



Energy-Saving

HOMES, BUILDINGS,
& MANUFACTURING

U.S. DEPARTMENT OF
ENERGY | Energy Efficiency &
Renewable Energy

How Energy Efficiency Programs Can Support State Climate and Energy Planning: *Efficiency as an Emission Reduction Approach*

energy.gov/eere/slsc/EEopportunities

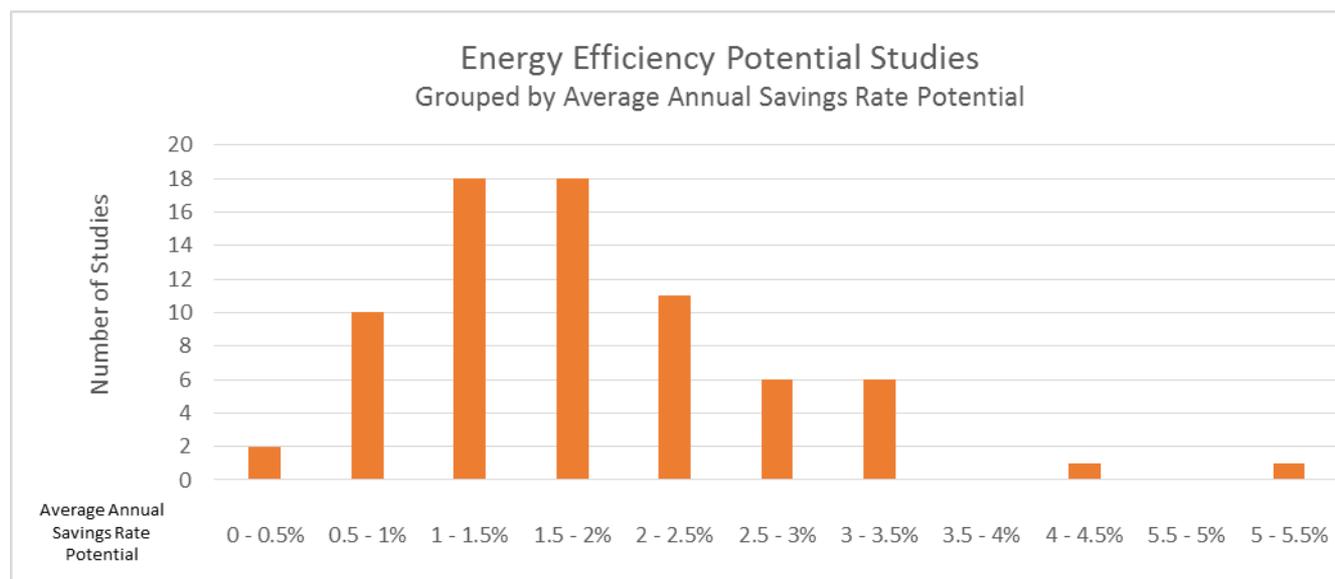
Outline

Energy Efficiency as an Emission Reduction Approach:

- Energy savings potential and achievements
- Electricity and carbon savings opportunity estimates
- Synopses of seven major opportunity areas
- DOE technical assistance available for energy and climate planning and implementation, by sector
- Appendix – assumptions and data sources for calculations of electricity and carbon savings

Energy Efficiency Potential Studies & Achieved Electricity Savings

- DOE identified 79 energy efficiency potential studies published between 2007 and 2015 completed for states, utilities, and NGOs.¹ They provide estimates across 44 states.
- The majority (60%) found an average savings rate of 1 to 2.5% from prior year electricity sales in economic or achievable potential.



- The 10 states leading on energy efficiency are already achieving 1.25 to 3.5% in annual electricity savings.² Many of these states have been running energy efficiency programs for decades and are continuing to increase savings.

¹ U.S. Department of Energy, 2016, *Energy efficiency potential studies catalog*, <http://energy.gov/eere/slsc/energy-efficiency-potential-studies-catalog>

² American Council for an Energy-Efficiency Economy (ACEEE), 2015, *State Energy Efficiency Scorecard*, <http://aceee.org/state-policy/scorecard>

Many Substantial, Well Documented Energy Savings Opportunities

Savings come from EE activities across:

- industrial, commercial, public, residential bldgs
- ratepayer-funded (e.g., utility) programs
- private sector initiatives
- state / local government-run programs

Typical Lead			Savings Pathways	Estimate of National Electricity Savings Potential in 2030*	Estimate of National Carbon Savings Potential in 2030**
Private Sector	S/L Gov't	Utility			
			✓ Ratepayer-Funded Efficiency Programs	645-895 million MWh	368-510 short tons
✓	✓	✓	Industrial Efficiency	85-130 million MWh	48-74 short tons
✓	✓	✓	Combined Heat and Power	75-115 million MWh	43-66 short tons
✓	✓		Energy Savings Performance Contracting	45-90 million MWh	26-51 short tons
	✓	✓	Building Energy Codes	50-60 million MWh	29-34 short tons
	✓		City-Led Energy Efficiency Efforts	25-50 million MWh	14-29 short tons

**DOE calculations of ballpark achievable potential based on sector-specific assumptions for activities occurring 2013-2030; see appendix.*

***Carbon emissions estimates based on national average total output emission rate published in 2012 eGRID; see appendix.*

NOTE: Savings Pathways may have overlapping savings, so estimates are NOT additive.

EE Savings Pathways Can be Incorporated into Climate Planning

Typical Lead			Savings Pathways	Helps reach carbon reduction goals	
Private Sector	S/L Gov't	Utility		Reduces smokestack emissions	Produces verifiable energy savings
✓	✓	✓	Industrial Efficiency	✓	✓
✓	✓	✓	Combined Heat and Power	✓	✓
	✓	✓	Building Energy Codes	✓	✓
✓	✓		Energy Savings Performance Contracting	✓	✓
	✓		City-Led Energy Efficiency Efforts	✓	✓
		✓	Ratepayer-Funded Efficiency Programs	✓	✓
	✓	✓	Low Income Energy Efficiency Programs	✓	✓

S/L Gov't = state or local government

Ratepayer-Funded Efficiency as an Emission Reduction Approach

Possible Leads

- Utilities (investor-owned, rural cooperatives, municipal utilities)
- Non-utility program administrators

E-Savings

- Savings in compliance year vs 2012 baseline

Potential Program Components

- New and existing residential buildings (single family, multi-family, low income)
- Small, medium & large commercial buildings
- Industrial facilities

Potential Electricity Savings

645 – 895 million MWh in 2030

368 – 510 short tons CO₂

Activity	EM&V
Energy Savings Approaches	
<ul style="list-style-type: none"> • Program administrators generate energy savings from: <ul style="list-style-type: none"> - EE programs that support improvements to residential, commercial, industrial buildings 	<ul style="list-style-type: none"> • Recent resources provide guidance, including: <ul style="list-style-type: none"> - SEE Action Energy Efficiency Program Impact Evaluation Guide - SEE Action EM&V Resource Portal - DOE Uniform Methods Project - NEEP EM&V Forum - Regional Technical Forum of the Northwest Power and Conservation Council
State Policy Options	
<ul style="list-style-type: none"> • Could include <ul style="list-style-type: none"> - Requiring a specified level of EE savings (e.g., EERS) - Requiring inclusion of EE as a resource in capacity planning (e.g., Integrated Resource Planning) - Regulatory policies to incentivize successful utility delivery of EE - Consider options for energy efficiency delivery agent 	
Low Income Opportunities	
<ul style="list-style-type: none"> • EE programs in low income neighborhoods 	

Industrial Energy Efficiency as an Emission Reduction Approach

Possible Leads

- State Energy Offices (SEOs)
- Utilities / Program Administrators
- Industrial End-Users
- ESCOs

E-Savings

- Metered electricity savings after installing measures or making operational and behavioral changes compared to project start

Potential Program Components

- Strategic Energy Management (SEM)
- ISO50001
- Superior Energy Performance (SEP)

Potential Electricity Savings
85 – 130 million MWh in 2030
48 – 74 short tons CO₂

Activities	EM&V
<p>Energy Savings Approaches</p> <ul style="list-style-type: none"> • SEOs, program administrators, industrial end users, ESCOs generate energy savings from: <ul style="list-style-type: none"> – Energy management – Energy management system – Training – Metering – Technical assistance – Capital improvements 	<ul style="list-style-type: none"> • Third-party verification of savings occurs within Superior Energy Performance in accordance with Superior Energy Performance EM&V Protocol • <i>Forthcoming resources:</i> <ul style="list-style-type: none"> – Library of common industrial EE projects/practices and accepted savings calculation methodologies – Uniform Methods Project Protocols for Strategic Energy Management/Superior Energy Performance (Summer 2016)
<p>State Policy Options</p> <ul style="list-style-type: none"> • Could include: <ul style="list-style-type: none"> – Energy efficiency resource standard (EERS) – Registry of energy savings from ISO50001 certification or Superior Energy Performance 	
<p>Low Income Opportunities</p> <ul style="list-style-type: none"> • Possible if facility located in a low income community 	

Combined Heat and Power as an Emission Reduction Approach

Possible Leads

- State energy offices (SEOs)
- City energy or sustainability office
- Utilities / program administrators
- Industrial end-users
- ESCOs

E-Savings

- kWh / MWh generated on site

Potential Program Components

- District energy / microgrids

Potential Electricity Savings
 75 – 115 million MWh in 2030
 43 – 66 short tons CO₂

Activities	EM&V
Energy Savings Approaches	
<ul style="list-style-type: none"> • Large energy users, utility, or state energy offices generate energy savings from: <ul style="list-style-type: none"> - Incentives to support CHP installation in buildings 	<ul style="list-style-type: none"> • Recent resources provide guidance, including: <ul style="list-style-type: none"> - Combined Heat and Power: A Clean Energy Solution - Guide to the Successful Implementation of State CHP Policies - Assessment of the Technical Potential for CHP in the U.S. [forthcoming]
State Policy Options	
<ul style="list-style-type: none"> • Could include <ul style="list-style-type: none"> - CHP in state energy resource standard (e.g., EERS, RPS) - Interconnection standards 	
Low Income Opportunities	
<ul style="list-style-type: none"> • CHP projects in low income neighborhoods (e.g., multifamily housing, schools, community centers, hospitals, facilities) 	

Energy Savings Performance Contracting as an Emissions Reduction Approach

Possible Leads

- State Energy Office
- State/Local General Services
- Local Sustainability Office
- Commercial building owner
- ESCO

E-Savings

- Annual kWh reduced since project installation date

Potential Program Components

- Green Bank or other internal state/city funding
- Utility
- State ESPC Support Program

Potential Electricity Savings
45 – 90 million MWh in 2030
26 – 51 short tons CO₂

Activities	EM&V
Energy Savings Approaches	
<ul style="list-style-type: none"> • State energy or general services office, building owners, ESCOs, utilities generate energy savings from: <ul style="list-style-type: none"> - Direct energy management - Capital improvements - Technical assistance - Training - Metering - Utility incentives 	<ul style="list-style-type: none"> • Recent resources provide guidance, including: <ul style="list-style-type: none"> - <u>Federal Energy Management Program M&V Guidelines Version 4.0</u>
State Policy Options	
<ul style="list-style-type: none"> • Could include: <ul style="list-style-type: none"> - Energy efficiency resource standard (EERS) - Executive Order or legislation to create ESPC program w/target savings or investments - State financing for ESPC projects - State admin. rules to support ESPCs 	
Low-Income Opportunities	
<ul style="list-style-type: none"> • Energy savings projects in low-income neighborhoods (e.g., schools, community centers, facilities, multifamily housing) 	

Building Energy Codes as an Emission Reduction Approach

Possible Leads

- State code administrator
- State energy office
- Utility
- NGO

E-Savings

- # new code or beyond code built bldgs. X reduction in kWh per bldg. from code in 2012

Potential Program Components

- Stretch Code Programs
- ENERGY STAR New Homes
- Zero Energy Ready Homes

Potential Electricity Savings
50 – 60 million MWh in 2030
29 – 34 short tons CO₂

Activities

Energy Savings Approaches

- State energy office, utility, or NGO generate energy savings from:
 - Education
 - Training
 - Enforcement activities

State Policy Options

- Could include:
 - Legislation to require adoption of latest national model energy code upon update
 - Legislation to require reduction in building energy use by date (e.g., 70% by 2030)

Low Income Opportunities

- Building code adoption and compliance in low income neighborhoods

EM&V

- Recent resources provide guidance, including:
 - DOE [Building Energy Codes Program \(BCEP\)](#)
 - [Achieving Energy Savings and Emission Reductions from Building Energy Codes: A Primer for State Planning](#)
 - *Multi-state in field evaluation (forthcoming)*

City-Led Efficiency Efforts as an Emission Reduction Approach

Possible Leads

- City energy or sustainability office
- City general services office
- Municipal utility
- Community-based organizations

E-Savings

- Aggregate city-wide (municipal, industrial, commercial, residential) electricity savings compared to starting year consumption

Potential Program Components

- Building performance policies
- Voluntary building efficiency challenges
- Financing (property assessed clean energy [PACE], performance contracting)
- Municipal building efficiency
- Water/wastewater treatment facilities
- Streetlight upgrades
- Homeowner outreach

Potential Electricity Savings
 25 – 50 million MWh in 2030
 14 – 29 short tons CO₂

Activities	EM&V
<p>Energy Savings Approaches</p> <p>City offices, utility, or community-based organizations generate energy savings from:</p> <ul style="list-style-type: none"> • Training, outreach, enforcement of building efficiency policies • Outreach and technical assistance for voluntary programs • Installing energy upgrades to municipal buildings, water/ wastewater treatment facilities, streetlights 	<p>Recent resources provide guidance, including:</p> <ul style="list-style-type: none"> • <u>DOE Benchmarking & Transparency Policy and Program Impact Evaluation Handbook</u> • <u>Assessment of Automated Measurement and Verification (M&V) Methods</u> • <u>Federal Energy Management Program M&V Guidelines Version 4</u>
<p>State Policy Options</p> <p>Could include:</p> <ul style="list-style-type: none"> • Enable cities to implement PACE • Provide guidance to utilities for streamlining energy data access for building benchmarking • Create state-led city programming (e.g., MA Green Communities) 	
<p>Low Income Opportunities</p> <ul style="list-style-type: none"> • Building energy efficiency programs in low income neighborhoods 	

Low-Income Efficiency Programs as an Emission Reduction Approach

Possible Leads

- State administrators
- State energy office
- Utility
- Housing NGO's focused on low income

E-Savings

- # of homes improved X average savings associated with improvement

Potential Program Components

- Weatherization Assistance Program
- Home Performance with ENERGY STAR
- Proper HVAC maintenance and installation practices
- Duct sealing
- Air sealing and insulation program
- Appliance rebate program

Activities

Energy Savings Approaches

- State energy office, utility, or NGO generate energy savings from:
 - Education
 - Training and certification of technicians
 - Manage homeowner relationships
 - Outreach
 - Connect clients with contractors to improve homes
 - Monitor EM&V

State Policy Options

- Could include:
 - Legislation to provide funds for retrofit program with incentives
 - Legislation to provide low-cost financing
 - Rate payer funded programs directed at low-income

Low Income Opportunities

- This program is targeted to low-income households

EM&V

- Recent resources provide guidance, including:
 - [Weatherization Works-Summary of findings from the Retrospective Evaluation of the U.S. Department of Energy's Weatherization Assistance Program](#)
 - [Better Buildings Residential Program Solution Center](#)
 - [Appliance Rebate Program-Design Guide](#)
 - [The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures](#)

Get More Information on These Pathways

Visit: energy.gov/eere/slsc/EEopportunities

[Pathways Presentations: How Specific Energy Efficiency Opportunities Can Support State Climate and Energy Planning](#)

Seven presentations (one for each pathway) of features and benefits associated with including energy efficiency opportunities in climate and energy plans, covering:

- current activity at the national and state levels
- best practices
- energy savings examples
- cost-effectiveness
- evaluation, measurement, and verification (EM&V) approaches
- DOE support

[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](#)

New State and Local Energy Efficiency Action Network (SEE Action) resource presents the pathways through:

- case studies of successful regional, state, and local approaches
- sources for more information
- resources to understand the range of expected savings from energy efficiency
- common protocols for documenting savings

Existing DOE Technical Assistance & Resources Available

DOE Provides Support for Clean Energy Planning & Implementation

Based on inquiry and resources available, technical assistance can include...

Existing Resources

Launching New Projects

Published Resources
Provide resources or links to toolkits, guides, webinars, data, and other technical materials

Partnerships / Initiatives
Share opportunities to join or leverage work from existing facilitated efforts

Expand Efforts Underway
Add new info, cases, or partners to existing projects to address a request

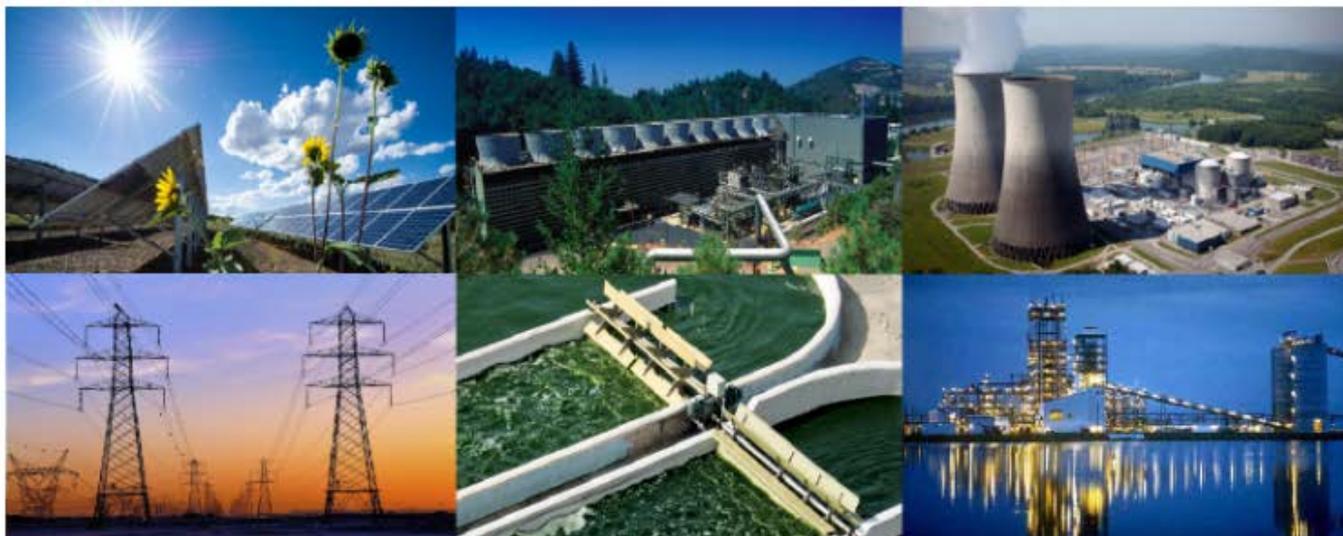
DOE Expert Consultations
Provide access to DOE and Lab staff for consultation and/or analytical assistance

Direct Funding
Provide funding through DOE funding announcements (e.g., SEP competitive, SunShot)

Fastest Way to Access Technical Assistance



STATE, LOCAL AND TRIBAL TECHNICAL ASSISTANCE GATEWAY



[Frequently Asked Questions](#)

[Featured Topic: Greenhouse Gas Reduction Strategies in the Electric Power Sector](#)

CONTACT US

For more information about technical assistance at the Department of Energy, contact us via [e-mail](#).

ENERGY.GOV/TA

The State, Local and Tribal Technical Assistance Gateway provides an access point to DOE's technical assistance and cooperative activities with state, local and tribal officials. Through its [program and staff offices](#), DOE has engaged extensively with various levels of state, local and tribal governments, providing technical assistance on a range of energy issues. Our existing technical assistance and other activities, as well as relevant information offered by other federal agencies, are provided below by program or topic.

If you're a state, local or tribal official, or a representative from an organization of such officials, with a specific question or need for assistance, [email us](#) and we'll work collaboratively across the DOE to address your inquiry. Responses could include access

Wide Range of DOE Existing Resources & Partnerships Available

Typical Lead			Savings Pathways	Example Best Practice Programs, Policies, EM&V
Private Sector	S/L Gov't	Utility		
		✓	Ratepayer-Funded Efficiency Programs	State and Local Energy Efficiency Action Network
✓	✓	✓	Industrial Efficiency	Superior Energy Performance
✓	✓	✓	Combined Heat and Power	CHP Technical Assistance Partnerships
✓	✓		Energy Savings Performance Contracting	Better Buildings ESPC Accelerator
	✓	✓	Building Energy Codes	Building Energy Codes Analyses of Savings
	✓		City-Led Energy Efficiency Efforts	Better Buildings Challenge
	✓	✓	Low Income Energy Efficiency	Home Performance with ENERGY STAR

S/L Gov't = state or local government

Industrial Sector Resource Highlights

Typical Leads	Savings Pathways	Direct Technical Assistance
<ul style="list-style-type: none"> • Private Sector • State / Local Utilities 	Industrial Efficiency	<ul style="list-style-type: none"> • Superior Energy Performance • Better Buildings Better Plants • Industrial Assessment Centers
	Combined Heat and Power	<ul style="list-style-type: none"> • CHP Technical Assistance Partnerships

Best Practice Programs and Policies

- [Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector](#)
- [Superior Energy Performance \(SEP\) Guide for the Development of Energy Efficiency Program Plans](#) (NEW)
- [SEP Cost Effectiveness Screening Tool](#) (NEW)
- [SEP Program Planning Template](#) (NEW)
- [SEP Program Transition Tables](#) (NEW)

Evaluation, Measurement, and Verification (EM&V) Resources

- ❖ [Superior Energy Performance EM&V Protocol](#)
- ❖ Uniform Methods Project Protocols for Strategic Energy Management/Super Energy Performance (forthcoming, Summer 2016)
- ❖ Uniform Methods Project Protocols for CHP (forthcoming, Summer 2016)

Commercial / Public Sector Resource Highlights

Typical Leads	Savings Pathways	Direct Technical Assistance
<ul style="list-style-type: none"> • State / Local • Utilities 	Building Energy Codes	<ul style="list-style-type: none"> • Building Energy Codes Program
	Energy Savings Performance Contracting	<ul style="list-style-type: none"> • Better Buildings ESPC Accelerator
	City-Led Energy Efficiency Efforts	<ul style="list-style-type: none"> • Better Buildings Challenge
	Ratepayer-Funded Efficiency Programs	<ul style="list-style-type: none"> • Better Buildings Alliances • State Energy Program
	Combined Heat and Power	<ul style="list-style-type: none"> • CHP Technical Assistance Partnerships

Documentation of Best Practice Programs and Policies

- [State and Local Solution Center](#)
- [Benchmarking and Disclosure: State and Local Policy Design Guide and Sample Policy Language](#)
- [New York City Benchmarking and Transparency Policy Impact Evaluation Report](#)
- [Energy Data Access Toolkit](#)

Evaluation, Measurement, and Verification (EM&V) Resources

- ❖ [DOE Benchmarking & Transparency Policy and Program Impact Evaluation Handbook](#)
- ❖ [Assessment of Automated Measurement and Verification \(M&V\) Methods](#)
- ❖ [FEMP M&V Guidelines Version 4](#)

Residential Sector Resource Highlights

Typical Leads	Savings Pathways	Direct Technical Assistance
<ul style="list-style-type: none"> • State / Local • Utilities 	Building Energy Codes	<ul style="list-style-type: none"> • Building Energy Codes Program
	Low Income Energy Efficiency	<ul style="list-style-type: none"> • Weatherization Assistance Program • Home Performance with ENERGY STAR
	Ratepayer-Funded Efficiency Programs	<ul style="list-style-type: none"> • Home Energy Score • Zero Energy Ready Homes • Better Buildings Residential Network

Documentation of Best Practice Programs and Policies

- [Weatherization Assistance Program Technical Assistance Center](#)
- [Building America Solution Center, Better Buildings Residential Program Solution Center](#)
- [SEE Action Policy Makers' Guide to Home Energy Upgrades](#) (NEW)

Evaluation, Measurement, and Verification (EM&V) Resources

- ❖ [Achieving Energy Savings and Emission Reductions from Building Energy Codes: A Primer for State Planning](#)
- ❖ [Savings and Cost Analysis for Zero Energy Ready Homes](#)
- ❖ [EM&V of Residential Behavior-Based EE Programs Guide](#)
- ❖ [Home Energy Upgrade Program Cost-Effectiveness Screening Tool](#)
- ❖ Cost/Benefit Report on Home Upgrade Program Models (forthcoming, Spring 2016)

Cross-Cutting Resource Highlights

Typical Leads	Topics	Direct Technical Assistance
<ul style="list-style-type: none"> • State / Local • Utilities 	<p>State Energy Planning</p> <hr/> <p>Evaluation, Measurement & Verification</p> <hr/> <p>Financing (e.g., on bill, PACE)</p>	<ul style="list-style-type: none"> • State Energy Program • DOE Technical Assistance Program

Documentation of Best Practice Programs and Policies

- [Energy Efficiency Savings Opportunities and Benefits](#)
- [SEE Action Guide: Energy Efficiency as a Least-Cost Strategy to Reduce Greenhouse Gas Emissions and Meet Energy Needs in the Power Sector](#)
- [State and Local Solution Center](#)
- 2015 Energy Efficiency Financing Snapshot: A Market Review and Guide for State and Local Governments (forthcoming, Spring 2016)

Evaluation, Measurement, and Verification (EM&V) Resources

- ❖ [Uniform Methods Project](#)
- ❖ [Energy Efficiency Program Impact Evaluation Guide](#)
- ❖ [Energy Efficiency Under Alternative Carbon Policies: Incentives, Measurement, and Interregional Effects](#)
- ❖ Evaluator Certification (forthcoming, 2016)

Appendix: Calculations of Electricity and Carbon Savings

Estimates of National Electricity and Carbon Savings Potential in 2030

NOTE: Pathways may include overlapping savings, so estimates are NOT additive.

Savings Pathway	Ballpark Achievable Potential Calculations Based on the Following Low to High Scenarios	Data Sources	Low estimate	High estimate
Ratepayer-Funded Efficiency Programs	Total estimated savings in 2030 from reduced electricity load growth rates due to ratepayer-funded energy efficiency programs achieving annual incremental savings of 1.1 - 1.5% from 2012 baseline.	LBNL, 2013, The Future of Utility Customer-Funded Energy Efficiency Programs in the U.S.	645 million MWh 368 short tons CO ₂	895 million MWh 510 short tons CO ₂
Industrial Efficiency	Total estimated savings in 2030 for 50 - 75% of industrial plants achieving 2% annual energy intensity improvements (based on the Better Plants standard) from the AEO 2015 forecasted baseline for 2030.	EIA 2015 AEO Tables 25-35	85 million MWh 48 short tons CO ₂	130 million MWh 74 short tons CO ₂
Combined Heat and Power	Total estimated savings in 2030 from completing 30 - 45% of economical (less than 10 year payback) CHP system installation projects smaller than 100 MW.	American Gas Association, 2013, The Opportunity for CHP in the United States	75 million MWh 43 short tons CO ₂	115 million MWh 66 short tons CO ₂
Energy Savings Performance Contracting	Total estimated savings in 2030 based on 0 - 8% annual growth rates in volume of ESCO projects from 2012 baseline.	LBNL, 2015, Estimating customer electricity and fuel savings from projects installed by the US ESCO industry and LBNL, 2014, A method to estimate the size and remaining market potential of the U.S. ESCO industry	45 million MWh 26 short tons CO ₂	90 million MWh 51 short tons CO ₂
Building Energy Codes	Total estimated savings in 2030 from 100% adoption and 70-95% compliance rates for ASHRAE 90.1-2010 / ASHRAE 90.1-2013 commercial building codes (compared to ASHRAE 90.1-2007 baseline) and IECC 2012 / IECC 2015 residential building codes (compared to IECC 2009 baseline)	DOE determinations and supporting analysis and PNNL Codes Impact Analysis	50 million MWh 29 short tons CO ₂	60 million MWh 34 short tons CO ₂
City-Led Energy Efficiency Efforts	Total estimated savings in 2030 from 5 - 10% savings in city-wide (residential, commercial, and industrial) electricity consumption for the largest 50 U.S. cities.	ACEEE, 2015, City Energy Efficiency Scorecard Table C6	25 million MWh 14 short tons CO ₂	50 million MWh 29 short tons CO ₂

Carbon emissions estimates based on national average total output emission rate (1,136.53 lb/MWh or .57 short tons/MWh) published in [2012 eGRID](#)