



Renewable Energy Modeling Tools, Calculators and Design Guides

SOFTWARE & CALCULATORS Energy-10 ENERGY-10 software can identify the best combination of energy-efficient strategies, including daylighting, passive solar heating, and high-efficiency mechanical systems. Using ENERGY-10 at a project's start takes less than an hour and can result in energy savings of 40%-70%, with little or no increase in construction cost. The simulation software is suitable for examining small commercial and residential buildings that are characterized by one, or two thermal zones (generally less than 10,000 ft².) Free (<http://www.nrel.gov/buildings/energy10.html>)

GHG Equivalencies Calculator Run by the U.S. Climate Technology Cooperation Gateway, the Greenhouse Gas Equivalencies Calculator is designed to enable public and private sector organizations and individuals to quickly and easily translate greenhouse gas (GHG) reductions from units that are typically used to report reductions (e.g., metric tons of carbon dioxide equivalent) into terms that are easier to conceptualize (e.g., equivalent number of cars not driven for one year).

Carbon Footprint Calculators The **BP calculator** (also see the animated **Flash version**) shows the amount of carbon dioxide emissions from major sources: home energy consumption and transportation by car and plane. The **Buckley calculator** determines your primary carbon footprint, based on your household fuel bills and your annual travel. **Be Green Now** shows how the emissions from various sources are calculated and gives suggestions on how to offset emissions

<http://www.carbonfootprint.com/calculator.aspx> and <http://www.begreennow.com/reduce-offset/carbon-calculator/>

Energy Ideas Clearinghouse: Energy Calculators EnergyIdeas is operated and managed by the Washington State University Extension Energy Program in Olympia, Washington. EnergyIdeas Clearinghouse is a comprehensive, technical resource for energy technologies and practices. http://googlemini.energy.wsu.edu/search?q=calculator&filter=0&restrict=EIC&siteparam=EIC&btnG=Google+Search&ie=&site=EP&output=xml_no_dtd&client=EP&lr=&proxystylesheet=EP&oe=&CFID=6510718&CFTOKEN=44003922

HOMER HOMER is a computer model that simplifies the task of evaluating design options for both off-grid and grid-connected power systems for remote, stand-alone, and distributed generation (DG) applications. HOMER's optimization and sensitivity analysis algorithms allow

The Stella Group, Ltd. (www.thestellagroupltd.com) is a strategic technology optimization and policy firm advancing the utilization of clean, distributed energy applications such as advanced batteries and controls, energy efficiency, fuel cells, geothermal, heat engines, microhydropower, minigeneration (natural gas), modular biomass, photovoltaics, small wind and solar thermal (air-conditioning, water and industrial process heat, and power generation), and water energy; with blended financing and customer facilitation.



you to evaluate the economic and technical feasibility of a large number of technology options and to account for variation in technology costs and energy resource availability. HOMER models both conventional and renewable energy technologies. Free (<http://www.homerenergy.com/>)

Hybrid2 The Hybrid2 code is a user-friendly tool to conduct detailed long-term performance and economic analysis on a wide variety of hybrid power systems. Free (http://www.ceere.org/rerl/rerl_hybridpower.html)

ET Finance RETFinance is a levelized cost-of-energy model, which simulates a detailed 20-year nominal dollar cash flow for renewable energy projects power projects including project earnings, cash flows, and debt payment to calculate a project's levelized cost-of-electricity, after-tax nominal Internal Rate of Return, and annual Debt-Service-Coverage-Ratios. Free (<http://analysis.nrel.gov/retfinance/login.asp>)

Real Options Analysis Center The Real Options Analysis Center (ROAC) features two online models for real options valuation of renewable energy R&D and valuation of distributed generation assets. This project is part of a larger Internet-based analysis effort within NREL called **e-Analysis**. Free (<http://www.nrel.gov/realoptions/>)

Personal Emissions Calculator Use this U.S. Environmental Protection Agency's personal greenhouse gas emissions calculator with your household energy bills to estimate your household's annual emissions and identify ways you can cut your emissions. Then move on to the next section of the calculator to explore actions you and/or your family can take to lower your emissions while reducing your energy and waste disposal costs. For each action you choose to take, the calculator displays the amount of emissions you could avoid and how that amount relates to your total emissions. (http://www.epa.gov/climatechange/emissions/ind_calculator.html)

Renewable Energy REcalculator This International Energy Agency calculator is a free is a web based tool for comparing costs and benefits for society for energy sources including all kinds of externalities. The tool will most likely be further expanded during late 2007/early 2009. (http://www.recabs.org/energy_calculator)

In My Backyard: for PV Arrays or Small Wind Turbines The In My Backyard (IMBY) tool estimates the electricity you can produce with a solar photovoltaic (PV) array or wind turbine at your home or business. Homeowners, businesses, and researchers use IMBY to develop quick

The Stella Group, Ltd. (www.thestellagroupltd.com) is a strategic technology optimization and policy firm advancing the utilization of clean, distributed energy applications such as advanced batteries and controls, energy efficiency, fuel cells, geexchange, heat engines, microhydropower, minigeneration (natural gas), modular biomass, photovoltaics, small wind and solar thermal (air-conditioning, water and industrial process heat, and power generation), and water energy; with blended financing and customer facilitation.



estimates of renewable energy production at locations throughout the continental United States, Hawaii, and northern Mexico. IMBY uses a map-based interface to allow you to choose the exact location of your PV array or wind turbine. Based on your location, system size, and other variables, IMBY estimates the electricity production you can expect from your system. The In My Backyard tool was developed by NREL's **Electric Systems Center Distributed Energy Systems Integration Section** (<http://www.nrel.gov/eis/imby/about.html>) .

PV WATTS PVWATTS calculates electrical energy produced by a grid-connected photovoltaic (PV) system. Researchers at DOE's National Renewable Energy Laboratory developed PVWATTS to permit non-experts to quickly obtain performance estimates for grid-connected PV systems within the United States and its territories. In a grid-connected PV system, PV modules, wired together to form a PV array, pass DC electricity through an inverter to convert it into AC power. If the PV system AC power is greater than the owner's needs, the inverter sends the surplus to the utility grid for use by others. The utility provides AC power to the owner at night and during times when the owner's requirements exceed the capability of the PV system. (<http://www.nrel.gov/rredc/pvwatts/>)

Solar Analysis Tools and Data An excellent site by Build It Solar. The site includes calculators, analytical tools for solar work; climate and solar radiation data; properties for materials used in solar projects; wire and pipe tables; and reference books on solar engineering. (<http://www.builditsolar.com/Tools/tools.htm>)

The Solar Estimator - Spinning Back Towards Savings! A resource offered by DOE, the California Energy Commission and the Solar Electric Power Association to give you an idea of price, savings and system size. The results are based upon many assumptions and the limited data you will enter. An actual site assessment by a qualified Solar Pro will be needed to determine the actual costs and benefits of installing a solar system. (http://www.solar-estimate.org/index.php?verifycookie=1&page=&subpage=&external_estimator=)

Solar Air Heating Project Model Software The FREE RETScreen Solar Air Heating Project Model can be used world-wide to easily evaluate the energy production (or savings), life-cycle costs and greenhouse gas emissions reduction for two basic applications: ventilation air heating and process air heating. The model is designed specifically for the analysis of transpired-plate solar collectors. This emerging technology has been successfully applied in a range of applications from small residential to larger commercial/industrial scale ventilation systems, as well in the air drying processes for various crops. (http://www.etscreen.net/ang/g_solara.php)

The Stella Group, Ltd. (www.thestellagroupltd.com) is a strategic technology optimization and policy firm advancing the utilization of clean, distributed energy applications such as advanced batteries and controls, energy efficiency, fuel cells, geoexchange, heat engines, microhydropower, minigeneration (natural gas), modular biomass, photovoltaics, small wind and solar thermal (air-conditioning, water and industrial process heat, and power generation), and water energy; with blended financing and customer facilitation.



Photovoltaic Project Model Software The FREE RETScreen Photovoltaic Project Model can be used world-wide to easily evaluate the energy production, life-cycle costs and greenhouse gas emissions reduction for three basic PV applications: on-grid; off-grid; and water pumping. For on-grid applications the model can be used to evaluate both central-grid and isolated-grid PV systems. For off-grid applications the model can be used to evaluate both stand-alone (PV-battery) and hybrid (PV-battery-genset) systems. For water pumping applications the model can be used to evaluate PV-pump systems. Developed by the Canadian government (http://www.retscreen.net/ang/g_photo.php)

Solar Water Heating Project Model Software The FREE RETScreen Solar Water Heating Project Model can be used world-wide to easily evaluate the energy production, life-cycle costs and greenhouse gas emissions reduction for three basic applications: domestic hot water, industrial process heat and swimming pools (indoor and outdoor), ranging in size from small residential systems to large scale commercial, institutional and industrial systems. (http://www.retscreen.net/ang/g_solarw.php)

Building Envelope and Passive Solar Heating Project Model Software The FREE RETScreen Passive Solar Heating Project Model can be used world-wide to easily evaluate the energy production (or savings), life-cycle costs and greenhouse gas emissions reduction for passive solar designs and/or energy efficient window use in low-rise residential and small commercial building applications. The model can be used where there is a relatively significant heating load. The model calculates, for both retrofit or new construction projects, the difference in heating and cooling energy consumption between a proposed passive solar building design (or energy efficient window use) and an identical building but without the passive solar (or energy efficient window) features. (http://www.retscreen.net/ang/g_passiv.php)

WIND In My Backyard: for Small Wind Turbine or PV Arrays The In My Backyard (IMBY) tool estimates the electricity you can produce with a solar photovoltaic (PV) array or wind turbine at your home or business. Homeowners, businesses, and researchers use IMBY to develop quick estimates of renewable energy production at locations throughout the continental United States, Hawaii, and northern Mexico. IMBY uses a map-based interface to allow you to choose the exact location of your PV array or wind turbine. Based on your location, system size, and other variables, IMBY estimates the electricity production you can expect from your system. The In My Backyard tool was developed by NREL's **Electric Systems Center Distributed Energy Systems Integration Section (v)** (nrel.gov/eis/imby/about.html) .

The Stella Group, Ltd. (www.thestellagroupltd.com) is a strategic technology optimization and policy firm advancing the utilization of clean, distributed energy applications such as advanced batteries and controls, energy efficiency, fuel cells, geoexchange, heat engines, microhydropower, minigeneration (natural gas), modular biomass, photovoltaics, small wind and solar thermal (air-conditioning, water and industrial process heat, and power generation), and water energy; with blended financing and customer facilitation.



Wind Energy Finance: An Online Calculator for Economic Analysis of Wind Projects A Wind Powering America web site. Wind Energy Finance (WEF) is a free online energy calculator, to enable quick, detailed economic evaluation of potential utility-scale wind energy projects. WEF should be used by anyone interested in evaluating the economics of potential utility scale wind energy projects. The tool is designed for those who have general experience with project financial analysis but little knowledge of wind projects. Read this **WEF fact sheet** and see the **WEF online sign-in page** (it may take awhile to download).
(<http://analysis.nrel.gov/windfinance/login.asp>)

RETScreen International Wind Energy Project Model Software Canada's free RETScreen International software can be used world-wide to easily evaluate the energy production, life-cycle costs and greenhouse gas emissions reduction for central-grid, isolated-grid and off-grid wind energy projects, ranging in size from large scale multi-turbine wind farms to small scale single-turbine wind-diesel hybrid systems. Version 3.0 upgrades include a Metric/Imperial unit switch; updated product data; an enhanced GHG model to account for emerging rules under the Kyoto Protocol; a Sensitivity & Risk Analysis worksheet; and the ability for users to now evaluate wind projects using wind power density data (in addition to wind speed data).
(http://www.retscreen.net/ang/g_win.php)

Jobs and Economic Development Impact (JEDI) Model A Wind Powering America web site. Jedi is a free, user-friendly tool that calculates economic impacts from wind projects. It allows you to easily identify the local economic impacts associated with constructing and operating wind power plants. JEDI is for wind developers, renewable energy advocates, government officials, decision makers, and other potential users who might not have the resources to develop their own economic development model. It is designed to accommodate a broad user base with varying experience with economic development modeling. It accommodates inexperienced spreadsheet users, those unfamiliar with economic impact analysis, and more experienced and knowledgeable users who need this type of analysis.
(http://www.windpoweringamerica.gov/filter_detail.asp?itemid=707)

Windustry's Wind Project Financial Calculator Tools Developed via Windustry. <http://www.windustry.com/your-wind-project/community-wind/community-wind-toolbox/chapter-3-project-planning-and-management/wi>

****Special thanks to the State of Texas Energy Conservation Office , September 2010****

The Stella Group, Ltd. (www.thestellagroupltd.com) is a strategic technology optimization and policy firm advancing the utilization of clean, distributed energy applications such as advanced batteries and controls, energy efficiency, fuel cells, geoexchange, heat engines, microhydropower, minigeneration (natural gas), modular biomass, photovoltaics, small wind and solar thermal (air-conditioning, water and industrial process heat, and power generation), and water energy; with blended financing and customer facilitation.