

**ANALYSIS OF EMISSIONS CALCULATORS FOR A  
NATIONAL CENTER OF EXCELLENCE ON DISPLACED  
EMISSIONS REDUCTIONS (CEDER)**

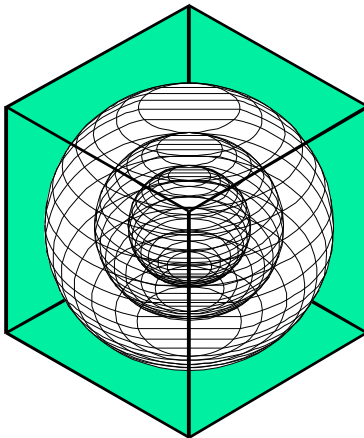
**ANNUAL REPORT**



**2007 Annual Report to the  
United States Environmental Protection Agency**

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**March 2008**



**ENERGY SYSTEMS  
LABORATORY**

**Texas Engineering Experiment Station  
Texas A&M University System**

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## ANALYSIS OF EMISSIONS CALCULATORS FOR A NATIONAL CENTER OF EXCELLENCE ON DISPLACED EMISSIONS REDUCTIONS (CEDER)

### ANNUAL REPORT

#### 1. EXECUTIVE SUMMARY

In August 2004, the Environmental Protection Agency (EPA) issued guidance on quantifying the air emissions benefits from electric sector energy efficiency and renewable energy. Because there was no clear best strategy, the EPA's guidance provided a framework and the basic requirements needed to demonstrate air quality improvements or emissions reductions with adequate certainty to be incorporated into a State Implementation Plan (SIP) for achieving or maintaining National ambient Air Quality Standards (NAAQS). The Energy Systems Laboratory, with guidance from both the US EPA and the Texas Commission on Environmental Quality (TCEQ), developed the first a comprehensive engineering toolkit and database that satisfies the EPA guidance. The value of this unique tool was demonstrated in 2005 when the ESL, at the request of the TCEQ, used it to develop integrated emissions estimates for all state agencies participating in the Texas Emissions Reduction Plan (TERP). Building on this expertise, the US EPA has established a National Center of Excellence on Displaced Emissions Reductions (CEDER) at the Energy Systems Laboratory to research and gather the state-of-the-art air pollution quantification techniques for Energy Efficiency / Renewable Energy (EE/RE) projects; provide technical support and customized analysis for state and local agencies seeking to estimate the environmental benefits from clean energy policies and programs; and document how a user-friendly tool, based on e2Calc, can be used by clients to fulfill their needs to quantify emissions reductions from energy efficiency and renewable energy measures.

The Energy Systems Laboratory, in fulfillment of its responsibilities, submits this annual report, "Analysis of Emissions Calculators for a National Center of Excellence on Displaced Emissions Reductions (CEDER)," to the United State Environmental Protection Agency.

The report is organized in several deliverables:

- Summary Report, which details the progress of tasks;
- Appendix, which shows the survey documentation; and
- Excel file, including summary table and screenshots of each online emissions calculator.

The three main tasks that have been performed in 2007 are as follows:

- Task 1: Develop a prototype web site.
- Task 2: Review existing emissions calculators from U.S. Department of Energy EE/RE's Building Energy Software Tools Directory.
- Task 3: Review and test existing online emissions calculators from the World Wide Web.

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## 2. INTRODUCTION

In August 2004, the Environmental Protection Agency (EPA) issued guidance on quantifying the air emissions benefits from electric sector energy efficiency and renewable energy. Because there was no clear best strategy, the EPA's guidance provided a framework and the basic requirements needed to demonstrate air quality improvements or emissions reductions with adequate certainty to be incorporated into a State Implementation Plan (SIP) for achieving or maintaining National Ambient Air Quality Standards (NAAQS). The Energy Systems Laboratory, with guidance from both the US EPA and the Texas Commission on Environmental Quality (TCEQ), developed the first a comprehensive engineering toolkit and database that satisfies the EPA guidance. The value of this unique tool was demonstrated in 2005 when the ESL, at the request of the TCEQ, used it to develop integrated emissions estimates for all state agencies participating in the Texas Emissions Reduction Plan (TERP). Building on this expertise, the US EPA has established a National Center of Excellence on Displaced Emissions Reductions (CEDER) at the Energy Systems Laboratory to research and gather the state-of-the-art on air pollution quantification techniques for Energy Efficiency and Renewable Energy (EE/RE) projects; provide technical support and customized analysis for state and local agencies seeking to estimate the environmental benefits from clean energy policies and programs; and document how a user-friendly tool, based on e2Calc, can be used by clients to fulfill their needs to quantify emissions reductions from energy efficiency and renewable energy measures.

### 2.1. Statement of Work for a U.S. EPA's Center of Excellence for Displaced Emissions Reductions (CEDER)

This summary report covers the Laboratory's work in 2007. This work is intended to cover the basic work outlined below:

- Task 1: Develop a prototype web site
- Task 2: Review existing emissions calculators from U.S. Department of Energy EE/RE's Building Energy Software Tools Directory.
- Task 3: Review and test existing online emissions calculators from the World Wide Web.

The progress toward completing each task is provided in the following section and throughout this report.

### 2.2. Progress to Date

#### Task 1: Develop a prototype web site

As a first task, a prototype CEDER website has been developed. Figure 1 shows the screenshot of the first screen of the website.



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**

# National Center of Excellence

## in Emissions Reduction

The USEPA established the National Center of Excellence in Emissions Reduction to provide technical support to States and Local Agencies in reducing emissions.

### Quick Finder

<a href="#">ASHRAE</a>	<a href="#">Conferences</a>	<a href="#">EPA</a>	<a href="#">Ozone</a>	<a href="#">Weather</a>
<a href="#">California Energy Commission (CEC)</a>	<a href="#">Consumer Information</a>	<a href="#">ICCC</a>	<a href="#">Renewable Energy</a>	<a href="#">Workshops</a>
<a href="#">Climate Change</a>	<a href="#">eCalc</a>	<a href="#">Mold</a>	<a href="#">Research</a>	
	<a href="#">Education</a>	<a href="#">NYSERDA</a>	<a href="#">SB5 -Texas</a>	

### Get Connected

#### Be More Energy Efficient and Reduce Emissions

Find out how you can lower your emissions and secure State Implementation Plan credits.

### Latest Partner News

News article submitted by an EPA partner

News content goes here. Content content content content. Don't forget all the content that goes here because if you do, that will be bad. And I'm talking to you, webmaster. yeah. you. [\[More\]](#)

Yet another news article

This is older news, so it's farther down on the page, but you can still click the link to read more if you really want to. It's good to keep a back-log of the news, but probably only the most recent articles should be published on this page. The rest can go on a history page. [\[More\]](#)

Questions? Comments? Contact us.

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Air Quality Outlook  
June 14-19, 2007

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Figure 1. Prototype Website for CEDER.

### Task 2: Review existing emissions calculators from U.S. Department of Energy EE/RE's Building Energy Software Tools Directory.

This task purposes to review existing emissions calculators from U.S. Department of Energy EE/RE's Building Energy Software Tools Directory. The EE/RE's Building Energy Software Tools Directory provides information on 345 building software tools for evaluating energy efficiency, renewable energy, and sustainability in buildings. The information provided for each software tool includes a short description of the tools, users, audience, input, output, computer platforms, programming language, strengths, weaknesses, technical contact, and availability.

Of the 345 software tools, 9 tools that have a capability to calculate energy-related pollution emissions have been found and summarized. The selected software tools are: Athena Model, BEES, Building Greenhouse Rating, Envest, EMISS, e-Bench, FEDS, HEED, and LISA. Appendix A in this report presents the detailed information of the selected 9 software tools.

### Task 3: Review and test existing emissions calculators from the World Wide Web.

This task is composed of the following subtasks:

- Search existing online emissions calculators from the World Wide Web
- Develop a summary spreadsheet for the online emissions calculators found
- Test the emissions calculators

Using several search engines such as Google, Yahoo, etc., online emissions calculators have been searched. The following information regarding the online tools was then entered in the summary spreadsheet. Figure 2 shows the summary table of the calculators.

- Name of the tool
- Web address
- Institute or Company
- Energy Source (Electricity, Natural Gas, Oil, Renewables)
- End Use (Residential building, Commercial building, Industrial, Transportation, Municipal)
- Emissions (CO<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub> for Annual and OSD)
- Emissions Data (U.S. Average, State Average, or County Average)
- Quality Control

In addition, the screenshot of each tool was added in a separate spreadsheet to give an idea how the calculator looks. Findings from this review are summarized as follows:

- As of April 9, 2008, 34 emissions calculators have been found.
- Of these 34 calculators, 24 calculators are online tools, and others are software that can be downloaded or tools that will be available in the near future.
- Most of the online tools provide emissions calculations due to electricity uses (22 tools), natural gas uses (18 tools), and heating oil uses (14 tools) in residential buildings.
- Carbon emission (CO<sub>2</sub>) is the most commonly calculated emission type (23 tools); and a few tools have a capability to calculate SO<sub>x</sub> (6 tools) and NO<sub>x</sub> (7 tools) emissions. Only 6 tools can calculate all three types of emissions impact.
- Each calculator uses emissions factors to calculate emissions impact. 12 calculators use the U.S. average emissions factors, 9 calculators use State average, and only three calculators use County or City average.
- Some calculators provide source of the emissions calculations. Most of them use emissions factors published in EPA's eGRID (1999, 2004 and 2006 version) and US DOE report.

Appendix B provides the whole spreadsheet showing the survey of existing emissions calculators.

In the next task, all the working emissions calculators have been tested. As of March 2008, two input parameters, annual electricity and N.G. use, have been selected and tested through the websites. The following assumptions have been used when the websites are tested:

- Number of occupants is 2 if a calculator has an option to enter the number of occupants.
- Two sets of tests: Electricity use only, N.G. use only.
- Annual electricity consumption is 12,000 kWh.
- Annual N.G. consumption is 92 MCF or 984 therms.
- Regional option: If a calculator has the state level option, Texas (or 77840) would be selected. If not, the U.S. would be selected.

Figure 3 shows the summary table that presents the calculation results from annual electricity use. As described earlier, most of the calculators provide CO<sub>2</sub> emissions calculations, while few can calculate NO<sub>x</sub> and SO<sub>x</sub> emissions. The summary table shows that the CO<sub>2</sub> emissions calculated due to the electricity uses are relatively consistent

across the emissions calculators. (i.e., 14,305 to 18,936 lbs/year), whereas the SO<sub>x</sub> and NO<sub>x</sub> emissions across the calculators vary by a factor of 3 or more.

Figure 4 shows the summary table that presents the calculation results from annual N.G. use. In the same fashion of the electricity case, the CO<sub>2</sub> emissions calculated due to the N.G. use are relatively consistent across the emissions calculators. (i.e., 11,520 to 13,547 lbs/year), whereas the SO<sub>x</sub> and NO<sub>x</sub> emissions across the calculators are varied. For the input parameter of N.G. use, only 2 calculators provide the SO<sub>x</sub> and NO<sub>x</sub> emissions calculations.

Appendix C provides the whole spreadsheet showing the test of existing emissions calculators.

Calculator Name	Website	Institute of Company	Energy Source				EPA USE				Emissions				Emissions Data		O&P
			Electricity	N.C. Oil	Renewable (Wind, Solar, etc.)	Commercial Buildings	Industrial	Transportation	Municipal	CO <sub>2</sub> Annual	SO <sub>2</sub> Annual	NO <sub>x</sub> Annual	U.S. Average	State Average	Country Average		
																CO <sub>2</sub> Annual	
1 Power Profiler	<a href="http://www.aha.com/aha/aha.html">http://www.aha.com/aha/aha.html</a>	IPA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
2 The Clear and Green Calculator from Electricity Use Calculator	<a href="http://www.clearandgreen.com/clearandgreen.html">http://www.clearandgreen.com/clearandgreen.html</a>	Clear and Green Academy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
3 The Clear and Green Calculator from Electricity Use Calculator	<a href="http://www.clearandgreen.com/clearandgreen.html">http://www.clearandgreen.com/clearandgreen.html</a>	Clear and Green Academy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
4 Airedair Emissions Calculator	<a href="http://www.airedair.com/aircalc.html">http://www.airedair.com/aircalc.html</a>	Airedair	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
5 New Fish carbon footprint calculator	<a href="http://www.newfish.com/newfish.html">http://www.newfish.com/newfish.html</a>	New Fish (recreation.com)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
6 New Fish carbon footprint calculator	<a href="http://www.newfish.com/newfish.html">http://www.newfish.com/newfish.html</a>	New Fish (recreation.com)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
7 NITRO Emissions Calculator	<a href="http://www.nitro.com/nitro.html">http://www.nitro.com/nitro.html</a>	Open Air Community	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
8 Residential Emissions Calculator	<a href="http://www.residentialemissionscalculator.com/">http://www.residentialemissionscalculator.com/</a>	AMERICAN ORE33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
9 Climate Change Calculator	<a href="http://www.climatechangecalculator.com/">http://www.climatechangecalculator.com/</a>	AMERICAN ORE33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
10 Climate Change Calculator	<a href="http://www.climatechangecalculator.com/">http://www.climatechangecalculator.com/</a>	AMERICAN ORE33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
11 Climate Change Calculator	<a href="http://www.climatechangecalculator.com/">http://www.climatechangecalculator.com/</a>	AMERICAN ORE33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
12 Calculate Your Impact	<a href="http://www.calculateyourimpact.com/">http://www.calculateyourimpact.com/</a>	AMERICAN ORE33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
13 Carbon Footprint Calculator	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	Bornville Environmental Foundation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
14 Carbon Footprint Calculator	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	Bornville Environmental Foundation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
15 Carbon Footprint Calculator	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	Bornville Environmental Foundation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
16 Carbon Footprint Calculator	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	Bornville Environmental Foundation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
17 Carbon Footprint Calculator	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	Bornville Environmental Foundation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
18 Carbon Footprint Calculator	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	Bornville Environmental Foundation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
19 Carbon Footprint Calculator	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	Bornville Environmental Foundation	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
20 Calculated your personal impact	<a href="http://www.calculatedyourpersonalimpact.com/">http://www.calculatedyourpersonalimpact.com/</a>	The Nature Conservancy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
21 America Drive's Personal Impact Calculator	<a href="http://www.americadrives.com/impactcalculator.html">http://www.americadrives.com/impactcalculator.html</a>	Carbon Footprint Ltd (UK Based)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
22 Travel Miles (Emissions Calculator)	<a href="http://www.travelmiles.com/">http://www.travelmiles.com/</a>	Environmental Defense	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
23 Travel Miles (Emissions Calculator)	<a href="http://www.travelmiles.com/">http://www.travelmiles.com/</a>	Environmental Defense	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
24 Carbon Footprint Calculator	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	TravelMiles	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
25 CoCalculator	<a href="http://www.cocalculator.com/">http://www.cocalculator.com/</a>	The Climate Trust	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
26 The Carbon Carbon Calculator	<a href="http://www.carboncarboncalculator.com/">http://www.carboncarboncalculator.com/</a>	Altera Institute	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
27 The Carbon Carbon Calculator	<a href="http://www.carboncarboncalculator.com/">http://www.carboncarboncalculator.com/</a>	Altera Institute	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
28 MARKAL	<a href="http://www.markal.com/">http://www.markal.com/</a>	Climate Cool Sheet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
29 MARKAL	<a href="http://www.markal.com/">http://www.markal.com/</a>	Climate Cool Sheet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
30 MARKAL	<a href="http://www.markal.com/">http://www.markal.com/</a>	Climate Cool Sheet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
31 Carbon Footprint carbon emissions calculator tool	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	Climate Cool Sheet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
32 Carbon Footprint carbon emissions calculator tool	<a href="http://www.carbonfootprintcalculator.com/">http://www.carbonfootprintcalculator.com/</a>	Climate Cool Sheet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
33 RES (Carbon Footprint Calculator)	<a href="http://www.res.com/">http://www.res.com/</a>	Climate Cool Sheet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
34 USA		Climate Cool Sheet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

Figure 2. Summary Table for Emissions Calculators.

Residential - All Electric							
Web	Institute or Company	Region	Annual Elec. Consumption:	Number of Occupants	NOx	SOx	CO2
1 Power Profiler	EPA	Texas (77840)	12000 kWh (Monthly, 1000 kWh)	N/A	13	42	18,587
2 EPA's Personal Emissions Calculator	EPA	N/A	12000 kWh (Monthly, 1000 kWh)	2	N/A	N/A	16,440
3 The Cleaner and Greener Pollution from Electricity Use Calculator	Leonardo Academy	Texas	12000 kWh	N/A	15	40	18,936
4 Airhead Emissions Calculator	Airhead						
5 Carbon Pollution Calculator, Electric Power Pollution Calculator	Texas State Energy Conservation Office	Texas	12000 kWh (Monthly, 1000 kWh)		Varied by Source	Varied by Source	Varied by Source
6 Non-Fish carbon footprint calculator	BP	United States	12000 kWh	2	N/A	N/A	16,720
7 NETZERO Emissions Calculators	Clean Air Conservancy						
8 NOx Calculator	ESA 21	United States	12000 kWh	2	23.04		
9 Residential Calculator & Business Calculator	Earthlogic, Inc.	United States	12000 kWh	2			16,300
10 Climate Change Calculator	AMERICAN FORESTS	United States	12000 kWh				18,000
11 Terrapass emissions calculator	TerraPass Inc	Texas (77840)	12000 kWh				16,920
12 Calculate your impact							
13 Carbon Calculator	Bonneville Environmental Foundation	Texas (77840)	12000 kWh				18,587
14 Emissions Calculator	Abrexis Energy Consulting	Texas	12000 kWh	N/A	46.8	56.4	18,600
15 Carbon Calculator	Ecosystem Restoration Associates						
16 a) eCalc	Energy Systems Laboratory	Texas (77840)	12000 kWh	N/A	17.04	10.93	14,305
16 b) eCalc	Energy Systems Laboratory	Texas (77840)	12000 kWh	N/A	32.25	19.52	15,907
17 Carbon Footprint Calculator	Carbon Footprint Ltd (UK Based)						
18 Carbon Calculator	The Nature Conservancy	Texas	12000 kWh	1			17,520
19 SciClimate carbon footprint calculator	Environmental Defense						
20 Calculated your personal impact	AOL	United States	\$100/month	2			18,776
21 America Online's Personal Impact Calculator	ICLEI	United States	12000 kWh	N/A			13,956
22 ICLEI Personal CO2 Calculation	TravelMatters						
23 Travel Matters Emissions Calculators	The Climate Trust						
24 Carboncounter	Athens Institute						
25 EcoCalculator	Clean Air-Cool Planet						
26 the Campus Carbon Calculator	ICLEI						
27 Clean Air and Climate Protection Software	EPA						
28 MARKAL	CARMA						
29 CARMA (Carbon Monitoring for Action)	UCIA						
30 HEED							
31 Clinton Foundation carbon emissions calculation tool							
32 GreenCert (Will be in market first half of 2008)	Enterprise Information Management, Inc. (EIM), and Evergreen Energy Inc.						
33 FEEDS (Cannot get the program)							
34 USA							

Figure 3, Summary Table for Test of Emissions Calculators: Electricity Use Only.

	Web	Institute or Company	Region	Annual N.G. Consumption:	Number of Occupants	NOx	SOx	CO2
1	Power Profiler	EPA	Texas (77840)	No N.G. Option	N/A			
2	EPA's Personal Emissions Calculator	EPA	N/A	96 MCF (8 MCF Monthly)	2	N/A	N/A	11,579
3	The Cleaner and Greener Pollution from Electricity Use Calculator	Leonardo Academy	Texas					
4	AirHead Emissions Calculator	AirHead						
5	Carbon Pollution Calculator, Electric Power Pollution Calculator	Texas State Energy Conservation Office	Texas	84 therm (82 therm Monthly)	2	N/A	N/A	11,799
6	Non-Flash carbon footprint calculator	BP	United States					
7	NETZERO Emissions Calculators	Clean Air Conservancy	United States	984 therm	2	4,536		
8	NOx Calculator	ESA 21	United States	984 therm	2			11,600
9	Residential Calculator & Business Calculator	Earthlogi, Inc.	United States	96 MCF (8 MCF Monthly)	2			11,554
10	Climate Change Calculator	AMERICAN FORESTS	United States	984 therm				11,564
11	Terrapass emissions calculator	TerraPass Inc.	Texas (77840)					
12	Calculate your impact	Bonneville Environmental Foundation	Texas (77840)	984 therm	N/A	14.8	0.6	11,521
13	Emissions Calculator	Abraxas Energy Consulting	Texas		N/A			11,600
14	Carbon Calculator	Ecosystem Restoration Associates						
15	Carbon Calculator	Energy Systems Laboratory	Texas (77840)		N/A			11,520
16	a-eCalc	Energy Systems Laboratory	Texas (77840)		N/A			11,520
17	Carbon Footprint Calculator	Carbon Footprint Ltd (UK Based)						
18	Carbon Calculator	The Nature Conservancy	Texas	984 Therm	1			12,852
19	SafeClimate carbon footprint calculator	World Resources Institute	Texas					
20	Calculate your personal impact	Environmental Defense	Texas					
21	America Online's Personal Impact Calculator	AOL	United States	\$110/Month	2			13,547
22	ICLEI Personal CO2 Calculation	ICLEI	United States		N/A			
23	Travel Matters Emissions Calculators	TravelMatters						
24	CarbonCounter	The Climate Trust						
25	EcoCalculator	Athena Institute						
26	the Campus Carbon Calculator	Clean Air-Cool Planet						
27	Clean Air and Climate Protection Software	ICLEI						
28	MARVAL	EPA						
29	CARMA (Carbon Monitoring for Action)	CARMA						
30	HEED	UCLA						
31	Clinton Foundation carbon emissions calculation tool							
32	GreenCERT (Will be in market first half of 2008)	Enterprise Information Management, Inc. (EIM), and Evergreen Energy Inc.						
33	FEDS (Cannot get the program)							
34	USA							

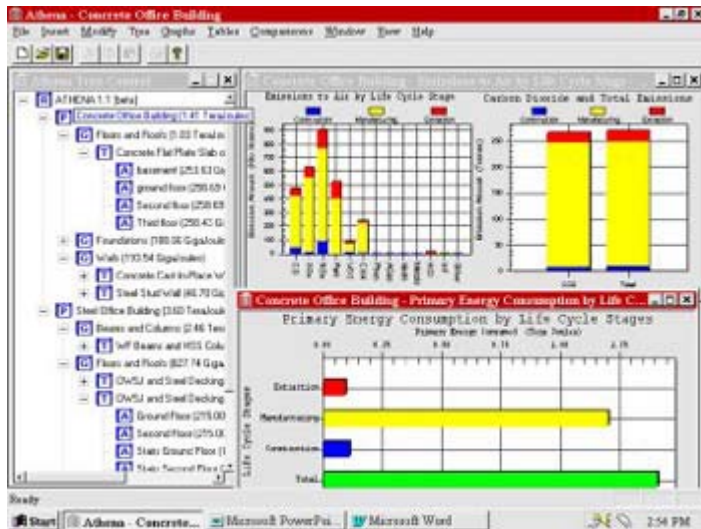
Figure 4. Summary Table for Test of Emissions Calculators: N.G. Use Only.

**APPENDIX A. Review of Emissions Calculators from the U.S. Department of Energy EE/RE's Building Energy Software Tools Directory.**

Appendix A presents the detailed information of the 9 emissions calculators found in the U.S. Department of Energy EE/RE Building Energy Software Tools Directory. The original documents of this information could be found in [http://www.eere.energy.gov/buildings/tools\\_directory/](http://www.eere.energy.gov/buildings/tools_directory/).

# 1. Athena Model

## Athena Model



Practical, easy-to-use decision support tool that provides high quality environmental data and assists with the complex evaluations required to make informed environmental choices. Our goal is to encourage the selection of material mixes and other design options that will minimize a building's potential life cycle environmental impacts and foster sustainable development. While there is a growing desire to put the environment on an equal footing with cost and other conventional design and product performance criteria, the task is by no means simple. It requires current, reliable and comparable environmental data in readily usable forms. The notion of Life-Cycle Assessment (LCA) has been generally accepted within the environmental research community as the only legitimate basis on which to compare alternative materials, components and services.

With Athena all the basic LCA work is done out of the sight and mind of the user. Give Athena a design for all or part of a building and you get back an environmental profile without having to be concerned with the intricacies of LCA or even knowing you are doing LCA. Better still enter two or more comparable conceptual designs and Athena will compare them across as many as six environmental measures.

### Keywords

life cycle assessment, environment, building materials, buildings

### Validation/Testing

N/A

### Expertise Required

None.

### Users

Approximately 100 beta testers and informal users.

### Audience

architects, engineers, designers, environmental consultants

### Input

Using Athena's own graphical user interface, you first enter a general description of your building project, including its location. You then specify one or more comparable designs by selecting from typical assemblies or by entering



specific quantities of individual products. Depending on the assembly, the user may have to answer prompts about floor or wall areas, working loads and spans, or other conceptual design information. Users may choose to work in either SI or Imperial units.

### **Output**

The model breaks down the selected assemblies comprising a design into their respective products for the purpose of applying the model's life cycle inventory (LCI) databases that contain estimates of the environmental effects per unit of each building product. The inventory data includes natural resource, energy and water inputs to processes as well as emissions to air, water and land for the manufacture, transportation and use of all of the individual building products.

Athena model users may either consult detailed inventory results or have Athena compare and contrast two or more designs across six predefined environmental measures covering embodied energy, resource use, air and water pollution, greenhouse gas effects and total solid waste produced. Users may also have results reported in absolute terms, on a square footage basis or normalized to a particular benchmark design.

### **Computer Platform**

PC with 150 Mhz Pentium, 32 Mbytes RAM, 4 Mbytes free disk space, Windows 95/98

### **Programming Language**

Visual C++

### **Strengths**

High quality, regionally sensitive databases, user-friendly interface, provides both detailed and aggregated results, and superior assembly and complete design comparison capability. It is "FREE" at this time for testing and use.

### **Weaknesses**

Limited to structural materials and assemblies. Right now the Athena model only contains databases for wood, steel and concrete products used in structural applications from cradle-to completion of the building site. But 'cradle to site' LCI databases have also been developed and will shortly be added for a range of cladding products, insulation and barrier materials, gypsum wallboard and related finishing materials, and selected glazing and window framing options. We will also be adding relevant occupancy/use and "end-of-life" activity stages to complete the building life cycle.

### **Contact**

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 Address: 8 Granville Avenue  
 Ottawa, Ontario K1Y 0M4  
 Canada  
 Telephone: +1 (613) 722-8075  
 Facsimile: +1 (613) 722-9628  
 E-mail: [JKMeil@fox.nstn.ca](mailto:JKMeil@fox.nstn.ca)  
 Website: <http://www.athenaSML.ca>

### **Availability**

A Beta version of Athena 1.2 is currently available free from [the Athena website](#). Be sure to also download the users manual as there is very limited technical support for this FREE version of the model.

## 2. BEES

### BEES



Powerful technique for selecting cost-effective, environmentally preferable building products. BEES (Building for Environmental and Economic Sustainability) is based on consensus standards and designed to be practical, flexible, and transparent. BEES reduces complex, science-based technical content (e.g., over 400 environmental flows from raw material acquisition through product disposal) to decision-enabling results and delivers them in a visually intuitive graphical format. The Windows-based decision support software, aimed at designers, builders, and product manufacturers, includes actual environmental and economic performance data for nearly 200 building products (both generic and brand-specific).

BEES measures the environmental performance of building products by using the environmental life-cycle assessment approach specified in ISO 14040 standards. All stages in the life of a product are analyzed: raw material acquisition, manufacture, transportation, installation, use, and recycling and waste management. Economic performance is measured using the ASTM standard life-cycle cost method, which covers the costs of initial investment, replacement, operation, maintenance and repair, and disposal. Environmental and economic performance are combined into an overall performance measure using the ASTM standard for Multi-Attribute Decision Analysis. For the entire BEES analysis, building products are defined and classified according to the ASTM standard classification for building elements known as UNIFORMAT II.

### Keywords

environmental performance, green buildings, life cycle assessment, life cycle costing, sustainable development

### Validation/Testing

N/A

### Expertise Required

None

### Users

Over 9000 copies of BEES 2.0 requested by users in over 80 countries.

### Audience

Designers, specifiers, builders, product manufacturers, purchasers, researchers, and policy makers.

### Input

User may set relative importance weights for 1) synthesizing up to 12 environmental impact scores (global warming, acid rain, eutrophication, fossil fuel depletion, indoor air quality, habitat alteration, ozone depletion, smog, human health, ecological toxicity, criteria air pollutants, and water intake) into an environmental performance score, 2) discounting future costs to their equivalent present value, and 3) combining environmental and economic performance scores into an overall performance score. Default values provided for all of this windows-based input. Weighting is optional.

## Output

Summary graphs depicting life-cycle environmental and economic performance scores for competing building product alternatives. Detailed graphs also available depicting physical flow quantities for each environmental impact (e.g., grams of carbon dioxide for the global warming impact), embodied energy, and first and future costs.

## Computer Platform

Windows 95, 98, 2000, NT, or XP personal computer with a 486 or higher microprocessor, 32 Megabytes or more of RAM, at least 110 Megabytes of available disk space, and a printer.

## Programming Language

CA Visual Objects

## Strengths

Offers a unique blend of environmental science, decision science, and economics. It uses life-cycle concepts, is based on consensus standards, and is designed to be practical, flexible, and transparent. It is practical in its systematic packaging of detailed, science-based, quantitative environmental and economic performance data in a manner that offers useful decision support. It is flexible in allowing tool users to customize judgments about key study parameters. It is transparent in documenting and providing all the supporting performance data and computational algorithms.

## Weaknesses

Includes environmental and economic performance data for only 200 building products covering 23 building elements.

## Contact

Company: National Institute of Standards and Technology

Address: Office of Applied Economics  
Building and Fire Research  
100 Bureau Drive, Stop 8603  
Gaithersburg, Maryland 20899-8603  
United States

Telephone: (301) 975-6133

Facsimile: (301) 975-5337

E-mail: [BLippiatt@nist.gov](mailto:BLippiatt@nist.gov)

Website: <http://www.bfrl.nist.gov/oae/bees.html>

## Availability

BEES 3.0 downloadable free of charge from the [web site](#). BEES 3.0 CD and printed documentation available free of charge through the EPA Pollution Prevention Information Clearinghouse at (202) 566-0799 or [ppic@epamail.epa.gov](mailto:ppic@epamail.epa.gov).

### 3. Building Greenhouse Rating

#### Building Greenhouse Rating



Provides assessments of the greenhouse intensity of office buildings by awarding a star rating on a scale of one to five. Buildings identified by the Australian Building Greenhouse Rating scheme with a high star rating will be more energy efficient and cheaper to run, and will result in lower greenhouse gas emissions. Separate components of the building can be rated - a base building rating measures the performance of those services provided by the building manager/landlord; and a tenancy rating measures the services for which the tenant is responsible. A whole building rating measures the combined effect.

The software tool uses information gathered from the existing building to benchmark the energy performance against the national Australian property market. Building owners, managers, tenants and investors can use the tool to self assess to roughly ascertain their property's performance. An assessment performed by an ABGR Accredited Assessor will provide an official ABGR Performance Rating, which may then be used in marketing and promotional materials.

#### Keywords

operational energy, greenhouse performance, national benchmark

#### Validation/Testing

N/A

#### Expertise Required

For self assessment, no expert knowledge required. Official ratings can only be performed by trained Accredited Assessors.

#### Users

More than 2000 downloads and more than 200 official ratings (all Australia).

#### Audience

Australian property market stakeholders - Building owners, managers, tenants, investors, developers, designers.

### **Input**

Requires building operational data - size in Net Lettable Area (NLA), location of the building, number of occupants, number of computers in regular use, number of hours per week that the building is occupied, and 12 months of billing data for all energy sources in the building. The user enters data via text inputs.

### **Output**

Report on greenhouse rating (stars), normalised greenhouse emissions (kgCO<sub>2</sub>/m<sup>2</sup>) and energy consumption (MJ/m<sup>2</sup>). The report shows what the star rating of the building means in terms of actual performance against the national benchmark.

### **Computer Platform**

Internet-based

### **Programming Language**

Java

### **Strengths**

Unique tool for providing insight into the actual energy and greenhouse performance of your office building against the national property market, enabling informed decision making on energy efficiency improvements. Useful for determining actual savings from implemented energy efficiency measures, by normalising the operational data for changes in usage patterns.

### **Weaknesses**

Normalising curves available for Australian office buildings only - will not provide meaningful results for other building types or locations without further industry benchmarking.

### **Contact**

Company: Sustainable Energy Development Authority  
Address: PO Box N442  
Grosvenor Place  
Sydney, NSW 1220  
Australia  
Telephone: +61 (2) 9249 6162  
Facsimile: +61 (2) 9299 0042  
E-mail: [SSalmon@seda.nsw.gov.au](mailto:SSalmon@seda.nsw.gov.au)  
Website: <http://www.abgr.com.au>

### **Availability**

Available as a free download from the [web site](#).

## 4. Invest

### Invest



First UK software for estimating lifecycle environmental impacts of buildings at the early design stage. This version is for office buildings and considers the environmental impacts of both the materials used during construction and the energy and resources consumed over the building's life.

Using minimal data entered through simple input screens, Invest allows designers instantly to identify those aspects of the building which have the greatest influence on its overall impact.

All environmental impacts are measured using a single points scale called Ecopoints, allowing designers to make direct comparisons between different designs and specifications. One hundred Ecopoints are equivalent to the environmental impact of the average UK citizen in one year.

### Keywords

sustainable design, green buildings, life cycle analysis, environmental impact analysis

### Validation/Testing

N/A

### Expertise Required

High level of computer literacy not required; architectural background helpful for analysis of buildings.

### Users

The software is presently used for internal consultancy by BRE, Invest is due to be launched on the 10th of May 2000.

### Audience

Architects, designers, environmental/energy consulting firms, authorities/clients, quantity surveyors, and research universities.

### Input

Building geometry, building fabric, structure and services specifications and operational life. The software has

pre-selected default values set on typical office building specifications; these can be edited by the user.

### **Output**

Total life cycle environmental impact of the building in Ecopoints. These are displayed both numerically and in graphic form. The graphs include total life cycle environmental performance of the study building, and environmental impacts comparison between the study building and a previously save building.

### **Computer Platform**

PC-compatible, Windows 95/98/NT, 30 megabytes of hard disk space.

### **Programming Language**

Visual Basic

### **Strengths**

There are a number of ways in which designers can use the tool, which performs a variety of functions. It allows the user to optimise the building form for least environmental impact and informs their choice on main construction materials. It also enables the environmental impacts of construction and building operation to be balanced over the life of the building. The designer can use Envest to make comparisons between different buildings and specifications and graphically illustrate the environmental credentials of various design options to clients. All environmental impacts are measured using a single points scale called Ecopoints, allowing designers to make direct comparisons between different designs and specifications.

### **Weaknesses**

Uses simplified methods. Some of the more exotic services option not covered.

### **Contact**

Company: BRE  
Address: Bucknalls Lane  
Garston  
Watford WD2 7JR  
United Kingdom  
Telephone: +44 (1923) 664462  
Facsimile: +44 (1923) 6644103  
E-mail: [Envest@bre.co.uk](mailto:Envest@bre.co.uk)  
Website: <http://www.bre.co.uk/envest>

## 5. EMISS

### EMISS

Generates a file of local air-pollution emissions coefficients. Used with the BLCC life-cycle cost program to estimate reductions in emissions associated with energy conservation projects. Three types of emissions factors are currently included: carbon dioxide, sulfur dioxide, nitrous oxide. Emissions factors are specified separately for six different end-use energy types: electricity, distillate and residual fuel oil, natural gas, liquid petroleum gas, and coal.

### Keywords

atmospheric pollution, energy-related pollution emissions

### Validation/Testing

N/A

### Expertise Required

None required.

### Users

Distributed in connection with the BLCC life-cycle cost program to several thousand users.

### Audience

Federal Energy Managers and energy coordinators, engineers and architects, budget analysts and planners.

### Input

Regional or local emissions factors or fuel-specific end-use data.

### Output

Preformatted tables of computed emissions factors by type of fuel.

### Computer Platform

PC-compatible. DOS version 3.0 or higher, Windows 3.x. No special graphics or hardware is required.

### Programming Language

Basic

### Strengths

Emissions factors for fossil fuels can be regionalized or localized. Program contains state-specific electricity emissions factors and U.S. average sulfur content of fossil fuels as default data. Users guide included as file with program.

### Weaknesses

The quality of the emissions factors depends on the user's knowledge of the factors that contribute to these emissions.

### Contact

Company: National Institute of Standards and Technology  
Address: Office of Applied Economics  
Building 226, Rm B226  
Gaithersburg, Maryland 20899  
United States



Telephone: (301) 975-6134

Facsimile: (301) 975-5337

E-mail: [Sieglinde.Fuller@nist.gov](mailto:Sieglinde.Fuller@nist.gov)

Website: [http://www.eere.energy.gov/femp/information/download\\_bfcc.cfm](http://www.eere.energy.gov/femp/information/download_bfcc.cfm)

**Availability**

Available for download from the FEMP [web site](#).

## 6. e-Bench

### e-Bench



Desktop computer tool for comprehensively measuring the energy, utility and environmental efficiency of a facility or process and comparing it to established benchmarks.

e-Bench enables organisations, industry sectors and even countries to improve energy, utility and environmental performance. It is a management tool that will create financial savings through reduced energy use and improved load management, and improve indoor environmental quality (IEQ) (and consequent staff productivity). It also enables organisations to achieve financial savings through picking up on errors in their supplier invoices and through additional process and production efficiencies as well as to more adequately meet the requirements of Triple Bottom Line reporting.

e-Bench has been designed as an interpretive tool suitable for use by everyone within an organisation from the Facilities Manager to the Chief Executive Officer and Chief Financial Officer. In New Zealand it is being used by their parliament, the majority of its universities, and many local health authorities and hospitals. It is also in extensive use by many primary and secondary schools where it is not only being used as a means of invoice checking and monitoring consumption and improving energy efficiency, but also as part of the science and math curriculum. It therefore has to be understood by students as well as more technically proficient individuals.

### Keywords

energy benchmarking, environmental benchmarking, energy audit, invoice verification and reconciliation, performance contract verification

### Validation/Testing

Benchmarking corrections made in accordance with the UK Chartered Institute of Building Services Engineers (CIBSE) guidelines. Averages, best and worst parameters are derived from the sample. Validation of data entry is undertaken when populating the database.

### Expertise Required

Populating the database with invoice consumption information is relatively straight forward, though collection and entering the facilities or processes attribute data requires a technical knowledge of the specific building or process, but nothing that an organisation should not already have available to them.

### Users

The majority of New Zealand's universities, many government departments, hospitals, schools, local authorities, property management companies and a number of key industry sector participants.

### Audience

Public, commercial and industrial organisations that want to verify their suppliers invoices, monitor consumption, benchmark and make improvements in their energy and utility performance. Available internationally.

## Input

Required data on energy and utility consumption, e.g. from electricity, gas and water meters, physical attributes, i.e. the floor areas, construction of walls, floors, roof, their materials, thickness, orientation, shape, etc. and utilisation information, i.e. hours of business, internal temperature settings, occupancy, widgets produced, etc. It probably requires more initial data than any other type of database as it has been developed to truly compare apples with apples. However once this data has been entered it may require no further input from a user's perspective as the database has been configured to accept electronic batch files on consumption and data from production or building management systems automatically.

## Output

The range of outputs is limitless and is capable of being fully customisable by the user. It verifies and reports on any errors in invoices and / or any unexpected variations in consumption. It reports by individual buildings, process segments and provides it in an easily interpreted format of \$, CO<sub>2</sub> and kWh. It compares like facilities or processes against the sample average, best and worst and quantifies these differences again in \$, CO<sub>2</sub> and kWh. Information is available both graphically and in individual reports. There are a range of pre-formatted reports but a user can customise and configure it to suit any application or process.

## Computer Platform

Web-based

## Programming Language

Java and Sybase database engine

## Strengths

e-Bench has been designed as a one-stop-shop capable of meeting ALL energy and environmental efficiency requirements. It is by default an energy management plan, an asset manager tool (maintains a register of facilities and their attributes), organisational tool (meets the environmental criteria for Triple Bottom Line reporting), and a financial tool (identifies and quantifies potential financial gains from efficiency measures and underpins their business cases).

e-Bench can include ALL energy sources, including electricity, reticulated gas, diesel, on-site solar generation, biomass etc., and has been designed to perform the following main functions:

- Checking, verifying and reconciling supplier's invoices;
- Checking consumption patterns to ensure equipment and processes are operating as intended;
- Identifying, quantifying and prioritising opportunities for improving energy and utility efficiency;
- Monitoring and targeting of energy and utility consumption;
- Assess performance contracts and determine if targets are being achieved;
- Fulfilling the envisaged reporting criteria for the UN Global reporting initiative and Kyoto Protocol;
- Identifying national and international best practice energy and environmental management; and
- Virtual audits of facilities and processes and, where data is available, of individual assets.

Planned extensions to the database will allow an organisation to:

- Model impacts of changes to facilities or processes (e.g. addition of insulation) on energy efficiency;
- Allow users and associations to define their own benchmarking indicators;
- Interfacing with all asset and maintenance management systems;
- Allow interfacing of demand response and demand management planning; and
- Allow Level Two Energy Audits to be largely conducted in the desktop environment.

## Weaknesses

No significant weaknesses -- it can be used for virtually all tasks related to energy, utility and environmental

benchmarking.

### **Contact**

Company: Energy and Technical Services

Address: L6, Waterside House  
220 Willis Street  
Wellington  
New Zealand

Telephone: +64 (4) 384 6121

Facsimile: +64 (4) 801 6210

E-mail: [gbennett@energyts.com](mailto:gbennett@energyts.com)

Website: <http://www.energyts.com>

### **Availability**

The cost is a few hundred dollars plus a percentage of the total energy expenditure that is capped at a value depending on the country the user is based.

## 7. FEDS

### FEDS



Provides a comprehensive method for quickly and objectively identifying energy improvements that offer maximum savings. FEDS (Facility Energy Decision System) makes assessments and analyzes energy efficiency of single buildings, multiple buildings, or all buildings of an entire facility. It provides an easy-to-use tool for identifying energy efficiency measures, selecting minimum life-cycle costs, determining payback, and enabling users to prioritize retrofit options and compare alternative financing options (site funding, leases, loans, ESPCs).

### Keywords

multibuilding facilities, energy simulation, retrofit opportunities, life cycle costing, emissions impacts, alternative financing

### Validation/Testing

N/A

### Expertise Required

Minimal using readily available information. Requires two or more hours depending on number of buildings.

### Users

Over 1,500

### Audience

Energy and facility managers, architects-engineers, utility planners, building technology researchers, educators, federal agencies, and energy consultants.

### Input

Location, building types, operating hours, age, square footage, fuels used by facility and energy price data are required. Numerous detailed engineering parameters are optional.

### Output

Fuel-neutral analysis with full life-cycle costing of retrofit options (ECMs) for the on-site buildings. Output data includes energy and cost savings, emissions reductions, and a wide range of economic measures.

### Computer Platform

PC-compatible, operating Windows 3.1x/9x/NT/2000. A Pentium-based (or equivalent) processor or higher is recommended.

### Programming Language

C

**Strengths**

Allows but does not require input of engineering parameters. Energy/economic analysis. Models peak demand. Optimizes retrofit opportunities. Performs analysis that meets unique Federal needs. Accepts unlimited number of buildings. Engineering and economic parameters provided are user adjustable.

**Weaknesses**

Not a buildings design tool.

**Contact**

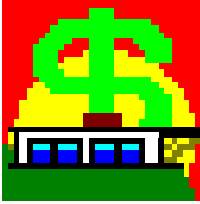
Company: Pacific Northwest National Laboratory  
Address: K6-05  
PO Box 999  
Richland, Washington 99352  
United States  
Telephone: (509) 375-6606  
Facsimile: (509) 372-4990  
E-mail: [Rosemarie.Bartlett@pnl.gov](mailto:Rosemarie.Bartlett@pnl.gov)  
Website: <http://www.pnl.gov/feds>

**Availability**

Version 4.1 available free to Federal agencies through the Energy Efficiency and Renewable Energy Clearinghouse, 1-800-DOE-EREC (363-3732).

## 8. HEED

### HEED



This user-friendly energy design tool shows how much money can be saved by making changes to your home. HEED (Home Energy Efficient Design) works equally well for remodeling projects or designing new buildings. You begin by giving four facts about your building, and then the expert system creates two basecase buildings, one that meets the energy code and another that incorporates more energy efficiency features. Then you can draw in your home's proposed floorplan, rotate it to the correct orientation, then click and drag windows to their exact location on each facade. Copy this to successive schemes to test various passive solar strategies such as window shading, thermal mass, night ventilation, and high performance glazing. For basic users the easy-to-understand bar charts show how energy bills change with each different design. For experienced users there are more detailed data input options, plus dozens of 3D graphic outputs that reveal subtle differences in of building performance. Clients will especially appreciate how these graphics clearly show the benefits of good energy efficient design.

Although HEED was developed for ratepayers in California, EnergyPlus climate data files for sites around the world can be read in directly (see read-usa.txt in the download docs folder). [Screen Shots](#)

### Keywords

whole building simulation, energy efficient design, climate responsive design, energy costs, indoor air temperature

### Validation/Testing

HEED has been validated against the BESTEST protocol (ASHRAE Standard 140), and against the results of experimental test cell data.

### Expertise Required

No special expertise is required in the Basic Design section, so homeowners and ratepayers will recognize all the terms. The Advanced Design and Evaluation sections are intended for designers familiar with energy efficiency issues, and for energy consultants and engineers working on smaller buildings.

### Users

As of May 2007 more than 7800 downloads. A survey in April 2002 showed 16 % of the users were in Southern California, 7 % were elsewhere in California, 48 % were elsewhere in the US, and the remaining 29 % were in another country. (Survey results available on the web site.)

### Audience

Homeowners and ratepayers will be comfortable with the Basic Design section of HEED which requires no special vocabulary or expertise. Designers and Energy Consultants, familiar with energy efficiency issues, will appreciate the features of the Advanced Design and Evaluation sections.

### Input

To start HEED only four facts are required: building type, square footage, number of stories, and location. From this the expert system creates the two basecase buildings called "Meets Energy Code" and "More Energy Efficient." The Basic Design information are things that any homeowner would know, and are input by

click and drag or by selecting from radio button lists of building components. The Advanced Design inputs are tabular inputs of thermal characteristics, dimensions, schedules, etc.

## Output

HEED is unique in that most of its performance data is presented graphically, in a wide array of formats. The basic output is a bar chart of gas and electricity annual costs, based on local utility rates, for up to nine different schemes. Advanced outputs include 3D plots for each hour of dozens of different variables including heat gain and loss for seventeen elements of the building's total load, plus indoor and outdoor air temperatures, air change rate, furnace and air conditioner outputs, power for lights and for fans, and gas and electricity costs. There are also 3D bar charts comparing over 40 variables against up to 9 schemes. Tabular data is also available.

## Computer Platform

HEED runs on all versions of Windows, from 95 to XP, and also on Mac OS 10.2 or later.

## Programming Language

HEED graphic user interface is written in Java and C. The Solar-5 computation kernel is written in Fortran.

## Strengths

HEED's strengths are simplicity of use, ease of input data, a wide array of graphic output techniques, computational speed, and the ability to quickly compare multiple design alternatives. It uses a sophisticated 8760 hour whole-building heat balance simulation algorithm. HEED includes an intelligent whole-house fan thermostat and window-dependent daylighting controls, and calculates the air pollution implications of design decisions. It can automatically manage up to nine schemes in up to 24 different projects. A full Spanish language version is also available, including Advice, Help and the FAQ file.

## Weaknesses

Limited to single-zone buildings and generic HVAC systems. Basic Design is limited to four types of residential buildings, but Advanced Design users can input data for any building type (see heed-faq.txt). Currently contains only California electric rates, but they can be user modified. HEED comes with climate data for many California zipcodes and all 16 California Climate Zones, plus it allows Energy Plus climate data for sites around the world to be loaded directly (see read-usa.txt).

## Contact

Company: Department of Architecture and Urban Design  
Address: Box 951467  
University of California at Los Angeles  
Los Angeles, California 90095-1467  
United States  
Telephone: +1 (310) 206-7021  
Facsimile: +1 (310) 825-8959  
E-mail: [energy.design.tools@ucla.edu](mailto:energy.design.tools@ucla.edu)  
Website: <http://www.aud.ucla.edu/energy-design-tools>

## Availability

HEED can be downloaded at no cost from the [web site](#).



## 9. LISA

### LISA



Streamlined Life Cycle Analysis (LCA) decision support tool for construction. It was developed in response to requests by architects and industry professionals for a simplified LCA tool to assist in green design. LISA stands for LCA in Sustainable Architecture. [Screen Shots](#)

### Keywords

life cycle analysis, sustainability, utilisation, embodied energy

### Validation/Testing

N/A.

### Expertise Required

No special training required; help files are included to assist use of interactive case studies.

### Users

400

### Audience

Architects, construction industry professionals, educators, and researchers

### Input

Bill of Materials & Quantities (along with possible alternative materials such as concrete which uses fly ash, a waste product from power production as a cement extender. From a sustainability perspective this reduces the need for energy intensive cement production). Work Schedule, Fuel consumption by construction equipment. HVAC, Services and Fittings. Utilisation schedules.

Data is entered into existing interactive case studies to determine the environmental impact (in terms of the sustainability and energy use) of design and material alternatives.

A developer mode exists for those who wish to add their own interactive case studies and findings to the knowledge embodied in the existing case study list. This feature can only be accessed by obtaining a developer password from info@lisa.com.au.

In developer mode equations that relate to material use and service use, such as water and electricity, are generated. These are typically associated with stages in the life cycle of the building typical stages. Includes but are not confined to: specification, construction, appliances, fitout, utilisation, transportation, decommissioning/recycling, and material transport.

### **Output**

Output is in graphical and table form showing the environmental impact of each stage in terms of: resource energy use in GJ, GGE in tonnes of equivalent CO<sub>2</sub>, SPM, NMVOC, Water, NO<sub>x</sub>, and SO<sub>x</sub>. Base Material Data and a Bill of Material Quantities are also reported.

### **Computer Platform**

PC, Pentium class or higher with Windows 95, 98, ME, NT, 2000, XP.

### **Programming Language**

Visual Basic

### **Strengths**

LCA, highlights the strengths and weaknesses of a building in terms of energy.

### **Weaknesses**

Doesn't do thermal modeling.

### **Contact**

Company: University of Newcastle  
Address: Centre for Sustainable Technology  
Port Macquarie, NSW  
Australia  
E-mail: [help@lisa.au.com](mailto:help@lisa.au.com)  
Website: <http://www.lisa.au.com>

### **Availability**

Free Download from [www.lisa.au.com](http://www.lisa.au.com).

## APPENDIX B. Review of Emissions Calculators from the World Wide Web

The enclosed file “Summary\_Emission\_Calculation.xls” presents the review of emissions calculations. The detailed description of this spreadsheet was illustrated in the section 2.2 “Task 3: Review and test existing emissions calculators from the World Wide Web” in this report.

This Excel workbook consists of 29 spreadsheets. The first tab named “Summary” provides the summary table of 34 emissions calculators. The first column of this table shows the Number assigned to each tool, and these numbers are the names of the rest of 28 spreadsheets. These 28 spreadsheets show the screenshots of each tool. The list of the programs and the assigned number is as follows:

- 1 Power Profiler
- 2 EPA's Personal Emissions Calculator
- 3 The Cleaner and Greener Pollution from Electricity Use Calculator
- 4 AirHead Emissions Calculator
- 5 Carbon Pollution Calculator, Electric Power Pollution Calculator
- 6 Non-Flash carbon footprint calculator
- 7 NETZERO Emissions Calculators
- 8 NOx Calculator
- 9 Residential Calculator & Business Calculator
- 10 Climate Change Calculator
- 11 Terrapass emissions calculator
- 12 Calculate your impact
- 13 Carbon Calculator
- 14 Emissions Calculator
- 15 Carbon Calculator
- 16 eCalc
- 17 Carbon Footprint Calculator
- 18 Carbon Calculator
- 19 SafeClimate carbon footprint calculator
- 20 Calculated your personal impact
- 21 America Online's Personal Impact Calculator
- 22 ICLEI Personal CO2 Calculation
- 23 Travel Matters Emissions Calculators
- 24 CarbonCounter
- 25 EcoCalculator
- 26 the Campus Carbon Calculator
- 27 Clean Air and Climate Protection Software
- 28 MARKAL
- 29 CARMA (Carbon Monitoring for Action)
- 30 HEED
- 31 Clinton Foundation carbon emissions calculation tool
- 32 GreenCert (Will be in market first half of 2008)
- 33 FEDS (Cannot get the program)
- 34 LISA

## APPENDIX C. Test of Emissions Calculators

The enclosed file “Summary\_Web\_Test.xls” presents the test results of emissions calculations. The detailed description of this spreadsheet was illustrated in the section 2.2 “Task 3: Review and test existing emissions calculators from the World Wide Web” in this report.

This Excel workbook consists of 16 spreadsheets. The first two tabs named “Residential-Elec.” and “Residential-N.G.” provides the test results for electricity and N.G. uses in residential buildings. The rest of 14 spreadsheets show the screenshots of test input and output screens for each tool. The list of the programs shown in the workbook is as follows:

- 1 Power Profiler
- 2 EPA's Personal Emissions Calculator
- 3 The Cleaner and Greener Pollution from Electricity Use Calculator
- 5 Carbon Pollution Calculator, Electric Power Pollution Calculator
- 8 NOx Calculator
- 9 Residential Calculator & Business Calculator
- 10 Climate Change Calculator
- 11 Terrapass emissions calculator
- 13 Carbon Calculator
- 14 Emissions Calculator
- 16-a eCalc
- 16-b eClac
- 21 America Online's Personal Impact Calculator
- 22 ICLEI Personal CO2 Calculation