User Guide for the ACEEE Local Energy Efficiency Policy Calculator (LEEP-C), Version 2.0 Beta

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This tool builds off of Version 1.0 Beta of the ACEEE Local Energy Efficiency Policy Calculator (LEEP-C), which was developed by Eric Mackres, John A. "Skip" Laitner, and Max Neubauer of ACEEE. Numerous members of the ACEEE staff past and present contributed their time toward helping to envision, scope, and review LEEP-C. These contributors include Therese Langer, Steven Nadel, Jennifer Amann, Harvey Sachs, Suzanne Watson, Dan York, Benjamin Foster, Maggie Molina, Catherine Bell, Shruti Vaidyanathan, and Michael Sciortino. Thanks to Kate Hayes, Fred Grossberg, and Roxanna Usher for editing this report. We would also like to thank Barton Kirk for his feedback and suggestions.

Previous versions of LEEP-C have also been reviewed by external experts. These peer reviewers included Elena Alschuler, MIT Energy Efficiency Strategy Project; Sarah Busche, National Renewable Energy Laboratory; Diana Lin and Kate Marks of the National Association of State Energy Officials; Anne McKibbin, Elevate Energy; Steve Morgan, Clean Energy Solutions, Inc.; and Andy Satchwell, Lawrence Berkeley National Laboratory. Before public release, LEEP-C Version 1.0 Beta was tested by several local government staff and local energy stakeholders. The testers were nominated by Jared Lang of the National

Association of Counties and Julia Parzen of the Urban Sustainability Directors Network. Testers include Barbara Buffaloe and Tina Worley, City of Columbia, Missouri; Matthew Naud, City of Ann Arbor, Michigan; and Jeaneen Zappa, Allegheny County, Pennsylvania.

By naming individuals and organizations above we do not mean to imply endorsement of the research product; instead our intention is to acknowledge their contributions and to thank them. ACEEE is solely responsible for the content of this tool and user guide.

Executive Summary

The ACEEE Local Energy Efficiency Policy Calculator, or LEEP-C (pronounced *leap-see*), is intended for use by state and local policymakers and stakeholders interested in advancing the adoption of energy efficiency in their communities. Currently the tool is capable of analyzing the impacts of a total of 23 different policy types from 4 energy-using sectors: public buildings, commercial buildings, residential buildings, and transportation. Based on research on the costs of and savings from specific policies, forecasted national and regional energy trends, and user inputs regarding local energy and economic characteristics and level of investment, LEEP-C is able to calculate estimated impacts of specific policy choices on energy savings, cost savings, pollution, jobs, and other outcomes over a time period set by the user. Additionally, the tool allows users to interactively explore the absolute and relative impact of select policies. Finally, the tool allows for the weighting of different policy options based on user inputs regarding community priorities to find those policies that best fit with community goals. While the tool is primarily designed to provide a first-cut, initial analysis of local policy options, it is also applicable to some issues of interest to state, regional, and national policymakers and stakeholders.

With LEEP-C, users can do the following:

- Explore the potential impacts of policy choices based on current and forecasted economic and demographic conditions in their community
- Customize the inputs for specific policies to match the likely level of investment that is possible in their community
- Discover the policies or portfolio of policies that best help them meet their community goals
- Explore the estimated impact of the policies in different communities and under different economic conditions

Resulting costs and benefits are available on an annualized basis and are presented as absolute values and/or in relation to costs for the following:

- Policy costs, including financing
- Energy savings for electricity, natural gas, gasoline, and diesel
- Energy cost savings
- Greenhouse gas emissions
- Criteria pollutant emissions
- Net jobs
- Standard benefit–cost tests (TRC, PAC, PCT)

The LEEP-C tool and related resources are available for free at http://aceee.org/sector/local-policy/toolkit.

Introduction

Goals and Uses

The ACEEE Local Energy Efficiency Policy Calculator, or LEEP-C (pronounced *leap-see*), is intended for use by state and local policymakers and stakeholders interested in advancing the adoption of energy efficiency in their communities. Currently the tool is capable of analyzing the impacts of a total of 23 different policy types from 4 energy-using sectors: public buildings, commercial buildings, residential buildings and transportation. Based on prior research on the costs of and savings from specific policies and user inputs regarding local energy and economic characteristics and level of investment, LEEP-C is able to calculate estimated impacts of specific policy choices on energy savings, cost savings, pollution, jobs, and other outcomes over a time period set by the user. Additionally, the tool allows users to interactively explore the absolute and relative impact of select policies. Finally, the tool allows for the weighting of different policy options based on user inputs regarding community priorities to find those policies that best fit with community goals. While the tool is primarily designed to provide a first-cut, initial analysis of local policy options, it is also applicable to some issues of interest to state, regional, and national policymakers and stakeholders.

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The sectors and policies users can customize and analyze with the tool include the following:

- Public buildings (retrofit, retrocommissioning, benchmarking and disclosure, and performance-based policy)
- Residential buildings (benchmarking and disclosure, building energy codes, efficient new homes)
- Commercial buildings (retrofit, retrocommissioning, benchmarking and disclosure, performance-based policy, building energy codes)
- Transportation (combined land use, pedestrian strategy, bicycle strategy, parking pricing, pay-as-you-drive insurance, congestion pricing, cordon pricing, vehicle-miles-traveled tax, employer-based commute strategies, increased levels of transit service, expanded urban public transportation)

Resulting costs and benefits are available on an annualized basis and are presented as absolute values and/or in relation to costs for the following:

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LEEP-C builds upon ACEEE's decades of experience in national, state, and local policy analysis; technology and program assessments; and economic impact analysis. These ACEEE projects include but are not limited to the *Change Is in the Air* analysis of energy efficiency as an emissions reduction strategy, the State Clean Energy Resource Project, and the Dynamic Energy Efficiency Policy Evaluation Routine (or DEEPER Modeling System). Our goal with this tool is to package some of these methodologies and associated data for use by the broader public. We hope the tool will provide greater understanding of the broad economic, environmental, and community development opportunities available from energy efficiency policies and programs and will allow for better integration of energy efficiency resources into public policy and planning processes.

Please note that LEEP-C is intended as a planning and decision support tool for communities in the United States and is designed to give first-cut estimates of impacts. It is not an economic model or financial tool, but a reconnaissance assistant. While we have made every effort to apply the best available data and analysis methodologies, actual results from the implementation of policies will vary. This tool should not be used as a substitution for gathering locally appropriate data, seeking out estimates of costs and benefits from potential project implementers, or developing detailed policy-specific analyses.

The LEEP-C tool and related resources are available for free at http://aceee.org/sector/local-policy/toolkit.

We are interested in your input on how LEEP-C can be improved to better meet your needs. Please send suggestions to David Ribeiro at dribeiro@aceee.org.

New Features in Version 2.0

We have added several new capabilities to the version 2.0 of LEEP-C. Some of the important changes are described below.

New sectors, programs, and policies. Additional policies and analysis capabilities have been added for the transportation and commercial buildings sectors, and for new buildings in the commercial, residential, and public sectors. The tool includes data on fuel types (including the addition of gasoline and diesel), costs, savings, jobs, and emissions for these new sectors and policies.

Energy-use baseline and business-as-usual forecast. Users can now input information about their current energy use characteristics or estimate an energy-use baseline for their community using national or regional averages. National and regional projections are also used to forecast energy use in future years. Having a baseline and forecast allows for a more complete energy-use picture and more compressive comparisons between business-as-usual and policy scenarios. Additionally, the tool now allows for users to set quantitative energy-related goals (energy savings, cost savings, job creation, and greenhouse gas reduction) relative to a baseline year or scenario.

Better data visualization and reports on results. The visual presentation of results has been improved, including adding a two-page, printable summary report of the results, which includes figures to compare energy use under business-as-usual and a policy scenario.

Customizable fuel prices. In addition to estimating retail fuel prices for electricity, natural gas, fuel oil, propane, gasoline, and diesel based on historic state and national cost and projections, LEEP-C now allows users to override these estimates and enter customized prices for the starting year of the analysis.

Benefit–cost tests and avoided costs. Calculations of the most common utility sector benefit–cost tests (total resource cost test, program administrator cost test, and participant cost test) are now presented for all buildings policies. In order to enable these calculations, estimates of avoided costs of infrastructure investment due to saved energy for the utility sector are included. These estimates are based on national and regional averages and are user customizable to better match local conditions.

Interactions between policies and policy portfolios. Improvements in the calculation methods for policy impacts now accounts for simple interaction effects among policies to avoid double counting. As a result, LEEP-C now allows users to calculate total impacts from a user-selected portfolio of the available policies. This enables better use of the tool to explore how much various combinations of policies will contribute toward achieving one or more particular goals.

Energy Efficiency Policies

For the purposes of this tool, energy efficiency policies are defined as systematic, multi-year efforts to increase the level of adoption of energy efficiency technologies and practices. Some of the policies included in LEEP-C would more commonly be described as programs but are considered policies for our purposes because they are analyzed as implemented over an extended period of time and are intended to contribute to specific policy aims. Others may look like energy efficiency projects; however, these are actually policies because they put in place a systematic approach through which to evaluate and pursue many projects over an extended period of time.

The question of who puts in place or implements a policy is not included as a variable in the LEEP-C analysis. Costs and benefits from implementation are calculated for the scale of analysis set by the user, but it is possible that the policies could be implemented at a scale different from that of the analysis (e.g., policies are implemented by the state government, but the analysis is set to determine the impacts on a single county in that state). In general, costs and benefits at the scale of analysis would be similar whether implemented at that scale or another; the major difference would be to whom costs accrue and how. However there can be advantages to implementing a policy over larger geographies, such as economies of scale, lower administrative costs, and greater market consistency.

It is important to recognize that choices among the policies included are not mutually exclusive. Many of them are even complementary to each other. LEEP-C evaluates the impact of the policies and accounts for simple interaction effects between them to avoid double counting of savings. Other more complex policy-specific interactions are not accounted for. These interactions could be synergistic in some cases, such as when policies A and B reinforce each other. This is similar to the interactions at the project level where, for example, residential building shell improvements could decrease the size required for a new furnace or boiler to replace obsolete equipment, decreasing its cost and increasing its cost effectiveness. Savings can also be path dependent, with cost effectiveness and savings varying with the sequence in which measures are undertaken. We do not attempt to include these interactions in this screening tool. More sophisticated modeling analyses do account for these interaction effects. Based on their needs, communities may want to consider a more complex analysis after using LEEP-C for a first-order estimate.

While LEEP-C results suggest which policies may have the greatest impact on the community if they are implemented successfully, the results do not provide a framework through which to think about which policies are most appropriate to the politics, experience, resources, and capacities, among other variables, in a particular community. With that caveat in mind, this section attempts to provide a few thoughts to help integrate these considerations into policy selection.

It may be helpful to think of the policies included in LEEP-C as fitting into categories differentiated by the level of political effort and investment that they require. Characteristics of these policies are as follows.

Energy information policies

Public and commercial building benchmarking and disclosure and residential benchmarking and disclosure. These are relatively low-cost policies because the actions they require are only marginal costs on top of the much larger costs associated with planned building improvements or real estate transactions. While they do require changes to practices for specific actors (notably building operators and realtors, and building owners to a lesser degree), these are also marginal. The greater level of information about energy use that is available because of these polices can lead to increased adoption of energy efficiency measures and actions.

Incentives for energy improvements and resulting encouragement of energy performance businesses

Commercial building retrofit, *commercial building retrocommissioning*, *and ENERGY-STAR®-certified new homes*. These policies provide financial incentives and technical assistance to building owners willing to make energy efficiency improvements. In addition to improving energy efficiency, these policies, if implemented correctly, can also help to foster a community of businesses, such as trained contractors, focused on improving energy performance. The upfront costs from financial incentives and the level of effort required to successfully administer these program can be high. As a result, partnership with energy utilities, state governments, or other existing service providers is often desirable.

Infrastructure and public service investments

Combined land use, pedestrian strategy, bicycle strategy, expanded urban public transportation, employer-based commute strategies, and increased levels of transit service. Choosing how public infrastructure and services investments are prioritized can have a significant impact on energy use in the built environment, particularly on energy use related to land use and transportation. The ways road, transit, and water systems are built have lasting energy implications. Similarly, the level of transit, transportation-demand management, or other public services can influence energy use. Depending on the investment or service, these decisions can be driven by local or state governments (often through cooperation between multiple levels of government), and can be implemented through integrating energy-use considerations into how investments are selected.

Energy performance or investment requirements

Public building retrofit, public building retrocommissioning, residential upgrade requirements, performance-based policy for new and existing public and commercial buildings, and residential and commercial energy codes. Any form of energy performance improvement requirement, whether directed at public or private buildings, can lead to greatly decreased public costs for financial incentives and other administration of voluntary programs, with policy enforcement becoming the major related function. However, if not accompanied with incentives or appropriate financing, this type of policy will considerably increase the upfront costs to building owners as a whole. While the number of buildings making improvements (and total resulting energy savings) would go up, depending on how the policy is designed, the average cost per household making energy improvements may go down because many participants would only be doing the bare minimum for compliance. Implementation of performance requirements benefits greatly from having an existing, trained building performance workforce.

Pricing policies

Parking pricing, pay-as-you-drive insurance, congestion pricing, cordon pricing, and vehicle-miles-traveled tax. Price signals influence consumer behavior. Appropriately pricing the costs of an energy-using behavior can often result in reduced consumption. As an example, in the transportation sector, there are a variety of situations in which drivers do not pay the full costs of their travel. Pricing policies can make users pay for the costs of choices (e.g., transportation modes, when and where to travel, where to park, etc.). With a few exceptions (like parking pricing), these policies are usually implemented through leadership at the state or metropolitan level in cooperation with local governments.

It is possible to view the first three of these categories of policies as foundational to the subsequent policies. For example, information policies can increase demand for incentives for energy improvement, and successful incentive programs can create greater acceptance for minimum energy performance. Of course, it makes sense to also think about policy strategies for specific sectors as well because, for example, the actions of building managers in the public sector are unlikely to impact the actions of homeowners. However it may be more appropriate to simply think of these policy types within a sector as working together in numerous ways and in any combination to create an ecosystem conducive to greater energy efficiency. If one takes that view, the specific policies that are adopted and the order in which they are implemented become questions of less importance. What is more important is that any one or more policies that make sense for a community are adopted and that they are used as starting points to develop momentum for continual improvement in energy efficiency.

Instructions

Getting Started

Learning how to use LEEP-C can take some time. Users are encouraged to set aside at least a few hours to get the most out of the tool. Users will need to learn how the tool functions, collect and enter data about their community, customize policies, consider resulting impacts, and make adjustments to variables. With this in mind, users who are quick learners can get a considerable amount of valuable information from LEEP-C in an hour or two. Other users may choose to use LEEP-C in the course of a community planning process; in this case the users may come back to the tool between or during meetings over the course of months.

When the LEEP-C Excel document is first opened, the user may be prompted with one or more security warning notices from Microsoft Excel. If prompted with *Macros have been disabled* or some similar message, the user should select *Enable content*. If prompted with the question *Do you want to make this file a trusted document*? select *Yes*. Some versions of Microsoft Excel are not compatible with macros. Users will likely receive a prompt when opening the file if the version is not compatible. The only limitation on the functionality of LEEP-C without macros is to the Attractiveness based on community priorities chart on the Results page. All other aspects of LEEP-C function without macros. Some users may also receive a prompt about circular references in the spreadsheet. Many of the formulas in LEEP-C are designed to function in iterative calculation mode, but when the file is opened in some versions of Excel, this functionality may be turned off. To turn on iterative calculations, click on *File* in the main menu bar, then *Options*, *Formulas*, and check the box titled *Enable iterative calculation* in the upper right of the window.

Throughout the tool, cells that can be edited by users are indicated by bold dark-green text with a light-green background. All other cells should not be edited, as they present outputs based on user inputs or are simply descriptive. When the file is first opened, many of the editable cells are already populated with default values. Once these values are changed by the user, the values cannot be reset to their defaults automatically. However each value with a default also has that default value written in the cell next to it in the format (*Default is* __). These cells can be used for reference if the user wants to manually return values to their defaults.

When a value is changed by a user, the change is automatically reflected throughout every sheet in the tool, with the one exception of the attractiveness index on the Results sheet. When users want to save their work, they need only save the file by selecting *Save* or *Save As*.

Checklist of User Inputs

To make the most out of LEEP-C, users will need to gather some data about energy use in their community. However the number of required inputs is small, and the information needed for most of them is readily available. The numerous optional inputs allow users to better customize the results to their community, but default values are preprogrammed into LEEP-C for each of these inputs.

Required

- Community name
- Population of community (available from US Census American FactFinder)
- Estimated annual population-growth rate
- Years over which policies will be implemented (determined by user)
- Years over which policy impacts will be evaluated (determined by user)
- For residential and transportation policies, number of occupied residential units in community, disaggregated by building type (single-family, multifamily, mobile home). Required for analysis of residential or transportation policies; available from US Census American FactFinder.
- For public and commercial buildings policies, total floor areas (or estimate, if not available). Public building floor areas may be available from the building management department of local government; estimates of commercial building floor area may be available from the local tax assessment offices or from private data vendors.

Optional

- A ZIP code in your community. Any ZIP code in the community will work (available from USPS)
- Total annual building energy consumption by sector and fuel type in your community (may be available from local energy utilities or local government)
- Estimated annual growth rate of households, public building floor space, and commercial building floor space in your community
- Community goals, determined by community stakeholders or user
- Financing terms of energy efficiency investments, based on the average cost of capital to be made available for the policies
- Specific policy design variable preferences, determined by local policymakers and stakeholders
- For transportation policies, vehicles per household and average annual miles traveled per household per vehicle (or total annual vehicle miles traveled in community), by vehicle type. Community estimates for light-duty vehicles available from the US Department of Housing and Urban Development's Location Affordability Portal; national averages or data from state surveys may need to be used for estimates for other vehicle types.

Navigation

The LEEP-C tool is contained in an Excel workbook-based file. It consists of nine spreadsheets organized by the tabs at the bottom left of the application screen. Users are encouraged to maximize the window in which they have the tool open. Many of the sheets in the tool are both very tall and wide. Users with lower-resolution monitors may have to scroll left and right to see the entirety of certain sheets. The nine spreadsheets are as follows.

1. Intro. This sheet contains general background information on the goal, including a brief description of its uses, development credits, and a link to the user guide.

2. Local conditions. Users input information about the location, size, and priorities of their community as well as information about their planning timeline and financing environment. This information is used to calculate inputs for the analysis in the next sheets.

3a. Pub bldgs. This sheet requires user inputs regarding the general size and energy consumption characteristics of public buildings in the community being analyzed, or allows for users to select default values. It also contains general descriptions of the polices to be analyzed, allows for user customization of the policy design, and provides outputs of annual cost and energy savings, policy costs, and jobs calculations for each policy. The policies included on this sheet are

- Public building retrofit
- Public building retrocommissioning
- Public building benchmarking and disclosure
- Performance-based policy for new and existing public buildings

3b. Res bldgs. This sheet contains identical functionality to sheet 3a but is designed for user inputs regarding general residential building characteristics and customization of policy variables. The policies included on this sheet are

- Energy-use disclosure
- Updating residential building energy codes
- Efficient new homes, ENERGY STAR certified

3c. Comm bldgs. This sheet is designed for user inputs regarding general commercial building characteristics and customization of policy variables. The policies included on this sheet are

- Commercial building retrofit
- Commercial building retrocommissioning
- Commercial building benchmarking and disclosure
- Performance-based policy for new and existing commercial buildings
- Updating commercial building energy codes

3d. Transportation. This sheet is designed for user inputs regarding general transportation characteristics and customization of policy variables. The policies included on this sheet are

- Combined land use
- Pedestrian strategy
- Bicycle strategy
- Parking pricing
- Pay-as-you-drive insurance
- Congestion pricing
- Cordon pricing
- Vehicle-miles-traveled tax
- Employer-based commute strategies
- Increased levels of transit service and improved travel times
- Expanded urban public transportation

4a. Results. This sheet displays the outputs of the analysis of the variables entered in the previous sheets in multiple formats. It includes five tables, four for buildings policy impacts and one for transportation policy impacts.

Absolute impacts of buildings policies. Displays the impacts of buildings-related policies in absolute units (e.g., electricity savings of 2,000,000 kWh) for financial costs and savings, energy savings, jobs, and pollutants.

Relative impacts of buildings policies. Displays the impacts of all buildings policies in relative units (e.g., electric savings of 15 kWh per dollar invested).

Benefit–cost tests. For each sector and policy, displays the cost of saved energy and the benefit–cost ratios under three cost tests.

Absolute impacts of transportation policies. Displays the impacts of all transportation-related policies in absolute units (e.g., energy savings of 100,000 MMBtu) for costs and savings, energy savings, and pollution reduction.

Community savings goals. Displays overall projected change in energy use, costs, and greenhouse gases in the ending year of the analysis period, in comparison to the quantitative goals set by the user on sheet 2. Local conditions.

The Results sheet also includes three figures (two for buildings and one for transportation):

Comparison of buildings policy performance. Displays a radar chart of 13 metrics by which the performance of each policy is measured. This allows for the visual comparison of the relative merits of each policy.

Attractiveness based on community priorities. Displays a modified bar chart on which 12 policies along with the aggregate for each sector (e.g., residential, public, commercial) are plotted on an index measuring relative attractiveness. The index is calibrated based on the user inputs of community priorities from spreadsheet 2. Local conditions.

Transportation energy savings. Displays a bar chart of 11 transportation policies and the resulting energy savings measured in MMBtu for each.

4b. Cash flow. This sheet displays year-by-year details of cash flow and other costs and benefits for each sector and policy. Summaries of each of these data points are provided on sheet 4. Results; however, this sheet lets users see more detail about when costs and benefits accrue.

5. Report. This sheet presents a two-page printable summary of the results. In particular, it presents the results under the policy portfolio developed by the user in comparison to a business as usual scenario.

The next sections of the document describe each spreadsheet of the tool and the use of its component sections and fields.

2. Local Conditions Spreadsheet

1	*Green values and light green boxes can be adjusted by user*				
2					
3	**Required user inputs**				
4					
5	**Community characteristics**				
6	**Community name**				
7	**Use national averages?**	No			
8	**If "No," enter a ZIP code in area**	68134	*Used to automatically calculate energy prices and emissions rates*		
9	*State*	NE			
10	*Census division*	4			
11	**Community population in starting year**	29,533	*Used to scale local job impact estimates to the size of the community*		
12	**Occupied residential units in starting year**	13,254			
13	*Persons per household*	2.23	(national average = 2.59)		
14	**Population growth rate, annual**	0.91%	*Used to calculate energy use growth rate (national average = 0.91%)*		
15					
16					
17	**Policy and financial conditions**				
18					
19	**Policy implementation period**	*Over which years will you be implementing your policies?*			
20	Starting year	2015			
21	Ending year	2016			
22	Total implementation period	2	years		Although the implementation and impact analysis period are controlled entirely by the user we recommend setting the analysis period at least twice the length of the implementation period. Energy efficiency program and policy benefits accrue long after implementation thus in order to capture the full potential of a policy the analysis period must be extended to reflect the long term savings that can be achieved.
23					
24	**Impact analysis period**	*Over which years would you like to evaluate the impacts of your policies?*			
25	Starting year	2015			
26	Ending year	2019			
27	Total analysis period	5	years		
28					
29	**Social discount rate**	*How much do you want to mark down costs and benefits in future years to account for lost investment opportunities?*			
30		3.00%	(default 3%)		
31					
32					
33	**Policy financing**				
34	**Percent down**	100%	(default: 20%)	*out-of-pocket share of investment (0-100%)*	
35	**Interest rate**	6.00%	(default: 6%)	*per year on loan to finance projects*	
36	**Loan period**	5	(default: 5 years)	*years to retire loan (must be greater than 0)*	

Community Characteristics

In this section the user provides inputs that are used to calculate local scaling factors for energy costs, energy-related pollution, and job impacts. Users should enter the name of the community or region they are analyzing in the first field, *Community name*. The next two fields in this section (*Use national averages?* and *If No, enter ZIP Code in area*) allow the user to select national averages or to enter a ZIP code in the area to be analyzed. Based on the response to this question, the associated *State* and *Census Division* will be displayed. Using the input, a number of variables are calculated elsewhere in the tool, including the appropriate state average retail prices for various fuels and the emissions rates of air pollutants associated with electricity generation in the eGRID emissions subregion in which the ZIP code is located. If the ZIP code field is left blank or a ZIP code for which data are not available is entered, then an error of #N/A will be displayed in the State field. If this error is displayed, the user must choose a different ZIP code or choose to use national average numbers. The final fields in this section (*Community population in Starting year* and *Occupied residential units in Starting year*) are used as variables to estimate sector-based energy use elsewhere in the tool and to estimate the purchase-diversity ratio, or the amount of spending from the community that stays in the community, which is a variable used to calculate job creation impacts.

Note: It is fine if the geography and population to be analyzed spans more than one ZIP code. ZIP codes are requested in this section simply because they are more geographically precise than states are. This is important for our calculations particularly because states often have more than one electricity emissions region.

Tip: Basic information about your community's characteristics can be obtained through the American FactFinder Web site of the US Census Bureau (Census 2014). This is a good place to start if you have limited data on your community. The data points relevant for inputs into LEEP-C include population and housing units by building type. Use the most recent data available.

Policy and Financial Conditions

Policy Implementation

This section requests the user to input the amount of years the policy will be in place by beginning with the implementation year and ending with the predicted final year. Depending on the characteristics of the specific policy, this selection can stretch the same level of investment over different periods of time or increase investment by replicating an annual level of investment over all years in the period. The implementation period of some policies can be further customized in spreadsheets 3a, 3b, 3c, and 3d, but they cannot be adjusted beyond the maximum bounds set in spreadsheet 2. The starting and ending years are counted inclusively (e.g., a starting year of 2015 and ending year of 2020 result in a total implementation period of six years).

Impact Analysis Period

The analysis period represents the timeframe over which impacts resulting from the policies are summed to determine the program results. The ending year of the analysis is customizable because it is often the case that savings from efficiency programs can be realized for years after the formal end of the policy measure; thus, we recommend extending this date past the length of the implementation period. In most cases, we recommend setting the analysis period to be at least twice the length of the implementation period because energy savings benefits continue for many years after implementation ends. Depending on the policy, these benefits can continue to accrue for between 1 and 50 years after implementation finishes. However setting the ending year of the analysis period for 20 years after the ending year for the implementation period will capture most direct benefits from the policies. Analysis will not extend past 30 years, given the unreliability of long-term calculations. To allow retrospective analysis for those policies that were implemented in prior years, the user can enter a starting period as far back as 2010.

Starting with 2010, any year can be selected for both the implementation period and analysis period. However, the tool is designed to function best between the years of 2010 and 2040, because energy price projections have been included for those years. Calculations of energy bill savings in any subsequent year use the prices from 2040, and therefore do not reflect projected price fluctuations. Additionally, it is important to note that the format of the spreadsheet in which the total impacts are calculated (Cash flow) is designed to accommodate a maximum of 30 years. As a result, the total analysis period is restricted to no more than 30 years, because any results after 30 years will not be accounted for.

Social Discount Rate

Wherever dollar values are presented in the tool, they are in constant, or real, 2012 US dollars. Users are able to customize the real *Social discount rate*, the value by which costs and benefits in future years are marked down (adjusted for inflation) in order to account for opportunity costs. LEEP-C uses a default real discount rate of 3%, which can be adjusted by users. Determining a social discount rate is an art and science in its own right, with a wide range of approaches used. For a good introduction to the issues surrounding social discounting see Zhuang et al. (2007).

Policy Financing

LEEP-C allows users to adjust three variables related to how policies and their associated investments are financed. *Percent down* is the portion of the total investment that is paid for out of pocket. *Interest Rate* is the annualized cost of borrowed money in real dollars. *Loan period* is the number of years over which the borrowed funds and interest are paid back. Finally, the capital recovery factor, the calculation of annual payments based on the interest rate and loan period, is automatically determined and displayed.

We strongly recommend that users select a loan period shorter than the number of years between the end of the policy implementation period and the end of the impact analysis period. This is to ensure that all costs of financing are included in the analysis period. Users should consider excluding financing from their analysis (through setting *Percent down* to 100%) if the implementation period will be the same as or close in length to the analysis period.

For simplicity, all policies and associated investments are assumed to be financed under the same terms in LEEP-C. However this assumption is not likely to reflect reality, because, for example, public investments are often able to be financed at a lower interest rate than those made by households. Also, some policies would be eligible for certain funds and financing, while others would not be. Users should estimate the average terms for all financing that is likely to be used.

Community Priorities

In this section the user is given a list of 13 specific issues and is requested to choose a value for each indicating its importance on a scale of 0 to 10, with 10 being extremely important and 0 being not important at all. The default value for each issue is a 5. Users are also asked to distinguish between the importance of the issue to the community at present and in 10 years. Finally users are asked to weight how important the present and future are (the value entered for these two fields must be greater than 0). The purpose of entering these preferences is to allow for the automatic weighting of buildings policies based on the selected preferences, which is quantified as *Attractiveness* and can be viewed in the *Attractiveness Based on Community Preferences* table found on tab 4a. In a sense this allows the raw results to be filtered through the values of the users to provide results that are more relevant to them. Individual or interest group preferences can, of course, be entered, but we strongly suggest that the importance values entered in this section be based on consensus preferences resulting from a community engagement process. Admittedly, the issues integrated in LEEP-C are limited and may not capture all the energy-related values prioritized by communities, but hopefully the tool should cover the majority of them. Based on user feedback, additional issues may be included in future versions of the tool.

The issues are split into two general categories: total impact and relative impact. *Total impact* issues are measured by the absolute contribution of a policy toward addressing that issue (e.g., electricity savings of 2,000,000 kWh). *Relative impact* issues are measured by impact relative to another value, most often for our purposes, impact per dollar spent (e.g., electric savings of 15 kWh per dollar invested). It is important to keep these distinctions in mind when entering values for each. Also, a user can choose to weight policies based on Total or Relative impact only by setting the values to all issues in the other category to 0. A 0 value for any issue will result in related impacts being ignored in automatic weighting calculations.

Note: The relevance of the output from the values entered will be greater if the user allows for more variation between responses to specific issues. For example, if every issue is important to the community in some form and it is tempting to give each one a score of 9 or 10, it is better to take time to think through their relative importance in order to allow for greater differentiation through scores ranging from, for example, 5 to 10.

Community Goals

Users can select to enter quantitative energy-related goals into LEEP-C. These goals can be used to compare the benefits achieved through the suite of policies analyzed in LEEP-C with related community objectives for the end of the analysis period. These goals can be ones that have been formally established through a community process or could be developed by the user alone as a way to benchmark the overall impacts of policies assessed.

To enter one or more goal, the user should first select *Yes* from the drop-down menu. Users have the option of entering up to seven different formulations of goals for the final year of the analysis period. Three formulation options (energy savings, cost savings, and greenhouse gas emissions reductions) are relative to the projected business as usual for the final year in the analysis period, and three options (energy savings, cost savings, and greenhouse gas emissions reductions) are for comparing the final year of the analysis to the starting year. Each formulation of these goals must be entered in the format of a percentage change. These inputs are used in the Results sheet to compare projected impacts of the policies modeled to these goals.

Local Characteristics Calculated with User Inputs

The remainder of this sheet displays values determined based on information entered previously by the user. None of these values need to be adjusted by the user. However some of them can be adjusted, and advanced users may want to consider doing so under certain circumstances. This section provides previews of some of the variables that will be used to calculate impacts in the next sheets.

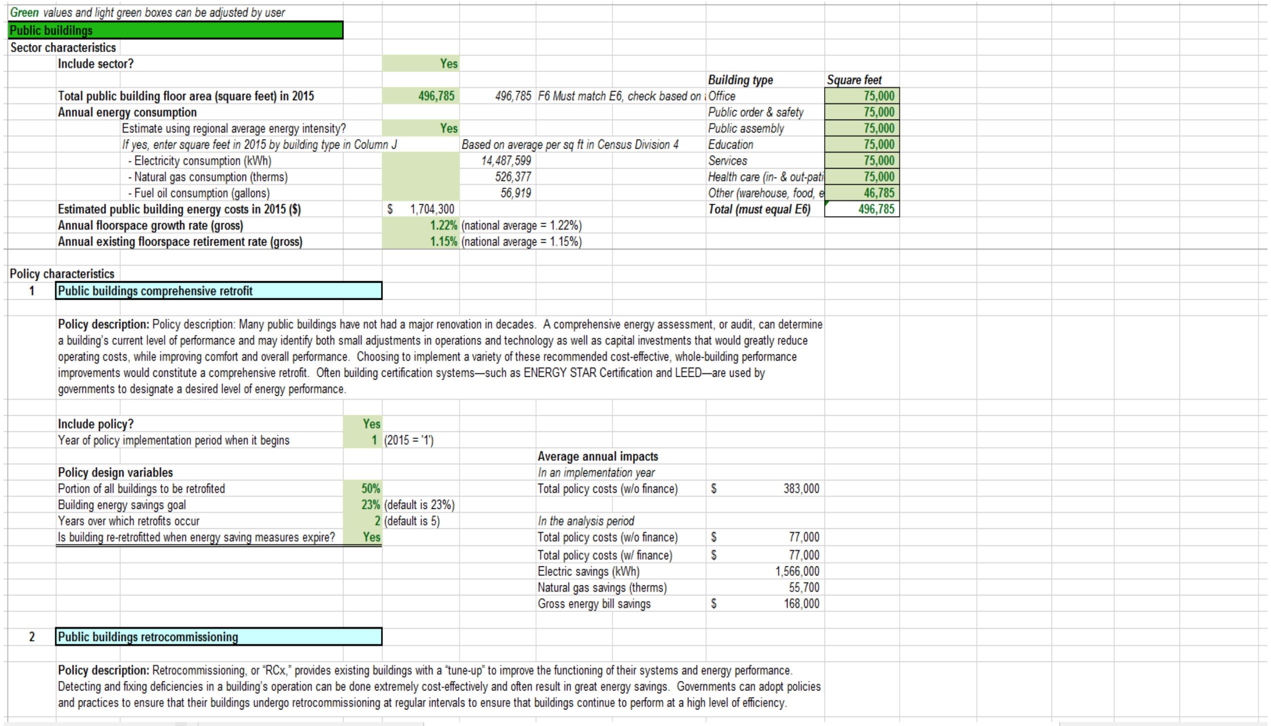
Average energy prices in [state] in [starting year] displays the projected average retail prices in the state selected by the user (or national averages if selected) for the year selected as the starting year for the implementation and analysis periods. Retail prices for residential, commercial, industrial, and transportation customers are displayed for electricity, natural gas, fuel oil, propane, gasoline, and diesel. These prices are a snapshot for only one year; however, when policy impacts are calculated, projected changes in prices from year to year are accounted for. These prices and the forecasted change in prices over time are derived at the state level from various datasets published by the US Energy Information Administration. Advanced users who would like to enter custom prices for the starting year can select *Yes* from the drop-down menu and enter those values in the cells to the right.

Estimated avoided costs from saved energy displays estimates of avoided costs of infrastructure investment due to saved energy by fuel type. These values are used elsewhere in the tool for calculations of two of the most common benefit–cost tests (total resource cost test and program administrator cost test). These estimates are based on national and regional averages and are user-customizable to better match local conditions. Advanced users who would like to enter custom avoided costs for the starting year can select *Yes* from the drop-down menu and enter those values in the cells to the right. Because data on forecasted cost trends are limited, and in contrast to the methodology used for energy prices, no escalation in avoided costs is applied to calculations in future years (e.g., the values displayed here are the values that are used for calculations in all years).

The next section, *Emissions rates*, displays the emissions of several air pollutants associated with each margin unit of energy use for each of the four fuels impacted by the policies in LEEP-C: electricity, natural gas, gasoline, and diesel. Electricity-related emissions are calculated using the US Environmental Protection Agency (EPA) eGRID emissions subregions, based on the user-entered ZIP code (or "US " if the user elected to use national averages) and the associated non-baseload rates of emission per unit of electricity use for six electricity-related pollutants: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_X), ozone season NO_X, and sulfur dioxide (SO_2). Non-baseload rates are the emissions associated with a marginal unit of electricity use (or avoided use), not the average for all electricity generation in that region. This section also calculates and displays the totaled emissions rates for all greenhouse gases for which data are available (CO_2, CH_4, N_2O) in units of carbon dioxide equivalents (CO_2e). Emissions rates for natural gas, gasoline, and diesel are similarly derived from standard national data sources; however, these emissions do not vary significantly by region, and the same rates are used for the entire country.

The final section displays *Jobs calculation multipliers*. These values are used to calculate the number of net jobs resulting from our policies based on the level of investment that is contributed or removed from particular economic sectors. More information on the methodology used to calculate energy prices, emissions, and employment impacts can be found in Appendix B.

3A. Pub Bldgs Spreadsheet



Green values and light green boxes can be adjusted by user

Public buildilngs

Sector characteristics

Include sector?	Yes			
			Building type	*Square feet*
Total public building floor area (square feet) in 2015	496,785	496,785 F6 Must match E6, check based on i	Office	75,000
Annual energy consumption			Public order & safety	75,000
Estimate using regional average energy intensity?	Yes		Public assembly	75,000
If yes, enter square feet in 2015 by building type in Column J		Based on average per sq ft in Census Division 4	Education	75,000
- Electricity consumption (kWh)		14,487,599	Services	75,000
- Natural gas consumption (therms)		526,377	Health care (in- & out-pati	75,000
- Fuel oil consumption (gallons)		56,919	Other (warehouse, food, e	46,785
Estimated public building energy costs in 2015 ($)	$ 1,704,300		Total (must equal E6)	496,785
Annual floorspace growth rate (gross)	1.22%	(national average = 1.22%)		
Annual existing floorspace retirement rate (gross)	1.15%	(national average = 1.15%)		

Policy characteristics

1 **Public buildings comprehensive retrofit**

Policy description: Policy description: Many public buildings have not had a major renovation in decades. A comprehensive energy assessment, or audit, can determine a building's current level of performance and may identify both small adjustments in operations and technology as well as capital investments that would greatly reduce operating costs, while improving comfort and overall performance. Choosing to implement a variety of these recommended cost-effective, whole-building performance improvements would constitute a comprehensive retrofit. Often building certification systems—such as ENERGY STAR Certification and LEED—are used by governments to designate a desired level of energy performance.

Include policy?	Yes				
Year of policy implementation period when it begins	1	(2015 = '1')			
			Average annual impacts		
Policy design variables			*In an implementation year*		
Portion of all buildings to be retrofited	50%		Total policy costs (w/o finance)	$	383,000
Building energy savings goal	23%	(default is 23%)			
Years over which retrofits occur	2	(default is 5)	*In the analysis period*		
Is building re-retrofitted when energy saving measures expire?	Yes		Total policy costs (w/o finance)	$	77,000
			Total policy costs (w/ finance)	$	77,000
			Electric savings (kWh)		1,566,000
			Natural gas savings (therms)		55,700
			Gross energy bill savings	$	168,000

2 **Public buildings retrocommissioning**

Policy description: Retrocommissioning, or "RCx," provides existing buildings with a "tune-up" to improve the functioning of their systems and energy performance. Detecting and fixing deficiencies in a building's operation can be done extremely cost-effectively and often result in great energy savings. Governments can adopt policies and practices to ensure that their buildings undergo retrocommissioning at regular intervals to ensure that buildings continue to perform at a high level of efficiency.

This sheet and the three that follow are where the user enters data on the characteristics of a particular sector in their community, learns about the policy options that can be evaluated for the sector, and customizes the design of the policies to be evaluated.

Sector Characteristics

If the user is intending to include this sector, then they must select *Yes* from the drop-down cell that corresponds to *Include sector?* If the user is excluding the sector, the rest of the sheet can be skipped. The user is requested to enter the *Total public building floor area* in the starting year for public buildings in their community. This will provide a baseline from which energy use and potential energy savings can be calculated. Next, the user can select how they would like to calculate *Annual energy consumption* for the square footage identified. If *Yes* is selected from the drop-down menu, energy consumption is calculated based on averages of electricity, natural gas, and fuel oil use per square foot in commercial buildings in the census division in which the community is located (or the national average, if no ZIP code has been entered). If this option is selected, the user is expected to enter an estimate of floor area by building use type in the cells to the right, which will result in a better estimate of overall energy use. If the user has actual data on public building energy consumption from a utility bill analysis or other source, *No* can be selected and the user is able to directly input their data on total annual electricity, natural gas and fuel oil consumption into the green boxes. Based on these user inputs, the *Estimated public building energy cost* for the starting year of the policy implementation period is displayed. Finally, to adjust projections for future floor area and related business-as-usual energy use, the user can customize the *Annual floorspace growth rate* and *Annual existing floorspace retirement rate*.

Tip: The best source of data on public buildings in your community is likely the building management department of your local government. They may know the total square footage of public buildings. They may also know information on annual energy consumption for the whole building portfolio. However it is also possible that the local government does not have this information aggregated. In that case, determining energy consumption would require collecting energy bills from many departments and analyzing them. Users should use their judgment to decide how to collect the best information possible in the time they have available. If the user is in a position to influence the building management department of the local government, this is a great opportunity to encourage it to begin using ENERGY STAR Portfolio Manager, if they are not already, to track the energy use in their buildings. This free, industry-standard tool has a strong record of enabling energy efficiency improvements in public buildings.

Policy Characteristics

Once the sector-wide inputs have been established, the *design of the specific policies* can be adjusted if desired. All of the remaining inputs on this page are optional, as defaults based on experience with these policies in other places have already been entered. However users are encouraged to adjust any of the policy variables, within reason, so that they better match the situation in their local community. In general, defaults are set to reflect the typical experiences with each policy; however, these values do vary based on local context and policy design.

Three pieces of information are presented for each policy. First is a short *Policy Description* (more details on and related resources for each policy are included in Appendix A). Below the description is an option to exclude (or include) the policy from analysis by selecting *No* (or *Yes*) in response to *Include policy?*, the ability to customize the starting year for the specific policy, and the major *Policy design variables* that can be adjusted by the user. And to the right is a summary of the *Average annual impacts*—costs and savings—resulting from the selected policy design.

For each of the four policies, *Average annual impacts* are displayed to the right of the user inputs. These outputs include averages for a typical implementation year (policy costs without financing) and for the impact analysis period as a whole (total policy costs with and without financing, annual electricity and natural gas savings, and energy bill cost savings). These numbers are automatically recalculated whenever changes are made to any variables that impact the policy. They are primarily intended to provide directional indications of the impact of a particular user adjustment. Of particular note is that the implementation year and analysis period average costs and benefits are from different timeframes, and comparisons should not be made between the categories to estimate cost effectiveness. More detailed and comprehensive outputs are provided in the subsequent sheets.

3B. Res Bldgs Spreadsheet

Green values and light green boxes can be adjusted by user						
Residential buildings						
Sector characteristics						
Include sector?	Yes					
Total occupied residential units in 2015	13,254	(set on "Local conditions" tab)		**Average floor area by housing type in 2015 (sq ft)**		
persons per household	2.23	(national average = 2.57)		Single-family	2,422	(national average = 2,422)
percent single-family	69.0%	(national average = 69%)		Multi-family	929	(national average = 929)
percent multi-family	25.0%	(national average = 25%)		mobile home	1,087	(national average = 1,087)
- multi-family w/ household incomes below $35,000	15.0%	(as percentage of multi-family housin		**Annual growth rate of average home floorspace**		
percent mobile home	6.0%	(national average = 6%)			0.66%	(national average = 0.66%)
Annual residential energy consumption						
Estimate using regional/state averages?	Yes	*Calculations from averages in KS., NE.*				
If no, enter total annual energy consumption in 2015 in E14-17		*Total*	*Single-family*	*Multi-family*	*Mobile homes*	
- Elec consumption (kWh)		*140,015,000*	*109,327,000*	*20,614,000*	*10,074,000*	
- Natural gas consumption (therms)		*8,423,000*	*6,796,000*	*1,468,000*	*159,000*	
- Fuel oil consumption (gallons)		*11,000*	*9,000*	*2,000*	-	
- Propane/ LPG (gallons)		*367,000*	*315,000*	*15,000*	*37,000*	
Estimated residential energy costs in 2015 ($)	$ 22,428,000					
Current residential building energy code	2000/2003 IECC					
Annual new contruction and housing retirement rates	***Units completed***	***Units retired***	***Annual growth in occupied residential units***			
Single-family	1.49%	0.52%	0.97%	(national average = 0.97%)		
Multi-family	1.75%	0.52%	1.23%	(national average = 1.23%)		
Mobile home	1.02%	0.60%	0.42%	(national average = 0.42%)		
Policy characteristics						
Existing buildings						
1 Energy use disclosure						

Policy description: A Building Rating and Disclosure policy works by requiring that information on the energy efficiency of a building be made available to buyers and renters through a standardized energy assessment. A home energy assessment evaluates an existing home to determine energy efficiency: where energy is being lost and the cost-effective improvements that can be implemented to enhance occupant comfort, make the home more durable, and lower utility costs. This mechanism aims to raise consumer awareness about energy performance and incentivize sellers to upgrade the energy performance of their buildings in order to boost their value and sell or rent building more easily to an informed public. As it is a foundational policy, governments can use rating and disclosure to build awareness of building energy performance and costs, improve participation in existing efficiency programs, or expand the local market for building performance professionals. The policies can be implemented in a variety of ways. Implementing agencies have established different mechanisms to "trigger" rating and disclosure and have used different rating systems.

Include policy?	Yes			
Year of policy implementation period when it begins	1	(2015 = '1')		
				Average annual impacts
Policy design variables				*In an implementation year*

Sector Characteristics

This sheet evaluates three policies that can be applied to existing or new residential buildings. All values entered on this sheet will apply to this sector and these policies only. First, the user is allowed to include or exclude this entire sector from the analysis by responding *Yes* or *No* to the question *Include sector?* If the user is excluding the sector, the rest of the sheet can be skipped.

Three major *Sector characteristics* are requested from the user. The user must enter an estimate of *Total occupied residential units* in the community as well as estimates of the percentage of units that are single-family, multifamily, multifamily affordable only, and mobile homes. The default percentages are based on national data from the 2009 Residential Energy Consumption Survey (EIA 2009). Users can also adjust the current average floor area for each housing type, and the growth rate of average home floorspace. Next, in a similar manner to the previous sheet, users are required to choose how they would like to calculate *Annual residential energy consumption* for these homes. If users select *Yes*, estimates will be based on regional or state average electricity, natural gas, fuel oil, and propane consumption per housing unit for each housing type. If *No* is selected, the user must manually enter estimates of total electricity, natural gas, fuel oil, and propane consumption for all housing units. While use of the regional average consumption data is an option, we discourage it if better information is available. Based on these selections and inputs, *Estimated residential energy costs* are displayed for the starting year of the implementation period. Next, the user is asked to select the closest equivalent to the *Current residential building energy code* in place in their community. Information on current state-level code status is available from the US Department of Energy. Additional information on municipal-level code adoption for some communities is available from the Building Codes Assistance Project. Finally, users are able to adjust the forecasted *Annual new construction and housing retirement rates* for each housing type based on their local market characteristics.

Policy Characteristics

The bottom portion of this sheet is designed in a manner very similar to the Pub Bldgs spreadsheet. As with that spreadsheet, making adjustments to *Include policy?*, the starting year, and the default *Policy design variables* is optional but can be done in order to better match the policy design to local characteristics. More details and information on each policy included can be found in Appendix A.

3C. COMM BLDGS SPREADSHEET

Green values and light green boxes can be adjusted by user

Commercial buildings

Sector characteristics

Include sector?	Yes		
Total commercial building floor area (square feet) in 2015	740,000,000	*740,000,000*	*F6 Must match E6, check based on total entered in Co*
Annual energy consumption			
Estimate using regional average energy intensity?	Yes		
If yes, enter square feet in 2015 by building type in Columns K & M		*Based on average per sq ft in U.S.*	
- Electricity consumption (kWh)		*12,802,138,925*	
- Natural gas consumption (therms)		*282,630,612*	
- Fuel oil consumption (gallons)		*20,061,908*	
Estimated commercial building energy costs in 2015 ($)	$ 1,593,705,500		
Current commercial building energy code	ASHRAE 90.1-2007		
Annual floorspace growth rate (gross)	1.22%	(national average = 1.22%)	
Annual existing floorspace retirement rate (gross)	1.15%	(national average = 1.15%)	

Building type	***Square feet***	***Building type***	***Square feet***
Vacant	9,800,000	*Education*	150,000,000
Office	50,000,000	*Food service*	25,000,000
Laboratory	100,000	*Inpatient health care*	55,000,000
Nonrefrigerated warehouse	10,000,000	*Nursing*	30,000,000
Food sales	30,000,000	*Lodging*	40,000,000
Public order and safety	50,000,000	*Strip shopping mall*	50,000,000
Outpatient health care	80,000,000	*Enclosed mall*	35,000,000
Refrigerated warehouse	100,000	*Retail other than mall*	10,000,000
Religious worship	10,000,000	*Service*	75,000,000
Public assembly	25,000,000	*Other*	5,000,000
		Total (must equal E5)	740,000,000

Policy characteristics

Existing buildings

1 **Commercial buildings comprehensive retrofit**

Policy description: A comprehensive energy assessment, or audit, can determine a building's current level of performance and may identify both small adjustments in operations and technology as well as capital investments that would greatly reduce operating costs, while improving comfort and overall performance. Choosing to implement a variety of these recommended cost-effective, whole-building performance improvements would constitute a comprehensive retrofit. LEEP-C can be used to model either retrofit requirements or technical assistance and incentive programs that result in retrofits, depending on the policy design variables that are selected by the user, particularly the setting for "Portion of all buildings to be retrofitted."

Include policy?	Yes	*(should be set to "Yes" only if policy 4 is "No")*
Year of policy implementation period when it begins	1	(2015 = '1')
Policy design variables		
Portion of all buildings to be retrofited	50%	
Building energy savings goal	23%	(default is 23%)
Years over which retrofits occur	2	(default is 2)
Financial incentive to participants (% of measure costs)	18%	(default 18%)
Administration costs (% of total policy costs)	5%	(default 5%)
Is building re-retrofitted when energy saving measures expire?	Yes	

Average annual impacts	
In an implementation year	
Total policy costs (w/o finance)	$ 569,874,000
- Program administration	$ 28,493,700
- Incentives to participants	$ 97,448,454
- Participant costs	$ 443,931,846
In the analysis period	
Total policy costs (w/o finance)	$ 113,975,000
Total policy costs (w/ finance)	$ 113,975,000
Electric savings (kWh)	1,340,071,000
Natural gas savings (therms)	29,885,300
Gross energy bill savings	$ 169,262,000

Sector Characteristics

This sheet evaluates five policies that can be applied to existing or new commercial buildings. All values entered on this sheet will apply to this sector and these policies only. The *Sector characteristics* section of this sheet is almost identical in design and function to the equivalent section on the Public Buildings sheet. The only addition to this sheet is the field where the user is asked to select the closest equivalent to the *Current commercial building energy code* in place in their community. Information on current state-level code status is available from the US Department of Energy. Additional information on municipal-level code adoption for some communities is available from the Building Codes Assistance Project.

Policy Characteristics

The policies included in this sheet are mostly equivalent to the policies included in the Pub Bldgs sheet. The major differences are that they are applied to private commercial buildings, and they are implemented with a combination of technical assistance, incentives, and requirements, rather than internal local government policy. One additional policy on this sheet is *Updating commercial building energy codes*, which is the equivalent of the building energy code policy in the residential buildings sheet, but for the commercial buildings sector.

3D. Transportation Spreadsheet

Green values and light green boxes can be adjusted by user

Transportation

Sector characteristics

Include sector?	Yes			
Include non-energy vehicle operating costs in calculations?	Yes	(default = Yes)		
Vehicle stock in 2015	**Cars and light trucks** (< 8,500 pounds)	**Commercial light trucks** (8,500 to 10,000 pounds)	**Freight trucks** (> 10,000 pounds)	
Vehicles per household	1.941	0.048	0.088	(2012 national averages = 1.941; 0.048; 0.088; TEDB33 Tables 8.1, 8.2, 4.3, 5.1/5.2)
Vehicles per person	0.871	0.022	0.039	(2012 national averages = 0.749; 0.019; 0.034; TEDB33 Tables 8.2, 4.3, 5.1/5.2)
Total vehicles	25,726	636	1,166	
Average VMT per vehicle annually	11,300	13,224	25,173	(national averages = 11,300 (2009); 13,224 (2000); 25,173 (2012); TEDB33 Tables 8.10, 4.3, 5.1/5.2)
Average VMT per household annually	21,934	635	2,215	
Total vehicle miles traveled (VMT)	290,713,236	8,413,003	29,360,579	
Annual energy consumption in 2015*				
- Gasoline (gallons)	13,947,331		**The projected baselines for future year vehicle stock, VMT, and*	
- Diesel (gallons)	4,161,571		*energy intensity are based on U.S. average rates of change per*	
Estimated transportation energy costs in 2015 ($)	$ 43,401,000		*capita and the user-entered rate of population change.*	

Policy characteristics

These policy options, levels of deployment and descriptions are adapted from the appendix of *Moving Cooler* (2009). Additional details can be found in that report. Unless otherwise noted all policy level of deployment are additive of the lower levels. All policies impact energy use of Cars and light trucks. VMT Tax also impacts Commercial Light Trucks. Congestion Pricing and Cordon Pricing impact energy use in all vehicle types including Freight Trucks. Energy savings reflect savings from reduced VMT only, not savings from improved traffic flow.

Land use development and design policies

1 **Combined land use**

Policy description:
Expanded best practice - The regional Metropolitan Planning Organization (MPO) (or another designated regional agency) develops a regional transportation and land use plan meeting-defined criteria for process and content. Plans collectively provide for at least 60 percent of new development in attached or small-lot detached units, in pedestrian- and bicycle-friendly neighborhoods (e.g., sidewalks, bicycle facilities, good connectivity) with mixed-use commercial districts and high-quality transit. The majority (nearly three-quarters) of local governments adopt zoning and planning standards allowing for sufficient densities and requiring pedestrian-friendly design in these areas.
More aggressive - Metropolitan land use plans call for at least 70 percent of new development in neighborhoods as described above. Local plan/zoning code compliance is higher (about 90 percent) as a result of stronger funding incentives. The state adopts comprehensive planning laws similar to Washington State's Growth Management Act, requiring local comprehensive plans meeting-defined objectives, designation of urban growth/priority funding areas, and interagency plan review. Require comprehensive plan adoption and revision of zoning and other municipal codes for consistency with regional plans in five years.
Maximum effort - States and metro agencies adopt enforceable growth boundaries around urban areas consistent with Oregon's model. Metropolitan land use plans and local zoning collectively provide for at least 90 percent of new development in neighborhoods as described above. Local plan/zoning code

Sector Characteristics

This sheet evaluates 11 policies that can be applied to influence energy use in the transportation sector. All values entered on this sheet will apply to this sector and these policies only. First, the user is allowed to include or exclude this entire sector from the analysis with a Yes or *No* response to *Include sector?* If the user excludes the sector, the rest of the sheet can be skipped. The next question, *Include non-energy vehicle operating costs in calculations?*, can be used to adjust the benefits captured in the subsequent calculations in the tool beyond fuel, to include or exclude vehicle mileage-related operating costs (maintenance, depreciation, and so on). Finally, users can adjust the characteristics of the community's *Vehicle stock in [starting year]* for three different vehicle classes: cars and light trucks, commercial light trucks, and freight trucks. For each class of vehicle, the user can change the average number of vehicles per household and the average vehicle miles traveled per vehicle (or household) annually. The product of these variables then results in a total number of vehicle miles traveled for each vehicle class in the starting year, which is used to estimate the energy consumption by fuel type and transportation energy costs, displayed under *Annual energy consumption in [starting year]* and *Estimated transportation energy costs in [starting year]* respectively.

Policy Characteristics

The bottom portion of this sheet is designed in a manner similar to the previous sector sheets. The option is available to make adjustments to *Include policy?* and the *Policy design variables* (the level of deployment and the starting year) for each policy. Adjustments can be made in order to better match the policy design to local characteristics. Each of these policies and the analyses for them in the tool have been adapted from *Moving Cooler* (Cambridge Systematics 2009), the most comprehensive analysis to date of the economic, greenhouse gas, and energy impacts of transportation system efficiency measures. The *Level of deployment* options for each policy (*Expanded current*, *More aggressive,* and *Maximum*) are also based on equivalent policy scenarios from *Moving Cooler*, and are described in detail in the *Policy description* section for each policy (more detail on the policies is available in Appendix A and in Vaidyanathan and Mackres 2013).

There are three categories of policies that users can analyze for the transportation sector: 1) *Land use development and design policies*, 2) *Pricing policie*s, and 3) *Mode shift and transit* p*olicies*. There are three policies in the first category. *Combined land use*, *Pedestrian strategy*, and *Bicycle strategy* all focus on elements of urban design and transportation infrastructure investment choices that enable travelers to more easily and safely choose a transportation mode other than a personal vehicle. The pricing policies include *Parking pricing*, *Pay-as-you-drive insurance*, *Congestion pricing*, *Cordon pricing*, and *Vehicle miles traveled fee*. These policies present a variety of methods to appropriately price the costs of an energy using behavior. In the transportation sector, there are a variety of situations in which drivers do not pay the full costs of their travel. These policies make users directly pay for the costs of choices (e.g., transportation modes, when and where to travel, where to park, etc.). The mode shift and transit policies included are *Employer-based commute strategies*, *Increased level of transit service*, and *Expanded urban public transportation*. These policies encourage the use of non-single-occupant vehicle travel modes through consumer incentives, improved alternative mode services, or improved alternative mode infrastructure.

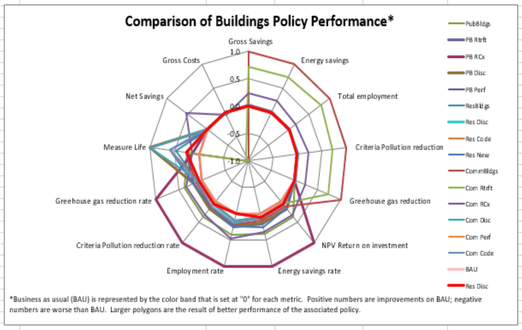
4a. Results Spreadsheet

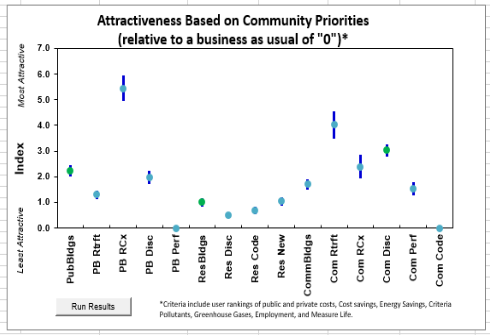
This spreadsheet summarizes the total impacts during the analysis period resulting from the policies implemented during the implementation period. The timeframe of these two periods is displayed at the top of the sheet in the title, Total impacts over the period of [*analysis period*] of policies implemented from [*implementation period*].

Policy Impacts of Buildings Policies

Policy impacts of buildings policies

Total impacts over the period of 2015 to 2024 of building policies implemented from 2015 to 2016





Res Disc — Dropdown menu to highlight specific policy in *Comparison of buildings policy performance* chart

Absolute impacts of building policies

	Net present value: Gross costs	Net present value: Gross savings	Net present value: Net savings	Energy savings: Electricity (kWh)	Energy savings: NG (therms)	Energy savings: Gasoline (gal)	Energy savings: Diesel (gal)	Energy savings: Total (MMBtu)	Energy savings: Percent (MMBtu)	Net jobs: Avg Jobs/yr	Criteria pollution svgs: lbs NOx	Criteria pollution svgs: lbs SOx	GHG svgs: lbs CO2e
Public buildings	**$ 822,900**	**$ 4,027,860**	**$ 3,216,900**	**36,893,900**	**723,850**	-	-	**198,300**	**13.6%**	**2.02**	**57,830**	**125,570**	**######**
1. Public building retrofit (PB Rtrft)	$ 754,000	$ 2,979,464	$ 2,225,500	27,641,500	542,540	-	-	148,600	10.2%	1.60	43,330	94,080	48,378,500
2. Public building retrocommissioning (PB RCx)	$ 44,200	$ 1,000,350	$ 956,100	8,793,900	174,050	-	-	47,400	3.2%	0.39	13,800	29,930	15,407,700
3. Public building benchmarking and disclosure (PB Disc)	$ 12,700	$ 48,047	$ 35,300	458,500	7,260	-	-	2,300	0.2%	0.03	700	1,560	782,600
4. Performance-based policy for new and existing public buildings (PB Pe		$ -							0.0%				
Residential buildings	**$ 2,158,300**	**$ 2,821,707**	**$ 882,300**	**22,632,800**	**965,420**	-	-	**173,800**	**1.4%**	**1.40**	**40,120**	**77,070**	**######**
1. Energy use disclosure (Res Disc)	$ 888,400	$ 1,169,815	$ 281,400	8,708,300	265,600	-	-	56,300	0.5%	(0.03)	14,500	29,650	16,320,300
2. Updating residential building energy codes (Res Code)	$ 853,000	$ 1,200,028	$ 347,000	9,967,900	353,590	-	-	69,400	0.6%	0.93	17,030	33,940	19,245,800
3. Efficient new homes - energy star certified (Res New)	$ 119,300	$ 451,864	$ 332,600	3,109,800	207,840	-	-	31,400	0.3%	0.25	6,180	10,590	7,115,640
Commercial buildings	**$ 1,268,271,100**	**$ 2,064,594,779**	**$ 814,800,100**	**18,630,536,800**	**402,877,610**	-	-	**103,873,200**	**14.2%**	**1,686.05**	**29,538,680**	**#######**	**######**
1. Commercial building retrofit (Com Rtrft)	$ 1,123,144,100	$ 1,472,860,092	$ 349,716,000	13,400,713,600	298,853,280	-	-	75,608,600	10.3%	1329.76	21,327,530	45,614,250	#######
2. Commercial building retrocommissioning (Com RCx)	$ 65,872,000	$ 496,745,322	$ 430,873,400	4,264,700,100	96,535,830	-	-	24,204,700	3.3%	274.49	6,800,070	14,516,550	#######
3. Commercial building benchmarking and Disclosure (Com Disc)	$ 37,932,700	$ 47,346,656	$ 9,414,000	444,567,400	7,996,070	-	-	2,316,500	0.3%	43.55	690,460	1,513,140	#######
4. Performance-based policy for New and Existing Commercial Buildings		$ -							0.0%				
5. Updating commercial building energy codes (Com Code)	$ 22,845,900	$ 47,642,708	$ 24,796,800	520,555,700	(507,570)	-	-	1,725,400	0.2%	38.24	720,620	1,771,210	#######
TOTALS	**$ 1,271,252,300**	**$ 2,071,444,346**	**$ 818,899,300**	**18,690,063,500**	**404,566,880**	-	-	**104,245,300**	**9.7%**	**1689.5**	**########**	**#######**	**######**

Relative impacts of building policies

	NPV benefit-cost	Leverage	Measure life	Energy savings rate	Jobs rate	Criteria pollution svgs rate	GHG svgs rate	Attractiveness

Sector Characteristics

Tip: The best source of data on public buildings in your community is likely the building

The sheet displays the policy impact data for public, residential, and commercial buildings in five ways: (1) a radar diagram that graphically represents performance of each buildings policy against 13 metrics, (2) a figure that displays each policy on an index of attractiveness to the community, (3) tables with the numeric values for several absolute and relative policy performance metrics, (4) a table comparing the performance of the policy portfolio to user-established goals, and (5) a table with the benefit–cost test results for each of the policies. All values on this sheet are calculated based on user inputs as entered on sheets 2, 3a, 3b, and 3c.

The policy performance metrics presented in the Absolute impacts of buildings policies table for each policy include totals for gross policy cost, gross policy savings, net savings, energy savings (electricity, natural gas, total, and as a percentage of forecasted energy use in the sector over the analysis period under business as usual), average net jobs per year (technically in units of job person-years), criteria pollution reductions (pounds of NOx and SOx), and greenhouse gas reductions in pounds of carbon dioxide equivalent. These metrics provide the user with information on progress towards increasing or decreasing the total amount of these positive or negative elements in their community. The Relative impacts of buildings policies table provides information on the level of impact relative to another variable, in most cases per dollar invested. Many of these numbers can give the user information on the relative cost effectiveness of the policies. The table includes a simple benefit–cost ratio of net present value, the percentage of costs that are borne by the public, the number of years over which energy savings will last (or measure life), the amount of energy savings per dollar invested (for electricity, natural gas, and total), the number of net jobs per year created per million dollars invested, the reduction in criteria pollutants per dollar (for NOx and SOx), greenhouse gas savings per dollar, and finally an attractiveness score (to be discussed in more detail below). Values in these tables can be converted into other units outside of the tool as desired by the user. Many reference guides for such conversions are available on the Internet. For example, one good resource for converting greenhouse gas impacts into different units or equivalencies more understandable to the general public is the EPA Greenhouse Gas Equivalencies Calculator (EPA 2011).

The next table, the Benefit–cost tests table, demonstrates the cost of saved energy (for all fuels, and specific to electricity and natural gas) and benefit–cost ratios under three different tests (total resource cost test, program administrator test, and participant cost test) for each policy in the buildings sector, and for the whole portfolio. These statistics are key metrics used to assess the value and cost effectiveness of customer-funded utility efficiency programs. That said, the design and use of these metrics can vary significantly from jurisdiction to jurisdiction and the presentation of the related statistics here should be viewed only as an approximation of how these programs would be evaluated in a particular jurisdiction.

The Comparison of buildings policy performance radar diagram visually compares 13 of the metrics from the Absolute impacts tables. Each policy is represented by a different color polygon. Each metric is represented as a radial string on the web (or, if you prefer, a different spoke on the wheel). For each metric, the policy with the highest impact is given a score of 1 and the rest of the policies are scored in the range of 0 to 1 relative to it. (For the two upfront cost metrics, this is reversed and the highest value is set as -1, because for our purposes higher costs represent poorer policy performance.) Note that the 0 value is not at the center of the web, but rather halfway between the center and the edge of the diagram. This scoring process is repeated for each metric and plotted on the diagram.

Additionally there is a polygon labeled BAU (for business as usual) that is scored with a 0 for every metric. Policies with higher relative performance for a number of metrics will result in a larger polygon. *The larger the polygon is for a particular policy, the better the overall performance of the policy in regard to all metrics.* Only the points on the radial strings have meaning; the points between strings do not. The metrics from the Absolute impacts table are grouped on the right-hand side, while those from the Relative metrics table are on the left-hand side. As a result, those policies with greatest total impact will have a large portion of their polygon on the right-hand side, and those that have a large impact *per dollar* will have a large portion of their polygon on the left-hand side. This diagram allows users to quickly see the comparative performance of policies based on all metrics. Additionally, this diagram can be used as a reference to quickly see the impact of a change in user inputs on the comparative policy performance. Because comparing a large number of policies can lead to visual clutter, the diagram is often most valuable when used to compare only a few policies or policies within a single sector.

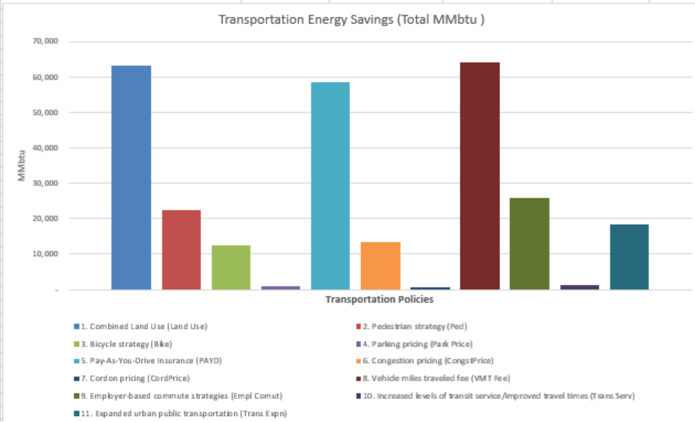
The final presentation of the building summary impacts on this sheet is the Attractiveness based on community priorities chart. This chart presents the performance of the policies weighted against the issues of importance selected by the user. Through use of a probabilistic linear vector analysis, or Monte Carlo simulation, the Community priorities as inputted by the user on the Local conditions sheet are used to create standardized weightings for each metric, and the policy impacts listed in the Impacts tables are used to create standardized scores for each metric for each policy. These values are then multiplied to develop a mean score for each policy on an index of relative attractiveness, represented by a light-blue dot (or a green dot for the values summarizing the sector-specific portfolios). The chart also presents 95% confidence intervals for each policy's score on the index. The shorter the length of the blue lines above or below the dot, the greater the certainty of the index score. The higher the score on this index, the more appropriate that policy is for achieving the user-defined issues of importance. While mean numeric values are provided for each policy, these values represent the qualitative inputs of users when ranking the issues of importance to them. These values are on a linear scale, meaning that a score for one policy double that of another translates into that policy's being twice as attractive for meeting the community's priorities. Changes in user inputs will change the scores of the policies. Because the calculations for this chart are complex, requiring a hundred simulations each time it is updated, they are made through a Visual Basic macro. Users must select the Run Results button every time they wish to update the scores on the index to reflect the changes caused by new inputs.

Users are encouraged to make adjustments to their inputs on previous sheets to explore the impacts that different policy designs, analysis periods, discount rates, financing terms, community priorities, and other variables have on the results. Making a series of adjustments like this can allow the user to see what conditions would be required to result in desired outcomes and to better understand the advantages and disadvantages of particular choices or conditions.

Policy Impacts of Transportation Policies

Policy impacts of transportation policies

Total impacts over the period of 2015 to 2024 of transportation policies implemented from 2015 to 2016



Absolute Impacts of transportation policies

	Net present value: Gross costs	Net present value: Gross savings	Net present value: Net savings	Energy savings: Gasoline (gal)	Energy savings: Diesel (gal)	Energy savings: Total (MMBtu)	Criteria pollutio: lbs NOx	GHG svgs: lbs CO2e
Transportation	**7,710,600**	**49,454,414**	**41,871,900**	**2,276,250**	**48,170**	**280,500**	**85,660**	**47,357,950**
1. Combined Land Use (Land Use)	$ 24,000	$ 18,114,217	$ 18,090,200	519,050	4,580	63,200	19,300	10,655,120
2. Pedestrian strategy (Ped)	$ 437,100	$ 5,149,683	$ 4,712,600	184,080	1,300	22,400	6,830	3,771,600
3. Bicycle strategy (Bike)	$ 340,600	$ 3,906,762	$ 3,566,100	102,930	920	12,500	3,830	2,113,080
4. Parking pricing (Park Price)	$ -	$ 97,198	$ 97,200	7,550	40	900	280	154,370
5. Pay-As-You-Drive Insurance (PAYD)	$ 952,000	$ 6,228,296	$ 5,276,300	483,150	2,370	58,500	17,890	9,875,540
6. Congestion pricing (CongstPrice)	$ 869,400	$ 1,354,655	$ 485,300	81,240	25,390	13,300	3,930	2,221,900
7. Cordon pricing (CordPrice)	$ 66,800	$ 68,996	$ 2,200	4,140	1,290	700	200	113,170
8. Vehicle miles traveled fee (VMT Fee)	$ 870,700	$ 6,773,747	$ 5,903,100	521,800	9,780	64,200	19,590	10,827,960
9. Employer-based commute strategies (Empl Comut)	$ 548,900	$ 4,072,866	$ 3,524,000	212,090	1,120	25,700	7,860	4,336,910
10. Increased levels of transit service/improved travel times (Trans Serv)	$ 275,900	$ 335,222	$ 59,400	10,010	70	1,200	370	204,970
11. Expanded urban public transportation (Trans Expn)	$ 3,197,200	$ 3,352,771	$ 155,600	150,220	1,310	18,300	5,580	3,083,330

The Absolute impacts of transportation policies chart is set up similarly to the Absolute impacts of building policies chart. We display estimates for cost savings, energy savings, and pollution reduction for each of the 11 transportation measures included in LEEP-C. We do not apply the aforementioned cost-effectiveness tests to these measures or present benefit–cost ratios, because these metrics may not be useful for comparing transportation measures with those in other sectors, or even with other transportation measures.

The bar graph displays the energy savings (in MMBtu) for each transportation policy.

Performance toward Goals

The Goals table presents the aggregate results for all policies and sectors in comparison to any energy-related goals for the ending year of the analysis period as entered by the user on the Local conditions sheet. It presents the user-entered target in comparison to the projected value for that same metric and displays the resulting goal status.

4b. Cash Flow Spreadsheet

Year		1	2	3	4	5	Analysis period		Entire sheet (years not = "0")	
		2015	2016	2017	2018	2019	TOTAL	Average	TOTAL	Average
Discount rate	3.00%	1	0.9709	0.9426	0.9151	0.8885				
Total for all sectors & policies selected										
Costs										
Policy total		$ 638,714,184	$ 640,248,658	$ -	$ -	$ -	**$ 1,278,962,843**	$ 255,792,569	############	$ 639,481,421.27
Loan amount		$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	**$ -**	$ -
Out-of-pocket		$ 638,714,184	$ 640,248,658	$ -	$ -	$ -	**$ 1,278,962,843**	$ 255,792,569	############	$ 639,481,421.27
Loan payments		$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	**$ -**	$ -
- Payments on interest only		$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	**$ -**	$ -
NPV costs		$ 638,714,184	$ 621,600,639	$ -	$ -	$ -	**$ 1,260,314,823**	$ 252,062,965	############	$ 630,157,411.69
Benefits										
Elec savings (kWh)		1,089,742,120	2,125,973,794	2,119,547,377	2,113,105,502	2,107,011,913	**9,555,380,707**	1,911,076,141	**25,906,178,397**	863,539,280
Elec savings (MMbtu)		3,719,256	7,255,883	7,233,950	7,211,964	7,191,167	**32,612,221**	6,522,444	**88,416,991**	2,947,233
Natural gas savings (therms)		23,381,231	47,534,644	47,297,759	46,739,429	46,225,921	**211,178,983**	42,235,797	**526,788,538**	17,559,618
Natural gas savings (MMbtu)		2,338,123	4,753,464	4,729,776	4,673,943	4,622,592	**21,117,898**	4,223,580	**52,678,854**	1,755,962
Fuel oil savings (gallons)										-
Fuel oil savings (MMbtu)										-
Propane/LPG savings (gallons)										-
Propane/LPG savings (MMbtu)										-
Gasoline savings (gallons)		611,628	822,684	171,020	116,705	115,124	**1,837,161**	367,432	**3,357,649**	111,922
Gasoline savings (MMbtu)		73,585	98,978	20,576	14,041	13,850	**221,030**	44,206	**403,499**	13,450
Diesel savings (gallons)		6,311	34,253	1,040	822	921	**43,346**	8,669	**73,639**	2,455
Diesel savings (MMbtu)		869	4,717	143	113	127	**5,969**	1,194	**10,141**	338
Total energy savings (MMbtu)		6,131,834	12,113,043	11,984,445	11,900,061	11,827,736	**53,957,118**	10,791,424	**141,509,485**	4,716,983
Elec bill savings (thous $)		$ 110,507.19	$ 222,637.15	$ 223,059.45	$ 220,962.01	$ 222,333.18	**$ 999,499**	$ 199,900	**$ 2,802,074**	$ 93,402.48
NG bill savings (thous $)		$ 19,970.21	$ 39,702.95	$ 40,792.10	$ 42,109.30	$ 42,254.34	**$ 184,829**	$ 36,966	**$ 489,763**	$ 16,325.43
Fuel oil bill savings (thous $)										$ -
Propane/LPG bill savings (thous $)										$ -
Gasoline bill savings (thous $)		$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	**$ -**	$ -
Diesel bill savings (thous $)		$ 17.06	$ 90.30	$ 2.73	$ 2.18	$ 2.50	**$ 115**	$ 23	**$ 199**	$ 6.62
Operating cost savings (thous $)		$ 7,935.63	$ 11,137.32	$ 4,487.81	$ 3,116.79	$ 3,902.81	**$ 30,580**	$ 6,116	**$ 252,014**	$ 8,400.45
Total bill savings (thous $)		$ 130,494.45	$ 262,430.39	$ 263,854.27	$ 263,073.48	$ 264,590.03	**$ 1,184,443**	$ 236,889	**$ 3,292,036**	$ 109,734.53
NPV total bill savings (thous $)		$ 130,494.45	$ 254,786.79	$ 248,707.96	$ 240,749.50	$ 235,084.81	**$ 1,109,824**	$ 221,965	**$ 2,700,310**	$ 90,010.33
NPV benefits (thous $)		$ 138,430.08	$ 265,599.72	$ 252,938.16	$ 243,601.81	$ 238,552.41	**$ 1,139,122**	$ 227,824	**$ 2,857,460**	$ 95,248.67
Net jobs		3,891.17	4,423.64	1,154.62	1,158.50	1,178.76	**11,806.69**	2,361.34	**22,006.93**	734
Net impacts										
Annual nominal savings (thous $)		$ (500,284)	$ (366,681)	$ 268,342	$ 266,190	$ 268,493	**$ (63,940)**	$ (12,788)	**$ 2,265,087**	$ 75,502.89
Net present value (thous $)		$ (500,284)	$ (356,001)	$ 252,938	$ 243,602	$ 238,552	**$ (121,193)**	$ (24,239)	**$ 1,597,145**	$ 53,238.18
Public buildings										
Total-Public buildings										
Costs										
Policy total		$ 411,329	$ 411,616	$ -	$ -	$ -	**$ 822,945**	$ 164,589	**$ 822,945**	$ 411,472
Loan amount		$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	**$ -**	$ -
Out-of-pocket		$ 411,329	$ 411,616	$ -	$ -	$ -	**$ 822,945**	$ 164,589	**$ 822,945**	$ 411,472
Loan payments		$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	**$ -**	$ -
- Payments on interest only		$ -	$ -	$ -	$ -	$ -	**$ -**	$ -	**$ -**	$ -

In a way, this sheet provides a behind-the-scenes look at the calculations made to determine the impacts of the policies. The outputs from this sheet are also summarized on sheet 4a. However the purpose of this sheet is to provide year-by-year details of cash flow and other costs and benefits for each policy and sector. All values on this sheet are calculated from inputs on sheets 2, 3a, 3b, 3c, and 3d.

Across the top of the sheet are up to 30 *Years*, beginning with the *Starting year* and ending with the *Ending year* of the impact analysis period as selected in sheet 2, displayed in both calendar year and counted from the *Starting year* as year 1. If macros have been enabled in your file, only the years in the *Impact analysis period* will be displayed. All data in the column below a year are associated with that year. The next line below the two rows of year information includes the *Discount rate* (as set on sheet 2) and the calculated discount multiplier for each year displayed under the appropriate year. These values are used to calculate net present value. Listed along the left-hand side of the sheet in the first column are the totals for all sectors and policies and the same sectors (*Public buildings, Residential buildings, Commercial buildings,* and *Transportation*) and their respective policies, in the same order, as found on the other sheets. In the second column are sets of rows describing costs, benefits, and net impacts. The identical line items are replicated for each of the buildings policies, and with only minor variation for the information displayed for Transportation policies. The *Costs* lines displayed are total annual policy cost, amount of the loan taken to finance the policy costs, amount of the policy costs paid without financing (or out-of-pocket), payments on loan principal in that year, and payments on loan interest in that year. The *Benefits* lines are energy savings for each fuel, energy bill savings in dollars for each fuel, and net jobs resulting from the policy in that year. For transportation policies, operating cost savings are also presented here. Finally, the *Net impacts* lines are annual net cost savings (or expenditures) in constant 2008 dollars and the net present value of those cost savings in that year. As you move to the right you see the associated value for each line item in the year represented by the respective column. These cells are populated based on the values set in the previous sheets.

On the far right side of the sheet, beyond the column for the last year presented, are four columns that present two versions of the totals and averages for each line item on the sheet. The first two columns, labeled *Analysis period*, display the sum and mean respectively for the values in that row from the years included in the analysis period as set on sheet 2. These values are used to derive many of the values included on the Results sheet. Finally, the next two columns, labeled *Entire Sheet (years not = 0)*, display the sum and mean for that row for every year on the sheet (for all 30 years on the sheet, even the columns that are hidden) where the value isn't 0. Although the values in these last two columns are not used elsewhere in the tool, they provide a quick way to check the values in the previous two columns. Also, the *Total* column can be referenced to see the total impacts of a policy over the 30-year period, even if the analysis period is set for a fewer number of years. The *Average* column provides averages for every year in which there is some activity in that row and ignores the cells with a value of 0. As a result it can display values such as average annual loan payments for all borrowers during the length of the loans, even if the analysis period ends before all loans are paid off.

This sheet lets users see more detail about when costs and benefits accrue. This information may be important if the user is under time constraints. For example, policies under consideration might have to be completed within a particular annual budget, or the user might like to see net cost savings within a set time period after the start of the policy. Users can adjust the various timeframe, financing, or policy parameters to better match the annualized outcomes to their goals or constraints.

5. Report Spreadsheet

The Report sheet is intended to serve as a printable two-page summary of the overall results of the analysis completed by the user in LEEP-C. The report first presents the baseline conditions in the community for the starting year: community energy use, associated costs, and sector breakdown of costs. Next, the two scenarios analyzed in LEEP-C are compared. For the *Business-as-usual scenario*, a few sentences describe the change in energy use, associated costs, sector breakdown of costs, and change in spending by sectors for the last year in the analysis period in comparison to the baseline conditions. Two figures, showing change over the analysis period of energy consumption by sector and of total energy costs by fuel, are displayed. In the next section the policy implementation period and the sectors and policies included in *Energy efficiency policy scenario* are described, and then the results of the scenario are presented in comparison to business-as-usual and baseline conditions. Change in total energy use and costs, change in sector-specific energy use, and change in fuel-specific spending are discussed. Two more figures are presented, this time presenting the savings achieved in each sector and for each fuel in comparison to the business-as-usual scenario. Next, the emissions and jobs benefits of the scenario are presented. This report is intended for use with general audiences to discuss the results of a local analysis completed using LEEP-C. The report does not detail the design of the model or the choices made by the user, because it is designed to provide a simple starting point for describing the variety of benefits that efficiency investments can provide to a community.

Possible Scenarios

While the detailed walk-through of the calculator's features in the previous section should bring users up to speed on the technical aspects of using the tool, this section provides a few examples of how the tool can answer questions that an energy efficiency stakeholder may have.

Budget- and Time-Constrained

The mayor of Omaha, Nebraska is interested in pursuing energy efficiency in public buildings and has been able to carve out a small budget of less than $100,000 for pursuing related policies and projects. However the city council is skeptical; as a result, the mayor wants to see significant cost savings by the time of the next election in four years. Within the constraints of the limited budget and timeline, how can Omaha maximize net savings while demonstrating the long-term value of energy efficiency?

Outcome Goal

The city council of Tampa, Florida, has set a goal of decreasing greenhouse gas (GHG) emissions through transportation policies by as much as possible, cost effectively, by 2030. The city's department of environment has been tasked with defining "cost effective" and establishing the strategies that will be used to meet the goal. What energy efficiency policies will contribute the greatest reductions in greenhouse gas emissions by 2030 cost effectively?

Buildings Focus

The state of Utah is exploring energy efficiency options for its building sector including residential, commercial, and public building space. Along with its interest in energy savings, the state is hoping to maximize the number of jobs created through its investments to provide an example of the positive economic development impacts energy efficiency can have for the state. How can Utah best maximize job creation through energy efficiency in its buildings while still reducing the state's energy costs over the next 15 years?

These are only three examples of questions for which LEEP-C can help provide answers. LEEP-C can be customized according to various community characteristics and preferences, allowing energy efficiency stakeholders to find the answer to a broad set of questions.

Options for Future Development

LEEP-C in its current form, like nearly all planning tools and models, has many limitations. Several of these limitations have already been discussed in this text. ACEEE may improve existing functions and develop additional functionality for the tool over the coming years. While there are many possible areas of improvement, some of our next efforts will be focused on improving functionality through changes including the following.

New sectors and policies. Although this edition adds many several new policies, there are still others that could add value to the tool. For transportation, for example, new policies could include those focused on encouraging the adoption of alternative-fuel or high-efficiency vehicles in addition to the urban design, pricing, and alternative-mode policies already included.

Efficiency savings for minor fuels. The current version of LEEP-C includes all important fuel in the buildings and transportation sectors. But the policies as designed do not result in savings to all fuels. In the building sectors, fuel oil remains an important heating fuel in some regions, particularly in the Northeast. Including policies to save fuel oil (and propane) could be valuable to these communities. Additionally, electricity and natural gas as transportation fuels are not accounted for in the tool. These will be important to add if these fuels gain a larger market share in the future, or if we choose to add alternative fuel transportation policies to the tool.

New community issues and related metrics. The current list of issues of which users are able to rank the importance is extensive but far from comprehensive. We will consider adding new issues and related metrics to the next version of LEEP-C. Potential new values and metrics may include impacts on peak energy demand; local investment and industries; net cost of living, net economic output, avoided infrastructure costs, water savings, and various cost-effectiveness tests.

Better data visualization and interface. The current LEEP-C design and interface are limited by its Excel platform and a limited use of Visual Basic macros. In a future version of LEEP-C it could be moved to a Web-based platform to allow for better and more varied visualizations of impacts, as well as allow users to save their settings, report their results to help with improving the tool, and generate summary reports.

User-customized policies. Users of LEEP-C are currently limited to the policies and related data pre-programmed into the tool by the developers. However these policies certainly do not include all of the policies that could be of interest to a community. A future version of the tool could allow for user-defined custom policies. To create a custom policy, users would need to enter data on costs, benefits, when they accrue, and to whom. Although using this feature would require research on the part of the user, it could make the tool more appropriate to their needs. Additionally, users could submit the data and sources used to create their custom policies to allow for them to be included in a future version of the tool and made available to other users.

Expanded treatment of uncertainty. The number of variables and related forecasts and assumptions necessary to develop a tool like LEEP-C means that the results have uncertainty associated with them. A future version of the tool could better describe and depict the level of uncertainty and, as a result, risk associated with outputs. Perhaps even more importantly the tool could put the risk associated with energy efficiency policies in the context of other common policy, investment, economic, and environmental risks.

Users are encouraged to submit comments about the tool and suggestions for its improvement.

Conclusion

LEEP-C can be used by local policymakers and stakeholders interested in advancing the adoption of energy efficiency in their communities to analyze the estimated impacts of policy choices. Currently, the tool can analyze a total of 23 different policy types from 4 economic sectors—public buildings, residential buildings, commercial buildings, and transportation— and calculate estimated impacts of specific policy choices on energy savings, cost savings, pollution, jobs, and other outcomes over a time period set by the user.

We are interested in your input on how LEEP-C can be improved to better meet your needs. Please send suggestions to David Ribeiro at dribeiro@aceee.org.

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Appendix A. Policies Included

Public Buildings Comprehensive Retrofit

Policy description. Many public buildings have not had a major renovation in decades. A comprehensive energy assessment, or audit, can determine a building's current level of performance and may identify both small adjustments in operations and technology as well as capital investments that would greatly reduce operating costs while improving comfort and overall performance. Choosing to implement a variety of these recommended cost-effective, whole-building performance improvements would constitute a comprehensive retrofit. Often building certification systems—such as ENERGY STAR Certification and LEED—are used by governments to designate a desired level of energy performance.

Performance. A 2005 ACEEE report determined the average energy savings from a comprehensive retrofit for commercial buildings to be around 23% with costs averaging around $2.50 per square foot. Costs and savings for public buildings would likely be similar to those of commercial buildings. LEEP-C allows users to adjust the average savings achieved through a retrofit. The user can select average savings from of 0%-30%, and the associated costs of these savings levels range $0.63–$5.18 per square foot.

Public Buildings Retrocommissioning

Policy description. Retrocommissioning, or RCx, provides existing buildings with a tune-up to improve the functioning of their systems and energy performance. Detecting and fixing deficiencies in a building's operation can be done extremely cost effectively and often results in great energy savings. Governments can adopt policies and practices to ensure that their buildings undergo retrocommissioning at regular intervals to ensure that buildings continue to perform at a high level of efficiency.

Performance. A 2009 study from the Lawrence Berkeley National Laboratory reviewed a sample of 163 commercial building retrocommissioning projects and found that half of projects saved between 9 and 31% of energy use, and the median energy savings of all projects was 16%. Costs most commonly ranged from $0.15 to $0.62 per square foot with a median of $0.30. The median payback was just over one year.

Who has implemented

- State of Minnesota. Public Buildings Enhanced Energy Efficiency Program (PBEEEP) provides technical assistance and financing to local governments for retrocommissioning and other energy efficiency measures.

Public Building Benchmarking and Disclosure

Policy description. The past few years have seen a surge of governments, both state and local, requiring regular benchmarking of energy performance in their own buildings through tools such as ENERGY STAR Portfolio Manager, which allows for tracking of energy consumption over time and for comparisons of performance to other similar buildings around the country. Many of these policies also require that the performance information be disclosed to the public through the Internet or other methods to improve transparency. Benchmarking allows for better management of building operations and maintenance and allows building departments to more effectively consider energy efficiency when making their capital investment plans.

Performance. Benchmarking can directly improve energy-related operations and maintenance in public buildings. Additionally, it frequently catalyzes investments in energy efficiency measures that would not have taken place otherwise. A California Energy Commission report estimated that the average commercial building participating in benchmarking would save 0.13 kWh and 0.002 therms per square foot annually. This translates to annual savings of 0.95% for electric and 0.77% for natural gas. Savings for public buildings may even be higher than in commercial buildings if policies also directly encourage or require energy investments in specific energy-saving technologies, retrocommissioning, or comprehensive retrofits.

Who has implemented

- Seattle. Seattle requires benchmarking and annual reporting, to the city, of energy performance of all public and nonresidential buildings greater than 10,000 square feet and multifamily residential buildings of four or more units. It complements a Washington state law that requires disclosure to prospective buyers, lessees, or lenders.
- Washington, DC. The Clean and Affordable Energy Act of 2008 requires annual disclosure of benchmarking results for all public buildings and private buildings greater than 50,000 square feet. Disclosures are to be made public on an Internet database.

Performance-Based Policy for New and Existing Public Buildings: ENERGY STAR Certified

Policy description. Local governments can go beyond disclosure of energy use and periodic investment in energy performance improvements by systematically requiring a certain level of energy performance in some or all of the buildings they own and lease. ENERGY STAR certification is the most widely adopted recognition system for high energy performance. It uses data collected through energy benchmarking with ENERGY STAR Portfolio Manager to certify the highest performing buildings. Performance against another standard, such as a percentage improvement from a baseline year, can also be adopted in policies. Policies can require ENERGY STAR certification or other performance standards for all large buildings, certain classes of buildings, or a certain portion of buildings. Policies can also be phased in over a certain period of time to allow for energy improvements to be implemented in the course of other planned buildings investments.

Performance. Buildings that are awarded the ENERGY STAR certification are required to demonstrate, through regular benchmarking, energy performance that places them in the top 25% (or better than 75%) of similar buildings nationwide. This translates to a 22% or greater energy savings compared to an average building. As modeled in LEEP-C, this policy can be customized to achieve energy savings of 0–40% at costs ranging from $0–$5.53 per square foot, as adapted from an analysis by the Institute for Market Transformation (Burr et al. 2012).

Who has implemented

- State of New York. Executive Order 88 directs state agencies to increase energy efficiency in state-owned and managed buildings by establishing a target of reducing average energy use intensity (EUI) by 20% relative to a fiscal year 2010–2011 baseline by April 1, 2020.
- State of Florida. House Bill 7135 mandates that the state may not enter into new leasing agreements for office space that does not meet ENERGY-STAR-certified building standards. Additionally, buildings constructed and financed by the state must comply with the Florida Green Building Coalition standards or a nationally recognized, high-performance green-building rating system, such as the US Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) rating system. (These and other policies and programs leveraging various ENERGY STAR tools are listed in ENERGY STAR 2013.)

RESIDENTIAL ENERGY USE DISCLOSURE

Policy description. A Building Rating and Disclosure policy requires that information on the energy efficiency of a building be made available to buyers and renters through a standardized energy assessment. A home energy assessment evaluates an existing home to determine energy efficiency, where energy is being lost, and the cost-effective improvements that can be implemented to enhance occupant comfort, make the home more durable, and lower utility costs. This mechanism aims to raise consumer awareness about energy performance and incentivize sellers to upgrade the energy performance of their buildings in order to boost their value and sell or rent buildings more easily to an informed public. As it is a foundational policy, governments can use rating and disclosure to build awareness of building energy performance and costs, improve participation in existing efficiency programs, or expand the local market for building performance professionals. The policies can be implemented in a variety of ways. Implementing agencies have established different mechanisms to trigger rating and disclosure and have used different rating systems.

Performance. Rating and disclosure policies have direct impacts on the level of actionable information available to building and homeowners. Additionally, they have indirect but tangible impacts on the adoption of energy efficiency improvements. A California Energy Commission study estimates that the average annual energy savings for a home covered by a rating and disclosure policy would be 543 kWh and 31 therms. In percentage terms, this is an annual savings of 6.0% for electricity and 6.8% for natural gas.

Who has implemented

- New York: Truth in Heating. The seller of a residential structure must provide purchaser a complete set of heating and/or cooling bills upon request of the purchaser.

UPDATING RESIDENTIAL BUILDING ENERGY CODES

Policy description. The building energy code is one of the foundational policies for energy efficiency. Building codes set a minimum standard for how energy efficiency is integrated into the design and construction of new buildings and major building renovations. Building energy codes are developed and updated through a process led by building professionals, and are eventually adopted as a model code as determined by the US Department of Energy. The model energy code for residential buildings is the International Energy Conservation Code (IECC). New versions of the energy code are often adopted through state policy and enforced by local jurisdiction, but in some cases local governments also have the authority to adopt improved energy codes.

Performance. Technical analysis by the US Department of Energy estimates the energy savings and costs associated with the adoption of new versions of the energy code. LEEP-C draws on these analyses (compiled at energycodes.gov) to model costs and energy savings associated with moving between versions of the model code. Depending on the starting and ending version of the code selected by the user (ranging from no code to the 2012 IECC), these policy choices are associated with a 0–38% energy savings per home and $0–3,400 in incremental costs per home.

Who has implemented. Building energy codes are widely adopted in the United States.

Efficient New Homes: ENERGY STAR Certified

Policy description. While building energy codes establish a minimum floor for the consideration of energy use in the design and construction of new homes, there are a variety of programs that encourage the voluntary construction of homes with even better energy performance. ENERGY-STAR-Certified New Homes is the one of the most broadly used voluntary standards for building high-performing homes. The certification is available for both single-family and multifamily homes.

Performance. ENERGY-STAR-Certified New Homes can achieve up to 30% savings in comparison to a typical new home. For LEEP-C we used average costs and savings values for participants in Version 3 of the program: 15% electricity savings, 28% natural gas savings, and $2,300 in incremental costs per home in comparison to the 2009 IECC code.

Who has implemented. Over 3,000 home builders and other building professionals in the United State are ENERGY STAR for Homes Partners. As of the end of 2014, over 1.5 million new homes had been certified. Many states, utilities, and other program implementers provide incentives to build to the ENERGY STAR standard.

Commercial Building Comprehensive Retrofit

Policy description. A comprehensive energy assessment or audit can determine a building's current level of performance and may identify both small adjustments in operations and technology as well as capital investments that would greatly reduce operating costs, while improving comfort and overall performance. Choosing to implement a variety of these recommended cost-effective, whole-building performance improvements would constitute a comprehensive retrofit. LEEP-C can be used to model either retrofit requirements or technical assistance and incentive programs that result in retrofits, depending on the policy design variables that are selected by the user, particularly the setting for *Portion of all buildings to be retrofitted*.

Performance. A 2005 ACEEE report determined the average energy savings from a comprehensive retrofit for commercial buildings to be around 23%, with costs averaging around $2.50 per square foot. LEEP-C allows users to adjust the average savings achieved through a retrofit. Average savings from 0% to 30% can be selected by the user, and the associated costs of these savings levels range from $0.63 to $5.18 per square foot.

Who has implemented

- Philadelphia: The EnergyWorks Commercial Loan Fund provides financing for comprehensive retrofits and other energy improvements for commercial buildings.
- Many other utilities and state and local governments implement programs to encourage commercial retrofits, some of which are profiled in Kwatra and Essig 2014 and listed in the DSIRE database.

Commercial Building Retrocommissioning

Policy description. Retrocommissioning, or RCx, provides existing buildings with a tune-up to improve the functioning of their systems and energy performance. Detecting and fixing deficiencies in a building's operation can be done extremely cost effectively and often results in great energy savings. Governments can adopt policies or incentives to encourage buildings in their community to be retrocommissioned at regular intervals to ensure that buildings perform at a high level of efficiency. LEEP-C can be used to model either retrocommissioning requirements or technical assistance and incentive programs that result in retrocommissioning, depending on the policy design variables that are selected by the user, particularly the setting for *Portion of all buildings to be retrocommissioned*.

Performance. A 2009 study from the Lawrence Berkeley National Laboratory reviewed a sample of 163 commercial building retrocommissioning projects and found that half of projects saved between 9% and 31% of energy use and the median energy savings of all projects was 16%. Costs most commonly ranged from $0.15 to $0.62 per square foot with a median of $0.30. The median payback was just over one year.

Who has implemented

- New York City. Local Law 87 (a component of the Greener Greater Buildings Plan) requires that the city's largest buildings (over 50,000 square feet) undergo an energy audit and undertake retrocommissioning at least every 10 years.
- San Francisco. The city's Existing Commercial Buildings Energy Performance Ordinance requires energy efficiency audit for each building over 10,000 square feet every 5 years. The policy does not directly require retrocommissioning, but it is designed to encourage building owners to choose to undertake retrocommissioning simultaneously with the audit. More information on these two policies and others that are similar is available in SEE Action 2013.
- Many other programs encourage voluntary retrocommisioning through enabling activities like benchmarking, challenges, and competitions. One such model, implemented in over a dozen communities, is the Kilowatt Crackdown competition that is in most cases administered by local chapters of the Building Owners and Managers Association International (BOMA).

Commercial Building Benchmarking and Disclosure

Policy description. The past few years have seen a surge of governments, particularly of large cities, requiring regular benchmarking of energy performance of large private buildings in their communities. This benchmarking is typically through tools such as ENERGY STAR Portfolio Manager, which allows for tracking of energy consumption over time and for comparisons of performance to other similar buildings around the country. Many of these policies also require that the building performance information be disclosed to the public, or at least to the local government, through the Internet or other methods to improve transparency. Benchmarking allows for better management of building operations and maintenance and allows building departments to more effectively consider energy efficiency when making their capital investment plans.

Performance. Benchmarking can directly improve energy-related operations and maintenance in large buildings. Additionally, it frequently catalyzes investments in energy efficiency measures that would not have taken place otherwise. A California Energy Commission report estimated that the average commercial building participating in benchmarking would save 0.13 kWh and 0.002 therms per square foot annually. This translates to annual savings of 0.95% for electric and 0.77% for natural gas. Savings can be even higher if benchmarking is coupled with policies that directly encourage or require energy investments in specific energy saving technologies, retrocommissioning, or comprehensive retrofits, or that encourage or require a certain level of energy performance.

Who has implemented. As of July 2015, 11 local governments require some form of building benchmarking and disclosure, including Austin, Texas; Montgomery County, Maryland; New York City; and the District of Columbia. (Additional information on these and other similar policies are available at Buildingrating.org.)

Performance-Based policy for New and Existing Commercial Buildings: ENERGY STAR Certified

Policy description. Policies can go beyond requiring disclosure of energy use and encouraging or requiring periodic investment in energy performance improvements by systematically requiring a certain level of energy performance in some or all of the buildings in a community. ENERGY STAR certification is the most widely adopted recognition system for high energy performance. It uses data collected through energy benchmarking with ENERGY STAR Portfolio Manager to certify the highest performing buildings. Performance against another standard, such as a percentage improvement from a baseline year, can also be adopted in policies. Policies can require ENERGY STAR certification or other performance standards for all large buildings, certain classes of buildings, or a certain portion of buildings. Policies can also be phased in over a certain period of time to allow for energy improvements to be implemented in the course of other planned buildings investments.

Performance. Buildings that are awarded the ENERGY STAR certification are required to demonstrate, through regular benchmarking, energy performance that places them in the top 25% (or better than 75%) of similar buildings nationwide. This translates to a 22% or greater energy savings compared to an average building. As modeled in LEEP-C, this policy can be customized to achieve energy savings of 0–40%, at costs ranging from $0 to $5.53 per square foot, as adapted from an analysis by the Institute for Market Transformation (Burr et al. 2012).

Updating Commercial Building Energy Codes

Policy description. Building energy codes are one of the foundational policies for energy efficiency. Building codes set a minimum standard for how energy efficiency is integrated into the design and construction of new buildings and major building renovations. Building energy codes are developed and updated through a process led by building professionals and are eventually adopted as a model code as determined by the US Department of Energy. The model energy code for commercial buildings is the American Society of Heating, Refrigerating, and Air-Conditioning Engineers' (ASHRAE) Standard 90.1 in combination with the International Energy Conservation Code (IECC). New versions of the energy code are often adopted through state policy and enforced by local jurisdiction, but in some cases, local governments also have the authority to adopt improved energy codes.

Performance. Technical analysis by the US Department of Energy estimates the energy savings and costs associated with the adoption of new versions of the energy code. LEEP-C draws on these analyses (compiled at energycodes.gov) to model costs and energy savings associated with moving between versions of the model code. Depending on the starting and ending version of the code selected by the user (ranging from No code/ASHRAE 90.1-1989 to ASHRAE 90.1-2010), these policy choices are associated with a 0–35% energy savings and $0–3.43 in incremental costs per square feet.

Who has implemented. Building energy codes are widely adopted in the United States.

Transportation Policies

The policies included in LEEP-C are directly based on the policies and implementation levels described in *Moving Cooler* (Cambridge Systematics 2009) as described below. The Level of Deployment options for each policy (Expanded current, More aggressive, and Maximum) are also based on equivalent policy scenarios from *Moving Cooler* and are included in the *Policy Descriptions* for each policy below and in the tool.

The performance of these various policies, as well as examples of who has implemented each of transportation policies in LEEP-C, are included in the ACEEE report *Improving Travel Efficiency at the Local Level* (Vaidyanathan and Mackres 2012).

Combined Land Use

Expanded best practice. The regional Metropolitan Planning Organization (MPO) (or another designated regional agency) develops a regional transportation and land use plan that meeting defined criteria for process and content. Plans collectively provide for at least 60% of new development in attached or small-lot detached units, in pedestrian- and bicycle-friendly neighborhoods (e.g., sidewalks, bicycle facilities, good connectivity) with mixed-use commercial districts and high-quality transit. The majority (nearly three-quarters) of local governments adopt zoning and planning standards allowing for sufficient densities and requiring pedestrian-friendly design in these areas.

More aggressive. Metropolitan land use plans call for at least 70% of new development in neighborhoods as described above. Local plan and zoning code compliance is higher (about 90%) as a result of stronger funding incentives. The state adopts comprehensive planning laws similar to Washington State's Growth Management Act, requiring local comprehensive plans that meet defined objectives, designation of urban growth and priority funding areas, and interagency plan review. This requires comprehensive plan adoption and revision of zoning and other municipal codes for consistency with regional plans in five years.

Maximum effort. States and metro agencies adopt enforceable growth boundaries around urban areas consistent with Oregon's model. Metropolitan land use plans and local zoning collectively provide for at least 90% of new development in neighborhoods as described above. Local plan and zoning code compliance is 100%. Density minimums are established inside urban growth boundaries. Requirements are established for minimum fractions of new jobs and housing to be located within walking distance of high-frequency transit service. MPOs have authority to disapprove local land use plans and ordinances if they are not consistent with the regional plan. They are enforced through withholding of funding for transportation projects.

Pedestrian Strategy

Expanded best practices. All new developments have buffered sidewalks on both sides of the street, marked or signalized pedestrian crossings at intersections on collector and arterial streets, and lighting. New or fully reconstructed streets in denser neighborhoods (greater than 4,000 persons per square mile and business districts) incorporate traffic calming measures such as bulb-outs and median refuges to shorten street-crossing distances. Complete streets policies are adopted by state and local transportation agencies, requiring appropriate pedestrian accommodations on all roadways. After 10 years, existing streets within one-quarter mile of transit stations, schools, and business districts are audited for pedestrian accessibility and retrofitted with curb ramps, sidewalks, and crosswalks.

More aggressive. After five years, existing streets within one-half mile of transit stations, schools, and business districts are audited for pedestrian accessibility and retrofitted with curb ramps, sidewalks, crosswalks, and limited traffic calming measures as appropriate to improve pedestrian accessibility.

Maximum effort. Same as described in the previous paragraph, but with more extensive traffic calming.

Bicycle Strategy

Expanded best practices. Complete streets policies are adopted by state and local transportation agencies, requiring appropriate bicycle accommodations on all roadways. Bicycle parking is provided at all commercial destinations. All new commercial buildings greater than 100,000 square feet are required to provide showers, lockers, and covered or protected bicycle parking; all new multi-unit residential buildings have indoor bicycle parking. Buses are fitted with bicycle carriers, rapid transit stations have bicycle parking, and all rapid transit lines are bike-accessible during off-peak hours. School curricula include safe-cycling skills for children. Primary central business districts have a bike station that provides services including parking, rentals, repair, changing facilities, and information.

Within 10 years of the start of the policy, citywide or regional plans will be fully implemented for on-street bicycle accommodations to create a continuous network of routes. The network includes bicycle lanes at one-mile intervals and other facilities (e.g., shared-use markings and signed routes using neighborhood streets) at one-mile intervals, for a combined network density of one-half mile, implemented in areas with population density more than 2,000 persons per square mile.

More aggressive. Within five years bicycle accommodations will be provided to create a continuous network of routes with approximately one-half-mile spacing. The bicycle network consists of a combination of bicycle lanes, bicycle boulevards, and shared-use paths provided at combined one-half-mile spacing, implemented in areas with population density more than 2,000 persons per square mile. Bicycle boulevards (on residential streets) include traffic diverters to limit automobile traffic on these routes.

Maximum effort. New development areas are planned with a network of off-street paths at approximately one-quarter to one-half-mile intervals. City-level plans support linkages among local paths. The bicycle network consists of a combination of bicycle lanes, bicycle boulevards, and shared-use paths provided at combined one-quarter-mile spacing, implemented in areas with population density more than 2,000 persons per square mile. Bike stations are located at all major activity centers and transit hubs as well as in the central business district (CBD).

Parking Pricing

Expanded best practices. Begin pricing all CBD, employment center, and retail center street parking; price to encourage park-once behavior.

More aggressive. Begin pricing all CBD, employment center, and retail center street parking; price to encourage park-once behavior; complete over six years. After 10 years introduce a tax or raise the tax on free private parking lots with more than 100 spaces (retail and employer). This includes employer-subsidized and paid spots for employees and validated parking. After 10 years also require residential parking permit for on-street parking in residential areas. (The minimum cost is $200 biannually).

Maximum effort. Begin pricing all CBD, employment center, and retail center street parking; price to encourage park-once behavior; complete over four years. After five years introduce a tax or increase the tax on free private parking lots with more than 50 spaces (retail and employer). This includes employer-subsidized and paid spots for employees and validated parking. After five years also require residential parking permit for on-street parking in residential areas. (The minimum cost is $400 biannually.) Delivery and service vehicles must purchase multi-zone permit at double cost; visitor's permits at $3 per day. Phase in by 2020.

Pay-As-You-Drive Insurance

Expanded best practices. Permit the offering of per-mile insurance rates in region.

More aggressive. After five years least 50% of policies in the region must have at least 50% mileage-based premiums. Assume increasing penetration due to market forces to 75% after 15 years.

Maximum effort. After five years, all auto insurance policies must have at least 75% of premiums paid for on a mileage basis, allowing but not mandating adjustments in mileage rates based on time of day, location, driving style, or other factors. Assume 100% penetration after 15 years.

Congestion Pricing

Expanded best practice. Begin pricing congested roadways with pricing completed within 15 years. Average peak hour per mile price is $0.49 on congested segments.

More aggressive. Begin implementing area-wide congestion pricing on all congested urban highways and roads with prices sufficient to maintain Level of Service (LOS) D on facilities previously LOS F. Complete pricing within 10 years. Average peak hour per mile price is $0.65 on congested segments.

Maximum effort. Begin congestion pricing on urban roads with prices sufficient to maintain LOS D. Begin implementing congestion pricing on congested rural freeways and arterials with prices sufficient to maintain LOS C. Average peak hour per mile price is $0.65 on congested segments.

Cordon Pricing

Begin to implement area pricing in CBD and major employment and retail centers. Ramp up over 10 years.

Vehicle-Miles-Traveled (VMT) Fee

Expanded best practice. Introduce a $0.01 per mile VMT fee to be paid based on odometer audit during each vehicle inspection or sale. Transition to electronic monitoring, which includes making annual inspections mandatory.

More aggressive. Introduce a $0.03 per mile VMT fee to be paid based on an odometer audit during each vehicle inspection or sale. Transition to electronic monitoring.

Maximum effort. Introduce a $0.12 per mile VMT fee to be paid based on an odometer audit during each vehicle inspection or sale. Transition to electronic monitoring.

Employer-Based Commute Strategies

Expanded best practice. States or MPOs provide online ride matching and vanpool services and guaranteed ride home programs for all areas where services are not already provided by TDM service providers. MPO or other designated agencies (such as TMAs) implement an aggressive outreach program to inform major employers (100 or employees) of alternative travel options and assist with providing information and incentives to employees. Transit agencies make monthly passes available through employers at discounted rates. For the private sector provide employer goals and tax incentives for offering and adopting telecommuting and compressed work-week targets. Provide public funding or subsidies for the private provision of regional telework centers and shared satellite offices. Require elimination of telecommuting barriers in state and local tax codes (e.g., double taxation). For the public sector, all government agencies allow the option of telecommuting and a compressed work week for eligible employees.

More aggressive. Establish requirements for employers with 50 or more employees to develop and implement plans to reduce SOV trips by 10%, compared to baseline levels. Offer technical assistance to employers for these plans and provide federal tax incentives for compliance and disincentives for noncompliance. Continues regional ride-matching, vanpool, GRH, and transit discount services. Tax the value of parking benefits but not cash-out or transit benefits. For the private sector, as part of employer-based TDM requirements (see below). For the public sector, all government agencies require four-day work weeks

Maximum effort. Levy a tax on all commercial parking spaces (e.g., $5 per space per weekday). Employers are required to pass along this cost to employees, and proceeds are used to provide free transit passes for employees and other TDM activities (e.g., transit shuttles). Coordinate with parking pricing measures above. Continue regional ride-matching, vanpool, GRH, transit discount, and employer outreach programs (but no TDM plan requirement). For the private sector, this is included as part of employer-based TDM requirements (see below). For the public sector, all government agencies require four-day work weeks.

Increased Levels of Transit Service and Improved Travel Times

Expanded best practice. Increase transit level of service by 1.5 times trend revenue mile expansion rates. Investments targeted in areas with at least 4,000 persons per square mile or that otherwise facilitate increases in pax/VRM. After five years, implement signal prioritization, limited stop service, and so forth over five years to improve travel speed an additional 10%.

More aggressive. Increase transit level of service by two times trend revenue mile expansion rates. Investments targeted in areas with at least 4,000 persons per square mile or that otherwise facilitate increases in pax/VRM. Immediately begin implementing signal prioritization, limited stop service, signal synchronization, intersection reconfiguration, and so forth over five years to improve travel speed an additional 15%.

Maximum effort. Increase transit level of service by four times trend revenue mile expansion rates. Investments targeted in areas with at least 4,000 persons per square mile or that otherwise facilitate increases in pax/VRM. Immediately begin implementation of signal prioritization, limited stop service, signal synchronization, intersection reconfiguration, AVS, and so on over three years to improve travel speed an additional 30%; boost reliability by 40%; boost ridership attraction through integrated transit fare systems; deploy full-scale BRT where it makes sense.

Expanded Urban Public Transportation

Expanded best practice. Expand service proportional to 3% per year ridership growth. Includes all transit modes.

More aggressive. Expand service proportional to 3.53% per year ridership growth. Includes all transit modes.

Maximum effort. Expand service proportional to 4.67% per year ridership growth. Includes all transit modes.

Appendix B. Analysis Methodology and Data Sources

ENERGY PRICES

Retail prices by state for electricity, natural gas, fuel oil, propane, gasoline, and diesel for 2010 through 2040 were compiled or projected based on recent datasets available from the Energy Information Administration (EIA). All prices are presented in 2012 dollars for comparability in real terms across years. We converted prices to 2012 dollars using deflators derived from the US Bureau of Economic Analysis (BEA 2014).

Electricity

State average electricity prices for 2013 were obtained from table 5.6.B of the February 2015 edition of *EIA Electric Power Monthly* (EIA 2014b). Electricity price projections at the state level are not available from EIA. Retail price projections for each sector through 2040 by census region are available from the EIA Annual Energy Outlook 2015 (Supplemental Tables 3-3.9) (EIA 2015a). Using the 2013 state prices as the starting point, we calculated estimated state prices by sector for 2014 through 2040 by using the regional price projections to determine a growth rate from year to year (EIA 2015a). The formula used to calculate the state projections for each year is as follows:

> Previous year state sector price * (Census region projected price for current year / Census region projected price for previous year)

We obtained the average electricity prices for 2010, 2011, and 2012 for each state from table 5.6.B of the February 2012, 2013, and 2014 editions of *EIA Electric Power Monthly* (EIA 2012b, EIA 2013, and EIA 2014b). We converted these prices into 2012 dollars.

Natural Gas

We obtained average retail natural gas prices by sector for 2010–2013 for each state from EIA (EIA 2014d). We converted 2010, 2011, and 2013 prices into 2012 dollars. Retail price projections for each sector through 2040 by census region are available from the EIA Annual Energy Outlook 2015 (Supplemental Tables 3–3.9) (EIA 2015a). Using the 2013 state prices as the starting point, estimated prices in each state by sector were calculated for the years 2014 through 2040 by using the regional price projections to determine a growth rate from year to year. The formula used to calculate the sector projections in each state for each year is as follows:

> Previous year state sector price * (Census region projected price for current year / Census region projected price for previous year)

Gasoline

The average gasoline prices by state for 2010, 2011, 2012, and 2013 were obtained from the EIA's State Energy Data System (SEDS) (EIA 2014c). We converted 2010, 2011, and 2013 prices into 2012 dollars. Similar to the methodology used for electricity and natural gas price projections, we used 2013 state prices as a starting point and estimated prices in each state for the years 2014 through 2040 by using the regional price projections to determine a growth rate from year to year (EIA 2015a). The formula used to calculate the sector projections in each state for each year is as follows:

> Previous year sector price * (Census region projected price for current year / Census region projected price for previous year)

Diesel

We compiled the actual state-by-state prices for diesel fuel for 2010, 2011, 2012, and 2013 from SEDS (EIA 2014c). We converted 2010, 2011, and 2013 prices into 2012 dollars. As mentioned, EIA does not project future energy prices state by state. Price projections for each sector through 2040 by census region are available from the EIA Annual Energy Outlook 2015 (Supplemental Tables 3 – 3.9) (EIA 2015a). Using the 2013 state prices as the starting point, we calculated estimated state prices by sector for 2014 through 2040 by using the regional price projections to determine a growth rate from year to year. The formula used is identical to the one used for both natural gas and gasoline price projections.

> Previous year state sector price * (Census region projected price for current year / Census region projected price for previous year)

Fuel Oil

State prices for residential and commercial heating oil were found in SEDS (EIA 2014c). We obtained fuel oil price projections (listed as distillate fuel oil for the residential and commercial sectors) for each sector through 2040 by census region from the EIA Annual Energy Outlook 2014 (Supplemental Tables 3–3.9) (EIA 2014a). Using the 2012 state prices as the starting point, we calculated estimated state prices by sector for 2013 through 2040 by using the regional price projections to determine a growth rate from year to year. The formula used is identical to the one used for both natural gas and gasoline price projections.

> Previous year state sector price * (Census region projected price for current year / Census region projected price for previous year)

Propane

Average propane prices by state were gathered from SEDS (EIA 2014c) for 2010, 2011, 2012 and 2013. (EIA 2014c). SEDS labels these as liquefied petroleum (LPG) prices rather than propane prices, but they are the same commodity. Retail residential propane price projections through 2040 by census region are available from the EIA Annual Energy Outlook 2015 (Supplemental Tables 3–3.9) (EIA 2015a). Using the 2013 state prices as the starting point, estimated prices in each state by sector were calculated for the years 2014 through 2040 by using the regional price projections to determine a growth rate from year to year. The formula used to calculate the sector projections in each state for each year is identical to those calculations used for electricity, natural gas, distillate fuels, and gasoline.

VEHICLE OPERATING COSTS

In addition to cost savings from reduced fuel consumption, policies that reduce vehicle miles traveled also result in a reduction the costs of operating a vehicle that are related to how much the vehicle is driven (i.e., oil, tires, maintenance and repair, and mileage-related depreciation). LEEP-C users can choose to include these cost reductions when calculating the impacts of the transportation policies. This cost is used for any transportation policy that affects VMT traveled. The savings per mile of vehicle travel avoided used in the tool are derived from *Moving Cooler* (Cambridge Systematics 2009, Technical Appendix C, Section II,

Table 1), and are set throughout the Analysis Period at $0.59/mile for policies that include only light-duty vehicles and at $0.68/mile for policies that include both light-duty and heavy-duty vehicles.

Avoided Costs

LEEP-C estimates avoided costs of infrastructure investment due to saved energy by fuel type. These values are used for calculations of two of the most common benefit–-cost tests

The automatically calculated values for avoided costs are derived from different sources depending on the fuel and sector. For electricity and natural gas, avoided costs represent a utility's avoided capital costs (typically building and maintaining power plants and transmission and distribution infrastructure). The values that are displayed in LEEP-C are regional averages (calculated for NERC regions for electricity and census divisions for natural gas) derived from the limited set of readily available data for each region. These sources included a national survey of energy efficiency potential studies (Neubauer 2014, Tables B-1 and B-2) and additional regional or state data from New England, California, Florida, Minnesota, New Jersey, North Carolina, and Texas.

Emissions

LEEP-C is able to estimate emissions reductions associated with reduced energy consumption. Version 2.0 of the tool calculates emissions related to electricity, natural gas, gasoline, and diesel. LEEP-C uses emissions rates that remain static over time and does not attempt to forecast changes in emission intensity from year to year.

Electricity emissions data are based on 2010 Annual Non-Baseload Output Emissions Rates from EPA eGRID 9th edition (EPA 2014a). In eGRID the emission rates (in the form of lbs./MWh or lbs./GWh) are available for each eGRID subregion for each of six electricity-related pollutants: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), nitrogen oxides (NO_X), ozone season NO_X, and sulfur dioxide (SO_2). Based on the ZIP code entered by the user, the emission rates from the eGRID region associated with that geography are applied to all electricity savings resulting from the policies.

Criteria pollutant and greenhouse gas emissions from residential and commercial natural gas equipment and appliances are calculated using emission rates from EPA 1998 (Tables 1.4-1 and 1.4-2) and EPA 2013 (Table A-84). For emissions from transportation, rates are derived from EPA 2008a, 2008b, 2013 (Table A-104), 2014b and EIA 2012a (Table D-3). National average emissions rates are used in the tool for all combustible fuels and all resulting pollutants.

When emission of individual greenhouse gas pollutants (CO_2, CH_4, and N_2O) are combined into one number in the tool, conversions are made into units of carbon dioxide equivalents (CO_2e) through the use of global warming potential coefficients as described in EPA (2005).

Employment

The net employment impacts calculated for LEEP-C are based on input–-output modeling. This methodology is a variation on the Dynamic Energy Efficiency Policy Evaluation Routine—or DEEPER Modeling System—a 15-sector quasi-dynamic input–output model of the US economy developed by ACEEE. (For a short introduction to DEEPER, see ACEEE 2011; for a more detailed description of the model in the context of a policy study, see Appendix B of Laitner 2011.) The methodology used in LEEP-C is a 24-sector model of the economy. Average multipliers for job creation (the number of jobs resulting from $1 million of investment) and regional purchase coefficients (the portion of economic activity in a sector that is supplied from within the region) for each of these sectors in 2011 for each of the 50 states, the District of Columbia, and the United States as a whole was obtained from the Minnesota IMPLAN Group (IMPLAN 2013). These values for the state in which a community is located were then scaled based on the community population size provided by the user. This scaling allows for a more accurate estimation of the net job impacts (i.e., including those jobs lost and gained) that result in the community itself (as distinct from job impacts in general, including those outside the community). The job outputs in LEEP-C are presented in job person-years, a unit equivalent of a full-time job for one person for one year.

Policy Costs and Energy Savings

LEEP-C uses data from a variety of sources to calculate the costs and resulting energy savings from the specific policies included. The data sources we used for calculation inputs for each policy are described in the following sections. As an example of the methodologies used in the tool, we include the equations for costs and savings for a comprehensive retrofit policy for public buildings in the following section. We do not list the equations used for other policies, but we used similar methodologies for all policies in LEEP-C.

Public Buildings Comprehensive Retrofit

For this policy a cost curve was constructed based on research summarizing the performance of comprehensive retrofit projects around the United States. Notably, it is based on data regarding average, high-end, and low-end costs and energy savings from a review of projects as reported in Mendelsohn and Amann 2005. The cost curve is then derived from these points through the use of the Long-Term Industrial Energy Forecast model, or LIEF (for a brief introduction to LIEF see the appendix to Laitner 2009). The high-end and low-end energy saving values are also used to set the range of possible user adjustments to the *Building Energy Savings Goal* on sheet 3a, while the average energy savings is used as the default.

Annual policy costs for each year in which retrofits occur—as displayed in the *Annual Policy Costs* field on sheet 3a—is derived from the following calculation:

> (Total public building square footage * Portion of buildings to be retrofitted * Cost per square foot at building energy savings goal) / Years over which retrofits occur

Energy savings (both electricity and natural gas) for a particular year—as displayed in the *Electric Savings* and *Natural Gas Savings* rows on sheet 5—are derived from the following calculation:

> [Number of Years in which retrofits occurred within the period of the measure life prior to and including the current year * Total annual consumption of fuel in starting year * ((1 + Annual energy use growth rate) ^ Year number in analysis period) *

Building energy savings goal * Portion of buildings to retrofitted] / Years over which retrofits occur

Public Buildings Retrocommissioning

Data on the typical distribution of costs per square foot and percentage of energy savings for retrocommissioning projects were collected from Amann and Nadel 2003 and Mills 2009. The LIEF model was then applied to the values from these two sources to develop a cost curve. The high-end and low-end energy savings values from Amann and Nadel 2003 were also used to set the range of possible user adjustments to the *Building Energy Savings Goal* on sheet 3a, while the average energy savings is used as the default.

Public Building Benchmarking and Disclosure

Data on the costs and benefits of this policy are derived from the Strategy Assumptions for Commercial Building Benchmarking as defined on pages 64–66 of the California Energy Commission report *Options for Energy Efficiency in Existing Buildings* (CEC 2005). Values for annual energy savings per square foot for both electricity and natural gas as well as costs per square foot for administration and to program participants are borrowed from this report. Energy savings in kWh and therms were converted to percentage of savings using data on energy intensity in an average California commercial building from the *California Commercial End-Use Survey* (Itron 2006). The CEC 2005 report is also the source of the default value for the portion of benchmarked buildings resulting in an audit and the life of measures resulting from the policy.

Performance-Based Policy for New and Existing Public Buildings

We calculated the impacts of this policy from savings and cost data pegged to levels of building energy savings as reported in Burr et al. 2012. Costs and savings data from operational building improvements as well as capital improvements were available.

Residential Energy Use Disclosure

Data on the costs and benefits of this policy are derived from the Strategy Assumptions for Time-of-Sale Information Disclosure as defined on pages 52–55 of *Options for Energy Efficiency in Existing Buildings* (CEC 2005). Values for annual energy savings per home for electricity and natural gas, as well as cost per home for administration and costs to the participant, were borrowed from the report. Energy savings in kWh and therms were converted to percentage of savings using data on residential energy use in an average single-family California home from the Residential Energy Consumption Survey (EIA 2005). The report is also the source for the default annual transaction rate, default compliance level, default incentive rate, and measure life.

Updating Residential Building Energy Codes

Data on the costs and benefits of updating IECC codes were found from DOE's building energy codes report (DOE 2012). The report consisted of a comparative analysis of the 2006, 2009, and 2012 editions of the IECC. Scenarios included in the report were run using the DOE's EnergyPlus software for single-family and multifamily homes with eight possible additions: four foundation types and four heating system types. The total costs reported for each of these scenarios can be found in table A.7 in the building energy codes report.

Savings from adopting building codes are reported as life-cycle cost savings, cash flow savings, and energy savings, which can be found in tables A.8–A.13.

Efficient New Homes: ENERGY STAR Certified

Data on the annual purchased energy cost, upgrade cost, and the energy savings data for ENERGY-STAR-certified new homes were borrowed from Exhibit 3 in ENERGY STAR 2013a. The EPA made estimations based on 13 homes in the cities of Miami, Tampa, Fort Worth, St. Louis, Indianapolis, Burlington, and Duluth. Those cities were meant to represent a wide geographic zone across various climate zones.

Commercial Building Retrofit

The same cost curve constructed for public building retrofits was also used for commercial buildings. For more information on the cost curve, see the *Public Buildings Comprehensive Retrofit* section above. The makeup of building types varies between commercial and public building stocks, leading to the difference in energy savings and costs for each. Also, the years over which retrofits occur is set at a default of five for public buildings compared to two years for commercial buildings.

Commercial Building Retrocommissioning

The data for cost and energy savings are borrowed from the same sources used for public building retrocommissioning: Amann and Nadel 2003 and Mills 2009. For more information, see the *Public Buildings Retrocommissioning* section above. The difference between commercial and public building calculations stems from the various building categories that fall within both sectors.

Commercial Building Benchmarking and Disclosure

Data on the costs and benefits of this policy are derived from the same source used for public building benchmarking and disclosure. For more information, see the *Public Building Benchmarking and Disclosure* section above.

Performance-Based Policy for New and Existing Commercial Buildings

As with public buildings, we calculated the impacts of this policy from savings and cost data pegged to levels of building energy savings as reported in Burr et al. 2012. Costs and savings data from operational building improvements as well as capital improvements were available.

Updating Commercial Building Energy Codes

Data on costs and benefits of updating commercial building codes were taken from several sources. ASHRAE data for electricity savings were gathered from analyses conducted by the DOE in 1999, 2004, 2007, and 2010 (Halverson 2011b). The DOE uses its own commercial reference buildings models to extrapolate savings that can be achieved under implementation of one of the building codes. The results for savings by building type were borrowed from tables 5–7 on pages 27–29 in the 2010 quantitative analysis (Halverson 2011a). The price per square foot was borrowed from another set of reports prepared by the Pacific Northwest National Laboratory (PNNL) and was further used to calculate the total energy cost of each building code. The results of the national cost estimates can be found from Athalye et al. 2011 and 2013, and Elliot et al. 2013.

Transportation Policies

LEEP-C includes 11 policies for the transportation sector. Data used to model the costs and savings from these policies came from *Moving Cooler* (Cambridge 2009). Data on percent annual greenhouse gas reductions for all transportation policies were taken from tables D.3 and D.4 in the *Moving Cooler* report and data on annual implementation costs and vehicle cost savings were found in tables D.9 through D.12. Cambridge also directly provided data on annual vehicle miles traveled reductions, which were included in some calculations. The level of deployment selected by the user (expanded current, more aggressive, and maximum) were equivalent to the three levels reported in the Cambridge report.