APPENDIX H

State LBE Tracking Tools and Resources

States are tracking the effectiveness of their LBE policies and programs, especially in terms of reduced energy consumption and the environmental and economic benefits associated with these reductions. This appendix provides information to help states identify and effectively use a variety of tracking tools. Additional information on tracking LBE projects and programs is provided in Chapter 6, *Track, Evaluate, and Report on Progress*.

APPENDIX H CONTENTS

TABLE H.1 SUMMARY OF LBE TRACKING TOOLS

Tool	Sector	Level of Analysis	Method	Description	Availability	Section No.
Tools for Assessing Building Performance						**H.1**
Portfolio Manager	Buildings	Buildings	Uses building characteristics and monthly energy use history.	Measures and tracks energy use and performance of buildings.	Free	H.1.1
Delta Score Estimator	Buildings	Buildings	Spreadsheet tool.	Estimates the percent energy reduction needed to improve an energy rating to the target rating.	Free	H.1.2
Target Finder	Buildings	Buildings	Uses new building characteristics and intended energy use during the design phase.	Sets aggressive energy performance targets for new buildings.	Free	H.1.3

TABLE H.1 SUMMARY OF LBE TRACKING TOOLS *(cont.)*

Tool	Sector	Level of Analysis	Method	Description	Availability	Section No.
Service and Product Providers (SPPs)	Negotiable	Negotiable	SPPs manage billing information and provide energy tracking services.	Analyses of energy consumption.	User fee	H.1.4
METRIX	Building	Project	Management of billing information.	Tracks energy consumption and potential savings.	User fee	H.1.5
Small Business Calculator	Buildings	Project	Uses building characteristics and energy use history.	Estimates a facility's energy intensity and potential energy and cost savings from energy efficiency upgrades.	Free	H.1.6
ENERGY-10™	Buildings	Whole-building design	Simulates energy consumption.	Assesses energy consumption and potential savings.	User fee	H.1.7
Utility Manager™	Buildings	Project	Manages billing information.	Tracks energy consumption.	User fee	H.1.8
Building Life Cycle Cost (BLCC) Program	Buildings	Buildings	Performs an economic analysis of provided costs of alternative building designs	Uses life-cycle costing to assess the relative cost-effectiveness of alternative building designs	Free	H.1.9
Building Energy Consumption Simulation Models	Buildings	Buildings and Projects	Simulates energy consumption.	Assesses energy consumption and potential savings.	Free	H.1.10
Emission Inventory Tools						**H.2**
CACP	All	Facilities	Emissions factors.	Develops emission inventories and analyzes emission reduction measures.	Free	H.2.1
GHG Protocol Initiative	All	All	GHG protocol.	Spreadsheet and guidelines to conduct emissions inventory.	Free	H.2.2
GHG Equivalencies Calculator	All	Project	Simple data entry form.	Translates GHG reductions into terms that are easier to conceptualize.	Free	H.2.3
ISO 14064 Standards	All	Project, organization	Published standards for accounting and verifying GHG emissions.	Includes tools and guidance for quantifying, verifying, and reporting GHG emission reductions.	User fee	H.2.4
eGRID	All	Electricity	Database information on utilities.	Emissions factors.	Free	H.2.5
CHP Emissions Calculator	CHP	CHP systems	Spreadsheet tool.	Calculates emissions from CHP system and compares to system using separate heat and power.	Free	H.2.6

TABLE H.1 SUMMARY OF LBE TRACKING TOOLS *(cont.)*

Tool	Sector	Level of Analysis	Method	Description	Availability	Section No.
Power Profiler	Region	Electricity	Data entry form by Zip code.	Evaluates air pollution and GHG impacts of electricity choices.	Free	H.2.7
State Inventory Tool (currently under development)	All	All	Default pre-loaded data from federal government on state GHG sources.	Assists states in developing GHG emission inventories.	Free	H.2.8
Emissions Forecasting Tool (currently under development)	All	All	Combines results from State Inventory Tool with federal emissions forecasts.	Assists states in forecasting business-as-usual emissions through 2020.	Free	H.2.9
Landfill Gas Emissions Model	Municipal solid waste landfills	Site	Calculates emissions rates based on landfill content and user-specified methane concentrations.	Enables states to estimate emission rates for GHGs and other pollutants resulting from landfills.	Free	H.2.10
Energy Savings Tools						**H.3**
EPA Energy Savings Calculators	Building	Project	Simple transparent spreadsheet tools.	Calculates energy savings and cost savings.	Free	H.3.1
DOE Energy Savings Calculators	Building	Project	Simple transparent spreadsheet tools.	Calculates energy savings and cost savings.	Free	H.3.2
Community Energy Opportunity Finder	Community	Building	Data entry form for building and community characteristics.	Calculates community benefits from energy efficiency and renewable energy opportunities.	Free	H.3.3
eCalc	Buildings in Texas	Building	Based on Texas buildings code.	Estimates energy savings potential.	Free	H.3.4
F-Chart Software	Renewables	Facilities, Building	Estimation of energy from solar installation.	Estimates energy savings from solar installation.	User fee	H.3.5
Financial and Economic Analysis Tools						**H.4**
Cash Flow Opportunity (CFO) Calculator	Existing Buildings	Facility	Financial decision-making tool.	Quantifies the costs of delaying energy efficiency improvements.	Free	H.4.1
Building Life-Cycle Cost (BLCC) Software	Buildings	Buildings	Analysis of capital investments in buildings.	Evaluates alternative designs that have higher initial costs but lower operating-related costs over the project life than the lowest-initial-cost design.	Free	H.4.2
Measurement and Verification Protocols						**H.5**
Environmental Management Systems	All	All	Management system for reducing environmental impacts and increasing operating efficiencies.	Provides a structured approach for monitoring and verifying energy use and savings.	Free	H.5.1

TABLE H.1 SUMMARY OF LBE TRACKING TOOLS *(cont.)*

Tool	Sector	Level of Analysis	Method	Description	Availability	Section No.
International Performance, Measurement, and Verification Protocol (IPMVP)	Buildings	Projects, Buildings, Facilities	Protocols and procedures for measuring and verifying energy efficiency, water efficiency, and renewable energy projects.	Provides framework for calculating and documenting energy and emissions reductions.	Free	H.5.2
Weather Normalization Information						**H.6**
Energy Cap Weather Software	Weather	All	Database with weather data.	Can be used to normalize LBE tracking results for variations in weather.	Free	H.6.1
National Oceanic and Atmospheric Administration (NOAA)	Weather	All	Databases with historical climate trends.	Can be used to normalize LBE tracking results for variations in weather.	Free	H.6.2
Additional Information Resources						**H.7**
EPA Green Power Partnership	Renewables	All	Database of green electricity providers.	Information on green electricity purchase.	Free	H.7.1
EPA Climate Leaders Program	Industry	All	Partnership to develop comprehensive climate change strategies.	Partners set GHG goals and conduct emission inventories to measure progress.	Free	H.7.2
EPA CHP Partnership	CHP	All	Information on CHP installation.	Estimates CO_2 reduction.	Free	H.7.3
School and University Partnerships	Schools and universities	All	Information on clean energy in K–12 schools and universities.	Uses vary according to resource.	Free	H.7.4
Additional Tools						**H.8**
	A number of additional tools are available for estimating the impacts of LBE activities.				Vary	H.8.1–H.8.8

H.1 TOOLS FOR ASSESSING BUILDING PERFORMANCE

H.1.1 PORTFOLIO MANAGER

EPA's Portfolio Manager is an on-line, interactive, software tool that makes benchmarking energy performance simple and accessible and enables states and other users to assess and track building energy performance.

Portfolio Manager tracks energy and water consumption by managing entire portfolios of buildings in a secure on-line environment. The tool calculates site energy intensity and weather-normalized source energy intensity for any building type; for certain building types it also provides a national energy performance rating. Once a baseline is established, Portfolio Manager can track the energy reduction and progress toward energy goals.

Key Features

Portfolio Manager allows users to:

- Track multiple energy and water meters for each facility
- Customize meter names and key information
- Benchmark facilities relative to their past performance
- View percent improvement in weather-normalized source energy
- Monitor energy and water costs
- Share building data with others

Rating Energy Performance

States can rate their building's energy performance on a scale of 1–100 relative to similar buildings nationwide. EPA's energy performance rating system, based on source energy, accounts for the impact of weather variations as well as key physical and operating characteristics of each building. Buildings rating 75 or greater may qualify for the ENERGY STAR.

The following types of commercial buildings, which represent over 50% of U.S. commercial floor space, are currently eligible to receive a rating:

Offices (general offices, financial centers, bank branches, and courthouses)

- K–12 schools
- Hospitals (acute care and children's)
- Hotels and motels
- Medical offices
- Supermarkets
- Residence halls/dormitories
- Warehouses (refrigerated and non-refrigerated)

EPA is developing rating criteria for additional segments of the commercial building market.

Verifying and Tracking Building Performance

Portfolio Manager can be used to verify building performance and track the progress of improvement projects. Users can generate a Statement of Energy Performance (SEP) for each building, which summarizes important energy performance information and building characteristics that are needed to:

- Apply for the ENERGY STAR
- Satisfy LEED-EB requirements
- Support mortgage, sale, and/or lease transactions
- Document performance in energy service contracts
- Communicate with tenants/owner/customers

Required Data

To assess building energy performance, users enter information about a building's physical characteristics, operating characteristics, and energy consumption, including, for example:

- Address (e.g., Zip code is used for weather normalization)
- Gross floor area
- Weekly operating hours
- Number of occupants
- Number of personal computers
- Monthly energy consumption for all fuel types
- Activity or operation data related to specific buildings

Renewable energy (e.g., solar) that is produced on site counts as energy savings rather than energy use. Hence, this information is not entered as energy consumption data.

For additional information on data requirements by type of building: *http://www.energystar.gov/index.cfm?c = eligibility.bus_portfoliomanager_eligibility*.

Modeling Approach/Calculating an Energy Performance Rating

To assess the performance of a building using the national energy performance rating system, two calculations are made after the user enters the required data. First, the user's actual annual source energy use (in kBTU/yr) is weather-normalized to reflect the building's annual source energy use during a normal (i.e., 30-year average) weather year.

Second, a regression model is run to calculate a predicted source energy use value based on the operating characteristics entered by the user. To calculate this value, the building's weather normalized source energy use is compared to a table of customized source energy use values.

CALCULATING SOURCE ENERGY

Source energy includes site energy plus the energy used to produce the site energy, such as the energy required to generate, transmit, and distribute the site energy to the building. Site energy use of each fuel is converted to its source equivalent using standard site-source energy conversion factors and then summed to yield annual total source energy use for each building.

Site	Source	
Fuel Type	(kBTU)	
Electricity	1	3.013
Natural gas	1	1.024
Fuel oil	1	1
Steam	1	1.38
Hot water	1	1

For additional information: *http://www.energystar.gov/index.cfm?c = evaluate_performance.bus_benchmark_comm_bldgs.*

Based on the building information provided by the user (e.g., size, location, number of occupants, number of personal computers), the rating system estimates how much energy the building would use if it were the best performing building, worst performing building, and every level in between. The system then compares the actual energy data for the building to the estimated values to determine where each building ranks relative to its peers.

All of the calculations are based on source energy. Using source energy is the most equitable way to compare building energy performance and correlates best with environmental impacts and energy costs.

To estimate building ratings, EPA conducts statistical analysis on data gathered by the DOE's Energy Information Administration during its quadrennial Commercial Building Energy Consumption Survey (CBECS). For each type of building for which EPA provides a rating, EPA goes through a rigorous process that involves:

- Ensuring that the quality and quantity of the data will support a rating
- Creating a statistical model that correlates the energy data to the operational characteristics for each building to identify the key drivers of energy use
- Testing the model with real buildings

In addition, each building's actual source energy data is normalized. This enables EPA to assess a building's performance relative to the typical weather in that region, without bias for the specific weather patterns during the rating year.

For additional information on the specific data analysis conducted for each available building type: *http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager_model_tech_desc*.

For additional information about weather normalization: *http://www.energystar.gov/index.cfm?c=business.bus_weather_normalization*.

Other Features

Portfolio Manager provides a variety of additional features, including:

- *Adjusted Percent Energy Reduction,* which measures the percentage change in a facility's energy consumption between its baseline energy period and current energy period. This provides a means to measure facility performance even if the facility cannot generate an energy performance rating.
- *Master Accounts,* which allow the centralized viewing of energy data across a number of portfolios. To allow other organizations to track the performance of a portfolio, building owners and operators can use a master account to share facility information. For example, a government agency can establish a master account to track the performance of all city departments, or an association can track the progress of its members.
- *Create Views,* a customized feature for reporting needs such as energy consumption, average energy intensity, rating of entire portfolio, and energy and dollar savings.
- CO_2 *emissions* tracking feature.
- *Water use* tracking feature.
- *A Group* feature, which allows users to manage data for individual buildings or groups of buildings. Users can group their building by any grouping criteria they choose. The tool includes a facility summary page that provides detailed information for each individual facility entered into Portfolio Manager.

Portfolio Manager Web site: *http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager*.

H.1.2 DELTA SCORE ESTIMATOR

This Excel spreadsheet tool provides a quick way to identify the relationship between the energy performance rating obtained through ENERGY STAR tracking tools and the percentage of energy saved in a building. After a building has been benchmarked and a current energy performance rating established, Delta Score can estimate the percent energy reduction needed to improve the existing rating to the target rating. In addition, it can be used to estimate a new energy performance rating by entering a percent reduction in energy use.

Web site: ***http://www.energystar.gov/index.cfm?c = delta.index.***

H.1.3 TARGET FINDER

Target Finder can be used to set energy performance goals, receive a rating for the intended energy use for new building design projects, and determine if projects are among the top 25% of buildings in the nation, in terms of intended energy performance. To set an energy target, states:

- Enter data on Zip code and building type for the new building that is being designed
- Select an energy performance target for achieving any of the following goals
  - *The "Designed to Earn the ENERGY STAR" rating*. Users can select a rating of 75 higher from the Target Rating section in Target Finder. It will display the EPA energy performance rating target using a 1–100 scale.
  - *The 2030 challenge and AIA goal*. Users select the Energy Reduction Target for 50% less than an average building.
  - *Other design targets*. Users can select a target for building types not available in Target Finder by using the *2003 Commercial* Buildings *Energy Consumption Survey National Averages and Design Targets*. These design targets are not normalized for climate nor adjusted for activities that may affect energy use. All targets are expressed in energy use intensity.

Target Finder displays the following data about the new building's design:

- Energy performance rating (1–100)—ENERGY STAR
- Energy reduction percentage (from an average building)—AIA/2030 Challenge Goal
- Source and site energy use intensity (kBTU/sf/yr)
- Source and site total annual energy use (kBTU)
- Total annual energy cost

Web site: ***http://www.energystar.gov/index.cfm?c = new_bldg_design.bus_target_finder.***

H.1.4 SERVICE AND PRODUCT PROVIDERS

SPPs offer energy management assistance either by selling a utility/energy accounting software product or providing energy accounting and analysis services. EPA has worked with these private companies to determine EPA energy performance ratings for eligible buildings. SPPs organize utility bill information into a database that manages energy expenses. They have developed software to identify opportunities for cost savings and energy efficiency and integrate Portfolio Manager benchmarking to provide the EPA energy performance rating. Some of these software products can also be used for forecasting, budgeting, and scenario analysis.

GEORGIA'S ENERGY ACCOUNTING SYSTEM

GEFA issued an RFP to develop an energy accounting system to track and analyze energy consumption for all state facilities. The goal is to secure a sophisticated, in-house energy accounting system that will permit the state to accurately report on its energy consumption and identify, initiate, and manage facility-specific or enterprise-wide cost saving strategies. The system will allow benchmarking buildings using Portfolio Manager. The system will also feature:

Creating groups of similar facilities (e.g., prisons, office buildings, dorm)

Comparing facilities (within a group and otherwise) according to criteria such as cost per kWh, cost per therm, energy expenditure per square foot, energy expenditure per occupant, and energy use per square foot per degree day

Source: Georgia, 2006.

TEXAS ENERGY MANAGEMENT PROJECT

Texas entered a four-year self-funded energy savings project with an SPP that will use the ENERGY STAR Portfolio Manager tool to help save the state an estimated $180 million in energy and other utility costs. As part of the Texas energy management project implementation, Texas will benchmark and track the performance of state buildings and to evaluate the energy performance of state buildings on the Portfolio Manager scale of 1 to 100, comparing them to similar buildings nationwide. The project will be funded by energy cost savings and will be completed at no cost to Texas. This energy performance project can serve as a model for other public and private entities that seek to improve energy performance and reduce energy costs.

Source: SECO, year.

The companies listed in Table H.1.1 offer EPA's energy performance ratings and links to ENERGY STAR as a part of their commercial energy information services.

TABLE H.1.1. SELECTED SERVICE AND PRODUCT PROVIDERS

Provider Name	Contact	Total Buildings Rated (as of 7/11/06)
Avista Advantage[a]	Ed Schlect 509-329-7602	4,259
Save More Resources[a]	Renee Rodgers 970-255-9786 x224	608
Cadence Network	Mark Duffer 513-763-3106	299
Energard	Kelly Scace 425-881-3451	148
Johnson Controls	Gerrit Reinders 414-524-7331	91
EnergySolve	Jeff Alba 203-245-0034	50
ei[3]	Spencer Cramer scramer@ei3.com	31
UtilityAccounts.com	Travis Vickford 716-852-4279	1

[a] These service providers are 2006 ENERGY STAR Partners of the Year.

Source: ENERGY STAR, 2007.

Web sites: ***http://www.energystar.gov/index.cfm?c=spp_res.pt_spps_automated_benchmarking; http://www.energystar.gov/index.cfm?c=spp_res.pt_spps.***

H.1.5 METRIX 3

METRIX is a desktop utility accounting system that helps users track utility performance, benchmark facilities, measure savings from clean energy projects, set clean energy targets, and measure performance. The software program breaks energy tracking into a tuning period, a project installation period, and a performance period. The tuning period is used to establish the relationships between energy consumption and weather or other factors. This period allows corrections to be made for buildings with seasonal changes in energy use. Energy savings are tracked during the performance period, which begins at the end of a project installation period. The program projects baseline and target scenarios for the performance period and compares actual use with both projections.

This program allows users to manually choose weather correction parameters. It can correct for heating degree-days, cooling degree-days, and user-defined production variables on a single meter. Project data can be imported from Market Manager, a building energy analysis program, for setting target energy consumption levels. METRIX also has a variety of options for electronic data input via ASCII or EDI formats.

Web site: ***http://www.abraxasenergy.com/intrometrix4.php.***

H.1.6 SMALL BUSINESS CALCULATOR

The ENERGY STAR Small Business Calculator can be used to estimate a facility's energy intensity and the potential energy and cost savings that can be achieved by implementing energy efficiency upgrades. By entering the size and type of a building and recent energy bill data, a facility manager or small business owner can determine the energy intensity of the facility in terms of energy used per square foot of space. The ENERGY STAR guide, *Putting Energy Into Profits,* provides background information about this tool.

Web sites: Calculator: ***http://www.energystar.gov/index.cfm?c=intensive_calc.mgr.***

Guide: ***http://www.energystar.gov/index.cfm?c=small_business.sb_index.***

H.1.7 ENERGY-10™

ENERGY-10™ software analyzes and illustrates the energy and cost savings that can be achieved by applying up to a dozen sustainable design features. This integrated design tool is ideal for use during the early design phases of moderate-sized (e.g., up to 50,000 sq. ft.) projects. ENERGY-10™ includes a set of integrated design guidelines and software for performing energy and cost calculations based on local climate, building orientation, materials, systems, and the interactions among them. Future program upgrades are expected to address larger structures.

Web site: ***http://www.nrel.gov/buildings/energy10.html.***

H.1.8 UTILITY MANAGER™

This software tool targets both the private sector and public sector markets. The program tracks line items from utility bills and generates reports that enable facility managers to identify billing errors and consumption anomalies, track and compare facilities, mark trends, make accurate projections, and create budgets. The

software can be purchased as part of a package that includes on-site training.

Web site: ***http://www.savemoreresources.com/solutions/inhouse.php.***

H.1.9 BUILDING LIFE CYCLE COST (BLCC) PROGRAM

The BLCC computer software program, developed by the National Institute of Standards and Technology, was designed to conduct economic analyses of alternative building designs by evaluating the relative cost-effectiveness of building systems or components. Analyses include calculations of net savings, savings-to-investment ratio, adjusted internal rate of return, and payback period. The program software is typically used to evaluate the relative benefits of building projects that have higher initial costs - but lower life-cycle costs - than conventional building projects with lower initial costs. The software can be particularly helpful in assessing the benefits and costs of incorporating water conservation technologies and renewable energy systems into a project design.

Web site: ***http://www1.eere.energy.gov/femp/information/download_blcc.html.***

H.1.10 BUILDING ENERGY CONSUMPTION SIMULATION MODELS (DOE-2, EQUEST, ENERGYPLUS)

Simulation is an effective way to pre-test proposed programs, plans, or policies before actual implementations. By using computer-based simulation models, it is possible to estimate in detail the consequences and implications of a particular project development on energy consumption.

DOE-2 is a computer program for designing energy-efficient buildings. Developed for DOE by the LBNL's Simulation Research Group, DOE-2 is a widely-used building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, infrastructure, occupant usage, conditioning systems (e.g., lighting, HVAC) and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building and to estimate utility bills.

EQUEST is an energy use analysis tool designed to perform detailed comparative analyses of building designs and technologies by applying sophisticated building energy use simulation techniques but without requiring extensive experience in the "art" of building performance modeling. This is accomplished by combining schematic and design development building model creation wizards, an energy efficiency measure wizard, and a graphical results display module with an enhanced DOE-2-derived building energy use simulation program.

EnergyPlus is an innovative building energy simulation program with capabilities such as sub-hour time steps, built-in template and external modular systems that are integrated with a heat balance-based zone simulation, and input and output data structures tailored to facilitate third-party module and interface development. Other capabilities include multi-zone airflow, moisture adsorption/desorption in building materials, radiant heating and cooling, and PV simulation.

Web site: ***http://www.doe2.com/DOE2/***

H.2 EMISSION INVENTORY TOOLS

The tools described in this section can be used to estimate the emissions associated with energy consumption and the emission reductions associated with reduced energy consumption.

H.2.1 CACP SOFTWARE

The National Association of Clean Air Agencies (NACAA, formerly STAPPA and ALAPCO) CACP is a Windows-based software tool designed to help state and local governments develop harmonized strategies to reduce both GHG and air pollution emissions. It allows users to create a cross-sectoral emission inventory at the entire community level or at the government operations level only. The software disaggregates government's own operations into seven main areas of analysis (see Table H.2.1). Using an extensive set of emissions factors, the software creates a comprehensive inventory of emissions resulting from government operations.

In addition to developing an inventory of cross-sector emissions, the CACP software offers a "measure" module that can provide users with suggested demand-side strategies for managing emissions. The "government measures" module helps assess the relative benefits and drawbacks of potential emission reduction measures by quantifying the projected GHG and criteria air pollutant emissions resulting from government-owned and -operated facilities and activities in both baseline and project scenarios. Possible measures described within the module include energy efficiency measures,

TABLE H.2.1. CACP SECTORS AND DATA REQUIREMENTS

Sector	Required Data	Optional Data
Buildings	Name of building or building group, energy consumption, and costs by type of fuel.	Floor area, operating hour, occupants.
Vehicle fleet	Name of vehicle or vehicle group, energy consumption by type of fuel or vehicles mile traveled by type of vehicle, and costs.	A complete set of fuel efficiency indicators are already predefined in the software.
Employee commute	Name of employee commute group, energy consumption by type of fuel or vehicles mile traveled by type of vehicle, and costs.	A complete set of fuel efficiency indicators are already predefined in the software.
Streetlights	Name of streetlight group, energy consumption, and costs by type of fuel (electricity/green electricity).	Number of street lights.
Water/ sewage	Name of water and/or sewage group, energy consumption, and costs by type of fuel.	Output in liters.
Waste	Name of landfill site or landfill group, tons of waste disposed per year, % category (e.g., paper, food), haulage and tipping costs, and waste disposal technology (e.g., open dump, open burning, incineration).	Employees.
Other	Allows users to account for emissions not represented in the sectors listed above.	

Source: CACP, 2006.

changes in energy source or fuel type, changes in vehicle types and vehicle miles traveled, and waste reduction and recycling measures.

Web site: ***http://www.cacpsoftware.org/.***

H.2.2 GHG PROTOCOL INITIATIVE

The World Resources Institute and the World Business Council for Sustainable Development (WRI/WBCSD) developed the Greenhouse Gas Protocol Initiative (GHG Protocol) to harmonize international GHG trading schemes. The GHG emission calculation tool offers step-by-step guidance for calculating GHG emissions data. The tool includes a guidance section and automated worksheets. Most agencies will need to apply more than one worksheet to cover the complete inventory of their GHG sources, which can include CO_2 emissions from building energy consumption, employee commuting, and business travel.

The automated worksheet section requires users to input activity data and appropriate emission factors; default emissions factors are provided if users do not enter them. The emissions of different GHGs are calculated separately and converted to CO_2 equivalents on the basis of their global warming potential.

Web site: ***http://www.ghgprotocol.org/.***

H.2.3 GHG EQUIVALENCIES CALCULATOR

The Greenhouse Gas Equivalencies Calculator is designed to translate GHG reductions from units such as tons and metric tons, into units that can be easier to conceptualize (e.g., equivalent number of cars not driven for one year). Results from the calculator can be used for communicating reduction targets and developing a GHG reduction strategy.

Web site: ***http://www.epa.gov/cleanenergy/energy-resources/calculator.html.***

H.2.4 ISO 14064 STANDARDS

The International Organization for Standardization (ISO) has published standards for accounting and verifying GHG emissions by government and industry sources. The new standards include an integrated set of tools for programs aimed at reducing emissions, including guidance at the organization level for quantifying and reporting emissions; at the project level; and for validating and verifying GHG emissions.

Web site: ***http://www.iso.org/iso/pressrelease.htm?refid=Ref994.***

H.2.5 EGRID

EPA's eGRID is a comprehensive source of data on the environmental characteristics of domestic electric power generation. It compiles data from 24 federal sources on emissions and resource mixes for virtually every power plant and company that generates electricity in the United States. It also provides user search options, including aspects of individual power plants, generating companies, states, and regions of the power grid. The current version contains U.S. power plant emission totals for 1996 through 2000, and state-by-state power plant emission totals for 2000.

Web site: ***http://www.epa.gov/cleanenergy/egrid/index.htm.***

H.2.6 CHP EMISSIONS CALCULATOR

The CHP Emissions Calculator is a tool that compares the anticipated emissions from a CHP system to the emissions from separate heat and power systems. Users select from a large number of different separate heat and power system profiles and compare them to a CHP system (characterized by the user). The calculator then estimates the carbon, CO_2, SO_2, and NO_x emissions from both systems and the corresponding emission reductions achieved by the CHP system. In addition to estimating emission reductions, the calculator presents the carbon equivalency of these reductions in terms of acres of trees planted and number of cars removed from the road. This tool is designed for users with at least a moderate understanding of CHP technology and terminology. Results are intended for educational and outreach purposes; the tool is not designed for developing emission inventories or preparing permitting processes.

Web site: ***http://www.epa.gov/chp/basic/calculator.html.***

H.2.7 POWER PROFILER

The EPA Power Profiler is an online tool that allows users to evaluate the air pollution and GHG impacts of their electricity choices. Using only a zip code, the Power Profiler can evaluate the environmental benefits of choosing cleaner sources of energy as compared with conventional energy sources. It is particularly useful given increased opportunities for customer choice, which allows many electricity customers to choose the source of their power.

Web site: ***http://www.epa.gov/cleanenergy/powerprofiler.htm.***

H.2.8 STATE INVENTORY TOOL

EPA's State Inventory Tool (SIT) is an interactive spreadsheet model designed to help states develop GHG emissions inventories. SIT gives users the option of applying their own state-specific numbers or using default data pre-loaded for each state. The default data is gathered by federal agencies and other sources covering fossil fuels, agriculture, forestry, waste management, and industry. SIT provides a streamlined way to update an existing inventory or complete a new inventory and is also accompanied by updated guidance describing best practices.

Web site: ***http://www.epa.gov/climatechange/wycd/stateandlocalgov/analyticaltools.html.***

H.2.9 EMISSIONS FORECASTING TOOL

This spreadsheet model builds on the design of the EPA State Inventory Tool (SIT) to help states create forecasts of business-as-usual GHG emissions through 2020. The tool estimates future emissions through a combination of linear extrapolation of SIT results and economic, energy, population, and technology forecasts conducted by the federal government. The tool can be customized, allowing states to enter their own assumptions about future growth and consumption patterns.

Web site: ***http://www.epa.gov/climatechange/wycd/stateandlocalgov/analyticaltools.html.***

H.2.10 LANDFILL GAS EMISSIONS MODEL

The EPA Landfill Gas Emissions Model is an automated tool for estimating air pollutant emissions from municipal solid waste landfills. The model can be used to estimate emission rates for methane, carbon dioxide, non-methane organic compounds, and individual air pollutants from landfills. The program can also be used by landfill owners and operators to determine if a landfill is subject to the control requirements of the federal New Source Performance Standard for new MSW landfills (40 CFR 60 Subpart WWW) or the emission guidelines for existing MSW landfills (40 CFR 60 Subpart Cc).

Web site: ***http://www.epa.gov/lmop/res/index.htm#5.***

H.3 ENERGY SAVINGS TOOLS

The tools described in this section can be used to estimate the energy savings associated with different clean energy measures and products.

H.3.1 EPA ENERGY SAVINGS CALCULATORS

EPA has developed a series of simple customizable tools that calculate energy savings and cost savings from ENERGY STAR-qualified equipment. Descriptions of a selection of products for which energy savings calculators are available are presented below. EPA periodically updates its savings calculators so it is important to check the Web site to identify the most updated version.

Web site: ***http://www.energystar.gov/index.cfm?c = bulk_purchasing.bus_purchasing.***

Lighting

Exit Signs. More than 100 million exit signs are in use throughout the United States. Typically lit by

incandescent bulbs, these signs consume 30–35 billion kWh hours of energy each year.

Web site: ***http://www.energystar.gov/index.cfm?c=exit_signs.pr_exit_signs.***

Compact Fluorescent Lights (CFLs). ENERGY STAR-qualified CFLs use 66% less energy than a standard incandescent bulb and last up to 10 times longer. Replacing a 100-watt incandescent with a 32-watt CFL can save at least $30 in energy costs over the life of the bulb.

Web site: ***http://www.energystar.gov/index.cfm?c=cfls.pr_cfls.***

Light Fixtures. ENERGY STAR-qualified light fixtures must last at least 10,000 hours. This means that with regular use (i.e., four hours per day), an ENERGY STAR bulb would not need to be replaced for at least seven years.

Web site: ***http://www.energystar.gov/index.cfm?c=fixtures.pr_light_fixtures.***

Traffic Signals. Energy and cost savings from LEDs are significantly better than standard incandescent signals, and many states, cities, and counties have already adopted LEDs to take advantage of these benefits. Transportation and public works officials are encouraged to specify and purchase ENERGY STAR-qualified traffic signals.

Web site: ***http://www.energystar.gov/index.cfm?c=traffic.pr_traffic_signals.***

Office Equipment

Office Equipment. Energy savings calculators are available for a variety of different types of office equipment, including computers, copiers, external power adapters, fax machines, laptops, mailing machines, monitors, multifunction devices, printers, scanners, and water coolers.

Web site: ***http://www.energystar.gov/index.cfm?c=ofc_equip.pr_office_equipment.***

Heating and Cooling

Heating and Cooling Equipment. Replacing old cooling and heating equipment with more efficient, ENERGY STAR-qualified equipment is one way to save energy and money.

Web site: ***http://www.energystar.gov/index.cfm?c=heat_cool.pr_hvac.***

Air Conditioning. About one-sixth of all the electricity generated in the United States is used to cool buildings.

Web site: ***http://www.energystar.gov/index.cfm?c=cac.pr_central_ac.***

Boilers. Whether gas or oil, ENERGY STAR-qualified boilers use about 10% less energy than a standard boiler.

Web site: ***http://www.energystar.gov/index.cfm?c=boilers.pr_boilers.***

Ducts. Ducts are an integral part of a forced-air heating or cooling system and their purpose is to circulate air to evenly heat and cool a building. Unfortunately, ducts are often leaky—wasting 7–12% of heating and cooling energy used.

Web site: ***http://www.energystar.gov/index.cfm?c=home_improvement.hm_improvement_ducts.***

Heat Pumps. Electric air-source heat pumps, often used in moderate climates, use the difference between outdoor air temperatures and indoor air temperatures to cool and heat.

Web site: ***http://www.energystar.gov/index.cfm?c=geo_heat.pr_geo_heat_pumps.***

H.3.2 DOE ENERGY SAVINGS CALCULATOR TOOLS

DOE's Office of Energy Efficiency and Renewable Energy maintains a database of software tools for evaluating energy performance in buildings and the associated costs and savings resulting from energy efficiency improvements. The database provides descriptions of each software tool, including required expertise to use each tool and the strengths or weaknesses of each tool. The database can be searched by a number of narrowing criteria to find the most appropriate tool.

Web site: ***http://www.eere.energy.gov/buildings/tools_directory/.***

H.3.3 COMMUNITY ENERGY OPPORTUNITY FINDER

The Community Energy Opportunity Finder is an interactive tool that can help determine a community's energy efficiency investment opportunities that are most likely to benefit the local economy, the community, and the environment. This tool helps collect information on a community's energy use, and then presents the potential benefits from specific programs,

including energy savings, dollar savings, reductions in CO_2, NO_x, and SO_2 emissions, and job creation. The Finder also provides an overview of the kinds of renewable energy sources that could power the community.

Web site: http://www.energyfinder.org.

H.3.4 ECALC

ECalc is a collection of Texas-based, Web-based calculators that building managers can use to design and evaluate a wide range of projects for energy savings and emission reduction potential. ECalc routes user-provided data to various specialty tools, including the DOE-2 program, PV-Chart, the ASHRAE Inverse Model Toolkit, and E-GRID. Using data obtained from these tools, ECalc calculates energy savings and associated CO_2 reductions for new buildings, community projects, and renewable energy sources. Community projects include municipal buildings (new construction and retrofits), street lights (new construction and retrofits), traffic lights (new construction and retrofits), municipal water supply and waste-water systems (retrofit only), and wind energy systems (new systems connected to the grid).

Web site: *http://ecalc.tamu.edu/.*

H.3.5 F-CHART SOFTWARE

F-CHART software estimates solar energy production and installation. It calculates monthly electricity or thermal output produced by a solar PV or solar thermal system based on information specified by the user. It also contains a weather database.

Requisite information for calculating the benefits of solar energy includes the type of PV system, the area of the PV array, the array of solar photovoltaic collectors, including the area of the array, the slope of the array, and whether the collector array is facing south (i.e., array azimuth). Information needed to calculate the benefits of solar thermal systems includes the same details required for the PV system plus information about the design of the solar thermal system, including size of the heating pool, pool temperature, hours of operation per day, and daily hot water usage. F-CHART software uses these data to calculate the thermal energy produced by using solar energy and/or the thermal heating system.

Web site: *https://www.fchart.com/.*

H.4 FINANCIAL AND ECONOMIC ANALYSIS TOOLS

H.4.1 CFO CALCULATOR

This ENERGY STAR financial decision-making tool can be used to quantify the costs of delaying energy efficiency improvements. It answers questions about the quantity of energy-efficient equipment that can be purchased and financed using anticipated savings, the timing of energy efficiency investments, and whether waiting for a lower interest rate will affect an energy efficiency investment. By comparing the costs and benefits of financing a project now versus waiting for a lower interest rate, the tool can provide answers to critical financial questions.

Using graphs and tables, the CFO calculator is written so that managers who are not financial specialists can use it to make informed decisions, yet it is sophisticated enough to satisfy financial decision-makers.

Web site: *http://www.energystar.gov/ia/business/cfo_calculator.xls.*

H.4.2 BUILDING LIFE-CYCLE COST SOFTWARE

The BLCC Program was developed by the National Institute of Standards and Technology (NIST) to provide computational support for analyzing capital investments in buildings. The BLCC program conducts economic analyses by evaluating the relative cost-effectiveness of alternative buildings and building-related systems or components. Typically, BLCC software is used to evaluate alternative designs that have higher initial costs but lower operating-related costs over the project life than the lowest-initial-cost design. It is especially useful for evaluating the costs and benefits of energy and water conservation and renewable energy projects.

Web site: *http://www1.eere.energy.gov/femp/information/download_blcc.html.*

H.5 MEASUREMENT AND VERIFICATION PROTOCOLS

H.5.1 ENVIRONMENTAL MANAGEMENT SYSTEMS

An Environmental Management System (EMS) is a framework used by states to manage environmental affairs and issues, including those where legal requirements exist. An EMS allows organizations to identify

activities that may have an adverse impact on the environment, develop plans and controls to ensure personnel have adequate training to manage and comply with system requirements, ensure that regulated activities are properly monitored and measured, and identify opportunities for improving environmental performance and pollution prevention. An EMS can provide a structured way to monitor and verify energy use and savings in addition to identifying additional energy and money saving opportunities. EPA maintains a Web site that provides information about EMS services.

Web site: ***http://www.epa.gov/ems/.***

H.5.2 IPMVP PROTOCOL

The IPMVP provides an overview of best practices for verifying the results of energy efficiency, water efficiency, and renewable energy projects. IPMVP provides a framework for calculating and documenting energy and emission reductions from energy efficiency projects. It presents the user with several measurement and verification options based on a project's particular energy consumption calculations and project-specific factors, such as the complexity of the efficiency measures under evaluation and the risk expectations.

IPMVP can also be used to verify reductions in emissions and for emissions trading programs, defining broad techniques for determining energy savings, and defining savings on a project or facility scale.

Web site: ***http://www.evo-world.org/.***

H.6 WEATHER NORMALIZATION INFORMATION

H.6.1 ENERGY CAP WEATHER SOFTWARE

Energy Cap is a quick and easy-to-use Web-based tool that provides information on historical degree days for 1,200 stations in the United States and Canada from 1994 to present. Users select a weather station and balance point temperature, and the software provides degree day report charts that show mean daily temperature, cumulative heating and cooling degree days, and monthly comparisons of any two years. An optional report (provided via e-mail) compares month-by-month degree days for any two years and any balance point temperature. These reports can help states adjust LBE tracking results to account for variations in weather.

Web site: ***http://www.energycap.com/weather/.***

H.6.2 NOAA

NOAA provides extensive data sets relating to historical climate trends. Its National Climatic Data Center provides users with a searchable database from weather observation stations from around the country. Weather reports are available for each of these stations. Additionally, the Center maintains a library of heating and cooling degree days that can help states adjust LBE tracking results to account for variations in weather.

Web sites:

Station Locator: ***http://www.ncdc.noaa.gov/oa/climate/stationlocator.html***

Degree Day Reports: ***http://www.ncdc.noaa.gov/oa/documentlibrary/hcs/hcs.html.***

H.7 ADDITIONAL INFORMATION RESOURCES

H.7.1 EPA GREEN POWER PARTNERSHIP

EPA's Green Power Partnership provides assistance and recognition to organizations that demonstrate environmental leadership by choosing green power. The Web site provides information about green power and how to purchase it. It also includes the national Green Power Locator tool to help consumers find green power options throughout the country.

Web site: ***http://www.epa.gov/greenpower/index.htm.***

H.7.2 EPA CLIMATE LEADERS PROGRAM

Climate Leaders is a voluntary EPA industry-government partnership that works with companies to develop long-term comprehensive climate change strategies. Partners set a corporate-wide GHG reduction goal and conduct an inventory of their emissions to measure progress. By reporting inventory data to EPA, partners create a record of their accomplishments. EPA Climate Leaders Partners use the WRI/WBCSD GHG protocol to develop their GHG emission inventory. Companies are required to document emissions of the six major GHGs (i.e., CO_2, CH_4, NO_x, HFCs, PFCs, and SF_6) on a company-wide basis.

Web site: ***http://www.epa.gov/climateleaders/index.html.***

H.7.3 EPA CHP PARTNERSHIP

The CHP Partnership is a voluntary program that seeks to reduce the environmental impact of power generation by promoting the use of CHP. The Partnership works closely with energy users, the CHP industry, state and local governments, and other stakeholders to support the development of new projects and promote their energy, environmental, and economic benefits.

Web site: *http://www.epa.gov/chp/.*

H.7.4 SCHOOL AND UNIVERSITY PARTNERSHIPS

The following Web sites, many of which are maintained by the ENERGY STAR program or the DOE Energy Efficiency and Renewable Energy office, provide information on clean energy initiatives in schools and universities.

- K–12 Schools:
  - EPA ENERGY STAR for K–12 Schools: *http://www.energystar.gov/schools*
  - Energy Efficiency and Renewable Energy: *http://www1.eere.energy.gov/buildings/energysmartschools/*
  - National Clearinghouse for Educational Facilities: *http://www.edfacilities.org/rl/energy.cfm*
  - Rebuild America: *http://www.rebuild.gov*
- Colleges and Universities:
  - EPA ENERGY STAR for Higher Education: *http://www.energystar.gov/highered*
  - EPA 2006 College and University Green Power Challenge: *http://www.epa.gov/greenpower/documents/highed_challenge_apr07.pdf*
  - Creating an ENERGY STAR Showcase Dorm Room: *http://www.energystar.gov/index.cfm?c = news.nr_dormroom&layout = print*
  - EPA's C&U Sector Strategies program: *http://www.epa.gov/sectors/pdf/2006/collegesbw.pdf*
  - State University of New York at Buffalo: *http://wings.buffalo.edu/ubgreen/guidelines.html*

H.8 ADDITIONAL TOOLS

A number of additional tools for estimating the impacts of LBE activities are available, as described below.

H.8.1 TRACE 600

This tool was developed by Trane Corporation to support HVAC design criteria, space heating and cooling load calculations, free cooling and heat recovery, thermal storage, and chilled water piping arrangements.

Web site: *http://www.wbdg.org/tools/trace.php.*

H.8.2 HAP V4.0

The Hourly Analysis Program (HAP) is an energy simulation module developed by Carrier Corporation that performs an 8,760-hour energy simulation of building heat flow and equipment performance.

Web site: *http://www.commercial.carrier.com/commercial/hvac/general/1,CLI1_DIV12_ETI496,00.html.*

H.8.3 BLAST

Building Loads and System Thermodynamics (BLAST) performs hourly simulations of buildings and central plant equipment, and zone analysis based on the fundamental heat balance method. This tool can also be used to analyze thermal comfort, passive solar structures, high- and low-intensity radiant heat, moisture, and variable heat transfers coefficients.

Web site: *http://www.cecer.army.mil/td/tips/product/details.cfm?ID=132&TOP=1.*

H.8.4 TRNSYS

The Transient System Simulation (TRNSYS) program is used for HVAC analysis and sizing, solar design, daylighting, building thermal performance, PV systems, wind systems, and analysis of control schemes.

Web site: *http://sel.me.wisc.edu/trnsys/.*

H.8.5 ADELINE AND RADIANCE

These specialized design tools are also available to evaluate daylight, air flows [computational fluid dynamics (CFD)], three-dimensional heat flows, and other design considerations.

Web sites: *http://www.eere.energy.gov/buildings/tools_directory/software.cfm/ID = 28/*; *http://www.eere.energy.gov/buildings/tools_directory/software.cfm/ID = 66/.*

H.8.6 ALGOR

This program quantifies and illustrates airflows (CFD) and three-dimensional heat flows.

Web site: ***http://www.algor.com.***

H.8.7 ASEAM

A Simplified Energy Analysis Method (ASEAM) is a simplified energy analysis tool that can also create DOE-2 input files. This is easier to use but less accurate than DOE-2.

Web site: ***http://gundog.lbl.gov/dirsoft/d2whatis.html.***

H.8.8 FRESA

Federal Renewable Energy Screening Assistant (FRESA) assesses the feasibility of various renewable energy applications, including active solar heating, active solar cooling, daylighting with windows, skylights, PV systems, solar thermal electric, wind electricity, small hydropower, biomass electricity, cooling load avoidance, and infiltration control.

Web site: ***http://analysis.nrel.gov/fresa/.***

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