operations and avoid energy waste in county facilities. These efforts were institutionalized in the 2007 Fresh AIRE (Arlington Initiative to Reduce Emissions) program. This multi-pronged program focuses on improving energy practices as well as working with citizens and local businesses to encourage energy-saving activities.²⁷⁸ Since 2000, the AIRE program has helped the county to reduce greenhouse gas emissions by 11.7 percent, exceeding its GHG reduction goal.²⁷⁹

Projects completed under AIRE include low-cost and no-cost measures such as changing energy use behavior of building occupants and adjusting operating settings for building equipment. Under AIRE's auspices, the county also


²⁷⁵ <http://energy.gov/eere/slsc/downloads/benchmarking-and-transparency-policy-and-program-impact-evaluation-handbook>.

²⁷⁶ Also including job creation, economic growth and higher real estate values.

²⁷⁷ EPA 2011.

²⁷⁸ Donnellan 2013.

²⁷⁹ *Ibid.*



has tackled longer-term capital upgrades for city assets, including streetlights and the wastewater treatment plant. Since 2007, overall energy intensity (energy use per square foot) in county buildings has declined 15 percent.²⁸⁰ In 2013 the county adopted a Community Energy Plan, which set a new goal of a 70 percent reduction below a 2007 GHG emissions baseline.²⁸¹

4.4.3.2 Expected Range of Energy Savings and Emissions Reductions

Energy savings from upgrading the efficiency of local government assets vary based on the specific projects undertaken. Following are illustrative examples:

- **Municipal building upgrades.** Several studies, including a National Association of Counties' analysis of energy use for 94 counties, found facility-level energy savings potential of 10 percent to 20 percent with little to no upfront investment. With additional investment, project-level electricity savings can reach 50 percent.^{282,283,284} Technology-specific studies can provide accurate savings estimates for specific projects.
- **Street lighting.** Street lighting can account for up to 40 percent of municipal electricity use, so adopting more efficient street lighting technology can yield large impacts.²⁸⁵ Savings from street lighting upgrades depend on current lighting fixtures and replacement technology. Light emitting diode (LED) streetlamps, a common choice for municipalities, can produce savings from 50 percent to 80 percent. Street lighting controls that allow for dimming of lamps during daylight hours can generate savings on the order of 25 percent.^{286,287}
- **Wastewater treatment facilities.** As a large energy user—up to 40 percent of municipal energy costs in some areas—upgrading wastewater treatment facilities can produce large energy and cost savings.²⁸⁸ A Global Water Research Coalition analysis of more than 100 wastewater treatment energy upgrades found typical savings ranging from 5 percent to 25 percent with improvements of 50 percent or more possible.²⁸⁹ EPA provides technical assistance and loans for biogas energy recovery for anaerobic digesters at wastewater treatment facilities. Biogas from the digesters can be used for combined heat and power systems at these facilities.²⁹⁰

The range of emissions reductions that can be achieved by improving the efficiency of local government buildings can be estimated in much the same way as the estimates for building performance policies described above. If the government building consumes the same amount of electricity as an average commercial building, a 10 percent improvement in electricity consumption might reduce CO₂ emissions on the order of 5.7 short tons per year (see Table 4.4.1-2).

²⁸⁰ *Ibid.*

²⁸¹ Arlington County, Virginia 2013.

²⁸² National Association of Counties 2013.

²⁸³ EPA 2011.

²⁸⁴ City of Boulder, Colorado 2014.

²⁸⁵ New York Department of Environmental Conservation 2014.


²⁸⁶ Minnesota Department of Commerce 2012.

²⁸⁷ DOE's Better Buildings Outdoor Lighting Accelerator program provides resources and assistance for local governments: <http://www1.eere.energy.gov/buildings/betterbuildings/accelerators/outdoor.html>.

²⁸⁸ EPA 2010.

²⁸⁹ Global Water Research Coalition 2010. Energy Efficiency in the Water Industry: A Compendium of Best Practices and Case Studies. <http://edepot.wur.nl/175846>.

²⁹⁰ See <http://www3.epa.gov/chp/markets/wastewater.html>.



A single LED streetlamp can save up to 400 kWh per year. Using the same national average emissions factor cited above, with the same caveats, an LED streetlamp program could reduce CO₂ emissions by about 0.3 tons per year per lamp.²⁹¹

The EPA study of wastewater treatment facilities cited above offers numerous case studies of electricity savings through efficiency efforts. Using the national average non-baseload generation emissions factor of 1,520 pounds of CO₂ per MWh for illustrative purposes, cited energy savings between 72 MWh and 4,643 MWh of electricity per year translates into annual avoided CO₂ emissions ranging from 55 short tons to 3,529 short tons per facility.

²⁹¹ For example, see <http://www.neep.org/led-street-lighting-assessment-and-strategies-northeast-and-mid-atlantic>.



4.5. State Lead by Example Efforts

States have a broad range of tools they can use to improve the energy efficiency of their own facilities and operations. These improvements directly contribute to reduced air emissions in the power sector and demonstrate successful policies and programs for others to consider, such as owners of commercial buildings in their state.

This section features a fundamental state lead-by-example strategy—Energy Savings Performance Contracting—and covers four additional areas: building performance policies, product procurement, state equipment efficiency standards and financing access. States can also adopt complementary policies and programs that support and enable these strategies, such as setting overarching energy savings goals for state facilities, establishing energy-efficient design and retrofit standards, and training and certification for state building operators and designers.

4.5.1. Energy Savings Performance Contracting

Energy savings performance contracting (ESPC) allows state government agencies to implement comprehensive energy-saving projects—and potentially address deferred maintenance needs such as asbestos removal, updating wiring and roof replacement²⁹²—using private capital.²⁹³ By partnering with an energy services company (ESCO), state agencies can use ESPC to pay for today's facility upgrades with tomorrow's energy savings—without tapping into capital budgets. Moreover, state agencies keep all the cost savings when annual savings exceed the amount guaranteed in the performance contract and after the contract period is completed. Energy, water, and operation and maintenance (O&M) savings pay back project installation and financing costs over the term of the contract, typically 10 to 20 years.

A typical performance contract reduces annual energy use by 15 percent to 30 percent.²⁹⁴ Electricity accounts for an estimated two-thirds of the energy savings for public and institutional (e.g., universities and hospitals) ESPC projects.²⁹⁵ About one-third of ESCO projects at institutional facilities report O&M savings.²⁹⁶

ESCOs provide performance contracting for energy efficiency projects and other value-added services, such as reduced maintenance costs and scheduling operations and controls. Their work encompasses design, installation, maintenance, measurement and verification (M&V), and arranging financing. The ESCO typically guarantees energy savings. The ESCO assumes project performance risk, and ESCO compensation is linked to the performance of the project.^{297,298} If there is a shortfall in savings, the ESCO reimburses the customer. If savings exceed the ESCO's guarantee, the customer typically keeps the excess. ESCOs validate annual savings through specified EM&V guidelines and protocols, discussed below. The customer (in this case, the state agency) is responsible for making debt-service payments under a separate financial contract.

The ESCO performs an investment grade audit to identify the most cost-effective energy efficiency measures. The audit typically takes place 12 to 24 months before the project begins and provides the basis for predicting energy savings over the lifetime of the contract.

The performance contract defines the scope of the project, including construction details, how it will be implemented during construction, and how it will be managed through the entire term of the agreement. The

²⁹² Larsen *et al.* 2013.

²⁹³ States also finance energy improvements out of capital budgets or with state revolving loan funds or tax-exempt bonds.


²⁹⁴ Patterson and Hessler 2014.

²⁹⁵ Carvallo *et al.* 2015.

²⁹⁶ Larsen *et al.* 2014.

²⁹⁷ Bharvirkar *et al.* 2008.

²⁹⁸ Larsen *et al.* 2012.



contract also addresses roles and responsibilities of the ESCO and customer and specifies the level of guaranteed savings.²⁹⁹ The typical installation cost for state and local government ESPC projects is about \$7 per square foot.³⁰⁰

The U.S. ESCO industry has a well-established track record of delivering substantial energy and dollar savings in the public and institutional buildings sector.³⁰¹ In fact, MUSH market customers accounted for about three-quarters of U.S. ESCO industry savings during the period 2003 to 2012.³⁰² The industry reported revenues of about \$5.3 billion in 2011, with estimated 2013 revenues of about \$6.4 billion. Still, the remaining investment potential in public and institutional facilities is large, estimated at about \$71 billion to \$133 billion.³⁰³ Thus, in addition to significant incremental electricity savings, ESCO energy upgrades for public and institutional facilities represent a large potential source of in-state jobs.

A pair of recent studies found that actual ESPC savings exceeded expected savings. Lawrence Berkeley National Laboratory researchers found that the energy savings from federal facility performance contracting exceeded the expected savings by 2 percent over the lifetime of the contract.³⁰⁴ Oak Ridge National Laboratory examined the persistence of cost savings for federal performance contracting projects and found that the federal government receives nearly twice the amount of the guaranteed savings for a typical project. There are several reasons why these projects achieve higher-than-expected savings. For example, ESCOs do not always guarantee all of the estimated savings, and the useful life of the equipment often extends beyond the performance period of the performance contract.³⁰⁵ Savings lifetimes depend on the measures installed and range up to 25 years.³⁰⁶

4.5.1.1 Requisite Policies

State legislation or an executive order that facilitates or requires the use of performance-based contracting with ESCOs for energy projects in the public and institutional sectors is key to success.³⁰⁷ Policies can cover local government facilities and schools, as well as state facilities.

Including deferred maintenance activities (e.g., roof replacement and asbestos mitigation) helps facilitate performance contracting for public and institutional facilities by bundling high priority projects with energy-saving measures. Other sector-specific priorities, such as student comfort and performance in schools, also can be a driver for ESPC projects. In addition, support from the governor's office is important. For example, a governor could establish energy savings targets for state facilities and require tracking and reporting on the state's progress using performance contracting to meet these targets.

Another helpful policy, through state legislation or governor's executive order, is designating a lead state agency to be a single point of contact for public agencies and institutions to facilitate performance contracting. The lead agency can:

- Establish a precertification process for qualified ESCOs
- Develop rules and processes for project contracting, procurement, development and performance
- Provide technical assistance services
- Train state facility managers, contractors, engineers and architects

²⁹⁹ Model ESPC documents are posted at <http://energy.gov/eere/wipo/energy-savings-performance-contracting>.

³⁰⁰ Stuart *et al.* 2013. Data from 2003 through 2012.

³⁰¹ Larsen *et al.* 2012; Hopper *et al.* 2005.

³⁰² Carvallo *et al.* 2015.

³⁰³ Stuart *et al.* 2013.

³⁰⁴ Coleman *et al.* 2014. For comparison, projects using Congressionally appropriated funds achieved only 67 percent of anticipated savings.

³⁰⁵ Shonder 2013.

³⁰⁶ See Appendix C in Larsen *et al.* 2012.

³⁰⁷ State-by-state summary at <http://web.ornl.gov/info/escos/legislation/newesco.shtml>.

- Develop oversight, program management, and evaluation and verification processes³⁰⁹

Some states use a fee-for-service model to support technical assistance for ESPC administration and management. Under this approach, the lead state agency covers its cost for providing services by collecting a fee directly from the public entity it is serving.

Some states require that public agencies use an ESCO pre-qualified to provide ESPC services. Pre-qualification may include accreditation by the National Association of Energy Services Companies (NAESCO). Accreditation requires demonstration of technical and managerial competence to develop comprehensive energy efficiency projects and provide a full range of energy services, as well as financial solvency and a regular business practice of developing performance-based projects.³¹⁰ NAESCO maintains a searchable of ESCO providers.³¹¹

States also may consider policies and programs that address small projects. The U.S. DOE's Federal Energy Management Program (FEMP) provides a model process—for small federal facilities—that states could replicate for their own facilities. FEMP's ENABLE program is attractive for small projects through features such as a streamlined list of standard, eligible energy conservation measures; a standardized energy audit tool (soon to be available on-line); streamlined EM&V procedures; and templates to guide agencies through the process. These features lower the administrative burden on agencies implementing ESPC projects.³¹²

Another strategy is to aggregate small projects across multiple organizations to a sufficient size for performance contracts with ESCOs. That's the idea behind public-purpose ESCOs.³¹³ For example, Commons Energy was established to aggregate small- to medium-sized facilities and provide performance contracting and financing for underserved markets such as multi-family housing and community buildings.³¹⁴

4.5.1.2 Case Studies

Additional case studies can be found on the Energy Services Coalition website at <http://www.energyservicescoalition.org/casestudies>.

FEE-FOR-SERVICE MODEL

The state of Washington has successfully used a fee-for-service model for its ESPC program for three decades. ESPC services are available to all levels of government—state agencies, local governments, school districts and higher education. Agencies can choose from a pre-approved list of about a dozen ESCOs. The Washington Department of Enterprise Services provides quality assurance, project negotiation, overall project management, and monitoring and verification procedures.³⁰⁸ In addition, the Washington Department of Commerce is piloting a fee-for-service model for benchmarking services using the ENERGY STAR Portfolio Manager tool for client agencies.

Similarly, Virginia established a small fee of \$0.00007 per kWh on electricity bills for state buildings. Fee proceeds offset the costs of the state's Energy Management Program, which includes providing overall direction for performance contracting and technical assistance.

³⁰⁸ <http://www.des.wa.gov/services/facilities/Energy/ESPC/Pages/default.aspx>.

³⁰⁹ Some states have published manuals for public agencies documenting the ESPC process and available technical assistance services—for example, Georgia: <http://gefa.georgia.gov/energy-performance-contracting>.


³¹⁰ <http://www.naesco.org/accreditation>.

³¹¹ <http://www.naesco.org/providers>.

³¹² <http://energy.gov/eere/femp/esp-enable>.

³¹³ For more information, see <http://www.ppescohowto.org>.

³¹⁴ <http://www.commonenergy.org>.



Colorado³¹⁵ – Colorado established its Energy Performance Contracting Program in the early 1990s to accelerate energy and water efficiency in facilities owned by state agencies, institutions of higher education, counties, municipalities, school districts and special districts. Key elements of the Colorado Energy Office program’s success are:

- Pre-qualified ESCOs
- Standardized contracts
- Protocols and guidelines
- Advice and technical assistance available without charge to any agency signing a standard Memorandum of Understanding
- A financing bid package to solicit private sector underwriting
- Maintaining the program’s Standards for Success and an active local ESCO industry

Working with pre-qualified ESCOs, 142 public agencies have leveraged almost \$29 million in annual utility savings guarantees into more than \$447 million in facility investments as of June 2014. To date, 182 projects have made energy and water efficiency improvements to public school and university buildings, veterans housing, health care facilities, libraries, parks, community centers, wastewater treatment plants, prisons and other public buildings in three-quarters of the counties in the state. The projects save taxpayers 141.8 million kWh of electricity costs per year.

Colorado participates in the DOE Performance Contracting Accelerator³¹⁶ to address barriers to ESPC uptake in small and rural communities. In 2015, the Colorado Energy Office initiated research into technical, legal, financial and other considerations for successfully aggregating, pooling and bundling projects. DOE and the Colorado Energy Office also completed work through a cooperative agreement venturing into the private sector with ESPC. The pilot program’s final report describes lessons learned engaging with 36 companies, market benefits and barriers, and considerations for a permanent state energy office program offering for the private sector.³¹⁷

Kansas^{318,319} – Kansas established a Facility Conservation Improvement Program in 2000 to help government agencies, school districts, universities, hospitals and others with ESPC-related administration and management. The program has made the ESPC process straightforward and streamlined through partnerships with 13 preapproved ESCOs, a no-bid process using standardized contracts and negotiated fees, and technical help and oversight from program staff. To date, the program has completed 86 projects involving over 43 million square feet of public facilities. The projects are saving more than \$20 million each year in avoided energy costs.

Participant fees fund the program. Fees are based on project cost, ranging from 0.5 percent (largest projects) to 4 percent (smallest projects). Fees can be included in total project financing.

4.5.1.3 EM&V

Performance contracting requires quantification of achieved savings typically on a project-by-project basis each year throughout the life of the contractual savings commitment. The ESCO industry uses long-standing,


³¹⁵ <http://stateenergyreport.com/2014/07/30/colorado-epc-designed-for-success/>;
<http://www.colorado.gov/cs/Satellite/GovEnergyOffice/CBON/1251599983018>; personal communication with Jeanna Paluzzi, Colorado State Energy Office, April 8, 2015.

³¹⁶ U.S. DOE’s ESPC Accelerator is designed to expand access to performance contracting by state and local governments and K-12 schools through the use of innovative and best practice approaches. See <http://www1.eere.energy.gov/buildings/betterbuildings/accelerators/performance.html>.

³¹⁷ <http://www.colorado.gov/cs/Satellite/GovEnergyOffice/CBON/1251627218748>.

³¹⁸ <http://www.kcc.state.ks.us/energy/fcip/index.htm>.

³¹⁹ <http://www.kcc.state.ks.us/energy/fcip/history.htm>.



standardized M&V approaches developed in partnership with government agencies and nongovernmental energy efficiency organizations. These approaches are documented in the following guidelines and protocols:

- International Performance Measurement and Verification Protocol (IPMVP)³²⁰
- American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) Guideline 14 - Measurement of Energy and Demand Savings³²¹
- Federal Energy Management Program’s (FEMP) M&V Guidelines³²² (based on IPMVP)

Each of these guidelines and protocols presents a number of options for determining savings. The required effort and rigor varies with the type of efficiency project, project costs, savings and savings risk. Fundamentally, all of the EM&V approaches compare energy use before the project (the “baseline”) and after the project (“post-installation” or “performance period”) in order to estimate energy savings. Determination of savings includes adjusting for changes that affect energy use but that are typically outside the ESCO’s responsibility. Such adjustments may account for changes in weather, occupancy, or other factors between the baseline and performance periods.

Some ESPC projects—or components of projects—apply a deemed savings approach. Deemed savings are an *estimate* of energy savings that are: (1) developed from data sources and analytical methods widely considered acceptable for the measure and purpose and (2) applicable to the situation being evaluated. Deemed savings are applied only to a single unit of an installed energy efficiency measure. Properly applied, deemed savings can actually improve the reliability of *average* savings estimates—in other words, savings across all projects, rather than for an individual project—and reduce ESPC transaction costs by providing certainty without ongoing EM&V; assuming there is some ongoing verification that the projects are continuing to operate correctly.

EPROJECT BUILDER

eProject Builder (ePB) is a web-based ESPC reporting and tracking system developed by LBNL with support from DOE. ePB standardizes the collection, calculation and reporting of performance data for ESPC projects for all sectors, including state, local and federal governments, K-12 schools, universities and hospitals. ePB also provides aggregated statistics on past ESPC projects, enabling benchmarking of proposed projects against historical data. In addition, ePB provides a template for drafting and negotiating project scenarios, generates energy and financial schedules, and produces ESPC project reports for submission to state, local or federal agencies. Collecting project data, including EM&V data, in a standardized format will help improve the accuracy of estimates of avoided air emissions from performance contracting. For more information, visit <https://eprojectbuilder.lbl.gov>.

4.5.1.4 Expected Range of Energy Savings and Emissions Reductions


Analysis of data in LBNL’s database of more than 5,200 ESCO projects indicates that electricity savings from ESPC projects for local and state government facilities typically range from about 2 kWh to 6 kWh per square foot of building space.³²³ This wide range is because energy savings from ESPC projects vary by type of measures, investment level, climate and other factors such as facility operating hours.

³²⁰ www.evo-world.org

³²¹ www.ashrae.org

³²² http://www1.eere.energy.gov/femp/pdfs/mv_guidelines.pdf

³²³ Estimate by JP Carvalho, February 2015, based on analysis of LBNL’s ESCO database. LBNL maintained this database for more than 15 years. ESCOs voluntarily provided project data as part of the accreditation process for the National Association of Energy Service Companies. The data include information on installed measures, project costs and reported savings. eProject Builder is replacing this database (see text box).



Using a different metric, savings from the projects in the LBNL database typically range from about 0.3 kWh to 1.2 kWh for each dollar invested. For example, expected savings from a \$10 million state ESPC program are on the order of 3,000 MWh to 12,000 MWh each year, for the life of the energy efficiency measures.³²⁴

LBNL estimates that in 2012, active U.S. ESCO industry projects generated about 34 Terawatt-hours (TWh) of electricity savings, or about 2.5% of U.S. commercial electricity retail sales in that year.³²⁵

Any of the methods described in Section 2.4 can be used to estimate emissions reductions from ESPC projects. These include using average emissions factors, marginal emissions rates or detailed dispatch modeling methods.³²⁶ A rough estimate of potential emissions avoided through the ESPC pathway can be calculated using the average energy savings from the LBNL/NAESCO database and average emissions factors for non-baseload EGUs from EPA's eGRID database. According to EPA's eGRID database, the average non-baseload CO₂ emissions rate for the U.S. in 2010 was about 1,500 pounds per MWh.³²⁷ This means that a \$10 million state ESPC program that saves 7,500 MWh each year (the mid-point of the range cited above) might reduce CO₂ emissions *on average* by about 5,600 short tons per year ((7,500 MWh * 1,500 lb/MWh)/2,000 lb/ton).³²⁸

The expected emissions reductions associated with ESPC projects are dependent on the level of energy savings and which EGUs' output are reduced—i.e., where the projects are located affects which EGUs supply the electricity. The emissions reductions also are somewhat dependent on the timing of the savings—from what time of day to what time of year. Different EGUs can be operating “on the margin” at different times of year and day, and weekends versus weekdays (see Section 2.4).

³²⁴ For a discussion of energy savings lifetimes, see Hoffman, et al. 2015. <http://emp.lbl.gov/sites/all/files/savings-lifetime-persistence-brief.pdf>.

³²⁵ Carvallo *et al.* 2015.

³²⁶ Evaluation protocols for ESPC projects may not have the hourly savings data that these methods require.

³²⁷ This number is steadily declining with time as more low-emitting EGUs are added to the generation portfolio, but the 2010 value is sufficient for illustrative purposes.

³²⁸ Estimate by Regulatory Assistance Project. The eGRID database and the rationale for using a non-baseload emissions rate are explained in Section 3.5.2. This methodology is generally only appropriate for making rough estimates of *near-term* emissions impacts. Other methods can produce more accurate results, but require much greater effort and more data.

State Energy Savings Performance Contracting (ESPC) Performance contracting is a partnership with an energy services company (ESCO) to design, construct, maintain, and conduct EM&V for energy efficiency and other facility upgrades with little or no up-front costs.

Screening Questions	Quick Answers	Resources: Documented State Experience or Recommended Practice
<p>FEASIBILITY Can ESPC programs help achieve GHG and criteria air pollutant reductions in the required time frame?</p>	<ul style="list-style-type: none"> • Yes. They reduce the amount of electricity generated, and fossil fuel consumed, at EGUs. Reduced energy demand yields emissions reductions. 	<ul style="list-style-type: none"> • Efficiency Power Plant Tool (RAP)
<p>IMPACT What energy savings and emission reductions can ESPC programs achieve, and are the savings permanent?</p>	<ul style="list-style-type: none"> • Project energy savings range from 15% to 30%. Savings from active ESPC projects in the U.S. in 2012 was 34 TWh. • Expected savings from a \$10 million state ESPC program is 3,000 to 12,000 MWh/year for the life of the measures. • Resulting emission reductions vary with the amount and timing of energy savings and EGU emission profiles. Values can be determined with simple estimates or detailed modeling. • Savings lifetimes depend on measures installed, often extending beyond the 10- to 20-year term of performance contracts. 	<ul style="list-style-type: none"> • Estimating Customer Electricity Savings From Projects Installed by the U.S. ESCO Industry (LBNL) • Evolution of the U.S. Energy Service Company Industry: Market Size and Project Performance From 1990-2008 (LBNL)
<p>RESPONSIBILITY Who is responsible for administering and implementing ESPC programs, and what are the best practices?</p>	<ul style="list-style-type: none"> • A lead state agency typically is responsible for administering the program. • Best practices include strong governor’s office support, including other public sectors (school and local governments) in the program, and allowing deferred maintenance work to be included. 	<ul style="list-style-type: none"> • DOE Energy Savings Performance Contracting website • Energy Services Coalition resources • State examples: Kansas, Colorado, Georgia
<p>COST What is the cost structure of ESPC programs, and how much do they cost?</p>	<ul style="list-style-type: none"> • ESCOs help to educate their customers about the available types of financing, or state agencies can use capital or maintenance budgets, tax-exempt bonds, or a revolving loan fund. ESCOs also leverage utility rebates. • Savings pay for project costs over the term of the contract, typically 10 to 20 years. Typical installation costs for state/local government projects: about \$7/ft² • The lead state agency role can be funded by the state general fund, energy supplier fee, or fee-for-service arrangement. 	<ul style="list-style-type: none"> • DOE’s Financing Solutions/ESPC page: ESPC financing webinar Financing methods for ESPCs • Current Size and Remaining Market Potential of the U.S. Energy Service Company Industry
<p>RELIABILITY How can I document the energy impacts of ESPC programs?</p>	<ul style="list-style-type: none"> • International Performance Measurement and Verification Protocol (IPMVP) • ASHRAE Guideline 14 • FEMP M&V Guidelines • Uniform Methods Project (UMP) • eProject Builder (ePB) to manage project data and benchmark projects 	<ul style="list-style-type: none"> • IPMVP • ASHRAE Guideline 14 - Measurement of Energy and Demand and Demand Savings • FEMP • UMP • ePB
<p>OTHER CONSIDERATIONS What are other considerations for successful delivery of energy savings from ESPC programs?</p>	<ul style="list-style-type: none"> • Addressing barriers to energy savings performance contracts for small projects 	<ul style="list-style-type: none"> • FEMP’s ENABLE program • Public-purpose energy services companies



4.5.2. Building Performance Policies

Building performance and product procurement policies for state agencies are two more high impact ways states can demonstrate successful policies and programs for others to consider, such as private sector building owners.

State and local governments across the U.S. own or lease 16 billion square feet of building space. Energy costs for these buildings can account for as much as 10 percent of a typical government's annual budget.³²⁹ State building performance policies reduce energy use and costs for new and existing state-owned buildings (and, in some jurisdictions, buildings leased by the state). Most states set mandatory energy savings targets for new and existing state government buildings.³³⁰ Other policies may require ongoing energy benchmarking, using a building rating system, requiring periodic disclosure of energy consumption to the public, conducting energy audits, commissioning new buildings and retro-commissioning³³¹ for existing buildings. These building performance policies can have a significant impact on electricity consumption and demonstrate successful approaches for others in the state.

For new buildings, improved practices and technologies—including whole-building design, high-efficiency construction materials, efficient lighting and equipment, and advanced controls—have made it possible to build better-performing buildings than ever before. Still, energy use for any building may increase over time due to such factors as aging equipment or changes in building use, occupancy levels and operation. For existing buildings, performance policies give state facility operators information on how the building is currently using energy so they identify ways to reduce consumption and costs.

State building performance policies are put into place through an executive order or by the state legislature. New buildings typically must meet or exceed international model codes (such as ASHRAE Standard 90.1—see Section 4.3.1) or a nationally recognized standard (such as ENERGY STAR[®] certification³³² or LEED certification). For existing buildings, policies commonly are in the form of energy savings goals that agencies can meet through a combination of operational improvements and investments in energy efficiency measures (see Section 4.3.2):

- **Energy benchmarking** – Compiling building-level energy consumption data and calculating summary metrics that can be compared to peer buildings or the same building's historical consumption, using tools such as EPA's ENERGY STAR[®] Portfolio Manager³³³
- **Building rating** – A system to rate building energy performance as compared to a reference building
- **Disclosure** – Periodic reporting of energy consumption data to the public to make energy performance of buildings transparent, encourage steps to improve performance over time, and allow the real estate market to reward high-performing buildings
- **Energy audits** – On-site evaluations of a building's major energy-consuming systems conducted by a certified auditor
- **Commissioning and retro-commissioning** – A structured process, conducted by a certified professional, which systematically examines a building's major energy-consuming systems to identify and correct sub-optimal performance


³²⁹ EPA 2009.

³³⁰ ACEEE 2015a.

³³¹ Retro-commissioning is a process by which a building's operations and maintenance procedures are improved to enhance a building's performance. The process identifies and addresses problems with a building's energy systems that have developed over time. The term suggests that the building has already been commissioned—i.e., it has undergone an intensive quality assurance process to ensure that the building operates as intended. Retro-commissioning ensures ongoing efficient performance. LBNL 2015.

³³² Compared to similar buildings, buildings that achieve ENERGY STAR[®] certification consume 35 percent less energy on average (ENERGY STAR 2015b).

³³³ ENERGY STAR 2015a.



Potential savings vary based on building type and use. For example, state university buildings consume more energy than courthouses, so a state with a large university system may have more potential savings than one with proportionally more low-consumption buildings.³³⁴

When setting or updating energy performance standards for state buildings, policymakers can follow established best practices:³³⁵

- Savings improvement targets should be aggressive but achievable.
- Policies should incorporate all or nearly all state-owned or leased facilities.³³⁶
- Protocols for setting baseline energy consumption should be clearly established.
- A lead state agency should be designated and funded to assist other state agencies in implementing efficiency improvements, including using energy savings performance contracting (EPSC).
- A list of pre-approved energy efficiency contractors should be provided to state agencies.
- Program oversight should include an effective tracking system that monitors and reports on progress regularly.

4.5.2.1 Case Study

Minnesota – A 2011 executive order illustrates Minnesota’s leadership in building energy performance, calling for a 20 percent reduction in energy use in state-owned buildings.³³⁷ The order instructed state agencies to:³³⁸

- Use the Minnesota Buildings, Benchmarks and Beyond (B3) Energy Benchmarking website to track energy consumption.³³⁹
- Establish site-specific savings goals to be met through energy efficiency and renewable energy measures and report on progress.
- Use ESPCs with the support of Minnesota’s Guaranteed Energy Savings Program,³⁴⁰ the state’s Improvement Financing Program, or other appropriate mechanisms for implementing efficiency and renewable energy measures.

The order also directed the creation of the Guaranteed Energy Savings Program to provide technical, contractual, and financial assistance to government agencies and institutions seeking to make energy upgrades to their facilities using guaranteed energy savings contracts.³⁴¹ Additionally, the order called on the Commissioner of Employment and Economic Development to develop a list of qualified efficiency and renewable energy suppliers in the state.

³³⁴ EPA 2009.

³³⁵ Gilleo, Annie, personal communication, Feb. 10, 2015.

³³⁶ Some state policies, for example, only include buildings larger than 25,000 square feet (Gilleo 2015).

³³⁷ The baseline for the 20 percent reduction is either the first year the agency begins to use the B3 tool or the year before the agency begins implementing conservation measures, whichever is later.

³³⁸ State of Minnesota 2011.

³³⁹ B3 2015.

³⁴⁰ See <http://betterbuildingsolutioncenter.energy.gov/implementation-models/guaranteed-energy-savings-program>.

³⁴¹ Minnesota Department of Commerce 2015.



4.5.2.2 EM&V

Quantifying the energy savings from public building performance standards can be done several ways. The most common approach for existing buildings is to compare utility energy bills from all or a sample of affected buildings before and after the effective date of the subject policy. Several commercial billing analysis software programs can be used to estimate savings using energy bill data as well as other information (e.g., weather, occupancy rates) to normalize the results so that only the energy use changes associated with the subject policy are included in the saving values.

Typically, for new construction, readily available building energy simulation programs are used to model what the buildings would have consumed if they were built without the policy's requirement. Simulated electricity use is compared with actual consumption once the building is occupied. The billing analysis and simulation approaches are described in the IPMVP and ASHRAE Guideline 14 (see Section 3.5.1).

4.5.2.3 Expected Range of Energy Savings and Emissions Reductions

Thirty-eight states have building performance policies with explicit savings or performance targets. Typical energy savings targets are between 10 percent and 20 percent. The time period over which the targets apply varies, in part depending on the baseline year and magnitude of the savings goal.³⁴²

For example, toward progress on a 2011 executive order calling for a 20 percent reduction in energy use in state-owned buildings, by 2014 Minnesota state agencies altogether had reduced annual electricity consumption by 3.8 percent—over 10 million kWh—at the same time facility square footage increased by 3.5 percent. The electricity consumption per square foot decreased by 7 percent.³⁴³

Energy savings in Minnesota can have a particularly potent impact on emissions. That region of the country has one of the highest average non-baseload CO₂ emission rates (2,114.93 lb/MWh) of any region, according to EPA's eGRID database. Estimated energy savings from Minnesota's state building performance policy translate into over 10,000 tons of avoided CO₂ emissions in 2014.³⁴⁴

4.5.3. Product Procurement Policies

In some states, legislation or executive orders that introduce performance policies for state buildings also include requirements for state agencies for product procurement. In states where these rules incorporate energy efficiency,³⁴⁵ they generally require that state agencies can purchase (or lease) only energy-efficient appliances or equipment.

State product procurement policies often use recognizable branding, such as the federal ENERGY STAR[®] certification, a requirement for agency purchasing decisions. Energy-efficient appliances or equipment typically consume 10 percent to 50 percent less energy than standard models.³⁴⁶

Virginia, for example, requires that agencies purchase or lease ENERGY STAR[®]-certified models if the federal program rates that product category.³⁴⁷ An ENERGY STAR[®] Product Purchasing and Procurement template can assist officials responsible for procurement.³⁴⁸

³⁴² See <http://database.aceee.org/state/public-building-requirements>.

³⁴³ LBNL calculations based on data provided by B3 and the Minnesota Department of Commerce. Data are not weather-normalized.


³⁴⁴ Estimate by Regulatory Assistance Project.

³⁴⁵ Many state product procurement policies are focused on the overall environmental impact of the purchased product.

³⁴⁶ Eldridge 2008.

³⁴⁷ Virginia 2007.

³⁴⁸ ENERGY STAR 2015c.



Other states set out broader performance criteria. For example, a 2009 Illinois Executive Order instructs the Department of Central Management Services to “enter into contracts for equipment or services designed to decrease energy consumption in State-owned or State-leased facilities or equipment, with preference given to contracts that can be cost-effectively implemented with a maximum 10-year payback period.”³⁴⁹

4.5.4. State Equipment Efficiency Standards

The federal government, through DOE, has statutory authority to set minimum appliance and equipment efficiency standards for a variety of residential products and commercial and industrial equipment.³⁵⁰ National energy standards are in effect for over 50 products. Federal end-use standards reduced U.S. energy consumption (all fuels) by an estimated 4 percent in 2014, compared to usage absent the standards (Meyers *et al.* 2015).³⁵¹

Federal government standards supersede state standards. States can only set standards for appliances that are not currently covered by a federal standard unless they obtain a waiver to do so. The federal government is working on standards for a number of new product categories based on the successful experience of state standards for these products. Although state standards will no longer be able to cover federally preempted products, new products will enter the market for which states may promulgate standards. Those will eventually lead the way to federal standards, in a productive cycle that transforms the market for appliances and equipment.

Additional products that consume significant amounts of energy, including computers, are not yet covered by a federal standard. (U.S. DOE is currently working on standards for a number of products.) Nine states (Arizona, California, Connecticut, Maryland, Nevada, New Hampshire, Oregon, Rhode Island and Washington) plus the District of Columbia have enacted energy efficiency requirements for products sold in their jurisdictions that are not covered by federal standards, spanning 14 product categories ranging from battery chargers to vending machines.^{352,353} For some types of equipment, states may turn to ENERGY STAR or Consortium for Energy Efficiency specifications for potential efficiency standards.

In many cases, state standards have led to coverage by national standards.³⁵⁴ For example, state standards for refrigerators in the 1970s and 1980s spurred the creation of the national efficiency standard for refrigerators established in 1987.³⁵⁵ Since 2001, state energy efficiency standards for 19 products—from automatic commercial ice makers to walk-in refrigerators—have been preempted by equivalent, or stronger, federal standards.^{356,357}

A study by the Appliance Standards Assistance Project (ASAP) and the American Council for an Energy-Efficient Economy (ACEEE) found that average savings from new standards are more than four times greater than average incremental costs to the consumer. They found the average payback for increased efficiency was 3.3 years.³⁵⁸

³⁴⁹ Illinois 2009.

³⁵⁰ <http://energy.gov/eere/buildings/statutory-rules-and-authorities>.

³⁵¹ Meyers *et al.* 2015.

³⁵² ASAP 2015.

³⁵³ State standards cover the following product categories: battery chargers, compact audio equipment, DVD players and recorders, external power supplies, general service lamps, hot food holding cabinets, luminaires, mercury vapor lamp ballasts, metal halide lamp fixtures, refrigeration products, pool pumps, portable electric spas, televisions and vending machines.

³⁵⁴ ASAP 2015.

³⁵⁵ Hayes 2014.

³⁵⁶ ASAP 2014.

³⁵⁷ Product categories originally covered by state standards and subsequently preempted by federal standards are automatic commercial ice makers, ceiling fans, commercial clothes washers, commercial refrigerators and freezers, HID lamp ballasts, illuminated exit signs, air conditioners (>20 tons), low- and medium-voltage dry-type transformers, residential boilers, residential furnace fans, residential furnaces, single voltage external power supplies, incandescent reflector lamps, torchieres, pedestrian and vehicular traffic signals, unit heaters, and walk-in refrigerators and freezers.

³⁵⁸ Lowenberger *et al.* 2012.



4.5.4.1 Case Studies

California – As the largest appliance market in the country, California is well positioned to set efficiency standards for equipment and has been a leader in doing so. The state currently has standards for 13 appliance categories.³⁵⁹

The California Energy Commission administers the program. Appliance and equipment manufacturers must certify to the Commission that their products meet current standards.³⁶⁰ The Commission also is responsible for periodic inspections of retailers and distributors to ensure subject products are in compliance.^{361,362} The Commission estimates that state and federal equipment efficiency standards saved California 2.4 million MWh in 2013.³⁶³

Connecticut – Connecticut has set equipment efficiency standards since the 1980s.³⁶⁴ It passed legislation for state energy standards most recently in 2004, 2007 and 2011.³⁶⁵ The Connecticut Department of Energy and Environmental Protection is responsible for regulating appliances, and the Bureau of Energy and Technology Policy creates and administers the standards.³⁶⁶ Connecticut’s current standards cover bottle-type water dispensers, commercial hot food holding cabinets, hot tubs, swimming pool pumps, compact audio equipment, televisions, and DVD players and recorders.

Regional approaches – A regional approach leverages the market power of several states (and sometimes other North American jurisdictions) to effectively set equipment standards. For example, Connecticut initiated the Multi-State Appliance Collaborative, which also includes California, New York, Oregon, Rhode Island and Washington. Member states have adopted comparable standards for a number of appliances, many straight from California’s standards.³⁶⁷

As another example, Washington, Oregon, Montana and Idaho have established voluntary standards through the Northwest Energy Efficiency Alliance (NEEA), which leverages a market of 12 million customers to accelerate the adoption of stronger standards.³⁶⁸

4.5.4.2 Expected Range of Energy Savings and Emissions Reductions

If all states adopted model standards—based on standards that have already been adopted by at least one state³⁶⁹ or ENERGY STAR® specifications—ASAP estimates that in the year 2025, annual savings would be nearly 21 million MWh.³⁷⁰ ASAP has developed savings estimates for each state assuming adoption of the model standards: <http://www.appliance-standards.org/map/benefits-from-state>.

Using the national average, non-baseload CO₂ emissions factor from EPA’s eGRID database (1,555.48 lb/MWh), this level of energy savings could result in up to 16.3 million tons (or 14.8 million metric tonnes) of avoided CO₂ emissions.³⁷¹ This could approach almost 0.7 percent of the expected total U.S. CO₂ emissions from the electric

³⁵⁹ ASAP 2014.

³⁶⁰ Singh 2014.

³⁶¹ *Ibid.*

³⁶² Manufacturers of non-complying products sold in California can be fined up to \$1,000 per violation. State of California 2015.

³⁶³ Kavalec 2014.

³⁶⁴ Ruckes 2008.

³⁶⁵ DSIRE 2015.

³⁶⁶ Melley 2015.


³⁶⁷ Multi-State Appliance Standards Collaborative 2015.

³⁶⁸ NEEA 2015.

³⁶⁹ Not including standards that have been preempted by federal standards.

³⁷⁰ Data from Joanna Mauer, ASAP.

³⁷¹ Estimate by Regulatory Assistance Project. Avoided emissions for 2025 are described here as “up to” 16.3 million tons because average non-baseload emissions factors are expected to decline over time. The actual impact of the stated amount of energy savings in 2025 is thus likely to be somewhat less than a 16.3 million-ton emissions reduction.



power sector in 2025, based on projections by the Energy Information Administration published in the 2015 Annual Energy Outlook.

4.5.5. Financing Access

Accessible and affordable financing can enable energy efficiency projects in state facilities by overcoming upfront costs and providing capital to fund projects with repayment offset by energy cost savings. While financing does not create energy savings or emissions reductions in and of itself, it may increase the number of projects completed or lead to larger projects that achieve deeper energy and cost savings, as analyses of state financing programs demonstrate.³⁷²

A state can enable access to financing for energy efficiency projects for its own facilities, as well as others, including local governments, school districts, sanitation districts, public hospitals, businesses and consumers. States can enact legislation or policies, directly invest public funds, and work with private capital markets to attract low-cost financing for energy efficiency improvements.

States have pursued a range of strategies to attract low-cost capital and deliver financing to complete energy upgrades, as well as achieve greater energy savings than without financing.³⁷³ These include:


- **Revolving loan funds.** State revolving loan funds are pools of public capital, private capital, or a mix that can be invested (loaned out) at attractive rates to borrowers for designated purposes—in this case, energy efficiency projects. State revolving loan funds typically focus on institutional projects but can include any project type and market segment (e.g., commercial businesses, multifamily, homeowners), depending on public policy priorities. When funds are repaid by borrowers, they return to the revolving loan fund and can be loaned out to new projects.³⁷⁴
- **Credit enhancements** are a class of tools that reduce lender or investor risk by providing a level of protection against losses in the event of borrower default or delinquency. States can use public funds to create credit enhancements such as loan loss reserves that protect against a portion of possible bad debt losses on a loan pool. These mechanisms are designed to attract private capital for energy efficiency projects at lower rates, better terms or both.
- **Qualified Energy Conservation Bonds (QECBs)** are bonds that state, tribal, or local governments may use to borrow money at low interest rates, subsidized by the U.S. Treasury, to fund energy conservation projects. QECBs can finance a range of activities, such as energy efficiency building upgrades, efficient street lighting, establishment of loan programs for energy efficiency projects, and construction of mass commuting facilities.
- **Green banks** are standalone, quasi-public entities that focus on attracting private capital for energy efficiency and renewable energy projects through the use of innovative financing products. Green Banks typically are capitalized initially with state or utility ratepayer funds and seek to attract large amounts of private capital with that seed funding. States also can issue general obligation bonds paid off over time through loan payments.
- **On-bill financing** involves repaying financing for energy-related improvements through a charge on a customer's utility bill. On-bill financing typically requires either state enabling legislation, direction from the public utility commission, or both. Across the U.S., on-bill programs have financed a range of energy-related improvements in the residential and nonresidential sectors. The upfront capital for these

³⁷² Cadmus 2014.

³⁷³ See NASEO's financing programs database: <http://www.naseo.org/state-energy-financing-programs>.

³⁷⁴ See NASEO's overview and trends for revolving loan funds:

http://www.naseo.org/Data/Sites/1/documents/selfs/state_energy_rlf_report.pdf.



improvements can come from utility customer funds, utility shareholder funds, private capital, or a combination of these sources.

- **Property Assessed Clean Energy (PACE) financing programs** use a jurisdiction's special property assessment authority to finance clean energy projects. Assessments are paid back over time through property tax bills and can remain with the property if it is sold. In the 31 states (as of this publication) where state PACE enabling legislation is in place, municipalities may use special assessments to finance energy efficiency, renewable energy and other improvements on commercial property. States also can develop residential PACE programs using eligible subordinate lien structures, under forthcoming guidelines from the Federal Housing Administration (FHA).³⁷⁵

4.5.5.1 Case Studies

Alabama – The AlabamaSAVES program, administered by the Alabama Department of Economic and Community Affairs (ADECA), makes loans to commercial, industrial, agricultural and institutional consumers for energy efficiency and renewable energy measures. Loans range from \$50,000 to \$4 million for up to 10 years at an interest rate of 1 percent.³⁷⁶

Both direct loans and subsidized third-party loans are available. The department uses a \$25.5 million revolving loan fund to capitalize direct loans. It also works with eight banks to offer loans, leveraging nearly \$16 million of private investment to date. The market rate on these private loans is reduced through a \$1.4 million loan loss reserve and through interest rate buydowns.

AlabamaSAVES was originally funded with grants under the American Recovery and Reinvestment Act (ARRA). The program has delivered over \$26 million in financing and has retrofitted over 10 million square feet of building space as of mid-2014.³⁷⁷

Nebraska – Nebraska's Dollar and Energy Saving Loan Program, established in 1990, is a \$37 million revolving loan fund that supports energy efficiency upgrades in all sectors across the state, mostly for residential equipment upgrades or weatherization. The program also has funded projects in the municipal, agricultural, small business and industrial sectors.³⁷⁸ The loan fund coordinates with a network of over 250 lenders to co-invest zero percent interest funding with market-rate loans, resulting in a blended interest rate to borrowers of 2.5 percent to 5 percent.

The Nebraska Energy Office reports that the Dollar and Energy Savings Program has invested \$307 million in more than 28,000 energy efficiency projects since 1990.³⁷⁹ A recent assessment estimated that for \$4 million of public investment, the program generated electric energy savings of more than 250 MWh.

Texas – In 1988, the Texas State Energy Conservation Office initiated the Texas Loans to Save Taxes and Resources Program, also known as LoanSTAR. The revolving loan fund finances energy-related retrofits for buildings operated by the state, public school districts, public colleges, public universities and tax district-supported public hospitals.³⁸⁰ Through the program, state government improves the energy efficiency of its own buildings and other public facilities, setting an example for private-sector building owners.

³⁷⁵ See FHA announcement on Aug. 24, 2015: <http://portal.hud.gov/hudportal/documents/huddoc?id=FTDO.pdf>.


³⁷⁶ "AlabamaSAVES: Overview." <http://www.alabamasaves.com/Overview.aspx>.

³⁷⁷ Personal communication with Kathy Hornsby (ADECA) and Derek McGarry (Abundant Power Group), July 30, 2014.

³⁷⁸ Loos 2003.

³⁷⁹ Nebraska Energy Office, 2014: http://www.neo.ne.gov/annual_rept/NEOAnnualReport.pdf.

³⁸⁰ NASEO 2013, SECO 2015a.



LoanSTAR administrators request applications twice per year. Loans of up to \$7.5 million are available at 2 percent interest with a maximum term of 10 years.³⁸¹

The state placed a total of \$162 million in the fund, from both petroleum violation (“oil overcharge”) settlement monies and an ARRA grant. Between 1988 and early 2014, the LoanSTAR program issued more than \$395 million in loans, generating cumulative savings exceeding \$419 million. The average loan, about \$1.7 million, saves the borrower about \$1.8 million.³⁸² All measures must have a payback period less than the expected useful life of the measure.³⁸³

³⁸¹ SECO 2015b.

³⁸² SECO 2015a.

³⁸³ NASEO 2013.



4.6. Large Energy Users – Voluntary Efforts of Industry and Business

The industrial sector consumed about one-third of total delivered energy in the U.S. in 2012.^{384,385} DOE estimates that system optimization—ensuring that energy components of production systems are optimally designed and operated—could, by itself, reduce that consumption by about 7 percent.³⁸⁶

Industry and business invest in energy-efficient equipment and processes to achieve corporate financial and sustainability goals. Energy efficiency programs that support these goals fall into two categories. We cover ratepayer-funded programs for commercial and industrial utility customers in Section 4.2 of this report. Many utilities offer incentive programs for these customers, including financial and technical support for energy audits and energy-saving investments. Activities beyond ratepayer-funded programs also have achieved substantial participation by large energy users and represent significant opportunities for energy savings and emissions reductions in the power sector. This section features four of these voluntary pathways: (1) energy management; (2) voluntary initiatives; (3) combined heat and power; and (4) energy savings performance contracting.

While states can play an important role through supportive policies, regulations and programs,³⁸⁷ there are several options for administration and aggregation for these voluntary pathways, including industry associations and nonprofit organizations as well as states. Regardless, a critical role for states is identifying and counting energy savings and avoided emissions.

4.6.1. Strategic Energy Management

Energy use and its associated costs can be managed for maximum benefit through energy-saving practices and technology investments for buildings, manufacturing facilities, processes, equipment and operations. Voluntary energy management programs for large energy users are initiatives that encourage firms to adopt effective energy management systems—the practices and processes used to systematically track, analyze and plan energy use. Participants are generally driven by the business case for energy efficiency: lower operating costs and increased productivity and competitiveness. Additional benefits include enhanced brand value, more information to make better decisions on energy use, increased reliability of energy-using systems and resource conservation.

Taking a strategic approach to energy management can be described as a culture of systematically and continually improving energy performance and efficiency. Strategic energy management (SEM) means that energy management is integrated within an organization’s normal business practice.

³⁸⁴ The industrial sector includes manufacturing, agriculture, construction and mining.

³⁸⁵ EIA 2013.

³⁸⁶ Therkelsen 2013.

³⁸⁷ SEE Action 2014.

Several approaches to SEM are yielding energy and cost savings for commercial and industrial companies across the country. These approaches span a spectrum of depth and sustainability of savings, but all provide resources to assist businesses with continually improving energy performance and reaping emissions and cost benefits. Figure 4.6.1-1 shows progressively rigorous approaches to SEM. Table 4.6.1-1 describes four example SEM programs.

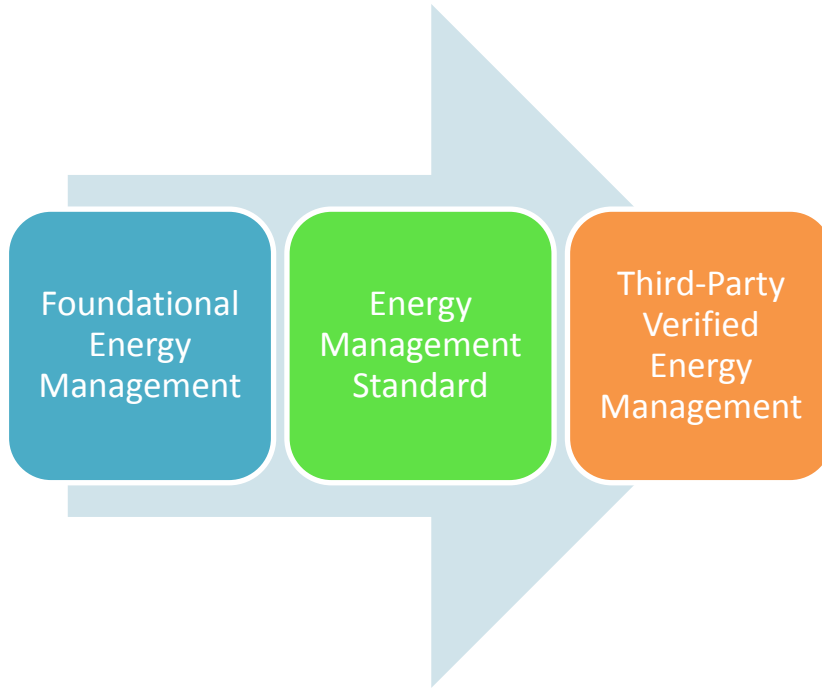


Figure 4.6.1-1. Example strategic energy management programs


Table 4.6.1-1. Programmatic Approaches to Strategic Energy Management

	Better Plants	ENERGY STAR for Industry	ISO 50001 Standard	Superior Energy Performance
Summary	Corporate energy intensity reduction goal of 25% over 10 years	Voluntary partnership program that promotes corporate best practices for energy management	Internationally recognized, continuous improvement energy management system; adoption of standard can be self-declared or 3 rd party-verified	Energy management system that meets ISO 50001 standard and provides 3 rd party verification of savings
Resources	Offers energy management best practices and technical assistance guidelines	Provides energy management guidance and resources, sector-specific energy guides and benchmarking tools, and recognition for performance	Framework to create and implement an energy management system following Plan-Do-Check-Act approach	Offers implementation toolkit and energy performance improvement tracking software
Reporting and Verification	Required annual self-reporting of energy intensity reductions; no 3 rd party verification	Verification of energy performance required for ENERGY STAR plant certification and Challenge for Industry recognition	No external reporting and no 3 rd party verification	Required reporting every three years; 3rd party verification of energy performance improvement of 5% or more over 3 years to achieve savings and Superior Energy Performance certification
Impact	Average annual improvement of 2.8% in energy intensity across all partners in first 18 months of Superior Energy Performance implementation*	Industrial partners saved 33,135 GWh and avoided nearly 40 million metric tons of CO ₂ e in 2013	3M has demonstrated a 5.3% improvement in energy efficiency in ISO 50001-certified facilities in first 18 months of certification*	Surveyed companies improving energy performance 10% on average in first 18 months of Superior Energy Performance implementation

*Therkelsen et al. 2015; Schultz 2015.

The Superior Energy Performance program is an example of a voluntary strategic energy management program, administered by DOE. The program reduces energy consumption at individual industrial facilities and provides a platform to continually improve energy performance. The program certifies facilities through third-party verification bodies, including verification of energy performance improvement, to implement an energy management system that conforms to the ISO 50001 global energy management system standard. The ISO 50001 standard includes developing a policy to engage entire organizations using data and metrics to understand and measure progress. Superior Energy Performance stresses continual improvement through setting objectives and targets to meet the Superior Energy Performance program’s energy performance improvement criteria. Re-certification is required every three years. Over the next 10 years, DOE projects that 30,000 plants in the U.S. could realize an economic payback of two years or less by participating in the Superior Energy Performance program with 200 to 1,000 potential participating plants in each state.³⁸⁸

³⁸⁸ Personal communication with DOE, Oct. 1, 2014.



The program is flexible to allow participants to reach their own goals, yet structured to provide a clear path to improved energy performance through the ISO 50001 standard and Superior Energy Performance Measurement and Verification Protocol (see below). The Superior Energy Performance program provides a number of resources for participants including:³⁸⁹

- **Guidance documents.** The *eGuide* provides step-by-step instructions and examples for implementing an ISO 50001-compliant energy management system.
- **In-person assistance** from Certified Practitioners in Energy Management Systems®
- **Software tools.** The Energy Performance Indicator tool (EnPI) determines energy performance improvement and is compatible with the Superior Energy Performance measurement and verification protocol.

Companies are responsible for the costs of energy improvement at participating facilities and third-party verification of savings, averaging about \$225,000 per facility. The cost is largely the salary of the energy manager/program champion, which many large energy users already have on staff and the fees associated with third party certification. Some utilities and third-party program administrators are beginning to offer financial incentives to offset a portion of the costs as well as training and technical support.

4.6.1.1 Requisite policies

Specific policies do not need to be in place for voluntary business and industry programs to be successful, but state action can support and complement Superior Energy Performance and similar types of programs increasing energy savings and related benefits. Many states set energy efficiency targets for utilities³⁹⁰ through policies such as energy efficiency resource standards. In turn, utilities can provide technical assistance and incentives for industrial facilities to achieve highly cost-effective savings toward these targets. Alternatively, state regulators may set energy-saving targets for individual utilities through integrated resource plans³⁹¹ and requirements to pursue all cost-effective opportunities for energy efficiency. In addition, at least 35 state energy offices administer energy programs for manufacturers and the industrial sector, implementing state policies to make businesses more energy-efficient and competitive.³⁹²

4.6.1.2 Case Studies

Nissan plant in Smyrna, Tennessee – Nissan is a global carmaker with over 140,000 employees and sales of approximately \$88 billion in 2013.³⁹³ Nissan’s largest U.S. plant in Smyrna, Tennessee, enrolled in the Superior Energy Performance program in 2010. Nissan used DOE’s Energy Performance Indicator tool to measure and track progress. In 2012, Superior Energy Performance audits verified that energy-saving upgrades led to an energy performance improvement of 7.2 percent³⁹⁴ and the plant earned Superior Energy Performance certification.³⁹⁵ The energy savings paid back the cost of the investments in just four months, and continuing savings go to the company’s bottom line.³⁹⁶

³⁸⁹ DOE 2013.

³⁹⁰ See https://www4.eere.energy.gov/seeaction/system/files/documents/ratepayer_efficiency_targets.pdf.

³⁹¹ See https://www4.eere.energy.gov/seeaction/system/files/documents/ratepayer_efficiency_irpportfoliomangement.pdf.


³⁹² NASEO 2012.

³⁹³ Nissan 2015.

³⁹⁴ EERE 2015a.

³⁹⁵ Superior Energy Performance participants receive Silver certification for achieved energy performance improvements between 5 percent and 10 percent over a three-year timeframe.

³⁹⁶ DOE 2014.



Harbec, Inc. plant in Ontario, New York³⁹⁷ – Harbec, Inc. is a specialty plastics manufacturer with annual revenues of approximately \$15 million. Its sole plant is located in upstate New York. Harbec, Inc. enrolled in Superior Energy Performance at the beginning of 2012 and implemented an energy management system by the end of that year. Between November 2012 and October 2013, the plant improved its energy performance by 16.5 percent. The improvements were achieved with no capital investment. The plant simply reduced unnecessary run times identified by energy audits. The energy savings paid back the \$127,000 cost of implementing Superior Energy Performance in under two and a half years.

Both Nissan and Harbec, Inc. installed sub-metering prior to enrolling in the Superior Energy Performance program. Sub-metering allows energy managers to measure the energy use of specific systems and set precise baselines to better identify savings opportunities and to accurately track progress. The program’s focus on continual improvement ensures that savings are persistent.

4.6.1.3 EM&V

As discussed in Section 2.4, energy savings are determined by comparing energy consumption between a baseline and reporting period. In industrial settings, variations in production levels, product changes, feedstock and the industrial processes themselves can occur between these periods, which in addition to the efficiency project itself, can affect energy consumption. Therefore, in order to identify the changes in energy consumption (i.e., the savings) associated with just the efficiency project(s), adjustments to the baseline and/or reporting period energy consumption are required to account for the non-efficiency project factors that also impact energy consumption.³⁹⁸

Energy consumption adjustments are usually based on determining savings in relation to either:

- **Typical or normalized operating conditions at the industrial facility**—for example, assuming a standard set of production levels and product characteristics for both the baseline and reporting period energy consumption, or
- **Real time or current operating conditions at the industry facility**—for example, to determine savings associated with just the efficiency project, baseline energy consumption is adjusted to what it would have been if production levels and product characteristics were the same as occur during the reporting period, for comparison with reporting period energy consumption.

Most facilities use simple or complex regression models to compare historic and current energy consumption under consistent conditions (e.g., production levels and product characteristics) to determine savings. In some cases, a facility may be able to adequately represent energy performance improvement through calculation of an intensity ratio (ratio of energy consumption to a single production level—e.g., MWh/tons of product produced).

Established methods for measurement and verification of reductions in energy consumption at industrial facilities are described in a number of public resources, including the International Performance Measurement and Verification Protocol (IPMVP).³⁹⁹


Another valuable resource is DOE’s Superior Energy Performance M&V protocol that was developed collaboratively with industry, M&V professionals, and accreditation organizations to create a transparent and credible documentation of a facility’s energy performance improvements.⁴⁰⁰ The Superior Energy Performance M&V protocol (based on IPMVP Option C) applies standard, whole-facility regression to the specific requirements

³⁹⁷ EERE 2015b.

³⁹⁸ The Northwest Energy Efficiency Alliance offers a guide for determining energy consumption baselines for industrial facilities, “Energy Baseline Methodologies for Industrial Facilities.” See NEEA 2013.

³⁹⁹ www.evo-world.org.

⁴⁰⁰ EERE 2015c.



of the Superior Energy Performance program. In order to receive Superior Energy Performance program certification, a participant's energy performance improvement must be verified by program Verification Bodies accredited by the American National Standards Institute (ANSI) and the ANSI-ASQ National Accreditation Board (ANAB).

DOE's Uniform Methods Project is developing evaluation protocols for strategic energy management generally and the Superior Energy Performance program in particular.

4.6.1.4 Expected Range of Energy Savings and Emissions Reductions

As part of the initial implementation of Strategic Energy Performance, a limited number of certified facilities (nine) provided data allowing for the calculation of electricity savings attributable to program activities.⁴⁰¹ Electricity consumption was compared between a 12-month reporting period and a 12-month baseline period. The average electricity savings was 7 percent,⁴⁰² with a maximum of 18 percent.⁴⁰³ A similar percentage reduction in the CO₂ emissions associated with serving the electrical needs of these facilities could be assumed, with the caveat that a 1 percent reduction in electricity usage can result in a greater than or less than 1 percent reduction in emissions, depending on the timing and location of energy savings (as discussed in Section 2.4).


⁴⁰¹ Data from additional facilities will be available soon.

⁴⁰² Electricity savings values were divided by the baseline electricity consumption to determine percentage electricity savings.

⁴⁰³ These results should not be considered average for all U.S. industry due to the limited number of facilities that were used in this analysis.

Superior Energy Performance® (SEP™) Programs SEP certifies industrial facilities that implement an energy management system that meets the ISO 50001 global energy management system standard and achieves improved energy performance.

Screening Questions	Quick Answers	Resources: Documented State Experience or Recommended Practice
<p>FEASIBILITY Can SEP programs help achieve GHG and criteria air pollutant reductions in the required time frame?</p>	<ul style="list-style-type: none"> • Yes. They reduce the amount of electricity generated, and fossil fuel consumed, at EGUs. Reduced energy demand yields emissions reductions. 	<ul style="list-style-type: none"> • DOE eGuide
<p>IMPACT What energy savings and emission reductions can SEP programs achieve, and are the savings permanent?</p>	<ul style="list-style-type: none"> • Recent analysis determined that ISO 50001 coupled with SEP improvement targets resulted in significant energy savings. Average electricity savings for a limited sample of plants participating in initial program implementation was 7%, with a maximum savings of 18%. • Emission reduction values can be determined with DOE’s EnPI tool. • The ISO 50001 energy management system supports energy savings persistence, with SEP recertification every 3 years verifying continual energy performance improvement. 	<ul style="list-style-type: none"> • <i>Assessing the Costs and Benefits of the Superior Energy Performance Program</i> (DOE, LBNL, Energetics) • DOE EnPI Tool
<p>RESPONSIBILITY Who is responsible for administering and implementing SEP programs, and what are the best practices?</p>	<ul style="list-style-type: none"> • DOE’s Advanced Manufacturing Office administers the SEP program. • Companies are responsible for facility implementation and certification costs. • Utilities can offer the SEP program to customers and provide additional incentives, training, and technical assistance. 	<ul style="list-style-type: none"> • <i>SEP Accelerator Ratepayer-funded Program Partners Fact Sheet</i> (DOE) • <i>SEP Fact Sheet</i>
<p>COST What is the cost structure of SEP programs, and how much do they cost?</p>	<ul style="list-style-type: none"> • DOE funds SEP administration. • Companies pay for implementation and third-party verification, which typically costs approximately \$225,000 per facility. Costs may be partially offset by utility incentives. Early analysis support high cost-effectiveness based on the total resource cost test. 	<ul style="list-style-type: none"> • <i>Assessing the Costs and Benefits of the Superior Energy Performance Program</i> (DOE, LBNL, Energetics) • <i>SEP Accelerator Ratepayer-funded Program Partners Fact Sheet</i> (DOE)
<p>RELIABILITY How can I document the energy impacts of SEP programs?</p>	<ul style="list-style-type: none"> • The SEP Measurement and Verification Protocol provides a transparent, credible record of energy performance improvement. • Participation savings are verified by SEP Verification Bodies accredited by the American National Standards Institute (ANSI) and the ANSI-ASQ National Accreditation Board (ANAB). 	<ul style="list-style-type: none"> • <i>SEP Measurement and Verification Protocol</i> (LBNL) • <i>ANSI ANAB Operating Procedures of the Energy Accreditation Committee</i> (ANSI, ANAB)
<p>OTHER CONSIDERATIONS What are other considerations for successful delivery of energy savings from SEP programs?</p>	<ul style="list-style-type: none"> • SEP appeals to global companies through its use of rigorous international and national standards and protocols. • An accredited credentialing program ensures that qualified experts are available to help implement SEP. 	<ul style="list-style-type: none"> • Institute for Energy Management Professionals accredited SEP lead auditor and SEP performance verifier program • Listing of accredited SEP Verification Bodies • SEP and ISO 50001



ENERGY STAR® for Industry (www.energystar.gov/industry), established by EPA in 2000, is another example of strategic energy management. It attracts industrial energy users of all sizes because of its proven results, broad base of participation, and streamlined set of energy management tools and resources. Participation is voluntary. Through the program, EPA helps manufacturers build strategic energy management systems and strong energy programs that improve efficiency and reduce energy-related GHG emissions.⁴⁰⁴ Over 750 manufacturing companies operating thousands of manufacturing plants in the U.S. have made a broad commitment to continuously improve their energy performance and protect the environment by becoming an ENERGY STAR partner.

ENERGY STAR works with these companies to build energy management programs based on implementation of the *ENERGY STAR Guidelines for Energy Management*. The guidelines provide a framework for continuous improvement and are compatible with the ISO 50001 standard.⁴⁰⁵ The program offers a large variety of business-oriented tools that assist companies in engaging their full complement of managed plants and facilities in setting and meeting energy goals, including:


- **Energy management guidance and tools.** The ENERGY STAR Guidelines for Energy Management, Energy Program Assessment Matrix, and Facility Energy Management Assessment Matrix help companies cost-effectively evaluate their current management practices and self-identify areas for improvement. A large variety of additional tools and resources are available to assist industry.
- **Plant energy performance indicators (EPIs).** Sector-specific energy performance benchmarking tools objectively score the performance of selected industrial plants and compare scores to others in the U.S. in the same industry. EPA has released 12 industrial EPIs with additional ones in development. EPIs enable an industrial plant to evaluate and benchmark its energy performance, compare it to its industry and set practical goals for improvement. EPIs also provide the basis for EPA to award ENERGY STAR Plant Certification.
- **Recognition for performance and improvement.** ENERGY STAR offers three forms of recognition for industrial energy performance, including the Partner of the Year Award for excellence in corporate energy management, ENERGY STAR Plant Certification for plants that achieve top energy performance in an industry, and ENERGY STAR Challenge for Industry for reaching a 10 percent reduction in energy at a plant.

EPA organizes ENERGY STAR Industrial Focuses for specific sectors (e.g., integrated steel mills, cement plants and food processing plants) to help companies in an industry concentrate on plant energy benchmarking, identify energy reduction opportunities in the sector's plants, and share best practices. Twenty-eight industrial sectors are currently engaged. Industrial Focuses develop an ENERGY STAR plant EPI with industry's participation, along with an Energy Guide.

ENERGY STAR Certified Plants are among the most efficient in an industry. For sectors where no EPI is available, EPA recommends the plants take the ENERGY STAR Challenge for Industry, which offers recognition to plants that reduce their energy intensity by 10 percent within five years. Plants achieving the ENERGY STAR Challenge and plants applying for ENERGY STAR Certification must have their energy performance improvement and savings verified by a licensed Professional Engineer (PE) before recognition is provided. EPA specifies the PE data verification protocol. PEs are licensed by the states.

⁴⁰⁴ Tunnessen 2004.

⁴⁰⁵ Dutrow 2015.



A recent report, *Reducing Greenhouse Gas Emissions by Advancing Industrial Energy Efficiency, 2000-2015*, reviews the formation of ENERGY STAR for Industry by EPA and the program's achievements.⁴⁰⁶

4.6.1.5 Case Studies⁴⁰⁷

Plant after Plant Achievement – General Motors (GM), an automobile producer that manufactures around the world, directed all of its plants to take the ENERGY STAR Challenge for Industry as the unifying platform for positive motivation for energy improvement. To date, 70 plants have achieved the ENERGY STAR Challenge for Industry goal of a 10 percent reduction in five years or less. Seven plants have achieved the goal twice. GM reports 220,000 metric tons of carbon dioxide emissions have been avoided and that many plants achieved the reduction goal in less than two years.⁴⁰⁸

Building a Corporate Program – HanesBrands is a global apparel company formed in 2006 from the integration of several business units and manufacturing entities that all had an independent approach to energy management. To align the business units under one strategic platform, HanesBrands used the *ENERGY STAR Guidelines for Energy Management* to build a cohesive energy program across all facilities worldwide. The approach helped the company to reduce energy intensity by over 21 percent, cut carbon emissions more than 27 percent, and increased the share of renewable energy used to 35 percent from a baseline year of 2007.⁴⁰⁹

Improvements in Whole Industrial Sector Efficiency – More plants achieve higher levels of performance as ENERGY STAR Focus Industries advance in energy management using their sector-specific EPI. To ensure the EPI serves as an effective management tool, EPA “re-baselines” or repopulates the actual industrial plant data underlying the detailed statistical model and produces a new version of the EPI for the industry to use in setting realistic energy improvement goals for participating plants. As part of the process of updating the EPI for automobile assembly plants, EPA found that the industry as a whole reduced fossil fuel use by 12 percent and reduced over 700,000 metric tons of energy-related GHG emissions. At the same time, the gap between top-performing plants and other plants closed while the performance of the entire set of U.S. automobile assembly plants improved.⁴¹⁰ The cement and wet corn milling industries had similar results.

4.6.1.6 Expected Range of Energy Savings and Emissions Reductions

As of 2013, ENERGY STAR industrial partners were responsible for electricity savings of 33,135 GWh and avoided emissions amounting to nearly 40 million metric tons of carbon dioxide equivalents.⁴¹¹ Plants that take the ENERGY STAR Challenge for Industry pledge must have their savings verified. As of March 2015, over 1,050 plants had taken the ENERGY STAR Challenge for Industry. Of these, over 320 have achieved the ENERGY STAR Challenge for Industry, and more than 50 plants have achieved it more than once. These plants have saved over 60 trillion Btu of energy and avoided over 12 million metric tons of carbon dioxide-equivalent emissions.

The average energy intensity reduction of plants taking the ENERGY STAR Challenge for Industry was 20 percent within two years. Table 4.6.1-2 shows average reductions by sectors with 10 or more plants that have achieved the Challenge.⁴¹²

⁴⁰⁶ https://www.energystar.gov/buildings/tools-and-resources/reducing_greenhouse_gas_emissions_advancing_industrial_energy_efficiency_2000

⁴⁰⁷ For additional case studies, see EPA, January 2014.

⁴⁰⁸ GM 2014.

⁴⁰⁹ EPA 2013.

⁴¹⁰ Boyd 2010.

⁴¹¹ EPA 2013.

⁴¹² EPA 2015.

Table 4.6.1-2. Sectors with 10 or More Plants Achieving the ENERGY STAR Challenge for Industry

Sector	Number of Achievers	Average Reduction	Average Time
Motor Vehicles	132	23.6%	1.9 Years
Personal Care Products	44	17.8%	2 Years
Dairy	29	14.2%	1.3 Years
Pharmaceuticals	23	18%	1.7 Years
Textile	18	19.5%	2.9 Years
Food Processing	14	15%	1.3 Years
Concrete	13	17%	1.3 Years

4.6.2. Voluntary Challenges: Better Buildings, Better Plants

Voluntary energy efficiency challenges, in which participants answer a challenge to improve their facilities, can be highly successful for promoting energy efficiency in the industrial sector, where there is potential for large improvements. Particularly in sectors where energy uses and savings opportunities are diverse and complex, setting energy improvement targets can be more effective than stipulating that energy consumers implement specific energy efficiency activities and measures. Companies join these challenges to improve competitiveness through cost control, to improve production, and to gain public recognition for their efficiency efforts. Examples of such challenges are the Northwest Energy Efficiency Alliance’s 25inTENSity Challenge, EPA’s ENERGY STAR® Challenge for Industry, and DOE’s Better Buildings, Better Plants Program and Challenge (Better Plants).⁴¹³ This section describes Better Plants to illustrate how these programs work.

Manufacturers have two opportunities to participate in Better Buildings, Better Plants program: the Better Plants program and the Better Plants Challenge. Through the broader-based Better Plants Program, companies set energy efficiency goals and report their progress once a year to DOE. A subset of these companies have joined the Better Plants Challenge and agreed to provide heightened transparency of their energy savings data and energy management strategies and practices so that others can follow their lead. For both the Program and Challenge, DOE supports participating industries to reduce energy intensity, usually by 25 percent over 10 years across all corporate facilities.⁴¹⁴ Because the Better Plants pledge is company-wide, participation can affect facilities in multiple states (see Figure 4.6.2-1). Partners in the program receive support from DOE, including in-plant trainings on specific systems, access to a DOE technical account manager, and a variety of software tools for managing plant energy use and optimizing systems and equipment.

Better Plants aims to save energy and increase competitiveness. Participants sign the voluntary pledge, develop an energy consumption baseline, assign an energy manager from the company, develop an energy plan, implement it and report on progress annually.⁴¹⁵

⁴¹³ Rao *et al.* 2013.

⁴¹⁴ EERE 2015d.

⁴¹⁵ EERE 2015e.

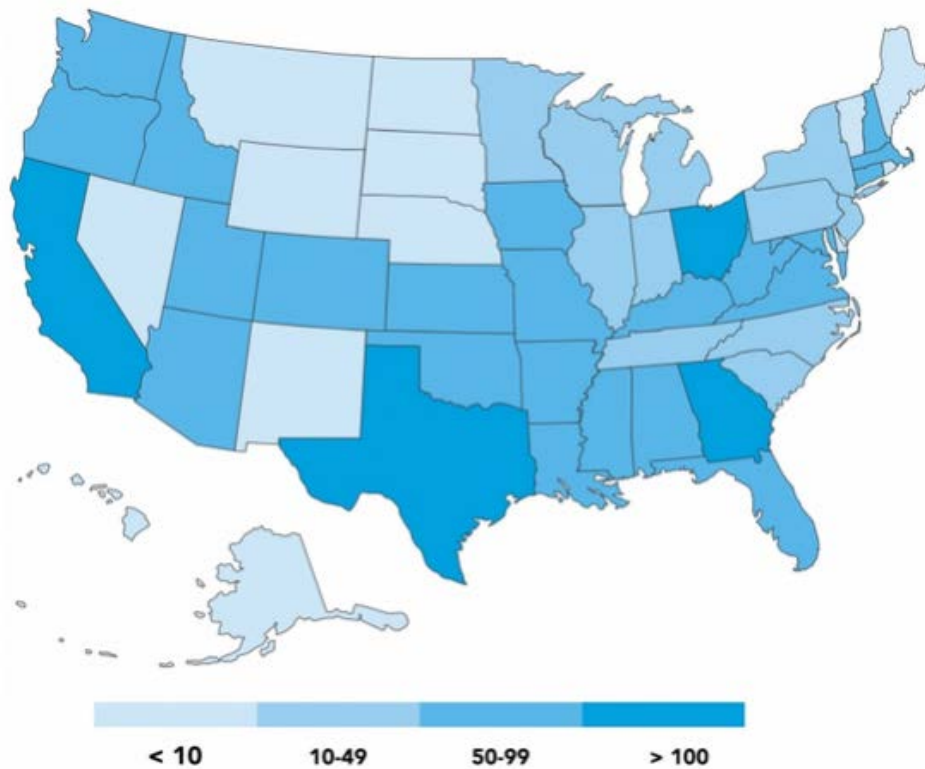


Figure 4.6.2-1. Regional distribution of Better Plants partner facilities

Source: EERE 2014f.

4.6.2.1 Case Study

Saint-Gobain, a producer of sustainable products for the home construction market, has 19,000 employees at facilities in 42 states in the U.S. As a Better Plants Challenge partner, the company pledged to reduce energy intensity in its operations 25 percent by 2020 at 118 of its plants. Saint-Gobain appointed an energy champion at every one of its U.S. plants. Each plant tracks its own energy intensity metrics, which are compared to business unit and corporate goals. Energy intensity is measured annually and monthly. Between 2010 and 2013, participating Saint-Gobain facilities achieved a cumulative energy intensity reduction of 10 percent.^{416,417}

4.6.2.2 Expected Range of Energy Savings and Emissions Reductions

As of June 2014, nearly 150 companies participate in Better Plants, representing some 2,300 facilities—11 percent of the U.S. manufacturing energy footprint.⁴¹⁸ Annually, participants save an estimated 3.2 billion kWh (nearly 1.4 million kWh per plant) from Better Plants activities as reported by participants. Since the beginning of the program in 2010, cumulative savings are estimated at 36.6 billion kWh⁴¹⁹ of electricity and 18.5 million metric tons of CO₂

⁴¹⁶ Compared to its 2009 baseline.

⁴¹⁷ EERE 2015g.

⁴¹⁸ DOE 2014.

⁴¹⁹ de Fontaine 2015.

emissions.⁴²⁰ The average rate of improvement in annual energy intensity for Better Plants participants through 2013 was 2.4 percent.⁴²¹

4.6.3. Combined Heat and Power Policies and Programs

Combined heat and power (CHP) provides both energy services in one energy-efficient step. Also called cogeneration, CHP generates useful hot water or steam and electricity from a single system at or near the point of use. Facilities such as hospitals, universities and manufacturing facilities rely on CHP to maintain business continuity, reduce operating costs, improve competitiveness and decrease environmental impacts.⁴²²

CHP has been in use in the U.S. for more than 100 years, but it remains underused (see Figure 4.6.3-1). Currently, CHP represents about 8 percent of U.S. generating capacity⁴²³—nearly 83 gigawatts (GW) at more than 4,300 industrial, institutional and commercial facilities.⁴²⁴

Natural gas fuels about three-quarters of that capacity. Some CHP facilities use renewable energy sources such as wood byproducts. The technical potential for additional CHP applications at industrial, commercial and institutional facilities is significant, at nearly 130 GW.⁴²⁵ Of that amount, 42 GW is estimated to have strong economic potential (payback of less than five years) or moderate economic potential (payback of less than 10 years).⁴²⁶

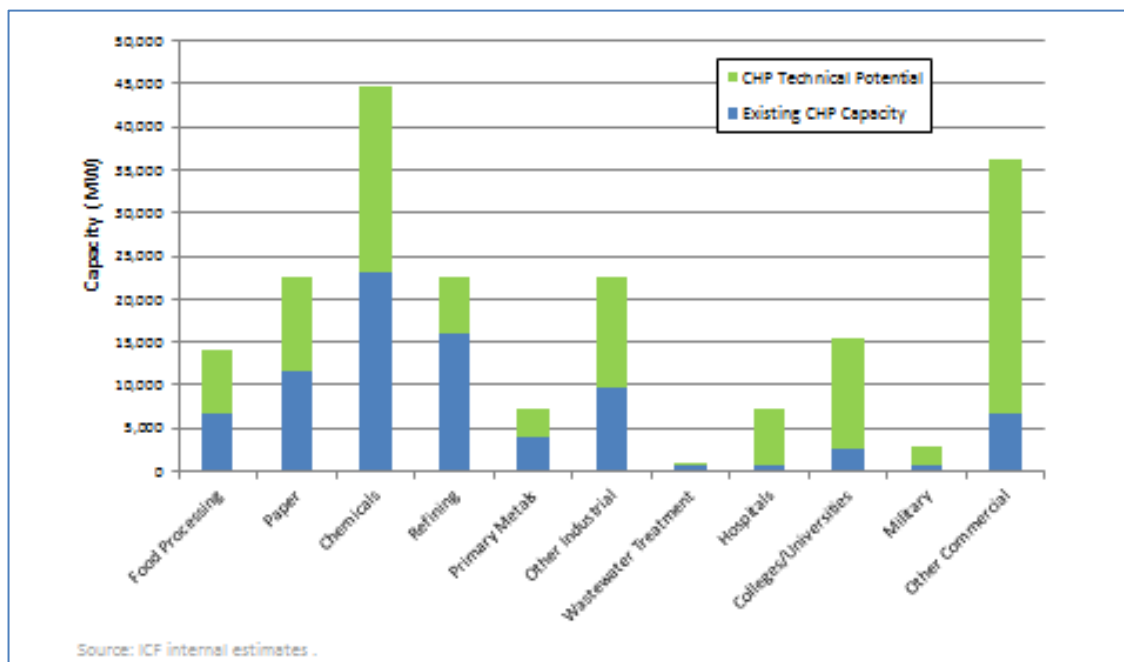


Figure 4.6.3-1. CHP in the U.S.: Existing capacity vs. technical potential

⁴²⁰ DOE 2014; includes non-electric sources.

⁴²¹ *Ibid.*


⁴²² David Gardiner and Associates and Institute for Industrial Productivity 2015.

⁴²³ DOE 2014.

⁴²⁴ CHP Installation Database maintained by ICF International for DOE/Oak Ridge National Laboratory; U.S. Installations as of Dec. 31, 2013. Available at <https://doe.icfwebservices.com/chpdb/>.

⁴²⁵ Based on DOE-funded ICF estimates.

⁴²⁶ Hedman *et al.* 2013. Includes state-by-state results.



CHP is inherently more efficient than (1) transmitting electricity from a remote power plant to power an industrial facility's electricity needs (because it avoids transmission and distribution line losses) and (2) separately producing hot water or steam from an on-site boiler to satisfy the plant's heating needs. In addition, the CHP process recovers thermal energy that would normally be lost in power generation. With these advantages, CHP can significantly lower the amount of electricity purchased from the grid and overall greenhouse gas emissions. The net energy savings from CHP is the fuel saved at the power plant less the on-site fuel consumed by the CHP system, plus avoided line losses.^{427,428}

CHP can be a cost-effective solution to upgrading old coal- and oil-fired boilers by replacing them with energy-efficient, cleaner-burning natural gas systems as well as providing new, highly efficient generating capacity. Properly designed CHP facilities also support energy security and reduce demand on the electricity grid.

4.6.3.1 Requisite Policies⁴²⁹

Many states feature CHP in programs and policies that support energy efficiency and clean energy generation because it is cost-effective, can be widely deployed, and provides multiple benefits—economic, reliability and air quality.

States can support CHP through the following policies:

- Set goals for developing new CHP capacity through legislation or executive order
- Allow efficient CHP systems to qualify under energy efficiency resource standards or renewable portfolio standards
- Provide allowance set-asides for CHP in emissions trading programs
- Recognize CHP's emissions reductions in state air permitting policies by using output-based emissions limits
- Recognize CHP's emissions reductions in state air quality planning and establish a system for performance-based emission reduction credits⁴³⁰
- Provide incentives for CHP through grants, loans or tax policies

In addition, to address barriers to CHP in utility regulation, state utility commissions can:

- Establish uniform technical standards, processes, applications, and agreements based on model protocols for interconnecting CHP systems to the electric grid
- Review the electric rates that customers with CHP systems pay to stay connected to the grid and receive backup and supplemental power, in order to ensure that all utility charges are based on the utility's actual costs of providing service, to evaluate fixed charges that adversely affect the economics of installing CHP capacity, and to provide incentives for customers to reliably operate and maintain CHP systems⁴³¹
- Recognize CHP as a solution to needed investments in new generation and distribution system infrastructure
- Consider strategies that enable utilities to invest in CHP facilities at customers' sites while mitigating risk to other ratepayers


⁴²⁷ USEPA 2012.

⁴²⁸ Hayes *et al.* 2014. USEPA 2015.

⁴²⁹ SEE Action Network 2013 describes these policies and programs. Also see <http://aceee.org/sector/state-policy/toolkit/chp>.

⁴³⁰ Kefer *et al.* 2014.

⁴³¹ Selecky *et al.* 2014; RAP and ICF 2009.

- 
- Provide standard offer rates—uniform prices that all CHP systems up to a certain size will be paid for power they sell to the utility, based on actual avoided costs to the utility, recognizing that those costs vary by location, time of day and other factors—or issue competitive solicitations to determine prices

4.6.3.2 Case Studies⁴³²

Maryland – In 2012, the Public Service Commission (PSC) approved a CHP pilot incentive program as part of several new initiatives to ensure that utilities could meet 2015 goals under the EmPOWER Maryland Energy Efficiency Act of 2008.⁴³³ The PSC approved the programs as part of a combined filing for approval of the utilities’ Energy Efficiency, Conservation and Demand Response Programs.⁴³⁴

While the individual utility programs differed slightly in design and implementation, Baltimore Gas and Electric’s (BGE’s) program is typical. The program provides incentives to industrial and commercial customers that install efficient (>65 percent higher-heating value) CHP systems. Incentives are partly performance-based and are provided for the design, installation, and construction phases to offset costs developers face throughout the process. Although CHP had long been eligible under BGE’s custom energy efficiency program, the utility never had any takers. The new program provides clear participation requirements and defined timelines and payment levels.

The initial pilot program was oversubscribed. BGE received 16 applications, and by March 2014 had approved nine CHP proposals representing potential annual energy savings of 68,500 MWh.⁴³⁵ For context, total savings in 2013 from all of BGE’s energy efficiency and conservation programs was 467,453 MWh.⁴³⁶ Thus, the addition of CHP will provide substantial new energy savings.

In September 2013, BGE received approval from the Maryland PSC to expand and continue the program due in large part to the positive reception that BGE received from its commercial and industrial customers. In 2015, the Maryland Energy Administration initiated a separate grant program to accelerate CHP investment in healthcare and publicly owned wastewater treatment facilities in the state.

Illinois – In June 2014, the Department of Commerce and Economic Opportunity established a pilot program offering incentives for CHP projects in the public sector. Part of the Illinois Energy Now Program, the incentives are available to local governments, municipal corporations, public school districts, community college districts, public universities, and state and federal facilities located in the service territories of Commonwealth Edison, Ameren Illinois, Nicor Gas, Peoples Gas, and North Shore Gas.

The incentives are performance-based and structured to provide financial assistance during various stages of a CHP project—after the design phase, after commissioning, and after 12 months of measured operational performance. The department capped the incentives per CHP system at \$2 million or 50 percent of project cost, whichever is less. To qualify, the CHP system must have a minimum measured annual energy efficiency of 60 percent (higher heating value), with at least 20 percent of the system’s waste-heat output in the form of useful thermal energy used in the host facility. The department received 17 applications in November 2014 for the initial program offering and selected seven projects for funding.

⁴³² For case studies of CHP projects, see http://www1.eere.energy.gov/manufacturing/distributedenergy/chp_database/Default.aspx.

⁴³³ At the end of 2011, Maryland’s utilities were achieving only 41 percent of their energy goals and 55 percent of their demand reduction goals for 2015 under the EmPOWER Act.

⁴³⁴ In Order No. 84955 for BGE, First Energy, Potomac Electric Power Company (PEPCO), Delmarva Power and Southern Maryland Electric Cooperative.

⁴³⁵ The first CHP project under the program was commissioned in August 2014—a 2 MW installation at Upper Chesapeake Medical Center that is projected to save 13,000 MWh of grid power annually.

⁴³⁶ The EmPOWER Maryland Energy Efficiency Act: Standard Report of 2014 (Data for Compliance Year 2013), Maryland Public Utility Commission, March 2014.

4.6.3.3 Expected Range of Energy Savings and Emissions Reductions⁴³⁷

New CHP applications can be expected to operate at 65 percent to 75 percent efficiency, a large improvement over the national average of 45 percent for heat and power services when separately provided. The increase in fuel use efficiency, combined with the use of lower carbon fuels such as natural gas, generally translates into reductions in GHG and criteria pollutant emissions compared to separate production of heat and power.

DOE estimates that existing CHP facilities in the U.S. save 1.8 Quads of energy annually and eliminate 240 million metric tons of CO₂ emissions each year, equivalent to the emissions of more than 40 million cars.⁴³⁸

4.6.4. Energy Savings Performance Contracting

As described earlier, energy savings performance contracting (ESPC) offers guaranteed energy savings, dollar savings, or both for energy efficiency projects. While institutional and public buildings account for a majority of ESPC projects, the private sector also takes advantage of this mechanism to reduce energy, water, and operation and maintenance costs. Energy services companies (ESCOs) provide a full suite of performance contracting services, from design to M&V, so private sector customers can continue to focus on their core business.

ESCOs report relatively low market penetration rates (under 10 percent) in private commercial and industrial facilities. However, because the total market size for these buildings is vast, the amount of ESCO-retrofitted floor area in this sector has been significant. Private commercial buildings accounted for about 13 percent of the floor area that ESCOs retrofitted between 2003 and 2012.⁴³⁹

Further, LBNL estimates that private commercial buildings account for 33.6 percent of the total floor area in the U.S. most readily addressed by ESCOs—owner-occupied facilities larger than 50,000 square feet.⁴⁴⁰ Thus, the remaining annual electricity savings potential for the U.S. ESCO industry for private commercial buildings is large, ranging from 25 TWh to 36 TWh annually.⁴⁴¹ That's roughly equivalent to the estimated annual savings from all active ESCO projects in the U.S. today, across all sectors.⁴⁴²

Similarly, the remaining market potential of the private commercial building sector is great, estimated at \$14 billion to \$34 billion.⁴⁴³ Thus, in addition to significant potential electricity and emissions reductions, ESCO retrofits of private commercial buildings represent a large potential source of in-state jobs.

A primary barrier to tapping these potential savings is the short payback requirements of business customers. Private sector companies in the U.S. generally are averse to financing energy efficiency measures, as well as allocating capital expenditures for energy projects with payback times longer than a year or two. ESPC, together with energy efficiency programs, can help overcome these barriers. For example, ESPC projects can take advantage of available utility and state incentive programs. Emerging financing options such as on-bill loan repayment and Property Assessed Clean Energy Bond (PACE) programs also may help ESCOs expand their reach into the private sector commercial market.⁴⁴⁴

Among the companies that have used ESCOs to reduce energy costs⁴⁴⁵ is the Electronics & Integrated Solutions operating group of BAE Systems, headquartered in New Hampshire. The firm produces aircraft self-protection

⁴³⁷ USDOE and USEPA 2014.

⁴³⁸ One Quad equals 10¹⁵ Btu and is equivalent to 1 percent of total annual energy consumption in the U.S. USDOE and USEPA 2012.

⁴³⁹ Stuart *et al.* 2013.

⁴⁴⁰ While not owner-occupied, large public housing projects are included in the total "ESCO addressable" floor area.


⁴⁴¹ Personal communication with Elizabeth Stuart, April 13, 2015.

⁴⁴² Carvallo *et al.* 2014.

⁴⁴³ Personal communication with Stuart, May 2015.

⁴⁴⁴ Stuart *et al.* 2013.

⁴⁴⁵ See <https://www4.eere.energy.gov/challenge/implementation-model/general-motors-for-another-example>.



systems and tactical surveillance and intelligence systems for military and commercial applications. The ESCO worked with BAE Systems to set up web-based access to all utility data—usage and cost data by location for all facilities within the division—providing timely and accurate information for site personnel and senior management. The ESCO also worked with facility personnel to assess and identify opportunities for energy efficiency projects to reduce BAE Systems’ energy costs and manage electricity and natural gas supply contracts.^{446,447}

⁴⁴⁶ <http://www.naesco.org/data/casestudies/BAE%20final.pdf>.

⁴⁴⁷ <http://betterbuildingssolutioncenter.energy.gov/implementation-models/efficiency-services-agreement-esa-bae-facilities-nationwide>.



5. Energy Efficiency for Low-Income Communities

A wide variety of programs and efforts across the country support energy efficiency in low-income communities. Each of these types of efforts can be run and funded by government entities, utilities, nonprofits and others. These programs take a variety of forms and include financing assistance and financial incentives, direct retrofits, technical assistance, and more.

Low-income households can benefit significantly from energy efficiency services. These households typically spend about 17 percent of their total annual income on residential energy costs, much more than the average of 4 percent across all households. Residential energy use accounts for much of the energy use in low-income communities. (Other energy use in these communities includes private, public, institutional and industrial energy consumption.) Nationally, residential energy use represents 22 percent of total U.S. energy consumption⁴⁴⁸ and \$230 billion spent each year.⁴⁴⁹ Low-income households use about 12 percent to 21 percent of this energy.⁴⁵⁰ Low-income families often have to cut back on other necessities such as groceries or medicine in order to pay their energy bills, which average \$1,871 a year per low-income household.⁴⁵¹

The federal government's poverty thresholds updated annually by the U.S. Census Bureau, along with Health and Human Services guidelines, are often used as part of establishing eligibility for low-income programs. Federal and other programs often use these guidelines or percentage multiples of the guidelines (e.g., 200 percent of the threshold established in the guidelines).⁴⁵² Definitions and eligibility guidelines for low-income programs may differ from one program to another.

5.1. State, Local, Utility, and Non-Governmental Organization (NGO) Efforts

Table 5.1-1 provides examples of the types of efforts and partnerships assisting low-income communities today. It is not intended to be comprehensive.

⁴⁴⁸ Based on EIA's Monthly Energy Review, June 2015, Table 2.1, Residential Total for 2014 (21,618) divided by Primary Total for 2014 (93,460). http://www.eia.gov/totalenergy/data/monthly/pdf/sec2_3.pdf.

⁴⁴⁹ U.S. total energy consumption based on 2009 EIA Residential Energy Consumption Survey Total Energy Expenditures for Total U.S. (cell C9). http://www.eia.gov/consumption/residential/data/2009/c&e/end-use/xls/CE3.6%20End-Use%20Expenditures_US.xlsx.

⁴⁵⁰ Low-income households' percentage of energy use based on 2009 EIA Residential Energy Consumption Survey (RECS) Site End-Use Consumption, Income Relative to Poverty Line, range between Below 100 Percent (cell C93) and 100 to 150 Percent (cell C94) divided by U.S. Total Site Energy Consumption (cell C9). <http://www.eia.gov/consumption/residential/data/2009/c&e/end-use/xls/CE3.1Site%20End-Use%20Consumption%20in%20US.xlsx>.

⁴⁵¹ EERE WIP Factsheet on WAP, May 2009. http://www1.eere.energy.gov/wip/pdfs/wap_factsheet.pdf.

⁴⁵² HHS 2015 Poverty Guidelines, January 2015. <http://aspe.hhs.gov/poverty/15poverty.cfm>.

Table 5.1-1. Energy Efficiency Programs in Low-Income Communities

Program Type	Administrator	Key Features
Ratepayer-funded, income-eligible, single-family retrofit programs	New York State Energy Research Development Authority	<p>EmPower New York provides free energy efficiency upgrades to income-eligible single-family households in New York. Started in 2006, the program is funded by a charge on utility ratepayers with supplemental funding through the Regional Greenhouse Gas Initiative (RGGI).⁴⁵³ In 2015, EmPower New York provided electric reduction services to 4,134 households and home performance and electric reduction services to 11,346 households, with an estimated annual savings of 6,160,636 kWh.⁴⁵⁴</p> <p>Assisted Home Performance with ENERGY STAR (Assisted HPWes) covers 50% of eligible energy efficiency improvements for income-eligible single-family households, up to \$5,000 per project.⁴⁵⁵ In 2015, NYSERDA's Assisted Home Performance with ENERGY STAR Program completed 4,050 projects with an estimated first year savings of 1,367,687 kWh.⁴⁵⁶</p>
Ratepayer-funded affordable housing energy efficiency program for multifamily buildings	Maryland Department of Housing and Community Development	Multifamily Energy Efficiency and Housing Affordability (MEEHA) is a utility-funded affordable housing energy efficiency program, providing funds to non-profit, for-profit, and government entities for multi-family affordable housing retrofits. ⁴⁵⁷ In 2014, the \$2 million program served almost 2,000 participants and saved over 3,000 MWh through measures that have lifetime energy cost savings of over \$3 million. ⁴⁵⁸
Low-income, single-family energy efficiency improvements	Maryland Energy Administration	EmPOWER Maryland Low Income Energy Efficiency Program (LIEEP) offers free energy efficiency improvements to low income single family households. ⁴⁵⁹ In 2014, the \$22 million program served almost 60,000 participants with over 12,000 MWh in reduced electricity use and over \$26 million in lifetime energy cost savings. ⁴⁶⁰

⁴⁵³ <http://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2012ContractorReports/2012-EmPower-New-York-Impact-Report.pdf>.

⁴⁵⁴ Email exchange with Kelvin Keraga, Senior Project Manager at NYSERDA. February 5, 2016.

⁴⁵⁵ <http://drivingdemand.lbl.gov/reports/lbni-3960e-nyserda.pdf>.

⁴⁵⁶ Email exchange with Laura Geel, Project Manager of Residential Energy Services at NYSERDA. February 5, 2016.

⁴⁵⁷ http://webapp.psc.state.md.us/newIntranet/Casenum/NewIndex3_VOpenFile.cfm?filepath=C:%5CCasenum%5C9100-9199%5C9156%5Citem_667%5C%5CDHCDLIEEPMEEHAEmpowerSemiAnnualReportTemplate.Q1Q22015.pdf.

⁴⁵⁸ DHCD Semi-Annual Report for 2014 filed to the Maryland Public Service Commission.

⁴⁵⁹ <http://webapp.psc.state.md.us/newIntranet/Maillog/content.cfm?filepath=C:%5CCasenum%5CAdmin%20Filings%5C110000-159999%5C159226%5C9153-57-IttronLowIncomeEnergyEfficiencyProgramReport-100214.pdf>.

⁴⁶⁰ DHCD Semi-Annual Report for 2014 filed to the Maryland Public Service Commission.



On-bill financing model program for energy efficiency improvements in rural households	Central Electric Power Cooperative and The Electric Cooperatives of South Carolina	Help My House was a two-year pilot program that established a model for on-bill financing program for rural electric cooperatives (co-ops) in South Carolina. The programs provide 10-year low-cost loans for rural households' energy efficiency improvements in regions where the family income levels are 15% below the national average, which are repaid through the participating co-op member's electric bills. The pilot started in 2011 with eight co-ops retrofitting 125 participating homes, which saw 1.35 million kWh in savings, with the average home cutting electricity use by 34% and seeing a simple payback of six and a half years from measures expected to last at least 15 years. ⁴⁶¹ Five South Carolina co-ops are currently running ongoing programs using this model, and surpassed 500 homes retrofitted as of November 2015, which are seeing an average electricity reduction of 26%. ⁴⁶²
Comprehensive State-wide Low Income Services	Efficiency Vermont	Efficiency Vermont's low-income energy efficiency programs leverages partnerships with non-profit service providers as well as implements a range of other energy efficiency initiatives since it was started in 2001. Services include installation of electrical efficiency measures in single-family homes occupied by households at or below 80% of the State Median Income, free energy efficiency products and rebates for property owners of existing affordable housing rental properties, and funding and technical assistance for deep energy retrofits of affordable multifamily housing. ⁴⁶³ In 2015, Efficiency Vermont low-income programs had a budget of about \$2 million and served over 1,600 low-income households for an estimated annual savings of 2,500 MWh.
Whole-home retrofit program in low-income communities	Tennessee Valley Authority (TVA)	Smart Communities' Extreme Energy Makeovers (EEM) is a two year pilot launched in seven communities in the Tennessee Valley, providing whole-home retrofits in homes 20 years or older in lower-income communities. The goal is to achieve a 25% energy reduction of the home's energy use, which will save an estimated 1,000 MWh annually, with over 3,300 home retrofit projects to be completed by December 2017. ⁴⁶⁴
Financing pilot for efficiency upgrades in affordable housing apartments	Mpower Oregon	Mpower pays the entire up-front cost of efficiency upgrades in affordable housing apartments. Part of the savings created by these improvements goes directly to the utility customer and the remainder of the savings is captured as repayment to Mpower through a tariff on the utility meter serving the building. ⁴⁶⁵ The 2-year pilot program invested about \$10 million and upgraded 28 properties, which consisted of about 2,300 household units, saving about 5,000 MWhs and avoiding almost 3,000 metric tons in carbon emissions. ⁴⁶⁶

⁴⁶¹ http://www.eesi.org/files/HelpMyHouseFinalSummaryReport_June2013.pdf.

⁴⁶² Email exchange with Miguel Yanez, Program Associate for On-Bill Financing at EESI, and Ford Tupper at The Electric Cooperatives of South Carolina. February 4, 2016.

⁴⁶³ <https://www.energycvermont.com/Media/Default/docs/plans-reports-highlights/2014/efficiency-vermont-annual-report-2014.pdf>.

⁴⁶⁴ Email exchange with Elizabeth Moore, Senior Program Manager at TVA EnergyRight Solutions. January 14, 2016.

⁴⁶⁵ <http://mpoweroregon.com/about-us/>.

⁴⁶⁶ Email exchange with Faith Graham, Managing Director of Mpower Oregon. January 22, 2016.



Full-service energy efficiency program for affordable multifamily buildings

Elevate Energy (Chicago)

Full-service energy efficient buildings program helps building owners and managers make energy-savings improvements, focusing on affordable multifamily buildings and facilities operated by nonprofit organizations. Since the program started in 2008 through the end of 2015, it has upgraded almost 600 multifamily buildings with almost 25,000 household units. These upgrades have resulted in about 16,000 MWh saved and 46,000 metric tons of CO₂e emissions avoided.⁴⁶⁷

⁴⁶⁷ Email exchange with Emily Robinson, Director of Communications and Outreach, Elevate Energy. January 20, 2016.



5.2. Federal Government Efforts

5.2.1. U.S. Department of Energy

Weatherization Assistance Program (WAP). WAP provides grants to states, territories, and some Indian tribes to improve the energy efficiency of the homes of low-income families. These governments, in turn, contract with local governments and nonprofit agencies to provide weatherization services to those in need using the latest technologies for home energy upgrades. Weatherization service providers must follow a rigorous, sophisticated whole-home analysis for each home and consider a comprehensive series of energy efficiency measures, as well as an all-around health and safety check. Approximately 7 million homes have been weatherized under WAP since its inception, resulting in over 750 kWh weighted average electricity savings.⁴⁶⁸

Better Buildings Multifamily Program. Through the Better Buildings Challenge, the Departments of Energy and Housing and Urban Development are partnering with both market rate and affordable housing owners as well as public housing agencies to cut energy waste and help families save on their utility bills. Through the Challenge expansion announced in December 2013, 50 multifamily partners – representing roughly 200,000 units and over 190 million square feet – have committed to cutting their energy use by 20 percent in ten years.

5.2.2. U.S. Department of the Treasury

QECBs (Qualified Energy Conservation Bonds). The 2009 Recovery Act authorized \$3.2 billion for states, territories, large local governments, and tribal governments to issue QECBs to finance energy efficiency and renewable energy projects. A Federal subsidy of up to 70 percent of the interest reduces the issuers' borrowing costs on these taxable bonds. The issuer can choose to receive this borrowing subsidy either through a direct cash subsidy from the U.S. Government paid to the issuer or through Federal income tax credits provided to investors in the bonds. Projects have been financed with QECBs in at least 34 states, and a handful of states have or are on track to exhaust their allocation (Kansas, Kentucky, California, Colorado, Montana, Nebraska, South Dakota). Up to 17% of states have yet to use any portion of their allocation. Approximately one-third of the Recovery Act-authorized \$3.2 billion are known to have been issued.


5.2.3. U.S. Department of Housing and Urban Development

Multifamily Property Assessed Clean Energy (PACE) Pilot in California. Earlier this year, California Governor Jerry Brown, the MacArthur Foundation, and Housing and Urban Development Department (HUD) Secretary Castro announced the launch of a PACE Financing pilot program for multifamily housing in California. The pilot program allows multifamily building owners and developers to gain access to capital to accelerate renewable energy and efficiency retrofits for energy and water. This will make existing multifamily housing more affordable to renters with low incomes and save money for consumers and taxpayers.

EPowerSaver. The Federal Housing Authority (FHA) is planning updates to its second-mortgage program that will make it easier for homeowners to borrow up to \$25,000 for energy-efficient improvements by cutting red tape and making improvements more affordable. EPowerSaver can help low-moderate income households finance cost effective energy efficiency improvements that reduce their monthly energy expenditures, and address key health and safety issues (e.g., high levels of carbon monoxide from malfunctioning equipment and appliances). Key features of the second mortgage program will include: 1) providing flexible underwriting to recognize the reduced cost of utilities for energy efficient homes; 2) allowing homeowners to control the disbursement of loan funds to the contractor; and 3) permitting contributions to lower out-of-pocket expenses and/or reduce borrower interest rates.

Clarified Policy to Pave the Way for Increased FHA Energy Efficient Financing on Federally Assisted and Insured Housing. FHA announced a new policy in August 2015 that will help households borrow slightly more when they buy or refinance a more energy-efficient home through FHA's energy efficient home program, and lower their monthly energy costs. FHA will provide flexible underwriting to recognize the reduced costs of utilities when those

⁴⁶⁸ http://weatherization.ornl.gov/RecoveryActpdfs/ORNL_TM-2015_139.pdf.



costs are established with the Department of Energy's Home Energy Score in areas where the Home Energy Score is available. FHA also recently released guidance regarding the intent to clarify its policy on Single Family FHA financing for properties with existing PACE loans that meet certain conditions in order to expand access to clean energy financing options for creditworthy borrowers.⁴⁶⁹ FHA is preparing additional guidance for lenders with details on specific program requirements, which will be released through a Single Family FHA Mortgagee Letter and an update to the Single Family Housing Handbook 4000.1.

⁴⁶⁹ <http://portal.hud.gov/hudportal/documents/huddoc?id=FTDO.pdf>.



References

Chapter 1. Executive Summary

Regulatory Assistance Project, August 2015. Personal communication with Chris James, State climate action plans at http://www.climatestrategies.us/policy_tracker/state/index.

Chapter 2. Energy Efficiency: An Energy Resource and Emissions Reduction Strategy

2.1. Energy Efficiency Is an Established Energy Resource

ACEEE (2015). “The 2015 State Energy Efficiency Scorecard.” <http://aceee.org/state-policy/scorecard>.

Barbose, G., C. Goldman, I.M. Hoffman and M. Billingsley (2013). The Future of Utility Customer-Funded Energy Efficiency Programs in the United States: Projected Spending and Savings to 2025. Lawrence Berkeley National Laboratory. January. LBNL-5803E. <http://emp.lbl.gov/sites/all/files/lbnl-5803e.pdf>.

Building Energy Codes Program (BECP). “Status of Energy Code Adoption: National Status At-A-Glance.” <https://www.energycodes.gov/status-state-energy-code-adoption>.

Carvallo, J.P., P. Larsen and C. Goldman (2015). “Estimating customer electricity and fuel savings from projects installed by the US ESCO industry.” *Energy Efficiency*, Volume 8, Issue 6, pp. 1251-1261. December. <http://link.springer.com/article/10.1007/s12053-015-9405-8>.

Consortium for Energy Efficiency 2015. “2014 State of the Efficiency Program Industry: Budgets, Expenditures and Impacts” May. http://library.cee1.org/sites/default/files/library/12193/CEE_2014_Annual_Industry_Report.pdf

Larsen, P., C. Goldman and A. Satchwell (2012). “Evolution of the U.S. Energy Service Company Industry: Market Size and Project Performance from 1990-2008.” Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division. Report #LBNL-5447-E. July. <http://eetd.lbl.gov/node/50182>.

Livingston, O.V., P.C. Cole, D.B. Elliott and R. Bartlett (2014). “Building Energy Codes Program: National Benefits Assessment, 1992-2040.” Prepared by Pacific Northwest National Laboratory for the Department of Energy. PNNL-22610 Rev 1. March. https://www.energycodes.gov/sites/default/files/documents/BenefitsReport_Final_March20142.pdf.

Livingston et al. (2013). Building Energy Codes Program: National Benefits Assessment, 1992-2040. PNNL-22610. October. [http://www.greenbuildinglawblog.com/uploads/file/DOE%20Building%20Energy%20Code%20Savings%20Report%20Oct%202013\(1\).pdf](http://www.greenbuildinglawblog.com/uploads/file/DOE%20Building%20Energy%20Code%20Savings%20Report%20Oct%202013(1).pdf).

Patterson, A. and C. Hessler (2014). “Energy Efficiency Case Study: Performance Contracting.” 3N Implementation Meeting: Energy Efficiency Compliance Options for 111(d). December. <http://111d.naseo.org/Data/Sites/5/media/events/2014-12-04/espc-patterson-hessler.pdf>.


Stuart, L., P. Larsen, C. Goldman and D. Gilligan (2013). “Current Size and Remaining Market Potential of the U.S. Energy Service Company Industry.” Lawrence Berkeley National Laboratory. Report #LBNL-6300E. August. <http://eetd.lbl.gov/publications/current-size-and-remaining-market-p-0>.

USDOE and USEPA 2012. *Combined Heat and Power: A Clean Energy Solution*. August. http://www.energy.gov/sites/prod/files/2013/11/f4/chp_clean_energy_solution.pdf.

U.S. Energy Information Administration (EIA), *January 2014 Monthly Energy Review*, Table 7.6 Electricity End Use. January 30, 2014 (Drawn from historic EIA-826 survey data) <http://www.eia.gov/electricity/data.cfm#sales>.

2.2. Energy Efficiency Saves Money and Is Cost Effective

Chris Neme and Rich Sedano (2012). US Experience with Efficiency as a Transmission and Distribution System Resource. Regulatory Assistance Project. February. <http://www.raponline.org/document/download/id/4765>.



Hoffman, I., G. Rybka, G. Leventis, C. Goldman, L. Schwartz, M. Billingsley and S. Schiller (2015). “The Total Cost of Saving Electricity Through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector and Program Level.” Lawrence Berkeley National Laboratory Technical Brief. April. <http://emp.lbl.gov/cost-saved-energy>.

Lazard (2014). “Lazard’s Levelized Cost of Energy Analysis—Version 8.0.” September. <http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf>.

National Action Plan for Energy Efficiency (2008). *Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers*. Energy and Environmental Economics, Inc. and Regulatory Assistance Project. www.epa.gov/eeactionplan.

2.3. Energy Efficiency Reduces Multiple Pollutants

Aburn, T. (2013). “Building Energy Efficiency and Renewable Energy into the Clean Air Act Planning Process.” Presentation at the ACEEE Market Transformation Conference, Washington, D.C., March 24-26, 2013.

Laitner, J.

---(2009). *Semiconductor Technology: The Potential to Revolutionize U.S. Energy Productivity*. American Council for an Energy Efficient Economy (ACEEE).

---(2013). An overview of the energy efficiency potential. *Environmental Innovation and Societal Transitions*, 9, 38–42. doi:10.1016/j.eist.2013.09.005.

National Research Council.

---(2010). *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use*. Washington, DC: The National Academies Press.

---(2004). National Research Council, Committee on Air Quality Management in the United States. “Air Quality Management in the United States.”

Regulatory Assistance Project (RAP). (2013).

---*Recognizing the Full Value of Energy Efficiency (What’s Under the Feel-Good Frosting of the World’s Most Valuable Layer Cake of Benefits*. Adapted from EEA, *Air Quality in Europe - 2012 Report*, 2012, page 9.

www.raonline.org/document/download/id/6739 (RAP 2013a).

---*Integrated, Multi-pollutant Planning for Energy and Air Quality (IMPEAQ)*, March 2013,

www.raonline.org/document/download/id/6440. (RAP 2013b).

Rosenfeld, A. (2008). “The First and Most Profitable Way to Delay Climate Change.” Presentation at Pacific Energy Center, San Francisco, CA, May 19, 2008.

Smart Energy Universe. (2014). “California PUC Outlines Energy Efficiency Success: Avoid New Power Plants.” Vol. 3, No. 9.

U.S. Energy Information Administration (EIA). (2015). *Frequently Asked Questions*,

<http://www.eia.gov/tools/faqs/faq.cfm?id=105&t=3>.

Xcel Energy. (2013). *Partnering for a Better Energy Future*.

2.4. Documenting Energy Savings and Emissions Reductions

James, C. and Colburn, K. Regulatory Assistance Project (RAP). (2015). *It’s Not a SIP: Opportunities and Implications for State 111(d) Compliance Planning*. <http://www.raonline.org/document/download/id/7491>.

Kushler, M., S. Nowak and P. Witte (2012). A National Survey of State Policies and Practices for the Evaluation of Ratepayer-Funded Energy Efficiency Programs, American Council for an Energy-Efficient Economy (ACEEE), Report Number U122. February. <http://www.aceee.org/research-report/u122>.

State and Local Energy Efficiency Action Network (SEE Action).

---(2012). “Energy Efficiency Program Impact Evaluation Guide.” Prepared by Steven R. Schiller, Schiller



Consulting, Inc.

https://www4.eere.energy.gov/seeaction/sites/default/files/pdfs/emv_ee_program_impact_guide_1.pdf.

---(2011). "Scoping Study to Evaluate Feasibility of National Databases for EM&V Documents and Measure Savings." Prepared by Jayaweera, T., H. Haeri, A. Lee, S. Bergen, C. Kan, A. Velonis, C. Gurin, M. Visser, A. Grant and A. Buckman. The Cadmus Group Inc.

www.eere.energy.gov/seeaction/pdfs/emvscoping_databasefeasibility.pdf.

---SEE Action Network EM&V Resource Portal: <https://www4.eere.energy.gov/seeaction/evaluation-measurement-and-verification-resource-portal>.

Wallace, P. and H.J. Forster (2012). State of the Efficiency Program Industry Budgets, Expenditures, and Impacts - 2011. Consortium for Energy Efficiency. www.cee1.org/files/2011_CEE_Annual_Industry_Report.pdf.

Young, R. and Hayes, S. (2015). "The State and Utility Pollution Reduction (SUPR) Calculator." American Council for an Energy Efficient Economy (ACEEE). Research Report E1501. <http://aceee.org/research-report/e1501>.

U.S. Environmental Protection Agency (EPA).

---(2012). *The Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs Into State and Tribal Implementation Plans*. <http://epa.gov/airquality/eere/manual.html>.

---(2015). "Avoided Emissions and generation Tool (AVERT)." <http://epa.gov/statelocalclimate/resources/avert/index.html>.

Chapter 3. Developing a State Energy Efficiency Portfolio: Practical Considerations

3.2. Building Sustainable Energy Efficiency Delivery Infrastructure

Anderson, D.M., O.V. Livingston, D.B. Belzer and M.J. Scott (2014). Assessing National Employment Impacts of Investment in Residential and Commercial Sector Energy Efficiency: Review and Example Analysis. June. Pacific Northwest National Laboratory. PNNL-23402. June.

http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-23402.pdf.

Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE).

--- "Guidelines for Home Energy Professionals." (EERE 2015a). <http://energy.gov/eere/wipo/guidelines-home-energy-professionals>.

--- "Better Buildings Workforce." (EERE 2015b). <https://www4.eere.energy.gov/workforce/node/7>.

--- "Become an Energy Management Professional." (EERE 2015c). <http://www.energy.gov/eere/amo/become-energy-management-professional>.

Goldman, C., E. Stuart and M. Fuller, Lawrence Berkeley National Laboratory; J. Peters and N. Albers, Research Into Action, Inc. (2010a). Energy Efficiency Services Sector: Workforce Education and Training Needs. March. LBNL-3163E. <http://emp.lbl.gov/publications/energy-efficiency-services-sector-workforce-education-and-training-needs>.

Goldman, C., M. Fuller and E. Stuart, Lawrence Berkeley National Laboratory; J. Peters, M. McRae, N. Albers, S. Lutzenhiser and M. Spahic, Research Into Action, Inc. (2010b). Energy Efficiency Services Sector: Workforce Size, and Expectations for Growth. September. LBNL-3987E. <http://emp.lbl.gov/publications/energy-efficiency-services-sector-workforce-size-and-expectations-growth>.

Chapter 4. Options to Cost-Effectively Achieve Energy Efficiency Goals: The Pathways Concept

4.1. Introduction – The Pathways Concept

Hoffman, I.M., S.R. Schiller, A. Todd, C.A. Goldman, L.C. Schwartz 2015. "Energy Savings Lifetimes and Persistence: Practices, Issues and Data" LBNL. May.



4.2. Ratepayer-Funded Efficiency Programs

ACEEE (Nov. 8, 2013). "State Energy Efficiency Policy Database: Arkansas Utility Policies." [LINK](#)

ACEEE (2013). "State Spending and Savings Tables: 2013 Spending Tables." [LINK](#)

ACEEE Policy Brief (2014). *State Energy Efficiency Resource Standards*. April. <http://www.aceee.org/files/pdf/policy-brief/eers-04-2014.pdf>.

ACEEE (2015). "The 2015 State Energy Efficiency Scorecard." <http://aceee.org/state-policy/scorecard>.

Arkansas Public Service Commission

- (Last revised May 20, 2014). "Rules for Conservation and Energy Efficiency Programs." Public Service Commission Utilities Division State Agency #126.03.
- (May 2014). "Rules for Conservation and Energy Efficiency Programs." Docket No. 06-004-R, Order No. 29.
- (Sept. 9, 2013). Docket No. 13-002-U, Order No. 7.
- (Dec. 10, 2010). Docket No. 08-144-U, Order No. 17.

California Public Utilities Commission (2001). "California Standard Practice Manual." October.

Eckman, T. and C. Grist (2014). "A Council Carol: A Visit From the Ghosts of Power Plans Past, Present and Future." Northwest Power and Conservation Council.

Energy Information Agency (EIA). "Electric power sales, revenue, and energy efficiency For EIA-861 detailed data files." <http://www.eia.gov/electricity/data/eia861/index.html>.

Entergy Arkansas, Inc. (April 1, 2009). "Entergy Arkansas, Inc. Energy Efficiency Quick Start Programs, 2008 Program Year, Annual Report." Arkansas Public Service Commission. Docket No. 08-038-RP.

Georgia Power Company (2013). "Certified Demand-Side Management Programs Fourth Quarter 2012 Status Report." Georgia Public Service Commission, Docket 31082, Document Filing #146408. [LINK](#).

Hoffman, I., G. Rybka, G. Leventis, C. Goldman, L. Schwartz, M. Billingsley and S. Schiller (2015). *The Total Cost of Saving Electricity Through Utility Customer-Funded Energy Efficiency Programs: National, State, Sector- and Program-Level Estimates*. Lawrence Berkeley National Laboratory. April. <http://emp.lbl.gov/cost-saved-energy>.


Hoffman, I., Billingsley, M., Schiller, S., Goldman, C. and Stuart, E. (2013). *Energy Efficiency Program Typology and Data Metrics: Enabling Multi-State Analyses Through the Use of Common Terminology*. Lawrence Berkeley National Laboratory.

Institute for Electric Efficiency (IEE). (May 2011). "Assessment of Electricity Savings in the U.S. Achievable through New Appliance/Equipment Efficiency Standards and Building Efficiency Codes (2010 – 2025)." Prepared by Ingrid Rohmund, Anthony Duer, Sharon Yoshida and Jan Borstein (Global Energy Partners LLC); and Lisa Wood and Adam Cooper (Institute for Electric Efficiency).

Louisiana Public Service Commission (Sept. 20, 2013). "Louisiana Public Service Commission General Order, Docket No. R-31106."

National Action Plan for Energy Efficiency, U.S. Environmental Protection Agency and U.S. Department of Energy
--- (Dec. 9, 2009.) "Rapid Deployment Energy Efficiency (RDEE) Toolkit: Planning & Implementation Guides." Prepared by Peter Lemoine, Tyler Huebner, David Pickles, Bill Prindle and Nora Buehler of ICF International.
--- (2008). *Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers*. Energy and Environmental Economics, Inc. and Regulatory Assistance Project. <http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf>.

State and Local Energy Efficiency Action Network. (2015). *Sustained Energy Savings Achieved through Successful Industrial Customer Interaction with Ratepayer Programs: Case Studies*. Department of Energy.



State and Local Energy Efficiency Action Network. (2014). *Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector*. Department of Energy.

State and Local Energy Efficiency Action Network (2012). *Energy Efficiency Program Impact Evaluation Guide*. Prepared by Steven R. Schiller, Schiller Consulting, Inc., www.seeaction.energy.gov.

Wilson, R. and B. Biewald, Synapse Energy Economics, Inc. (2013). *Best Practices in Electric Utility Integrated Resource Planning: Examples of State Regulations and Recent Utility Plans*. Regulatory Assistance Project. June. www.raponline.org/document/download/id/6608.

4.2.3. Deep Savings Programs

Cluett, R. and J. Amann. (March 2014). “Residential Deep Energy Retrofits.” American Council for an Energy Efficient Economy (ACEEE). Report Number A1401. <http://aceee.org/research-report/a1401>.

Department of Energy (DOE).

--- “Home Performance with ENERGY STAR Annual Report—Public Service Company of Oklahoma.” (DOE 2015a).

--- “Home Performance with ENERGY STAR® Annual Report—Entergy Texas.” (DOE 2015b).

Energy Information Administration (EIA). (February 19, 2015). “Electric power sales, revenue, and energy efficiency Form EIA-861 detailed data files.” <http://www.eia.gov/electricity/data/eia861/index.html>.

Less, B., J. Fisher and L. Walker. (October 2012). “Deep Energy Retrofits—Eleven California Case Studies.” Lawrence Berkeley National Laboratory. Report Number LBNL-6166E. <http://eetd.lbl.gov/publications/deep-energy-retrofits-eleven-california-case-studies>.

New Jersey’s Clean Energy Program.

--- “Rebates and Promotions.” (NJ Clean Energy Program 2015a).

<http://www.njcleanenergy.com/main/rebates-and-promotions/rebates-and-promotions>.

--- “Hurricane Sandy Information” (NJ Clean Energy Program 2015b). <http://www.njcleanenergy.com/SANDY>.

State and Local Energy Efficiency Action Network (SEE Action). (2014). *Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector*. Prepared by A. Goldberg, R.P. Taylor, and B. Hedman, Institute for Industrial Productivity.

State of New Jersey, Board of Public Power (BPU). Residential Customer Programs.

<http://www.state.nj.us/bpu/residential/program/>.

Schwimmer, A. and A. Fournier. (2014). *Energy Efficiency Quick Start Programs: A Guide to Best Practices*.

Southeastern Energy Efficiency Alliance (SEEA). <http://www.seealliance.org/wp-content/uploads/Quick-Start-Best-Practices-041414-FINAL.pdf>.

U.S. Department of Energy (DOE). (October 1, 2014). “DOE Subject Matter Expert presentation.”

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE). (June 20, 2013). “Deep Energy Retrofits & State Applications.” Department of Energy’s State and Local Technical Assistance Program. ([LINK](#)).


4.2.4. Public Power Programs

Austin Energy. “Energy Use & Sales: Sales – kWh by Customer Class.” ([LINK](#)).

Burlington Electric Department (BED) (n.d.). “2013 Energy Efficiency Annual Report.”

<http://www.burlingtonelectric.com/energy-efficiency/our-commitment/annual-energy-efficiency-report>.

Energy Information Administration (EIA). (February 19, 2015). “Electric power sales, revenue, and energy efficiency Form EIA-861 detailed data files.” <http://www.eia.gov/electricity/data/eia861/index.html>.



Hoosier Energy.

--- "Corporate Information." Accessed April 10, 2015. (Hoosier Energy 2015a).

<http://www.hepn.com/corporate.asp>.

--- "Refrigerator recycling pilot program." (Hoosier Energy 2015b). <http://hoosierenergy.com/refrigerator.asp>.

--- "Hoosier Energy – Demand Side Management, 2014 Annual Report." (n.d.).

<http://hepn.com/assets/files/HoosierEnergyDSM2014Report.pdf>.

Regulatory Assistance Project (RAP). (March 2011). "Electricity Regulation in the US: A Guide."

www.raponline.org/document/download/id/645.

Tennessee Valley Authority (TVA). "About TVA." <http://www.tva.com/abouttva/index.htm>.

U.S. Census Bureau. "Manufactured Housing Units Annual Shipments to States: 2011 – 2015 (2015 YTD: Through January)." <http://www.census.gov/construction/mhs/stship.html>.

4.3. Building Energy Codes

American Council for an Energy Efficient Economy (ACEEE).

--- "State and Local Policy Database: Washington—State Scorecard." <http://www.aceee.org/energy-efficiency-sector/state-policy/washington/218/all/193>.

--- "Compliance." Accessed March 11, 2015. <http://database.aceee.org/state/compliance>.

Anuta, Joe. (August 18, 2014). "9 of 10 building plans fail basic test." *Crain's New York Business* (crainsnewyork.com), Real Estate section.

http://www.crainsnewyork.com/article/20140818/REAL_ESTATE/308179994/9-of-10-building-plans-fail-basic-test.

Bowles, Liza, D. Brignati, J. Nebbia and P. Sapone. (February 2012). "Reaching 90% Compliance: Maryland Building Code Compliance Roadmap." Prepared for the Maryland Energy Administration by SRA International and Newport Partners LLC.

Building Energy Codes Assistance Project (BCAP).

--- Online Code Environment & Advocacy Project. <http://energycodesocean.org>.

--- Online Code Environment & Advocacy Project. "State And Federal Policy."

<http://energycodesocean.org/research-topic/state-and-federal-policy>. (2014b).

--- "An Action Plan for Commercial Codes and Standards: Supporting Commercial Code Advancement and Consistency." February 1, 2010. <http://energycodesocean.org/resource/action-plan-commercial-codes-standards>.

Building Energy Codes Program (BCEP).

--- "Status of Energy Code Adoption: National Status At-A-Glance." <https://www.energycodes.gov/status-state-energy-code-adoption>.

--- "Development: Residential Codes and Standards." Accessed December 10, 2015.

<http://www.energycodes.gov/development/residential/codes>


The Cadmus Group, Inc. (Cadmus).

--- "Montana Residential Energy Code Compliance: Final Report." (February 13, 2012). Prepared by Allen Lee, Ryan Cook and Dale Horton, Cadmus, for David Cohan, Northwest Energy Efficiency Alliance. Report #E12-236.

--- "Washington Residential Energy Code Compliance." 2013a. (March 27, 2013). Prepared by Allen Lee, Blake Standen, Shannon Donohue, Mihir Desu and Andrew Wood, Cadmus. Report #E13-251.

--- "Idaho Residential Energy Code Compliance." 2013b. (January 2013). Prepared by Allen Lee, Blake Standen, Shannon Donohue, Mihir Desu and Andrew Wood, Cadmus, for Steve Phoutrides, Northwest Energy Efficiency Alliance. Report #E13-250.

--- "Oregon Residential Energy Code Compliance." (April 9, 2014). Prepared by Allen Lee, Eli Caudill, Shannon Donohue, Mihir Desu and Andrew Wood, Cadmus. Report #E14-276.



Cohan, David.

--- (2012). “A Comprehensive Approach to Energy Code Education and Training.” 2012 American Council for an Energy Efficient Economy, Summer Study on Energy Efficiency in Buildings.

--- (Forthcoming, 2015). “Energy Savings and Building Energy Codes in Brief.”

Department of Energy’s (DOE) Building Energy Codes Program. (June 2011). “Building Energy Codes Resources Guide for Policy Makers.”

Department of Energy (DOE) Building Technologies Program (BTP). (2011). “DOE’s Involvement in Residential Energy Codes.” Z. Todd Taylor, PNNL.

http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/ns/webinar_residential_energycodes_20110222.pdf.

Department of Energy. (2015). *Achieving Energy savings and Emission Reductions from Building Energy Codes: A Primer for State Planning*. Office of energy Efficiency & Renewable Energy.

https://www.energycodes.gov/sites/default/files/documents/Codes_Energy_Savings_State_Primer.pdf.

Energy Efficiency and Renewable Energy Office (EERE), DOE. “EnergyPlus Energy Simulation Software.”

<http://apps1.eere.energy.gov/buildings/energyplus/>.

Energy Information Administration.

--- “2012 Utility Bundled Retail Sales – Residential.” (Data from forms EIA-861- schedules 4A & 4D and EIA-861S).

--- “2012 Utility Bundled Retail Sales – Commercial.” (Data from forms EIA-861- schedules 4A & 4D and EIA-861S).

Illinois Department of Commerce & Economic Opportunity. “Illinois Energy Conservation Code for Commercial and Residential Buildings.” <http://www.illinois.gov/dceo/whyillinois/KeyIndustries/Energy/Pages/IECC.aspx>.

Illinois General Assembly. (Effective August 28, 2009). “Energy Efficient Building Act.” Illinois Compiled Statutes, 20 ILCS 3125/1. <http://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=2614&ChapterID=5>.

Pacific Northwest National Laboratory (PNNL). (March 2014). “Building Energy Codes Program: National Benefits Assessment, 1992-2040.” Prepared by O.V. Livingston, P.C. Cole, D.B. Elliott and R. Bartlett for the Department of Energy. PNNL-22610 Rev 1.

https://www.energycodes.gov/sites/default/files/documents/BenefitsReport_Final_March20142.pdf.

Prindle, Bill. (December 4, 2014). “Building Energy Codes as Compliance Options in the Clean Power Plan.” 3N Meeting. ICF International.

Maryland General Assembly, Department of Legislative Services. (2009). “Senate Bill 625: Fiscal and Policy Note, Revised. Maryland Building Performance Standards – Energy Conservation and Efficiency.” Senator Frosh, et al. 2009 Session.

Midwest Energy Efficiency Alliance (MEEA). “I Want CANDI: Establishing a Utility Code Compliance Program in Illinois.” <http://www.mwalliance.org/node/3578>.

Northwest Energy Efficiency Alliance (NEEA). (January 2, 2014). “Non-Residential Energy Savings From Northwest Energy Code Changes 2011-2015. Final Report.” Prepared by Mike D. Kennedy.

Northeast Energy Efficiency Partnerships (NEEP), Innovation Electricity Efficiency (IEE), and the Institute for Market Transformation (IMT). (2013). *Final Report: Attributing Building Energy Code Savings to Energy Efficiency Programs*. Prepared by The Cadmus Group, Inc.

Online Code Environment & Advocacy Network (OCEAN).

--- “Code Development.” Web page, Accessed December 14, 2014. <http://energycodesocean.org/research->



[topic/code-development.](#)

--- "Illinois." A <http://energycodesocean.org/state-country/illinois>.

South-central Partnership for Energy Efficiency as a Resource (SPEER). (2015). "Recommendations of the SPEER Commission on Texas Energy Efficiency Policy."

https://eepartnership.files.wordpress.com/2014/03/speer_report_021615_d10lr.pdf.

State of Massachusetts. (n.d.) "Summary of the Massachusetts 'Stretch' Energy Code."

<http://www.mass.gov/eea/docs/doer/green-communities/grant-program/stretch-code-summary-jun20-2011.pdf>.

U.S. Department of Energy (DOE). (February 2010). "Building Energy Codes 101: An Introduction." Building Energy Codes. PNNL-SA-70586.

http://energycodesocean.org/sites/default/files/resources/20100301_std901_codes_101.pdf.

Washington Department of Commerce. (January 2014). "Energy-Efficiency Building Strategy Update 2014." Report to the Legislature. <http://www.commerce.wa.gov/Documents/Commerce-Energy-Efficiency-Building-Strategy-Update-2014.pdf>.

4.3.1. Additional References on Building Energy Codes

The American Council for an Energy Efficient Economy's compliance database lists compliance plans, baseline and updated compliance studies, utility involvement in compliance efforts, stakeholder advisory groups, and compliance training and outreach groups in all 50 states. <http://database.aceee.org/state/compliance>.

The Online Code Environment and Advocacy Network (OCEAN) Resource Library has resources on all aspects of building energy codes, from adoption to compliance to enforcement.

<http://www.energycodesocean.org/resources>.

The Department of Energy's Building Energy Codes Program (BCEP) offers a help desk for technical assistance on building energy codes. The site also has links to the REScheck and COMcheck tool suites as well as resources on code development, adoption, compliance and regulation. <http://www.energycodes.gov/>.

The Responsible Energy Codes Alliance promotes adoption, implementation and enforcement of the most recent version of the International Energy Conservation Code (IECC) and offers IECC compliance guides. <http://www.reca-codes.org/>.

4.4. Local Government-Led Efforts

Arlington County, Virginia. (2013). "Community Energy Plan." <http://freshaireva.us/wp-content/uploads/2013/05/052113-CMO-AIRE-2012-goal-report-Final.pdf>.

City of Austin. (2013). "City Code: Title 6. Environmental Control and Conservation. Chapter 6-7. Energy Conservation."

City of Berkeley.

---(2008). "Residential Energy Conservation Ordinance."


http://www.ci.berkeley.ca.us/uploadedFiles/Planning_and_Development/Level_3_-_Energy_and_Sustainable_Development/Residential%20Energy%20Conservation%20Ordinance%20Compliance%20Guide%202008.pdf.

---City of Berkeley. (2010). "Commercial Buildings—Energy Conservation Measures."

<http://www.codepublishing.com/CA/Berkeley/html/pdfs/Berkeley19.pdf>.

City of Boston. (2013). "An Ordinance Amending the Air Pollution Control Commission Ordinance in Relation to Reporting and Disclosing the Energy and Water Efficiency of Buildings."

http://www.cityofboston.gov/images_documents/Signed%20Ordinance_tcm3-38217.pdf.



City of Boulder, Colorado. (2014). “Energy Efficiency Upgrades at City Facilities.”

<https://bouldercolorado.gov/public-works/energy-efficiency-upgrades-at-city-facilities-energy-performance-contract>.

City of Minneapolis. (2013). “Minneapolis Building Rating and Disclosure Policy: A Review of the Ordinance.”

<http://www.ci.minneapolis.mn.us/www/groups/public/@regservices/documents/webcontent/wcms1p-102210.pdf>.

City of San Francisco. (2014). “Existing Commercial Buildings Energy Performance Ordinance.”

<http://www.sfenvironment.org/energy/energy-efficiency/commercial-and-multifamily-properties/existing-commercial-buildings-energy-performance-ordinance>.

Department of Energy, Office of Energy Efficiency & Renewable Energy (EERE). (2014).

---“Energy Data.” <http://energy.gov/eere/slsc/energy-data-access> (EERE 2014a).

---“Uniform Methods Project for Determining Energy Efficiency Program Savings.”

<http://energy.gov/eere/about-us/initiatives-and-projects/uniform-methods-project-determining-energy-efficiency-progr-0> (EERE 2014b).

Department of Energy, Weatherization and Intergovernmental Programs Office (WIPO). (2014). “Advancing Clean Energy with State and Local Governments.”

<http://energy.gov/eere/wipo/weatherization-and-intergovernmental-programs-office>.

Energy Star.

---(2012). “Benchmarking and Energy Savings.”

http://www.energystar.gov/ia/business/downloads/datatrends/DataTrends_Savings_20121002.pdf.

---(2014). “State and local governments.” <https://www.energystar.gov/buildings/program-administrators/state-and-local-governments>.

Donnellan, B. (2013). “Memorandum to City Board: 2012 AIRE Goals Report.” <http://freshaireva.us/wp-content/uploads/2013/05/052113-CMO-AIRE-2012-goal-report-Final.pdf>.

Environmental Protection Agency (EPA).

---(2014). “Sources of Greenhouse Gas Emissions.”

<http://epa.gov/climatechange/ghgemissions/sources/commercialresidential.html>.

---(2011). “Energy Efficiency in Local Government Operations: A Guide to Developing and Implementing Greenhouse Gas Reduction Programs.”

http://www.epa.gov/statelocalclimate/documents/pdf/ee_municipal_operations.pdf.

---(2010). Evaluation of Energy Conservation Measures for Wastewater Treatment Facilities.

<http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf>.

Global Water Research Coalition. (2010). “Energy Efficiency in the Water Industry: A Compendium of Best Practices and Case Studies.” <http://edepot.wur.nl/175846>.


Institute for Market Transformation. (2014). “Map: U.S. Building Benchmarking and Transparency Policies.”

www.buildingratings.org.

Mills, E. (2009). “Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse Gas Emissions. Lawrence Berkeley National Laboratory. <http://cx.lbl.gov/documents/2009-assessment/lbnl-cx-cost-benefit.pdf>.

Minnesota Department of Commerce. (2012). “Cost-Benefit Analysis of Energy Efficient Technologies Available for Use in Roadway Lighting.” <http://mn.gov/commerce/energy/images/RoadwayLightingTechReport.pdf>.

National Association of Counties. (2013). “Energy Efficient County Buildings: Realizing Money and Energy Saving Opportunities.” <http://www.naco.org/programs/csd/Documents/Energy-Efficient-County-Buildings.pdf>.



National Conference of State Legislatures (NCSL). (October 20, 2014). "PACE Financing."
<http://www.ncsl.org/research/energy/pace-financing.aspx>.

National Renewable Energy Laboratory (NREL). (2014). "Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 16: Retrocommissioning Evaluation Protocol."
<http://energy.gov/sites/prod/files/2014/10/f18/Chapter%2016--Retrocommissioning%20Evaluation%20Protocol.pdf>.

New York City, Mayor's Office of Sustainability (NYC). (2014).
---"LL84: Benchmarking." <http://www.nyc.gov/html/gbee/html/plan/ll84.shtml>. (NYC 2014a).
---"LL87: Energy Audits & Retro-commissioning." <http://www.nyc.gov/html/gbee/html/plan/ll87.shtml> (NYC 2014b).

New York Department of Environmental Conservation. (2014). "Reduce Utility Bills for Municipal Facilities and Operations." <http://www.dec.ny.gov/energy/64089.html>.

U.S. Energy Information Administration (EIA). (2015). "Monthly Energy Review, Table 7.6 Electricity End Use."
http://www.eia.gov/totalenergy/data/monthly/pdf/sec7_19.pdf.

4.5. State Lead by Example Efforts

4.5.1. Energy Savings Performance Contracting

Bharvirkar, R., C. Goldman, D. Gilligan, T. Singer, D. Birr, P. Donahue and S. Serota (2008). Performance Contracting and Energy Efficiency in the State Government Market. LBNL-1202E. November.

Carvallo, J.P., P. Larsen and C. Goldman (2015). "Estimating customer electricity and fuel savings from projects installed by the US ESCO industry." Energy Efficiency, Volume 8, Issue 6, pp. 1251-1261. December.
<http://link.springer.com/article/10.1007/s12053-015-9405-8>.

Coleman, P., S. Earni and C. Williams, Lawrence Berkeley National Laboratory (2014). "Could What That ESCO Sales Rep Said Really Be True? Savings Realization Rates in ESPC versus Bid-to-Spec Projects" Proceedings of the ACEEE 2014 Summer Study on Energy Efficiency in Buildings, Washington, DC: American Council for an Energy-Efficient Economy. August. <http://www.aceee.org/files/proceedings/2014/data/papers/5-1278.pdf>.


Hoffman, I.M., S.R. Schiller, A. Todd, C.A. Goldman, L.C. Schwartz 2015. "Energy Savings Lifetimes and Persistence: Practices, Issues and Data" LBNL. May.

Hopper, N., C. Goldman, J. McWilliams, D. Birr and K. McMordie-Stoughton (2005). Public and Institutional Markets for ESCO Services: Comparing Programs, Practices and Performance. Lawrence Berkeley National Laboratory, LBNL-55002. March. <http://emp.lbl.gov/publications/public-and-institutional-markets-esco-services-comparing-programs-practices-and-perform>.

Larsen, P., C. Goldman and A. Satchwell (2012). Evolution of the U.S. Energy Service Company Industry: Market Size and Project Performance From 1990-2008. Lawrence Berkeley National Laboratory, 5447-E. July.
<http://emp.lbl.gov/publications/evolution-us-energy-service-company-industry-market-size-and-project-performance-1990-2>.

Larsen, P., E. Stuart and C. Goldman, LBNL; D. Gilligan, NAESCO (2014). Current Policies and Practices Related to the Incorporation of Non-energy Benefits in Energy Saving Performance Contract Projects. Proceedings of the ACEEE 2014 Summer Study on Energy Efficiency in Buildings, Washington, DC: American Council for an Energy-Efficient Economy. August.

Patterson, A. and C. Hessler (2014). "Energy Efficiency Case Study: Performance Contracting." 3N Implementation Meeting: Energy Efficiency Compliance Options for 111(d). December.
<http://111d.naseo.org/Data/Sites/5/media/events/2014-12-04/espc-patterson-hessler.pdf>.



Shonder, J. 2013. “Beyond Guaranteed Savings: Additional Cost Savings Associated With ESPC Projects” Oak Ridge National Laboratory. March. <http://btrc.ornl.gov/publications/Publication%2041816.pdf>.

Stuart, E., P. Larsen, C. Goldman and D. Gilligan (2013). Current Size and Remaining Market Potential of the U.S. Energy Service Company Industry. Lawrence Berkeley National Laboratory, LBNL-6300E. September. http://emp.lbl.gov/sites/all/files/lbnl-6300e_0.pdf.

4.5.2. Building Performance Policies and 4.5.3 Product Procurement Policies

American Council for an Energy Efficient Economy (ACEEE). “Public Building Requirements.” (ACEEE 2015a). <http://database.aceee.org/state/public-building-requirements>.

“Energy Savings Performance Contracting.” (ACEEE 2015b). <http://database.aceee.org/state/energy-savings-performance>.

Eldridge, M., M. Neubauer, D. York, S. Vaidyanathan, A. Chittum and S. Nadel. (October 2008). “The 2008 State Energy Efficiency Scorecard.” American Council for an Energy Efficient Economy. ACEEE Report Number E086. <http://www.aceee.org/sites/default/files/publications/researchreports/E086.pdf>.

ENERGY STAR.

--- “ENERGY STAR Portfolio Manager.” (ENERGY STAR 2015a). <http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager>.

--- “About ENERGY STAR for commercial and industrial buildings.” (ENERGY STAR 2015b).

--- “Product Purchasing & Procurement template.” (ENERGY STAR 2015c).

<http://www.energystar.gov/buildings/tools-and-resources/product-purchasing-procurement-template>.

(Illinois) State of Illinois, Executive Department. April 1, 2009. “Executive Order 7 (2009): Executive Order to Reduce Energy consumption in State Facilities.” http://www.illinois.gov/Government/ExecOrders/Pages/2009_7.aspx.

Lawrence Berkeley National Laboratory (LBNL 2015). “Definition – Building Commissioning: A Golden Opportunity for Reducing Energy Costs and Greenhouse-Gas Emissions.” <http://cx.lbl.gov/definition.html>.

Massachusetts (2004). Massachusetts Climate Action Plan. <http://www.massclimateaction.org/pdf/MAClimateProtPlan0504.pdf>.

Minnesota Buildings, Benchmarks and Beyond (B3). “Tools and Buildings for Sustainable Buildings in Minnesota.” <http://www.b3mn.org>.

Minnesota Department of Commerce. “Energy Savings Programs.” <http://www.mn.gov/commerce/energy/topics/financial/Energy-Savings-Program/>.


National Governors Association, Center for Best Practices (NGA) (July 13, 2008). “Greening State Government: “Lead by Example” Initiatives.” NGA Issue Brief. ([LINK](#)).

Responsible Purchasing Network. “Green 101: Policies.” http://www.responsiblepurchasing.org/purchasing_guides/all/policies/#California.

State of Minnesota.

--- (November 10, 2005). “Executive Order 05-16: Providing for Energy Conservation Measures for State Owned Buildings.” State of Minnesota Executive Department, Tim Pawlenty, Governor. <http://www.leg.mn/archive/execorders/05-16.pdf>.

--- (April 8, 2011). “Executive Order 11-12: Providing Job Creation through Energy Efficiency and Renewable Energy Programs for Minnesota’s Public Buildings.” State of Minnesota Executive Department, Mark Dayton, Governor. <http://mn.gov/governor/multimedia/pdf/EO-11-12.pdf>.



U.S. Environmental Protection Agency (EPA) (2009). “State Lead by Example Guide: Strategies, Resources, and Action Steps for State Programs.” Prepared by Joanna Pratt and Joe Donahue, Stratus Consulting, Inc. <http://www.epa.gov/statelocalclimate/resources/example.html>.

(Virginia) Commonwealth of Virginia, Office of the Governor. (April 5, 2007). “Executive Order 48 (2007): Energy Efficiency in State Government.” ([LINK](#)).

4.5.4. State Equipment Efficiency Standards

Appliance Standards Awareness Project (ASAP).

--- “State Standards.” (ASAP 2015). <http://www.appliance-standards.org/states>

--- (updated February 2014). “Energy and Water Efficiency Standards Adopted and Pending by State.” (ASAP 2014). http://www.appliance-standards.org/sites/default/files/State_status_grid_Feb_2014.pdf.

--- (n.d.). “National Benefits from Potential State Appliance Standards: United States.”

Database of State Incentives for Renewables & Efficiency (DSIRE). “Connecticut: Incentives/Policies for Renewables & Energy Efficiency – Energy Efficiency Standards for Appliances.”

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CT09R&ee=1.

Hayes, S., G. Herndon, J. Barrett, J. Mauer, M. Molina, M. Neubauer, D. Trombley and L. Ungar (April 2014).

“Change Is in the Air: How States Can Harness Energy Efficiency to Strengthen the Economy and Reduce Pollution.” American Council for an Energy-Efficient Economy (ACEEE), Report E1401. <http://aceee.org/research-report/e1401>

Kavalec, C., N. Fugate, B. Alcorn, M. Ciminelli, A. Gautam, K. Sullivan and M. Weng-Gutierrez (2014). *California Energy Demand 2014-2024. Final Forecast, Volume 1: Statewide Electricity Demand, End-User Natural Gas Demand, and Energy Efficiency*. California Energy Commission, Electricity Supply. Analysis Division. Publication Number: CEC-200-2013-004-V1-CMF.

http://www.energy.ca.gov/2013_energypolicy/documents/#adoptedforecast.

Lowenberger, A., J. Mauer, A. deLaski, M. DiMascio, J. Amman and S. Nadel (March 2012). “The Efficiency Boom: Cashing In on the Savings from Appliance Standards.” ACEEE. Updated from and supersedes ASAP-7/ACEEE-A091. Report Number ASAP-8/ACEEE-A123.

Melley 2015. Personal communication with Michele Melley, Bureau of Energy and Technology Policy, Connecticut Department of Energy and Environmental Protection, March 10, 2015.

Meyers, S., A. Williams, P. Chan and S. Price (2015). Energy and Economic Impacts of U.S. Federal Energy and Water Conservation Standards Adopted from 1987 Through 2014. <http://eetd.lbl.gov/sites/all/files/lbnl-6964e.pdf>.

Ruckes, J. (February 2008). “Appliance Efficiency Standards.” Connecticut Office of Policy and Management. SIPRAC Meeting. ([LINK](#)).

Singh, H., K. Rider, B. Chrisman and J. Babula. 2014. *2014 Appliance Efficiency Regulations*. California Energy Commission. Publication Number: CEC-400-2014-009-CMF.


Multi-State Appliance Standards Collaborative. “Multi-State Appliance Collaborative.” <http://www.appliancestandards.org/>.

Northwest Energy Efficiency Alliance (NEEA). “Standards: Establishing appliance and equipment standards.” <http://neea.org/initiatives/codes-standards/standards>.

State of California. “California Government Code Sections 11445.10-11445.60: Informal Hearing.” <http://www.leginfo.ca.gov/cgi-bin/displaycode?section=gov&group=11001-12000&file=11445.10-11445.60>.

4.5.5. Financing Access

National Association of State Energy Offices (NASEO) 2013. “Unlocking Demand: An Analysis of State Energy Efficiency and Renewable Energy Financing Programs in the Buildings and Industrial Sectors.” December. <http://www.ourenergypolicy.org/wp-content/uploads/2014/01/Unlocking-Demand.pdf>.



Texas State Energy Conservation Office (SECO). “LoanSTAR Revolving Loan Program.” (SECO 2015a). <http://www.seco.cpa.state.tx.us/lr/>.

SECO “Notice of Loan Fund Availability (NOLFA) – LoanSTAR Program.” (SECO 2015b). <http://www.seco.cpa.state.tx.us/funding/nolfa/042514/>.

U.S. Department of Energy State and Local Solutions Center, <http://energy.gov/eere/slsc/financing-solutions>.

4.6. Large Energy Users – Voluntary Efforts of Industry and Business

4.6.1. Strategic Energy Management and 4.6.2. Voluntary Challenges

Boyd, Gale (2010) “Assessing Improvement in the Energy Efficiency of U.S. Auto Assembly Plants” Department of Economics, Duke University, Working Paper EE 10-01.

<http://sites.nicholasinstitute.duke.edu/environmentaleconomics/files/2013/01/Duke-EE-WP-1.pdf>.

de Fontaine, Andre. (June 19, 2014). “Better Plants Challenge: Program Update.” U.S. Department of Energy.

de Fontaine Andre. (February 4, 2015). Personal communication.

Dutrow, E. 2015 “Protecting the environment and influencing energy performance within process industries.” In *Energy Management and Efficiency for the Process Industries*, ed. A Rossiter and B. Jones. 81-92. Hoboken, NJ: John Wiley and Sons.

Efficiency Valuation Organization (EVO). “Core Products page.” www.evo-world.org.

Environmental Protection Agency (January 2014). “Energy Treasure Hunt Guide: Simple Steps to Finding Energy Savings.” <http://www.energystar.gov/buildings/tools-and-resources/energy-star-treasure-hunt-guide-simple-steps-finding-energy-savings>.

General Motors. “70 GM Plants Meet ENERGY STAR Challenge for Industry.” November 5, 2014. <http://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2014/Nov/1105-energy-star.html>.

Goldberg, A., R.P. Taylor and B. Hedman 2014. Institute for Industrial Productivity.

Industrial Efficiency Policy Database. “US-4b: Better Buildings, Better Plants.” <http://iepd.iipnetwork.org/policy/better-buildings-better-plants>.

Nissan Motor Corporation. “Our Company: Outline of Company TOP.” <http://www.nissan-global.com/EN/COMPANY/PROFILE/>.

Northwest Energy Efficiency Alliance (NEEA). (Oct. 17, 2013). “Energy Baseline Methodologies for Industrial Facilities, Northwest Energy Efficiency Alliance.” Prepared by EnerNOC Utility Solutions. NEEA REPORT #E13-265. <https://neea.org/docs/default-source/reports/energy-baseline-methodologies-for-industrial-facilities.pdf?sfvrsn=7>.

NREL. International Performance Measurement and Verification Protocol. Revised March 2002. <http://www.nrel.gov/docs/fy02osti/31505.pdf>.

Office of Energy Efficiency and Renewable Energy (EERE).

--- “Superior Energy Performance: Nissan Case Study for Superior Energy Performance” (EERE 2015a). <http://energy.gov/eere/amo/downloads/nissan-case-study-superior-energy-performance>.

--- “Superior Energy Performance: Harbec, Inc. Case Study for Superior Energy Performance” (EERE 2015b). <http://energy.gov/eere/amo/downloads/harbec-inc-case-study-superior-energy-performance>.

--- “Superior Energy Performance Measurement and Verification Protocol for Industry” (EERE 2015c). <http://www.energy.gov/eere/amo/downloads/superior-energy-performance-measurement-and-verification-protocol-industry>.

- “Better Plants” (EERE 2015d). <http://energy.gov/eere/amo/better-plants>.
- “How to Join Better Plants” (EERE 2015e). <http://energy.gov/eere/amo/how-join-better-plants>.
- “Better Plants Program Partners” (EERE 2015f). <http://energy.gov/eere/amo/better-plants-program-partners>.
- “Saint-Gobain Corporation: Energy Performance.” (EERE 2015g). <https://www4.eere.energy.gov/challenge/energy-performance/saint-gobain>.

Office of Energy Efficiency and Renewable Energy (EERE). (November 2011). “Guide for Better Buildings, Better Plants Program Partners: Taking a Bold Pledge to Reduce the National’s Energy and Carbon Footprint.” http://www1.eere.energy.gov/manufacturing/pdfs/betterplants_guide.pdf.

Rao, P., P. Therkelesen, and A. McKane. (2013). “Establishing Effective Industrial Energy Performance Improvement Targets.” 2013 ACEEE Summer Study on Energy Efficiency. http://aceee.org/files/proceedings/2013/data/papers/5_139.pdf.

Schultz, Steve. (2015). Tapping into DOE’s Portfolio of Manufacturing Energy Efficiency Resources, May 27, 2015, Better Buildings Summit.

State and Local Energy Efficiency Action Network. (March 2014). *Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector*. https://www4.eere.energy.gov/seeaction/system/files/documents/industrial_energy_efficiency.pdf.

Therkelsen, Peter, A. McKane, R. Sabouni, T. Evans, and P. Scheihing. (July 2013). “Assessing the Costs and Benefits of the Superior Energy Performance Program.” Lawrence Berkeley National Laboratory. Report LBNLO-6349E. <http://buildings.lbl.gov/publications/assessing-costs-and-benefits-superior>.

Therkelsen, P., McKane, A., Sabouni, R., Tamm, Y., Rao, P., and Scheihing, P. (2015) Development of an Enhanced Payback Function for the Superior Energy Performance Program, 2015 ACEEE Summer Study on Energy Efficiency in Industry.

Tunnessen, W. 2004. “Closing the Energy Management Gap,” *Environmental Quality Management*, Volume 14, Number 1, pp. 49-57.

U.S. Department of Energy (DOE).


- “Superior Energy Performance FAQs (Nov. 2013)” (DOE 2013). <http://energy.gov/eere/amo/downloads/superior-energy-performance-faqs>.
- “Better Plants: Progress Update, Fall 2014” (DOE 2014). <http://energy.gov/eere/amo/downloads/better-plants-progress-update-2014>.

U.S. Energy Information Administration (EIA). (December 16, 2013). “Annual Energy Outlook: 2014 Early Release Overview.” http://www.eia.gov/forecasts/aeo/er/early_consumption.cfm.

U.S. Environmental Protection Agency (EPA)

- “ENERGY STAR Success Story: How EPA’s ENERGY STAR® Program Helped Unite HanesBrands’ Energy Strategy” (EPA 2013) <http://www.energystar.gov/buildings/tools-and-resources/how-epa%E2%80%99s-energy-star-program-helped-unite-hanesbrands%E2%80%99-energy-strategy>.
- “ENERGY STAR Challenge for Industry – Spring 2015 Update” (EPA 2015) <http://www.energystar.gov/industrychallenge>.
- 2013 Annual Report, Office of Atmospheric Programs, Climate Protection Partnerships. Office of Air and Radiation. http://www.energystar.gov/ia/partners/publications/pubdocs/ENERGYSTAR_2013AnnualReport-508.pdf.
- Reducing Greenhouse Gas Emissions by Advancing Industrial Energy Efficiency, 2000-2015”, (EPA 2015) http://www.energystar.gov/buildings/tools-and-resources/reducing_greenhouse_gas_emissions_advancing_industrial_energy_efficiency_2000.

4.6.3. CHP Policies and Programs



David Gardiner and Associates and Institute for Industrial Productivity 2015. *Combined Heat and Power (CHP) as a Compliance Option under the Clean Power Plan*, http://www.dgardiner.com/wpcontent/uploads/2015/07/CHP_Pathway_Final_7_23_15.pdf.

Hayes, S., G. Herndon, J. Barrett, J. Mauer, M. Molina, M. Neubauer, D. Trombley and L. Ungar 2014. *Change Is in the Air: How States Can Harness Energy Efficiency to Strengthen the Economy and Reduce Pollution*. April. American Council for an Energy-Efficient Economy, Report E1401. <http://aceee.org/sites/default/files/publications/researchreports/e1401.pdf>.

Hedman, B., A. Hampson and K. Darrow 2013. *The Opportunity for CHP in the United States*. Prepared by ICF International for American Gas Association. http://www.aga.org/Kc/analyses-and-statistics/studies/efficiency_and_environment/Pages/TheOpportunityforCHPintheUnitedStates.aspx.

Kefer, J., B. Hedman and D. Wooley 2014. "111(d) Energy Efficiency Compliance Pathways: Combined Heat and Power." 3N Implementation Meeting: Energy Efficiency Compliance Options for 111(d). December. <http://111d.naseo.org/Data/Sites/5/media/events/2014-12-04/chp-kefer-hedman-wooley.pdf>.

Regulatory Assistance Project (RAP) and ICF International 2009. "Standby Rates for Customer-Sited Resources: Issues, Considerations and the Elements of Model Tariffs" Prepared for U.S. EPA. December. http://www.epa.gov/chp/documents/standby_rates.pdf.

Selecky, J., K. Iverson, A. Al-Jabir, L. Schwartz and R. Sedano 2014. "Standby Rates for Combined Heat and Power Systems: Economic Analysis and Recommendations for Five States" Prepared by Regulatory Assistance Project for Oak Ridge National Laboratory. February. www.raponline.org/document/download/id/7020.

State and Local Energy Efficiency (SEE) Action Network 2013. *Guide to the Successful Implementation of State Combined Heat and Power Policies*. Prepared by B. Hedman, A. Hampson, J. Rackley and E. Wong, ICF International; L. Schwartz and D. Lamont, Regulatory Assistance Project; T. Woolf, Synapse Energy Economics; J. Selecky, Brubaker & Associates. March. <https://www4.eere.energy.gov/seeaction/publication/guide-successful-implementation-state-combined-heat-and-power-policies>.

USDOE and USEPA 2012. *Combined Heat and Power: A Clean Energy Solution*. August. http://www.energy.gov/sites/prod/files/2013/11/f4/chp_clean_energy_solution.pdf.

USEPA 2015. *CHP Partnership, Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems*. February. http://www.epa.gov/chp/documents/fuel_and_co2_savings.pdf.

4.6.4. Energy Savings Performance Contracting

Carvallo, J.P., P. Larsen and C. Goldman (2014). Estimating customer electricity savings from projects installed by the U.S. ESCO industry. <http://emp.lbl.gov/sites/all/files/lbnl-6877e.pdf>.

DOE's Energy Savings Performance Contracting web site: <http://energy.gov/eere/slsc/energy-savings-performance-contracting>.

Energy Services Coalition web site: <http://www.energyservicescoalition.org>.

Stuart, E., P. Larsen, C. Goldman and D. Gilligan (2013). Current Size and Remaining Market Potential of the U.S. Energy Service Company Industry. Lawrence Berkeley National Laboratory, LBNL-6300E. September. http://emp.lbl.gov/sites/all/files/lbnl-6300e_0.pdf.



Appendix A. Energy Efficiency and Emission Reduction Planning Tools for States⁴⁷⁰

Various tools, reports and references provide information and materials for state planning processes to reduce greenhouse gas and other air pollutant emissions in the power sector using cost-effective approaches. Many of these tools also can calculate criteria pollutant benefits from energy efficiency programs. Whether states are preparing plans to meet GHG emission requirements, developing or updating their state implementation plans for compliance with other pollutant regulations (e.g., NAAQS), or establishing programs to achieve voluntary targets for reducing air pollutant emissions, states should be cognizant of the multiple pollutant benefits from energy efficiency and allocate pollutant reductions to each program as appropriate. This action, to calculate multiple pollutant benefits at the same time, also uses state resources efficiently. Examples are described below; this list is not intended to be exhaustive.

Also see collections of tools and resources such as:

- EPA's Assessing the Multiple Benefits of Clean Energy Resource: describes a variety of tools and approaches that can be used to estimate energy, economic, emissions and/or health impacts of energy efficiency and key considerations when using the tools or approaches. <http://www3.epa.gov/statelocalclimate/resources/benefits.html>.
- EPA's Clean Power Plan Toolbox for States: resources providing information on state plan development and that help states determine the most cost-effective approaches to reducing greenhouse gas emissions from the power sector. <http://www2.epa.gov/cleanpowerplantoolbox>.
- Synapse Energy Economics and Argonne National Laboratory Guide to Clean Power Plan Modeling Tools: dissects and discusses a spectrum of compliance modeling tools in the context of modeling Clean Power Plan-related decisions. <http://www.synapse-energy.com/sites/default/files/Guide-to-Clean-Power-Plan-Modeling-Tools.pdf>.

ACEEE's State and Utility Pollution Reduction (SUPR) Calculator⁴⁷¹

ACEEE created the State and Utility Pollution Reduction (SUPR) calculator to give policymakers and stakeholders a rough estimate of some of the costs and benefits of various policies and technologies that could help a state meet its air quality goals. The tool allows the user to select up to 10 different policies and technologies from 19 options, including nine energy efficiency policies, six renewable energy and nuclear power options, and four emission control options including fuel switching to natural gas. The results provide users with an idea of the magnitude of the costs and the impacts of selected options on energy use and air pollution (CO₂, SO₂, and NO_x emissions). Similar to other tools, SUPR provides high-level estimates that are not intended to replace more detailed modeling processes that states will likely undertake in developing their 111(d) compliance plans and criteria-pollutant state implementation plans (SIPs).⁴⁷²

Advanced Energy Economy's State Tool for Electricity Emissions Reduction (STEER)⁴⁷³

An open access integrated resource planning model, developed for analyzing least-cost strategies to implement the Clean Power Plan. It automatically calculates the least-cost plan given policy options, load and technology price forecasts. All data, inputs, and formulae are visible to user and can be modified as necessary.

⁴⁷⁰ Inclusion of tools in this section does not indicate that they necessarily meet the requirements of federal Clean Air Act regulatory programs, where EPA sources are the only authoritative information.

⁴⁷¹ See www.aceee.org.

⁴⁷² [Hayes and Young 2015](#).

⁴⁷³ <http://info.aee.net/steer>.



Avoided Emissions & generation Tool (AVERT)⁴⁷⁴

AVERT is a free tool for state and local air quality planners and others to evaluate county, state and regional emissions displaced at electric power plants as a result of energy efficiency and renewable energy policies and programs. The tool employs publicly available data from EPA's Air Markets Program Data (AMPD). AVERT is designed to help state and local air quality planners, state energy offices, public utility commission staff, and others identify the emission benefits of energy efficiency energy policies and programs to:

- Quantify the nitrogen oxides (NO_x), sulfur dioxide (SO₂), and carbon dioxide (CO₂) emissions benefits of state and multi-state policies and programs
- Examine the regional, state, and county level emission impacts of different programs based on temporal energy savings and hourly generation profiles
- Compare the emission impacts of various programs, such as the emission impacts of wind installations versus solar installations
- Understand the emission impacts of different policies and programs during high electricity demand days
- Analyze the emission benefits of policies and programs implemented in multiple states within a region

AVERT estimates the displaced emissions likely to result from energy efficiency and renewable energy programs in comparison to a base-year or future-year scenario. For energy efficiency policies and programs, users need to input annual energy savings (in MWh or MW) and have an understanding of the temporal profiles of the policy or program they want to evaluate. For example, would the program save energy during peak periods or save level amounts throughout the year? Alternatively, users can use EPA's hourly load impact profiles.

MJB&A's Clean Power Plan Evaluation Tool⁴⁷⁵

Allows users to analyze state progress towards compliance with the final Clean Power Plan rule under a range of electricity demand and generation scenarios and a variety of emissions reduction targets. The tool incorporates policy options outlined in the final rule, and provides the ability to alter all major drivers of state electric sector emissions and ascertain their impacts on state's CPP compliance status. Results are analyzed and displayed based on real-time changes made by the user in a variety of graphs to track how each option influences compliance with interim and final targets.

Regulatory Assistance Project Energy Efficiency Power Plant (EPP) Tool⁴⁷⁶

The Regulatory Assistance Project (RAP) and Energy Futures Group developed this free, simplified, Excel-based planning tool for air quality regulators who are tasked to assemble a portfolio of energy efficiency measures to avoid or remove pollution from a particular airshed. The tool demonstrates how the energy-saving effects of thousands or even millions of efficiency measures installed at nearly as many sites can be aggregated into a single "Efficiency Power Plant," resulting in substantial reductions in emissions that can be characterized with a great deal of sophistication. The tool is only intended to be illustrative, not to be used directly for a state's compliance with air quality regulations.

Synapse Energy Economics' Clean Power Plan Planning Tool (CP3T)⁴⁷⁷


Synapse's Clean Power Plan Planning Tool (CP3T) is a free, Excel-based spreadsheet tool for performing first-pass planning of statewide compliance with EPA's proposed CPP requirements. In CP3T, users set up a scenario by selecting a state and adjusting generation, emission rates, and capacity factors until peak demand requirements,

⁴⁷⁴ [EPA 2015](#).

⁴⁷⁵ <http://www.mjbradley.com/about-us/case-studies/clean-power-plan-evaluation-tools>.

⁴⁷⁶ See <http://www.raonline.org/featured-work/cutting-through-the-fog-to-build-energy-efficiency>.

⁴⁷⁷ See <http://synapse-energy.com/tools/clean-power-plan-planning-tool-cp3t>.



annual generation requirements, and emission rate requirements per EPA are met. Users may increase capacity factors, enter unit retirements, add energy efficiency savings or renewable energy generation, and add new generation from CPP-exempt natural gas-fired combined cycle or combustion turbine generators. Users then evaluate peak demand and generation requirements in each year of the study period (2013-2030) to ensure reliability requirements are met. Finally, users evaluate the emission rates and emissions that result in each year to ensure the scenario complies with the target emission rates and emissions proposed by EPA. This tool is intended to give users the greatest flexibility possible in the creation of state scenarios. CP3T is an open-source model, so users are free to make changes to any of the formulas and inputs.

Appendix B. Types of Utility Ratepayer-Funded Programs

Chapter 4 highlights several types of energy efficiency programs for utility customers. There are many others.

LBNL developed a typology of standardized program categories, as well as metrics and definitions for program characteristics, costs and impacts. Such standardization facilitates analysis of energy efficiency program results across multiple program administrators on a state, regional or national basis.

Figure A-1 is the simplified categorization of common types of energy efficiency programs. Figure A-2 is a *sample* of the detailed program categories and descriptions. LBNL also developed common definitions for reporting program data and metrics: number of participants, program activity (e.g., number of measures installed, buildings retrofitted), budgets, committed spending, actual expenditures grouped into various categories of program costs, measure lifetimes and energy savings. For the full list of detailed program categories and descriptions, metrics and definitions, please see LBNL’s report: <http://emp.lbl.gov/sites/all/files/lbnl-6370e.pdf>.

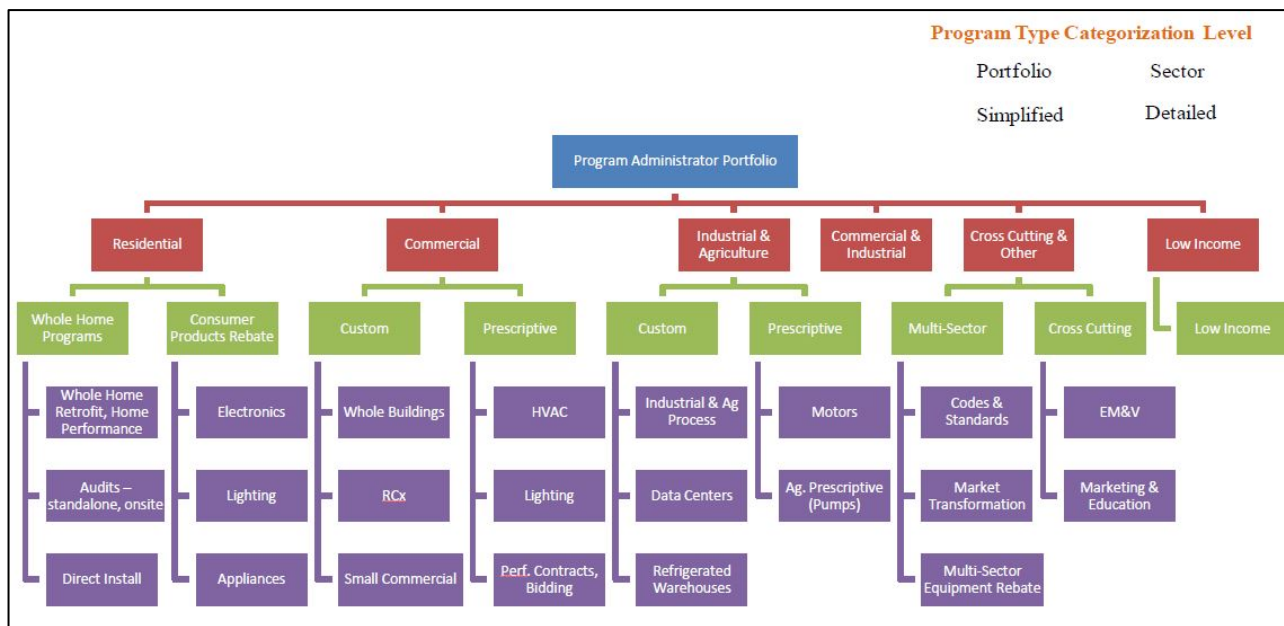



Figure A-1. Simplified organizational chart of energy efficiency programs for utility customers⁴⁷⁸

⁴⁷⁸ Hoffman, I., M. Billingsley, S. Schiller, C. Goldman, and E. Stuart. (August 28, 2013). “Energy Efficiency Program Typology and Data Metrics: Enabling Multi-State Analyses Through the Use of Common Terminology.” Lawrence Berkeley National Laboratory, Clean Energy Program Policy Brief. LBNL-6370E. <http://emp.lbl.gov/sites/all/files/lbnl-6370e.pdf>.



Detailed Category	Detailed Program Definition	Simplified Category
Behavioral/ Online Audit/ Feedback	Residential programs designed around directly influencing household habits and decision-making on energy consumption through quantitative or graphical feedback on consumption, sometimes accompanied by tips on savings energy. These programs include behavioral feedback programs (in which energy usage reports compare a consumer's household energy usage with those of similar consumers); online audits that are completed by the consumer; and in-home displays that help consumers assess their usage in near real time. This program category does not include on-site energy assessments or audits.	Behavior/ Education
Consumer Product Rebate/ Appliances	Programs that incentivize the sale, purchase and installation of appliances (e.g., refrigerators, dishwashers, clothes washers and dryers) that are more efficient than current standards. Appliance recycling and the sale/purchase/installation of HVAC equipment, water heaters and consumer electronics are accounted for separately.	Consumer Product Rebate
Consumer Product Rebate/ Electronics	Programs that encourage the availability and purchase/lease of more efficient personal and household electronic devices, including but not limited to televisions, set-top boxes, game consoles, advanced power strips, cordless telephones, PCs and peripherals specifically for home use, chargers for phones/smart phones/tablets. A comprehensive efficiency program to decrease the electricity use of consumer electronics products includes two focuses: product purchase and product use. Yet not every consumer electronics program will seek to be comprehensive. Some programs will embark on ambitious promotions of multiple electronics products, employing upstream, midstream, and downstream strategies with an aggressive marketing and education component. At the other end of the	

Figure A-2. Sample of detailed program categories and descriptions⁴⁷⁹

⁴⁷⁹ Ibid.

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