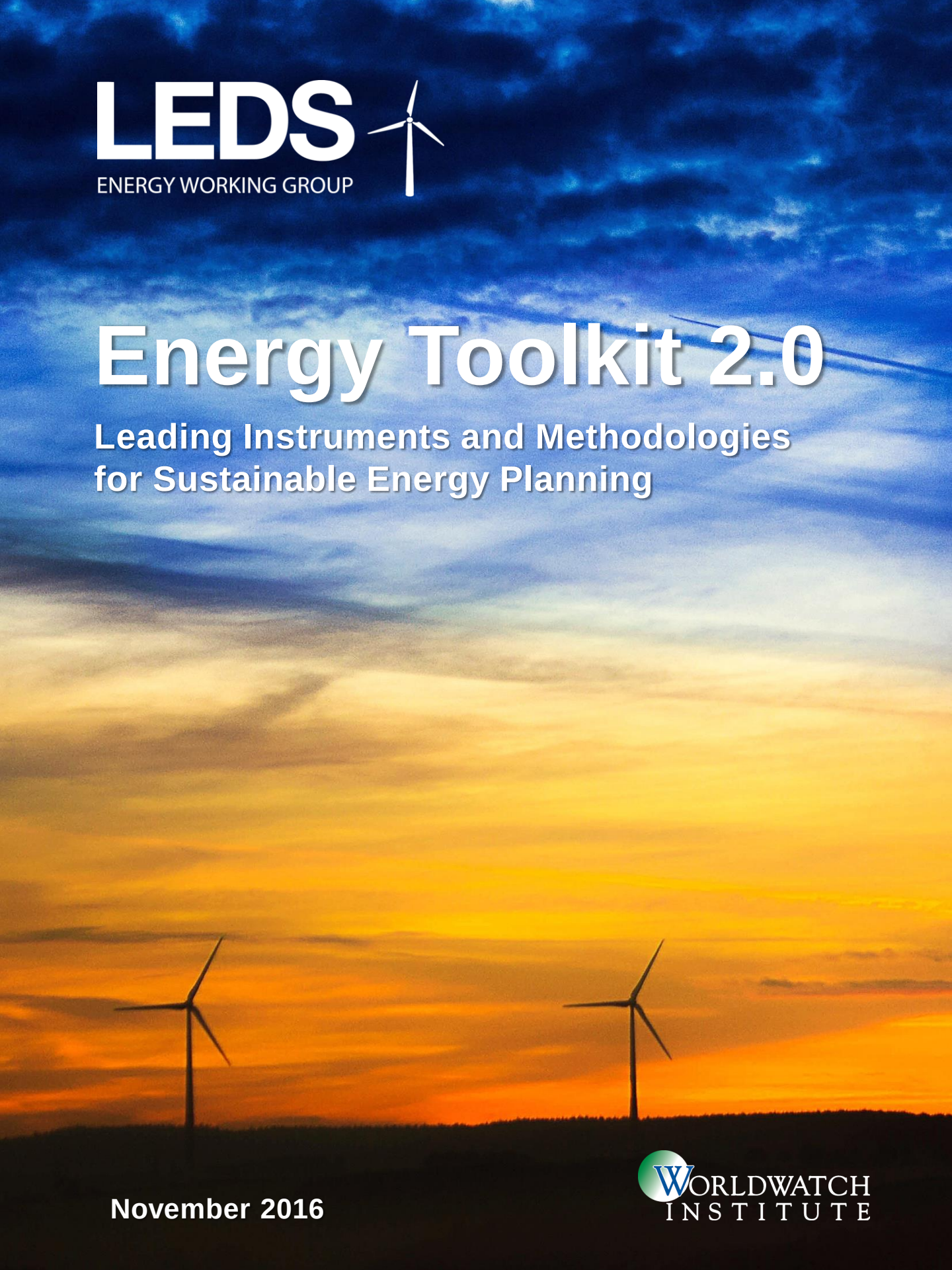
LEDS
ENERGY WORKING GROUP
Energy Toolkit 2.0
Leading Instruments and Methodologies
for Sustainable Energy Planning
November 2016
WORLDWATCH
INSTITUTE

Energy Toolkit 2.0

Leading Instruments and Methodologies for Sustainable Energy Planning

The second iteration of the Energy Toolkit, a collection of leading instruments and methodologies for climate-compatible energy planning, offers energy practitioners, policymakers, and experts a quick reference guide to some of the best-established instruments available at no or low cost. The result is a compilation of 25 tools from agencies around the world.

The toolkit was produced as a team effort with the many members of the Low-Emissions Development Strategies Global Partnership (LEDS GP), in particular its Energy Working Group (LEDS EWG).

The LEDS GP was founded in 2011 to facilitate peer learning, technical cooperation, and information exchange to support the formation and implementation of low emission development strategies. It has a focus on supporting developing countries and regions. It engages leaders from over 300 institutions across government agencies, technical institutes, international agencies, and non-governmental organizations.

The LEDS EWG promotes sustainable and climate-compatible development in the energy sector through a work program focused on peer-to-peer learning, technical assistance, and enhanced opportunities for coordination and collaboration between LEDS GP members. The LEDS EWG also produces supporting materials, such as best-case studies or reference guides like the one presented here.

This toolkit does not claim to be a complete encyclopedia of all available tools. We hope to update and further improve the toolkit in coming years. If you have developed a sustainable energy modelling tool or know of one that should be featured here, please contact us at energy@ledsgp.org. Thank you!

We hope this toolkit will help you to make energy fairer, safer, and greener for all.

Alexander Ochs | **Lead Editor**
Director of Climate and Energy, Worldwatch Institute | LEDS EWG Chair
Philip Killeen | **Co-editor, Version 2.0**
Research Associate, Worldwatch Institute | LEDS EWG Secretariat Manager
Max Lander | **Co-editor, Version 1.0**
Former Research Assistant, Worldwatch Institute

Acknowledgements

The authors thank the U.S. Department of Energy for their support of the LEDS GP which allowed us to work on this toolkit. We would also like to thank the National Renewable Energy Laboratory (NREL) for being invaluable supporters of our work in their role of managing the LEDS GP Secretariat.

Production of this LEDS Energy Toolkit 2.0 would also not have been possible without the participation and assistance of our broad and growing network of partners in the LEDS Energy Working Group.

Our sincere gratitude goes to all tool designers and stewards who graciously contributed profiles of their product; to the leads and EWG co-chairs from the LEDS GP regional platforms in Africa, Asia, and Latin America and the Caribbean who advised the editors on defining issue-areas of highest need to LEDS GP member countries and thereby helping to identify the most useful tools; to Ana Rojas of the IUCN Global Gender Office who provided support on identifying effective gender methodologies.

We also like to thank our colleagues Gaelle Gourmelon for helping with design, outreach, and public relations, as well as Lisa Mastny for line editing.

Contents

COST AND BENEFIT

LEDS
ENERGY WORKING GROUP

CREST

Cost of Renewable Energy Spreadsheet Tool

User-friendly cost of energy calculator for solar, wind, geothermal, biomass, and fuel cell projects

Typical Clients

- Policymakers
- Regulators
- Researchers
- Beginning developers and financiers

Associated Costs

Free

Current and Past Users

- Government of Rhode Island
- Apex Consulting
- VenLogic

More Information

https://financere.nrel.gov/finance/content/crest-cost-energy-models

Contact Information

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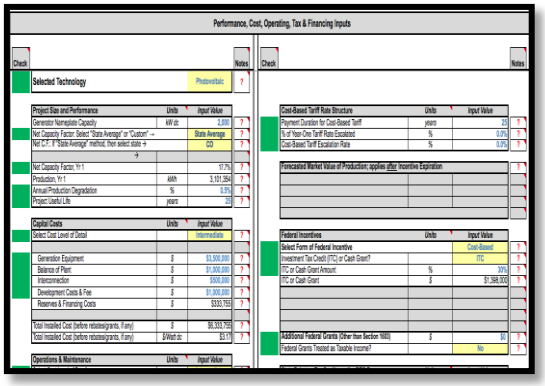


NREL
NATIONAL RENEWABLE ENERGY LABORATORY

CREST | Cost of Renewable Energy Spreadsheet Tool

What is it?

An Excel-based cost of energy and *pro forma* model to perform back-of-the-envelope calculations for wind, solar, geothermal, biomass, and fuel cell projects. CREST can also be used by governments to set feed-in tariff rates and other incentive levels.

Key Goals

CREST assists policymakers in the design of cost-based incentives to support renewable energy development in their jurisdictions.

Data Inputs

- Project data (including size, expected performance, and capital costs)
- Financial data (including debt and equity terms, and tax information)
- Ongoing costs (including O&M, operating capex, and debt service)

Outcomes

- Year one cost of energy
- Cash flows over project lifetime
- *Pro forma* analysis

META

Model for Electricity Technology Assessment

Integrating externalities into electricity supply decisions

Typical Clients

- Power sector policy-makers
- Power system planners

Associated Costs

Free

Current and Past Users

- Dominica, Egypt, Kosovo, Macedonia, Morocco, and Vietnam (as part of the World Bank's engagement)
- By consultants (e.g., Worldwatch Institute in Haiti and Jamaica)

More Information

https://www.esmap.org/META

Contact Information

esmap@worldbank.org

META

THE WORLD BANK

META | Model for Electricity Technology Assessment

What is it?

META facilitates the comparative assessment of the economic costs of more than 50 electricity generation and delivery technologies, including conventional generation options (e.g., thermal, hydroelectric), nonconventional options (renewables), and emerging options such as power storage and carbon capture and storage (CCS).

Key Goals

META provides cost assessments for various electricity technology options and can be used for analysis on:

- Investment projects
- Energy policy
- Electricity system planning
- Sector studies
- Estimating environmental damage costs

Data Inputs

Default performance and cost data inputs are provided, drawn from three representative countries: India, Romania and the United States of America, which were chosen as proxies for developing, middle-income and developed countries, respectively.

Users also have the option of customizing the data for new countries by entering detailed input data directly into model and for as many parameters as they consider necessary.

Outcomes

- Levelized costs for generation, transmission, and distribution for each electricity supply technology option from a relatively few input parameters
- Integration of environmental externalities, such as local pollution and greenhouse gas emissions
- Cost analysis of adding or expanding generation from a particular power source if, for example, a carbon price is factored in

JEDI

International Jobs and Economic Development Impact Models

Estimating the job and economic potential of renewable energy projects

Typical Clients

- County and state decision-makers
- Public utility commissions
- Potential project owners
- Developers

Associated Costs

Free

Current and Past Users

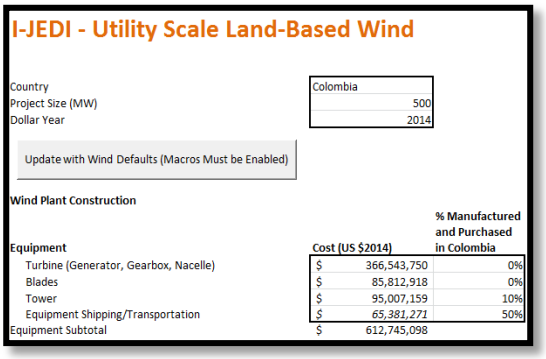
- 3,000 downloads per year
- Mentioned in over 70 peer-reviewed papers since 2004
- Arizona State University, Illinois State University, Texas Christian University, and others

More Information

www.nrel.gov/analysis/jedi

Contact Information

jedisupport@nrel.gov



I-JEDI - Utility Scale Land-Based Wind

Country	Colombia
Project Size (MW)	500
Dollar Year	2014

Update with Wind Defaults (Macros Must be Enabled)

Wind Plant Construction

Equipment	Cost (US $2014)	% Manufactured and Purchased in Colombia
Turbine (Generator, Gearbox, Nacelle)	$ 366,543,750	0%
Blades	$ 85,812,918	0%
Tower	$ 95,007,159	10%
Equipment Shipping/Transportation	*$ 65,381,271*	50%
Equipment Subtotal	$ 612,745,098	

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

JEDI | International Jobs and Economic Development Impact Models

What is it?

I-JEDI estimates the regional economic impacts of constructing and operating renewable energy plants using Excel as its platform.

Key Goals

I-JEDI assists users of all levels of experience, from entry-level users who may prefer to use I-JEDI's default data, to experienced users wishing to perform more sophisticated analysis.

Data Inputs

Inputs include country or region of interest, project size, equipment, construction and operation costs, and percentage of expenditures made in the country or region of interest.

Users can use default cost inputs or enter project-specific data.

I-JEDI has default data for Colombia, Mexico, the Philippines, Zambia and South Africa.

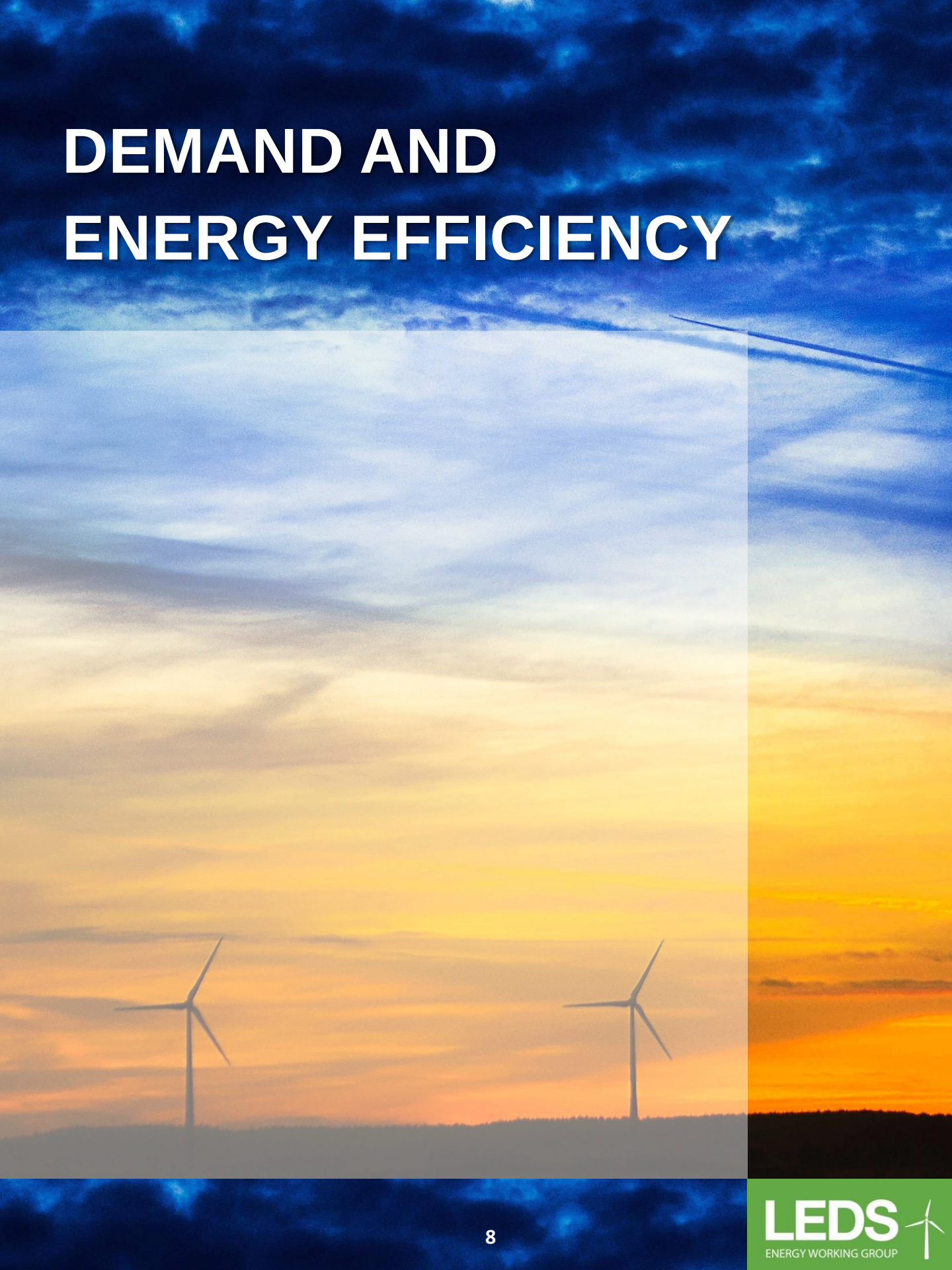
The model accepts regional multipliers and project data from any region to enable economic impact analysis in other countries or subnational regions.

Outcomes

Estimated jobs, earnings, value added and economic output from new renewable energy projects in three categories:

- Project development and onsite labor impacts
- Local revenue and supply chain impacts
- Induced impacts

DEMAND AND ENERGY EFFICIENCY



LEDS
ENERGY WORKING GROUP

EnergyPlus

Building Energy Simulation Program

State-of-the-art open-source whole-building energy modeling engine

Typical Clients

- Energy consultants, mechanical engineers, and architects
- Energy-efficiency program administrators and code officials
- Policy analysts, researchers, educators, and students

Associated Costs

Free and open-source

Current and Past Users

- 35,000 registered users world-wide
- Basis for ASHRAE 90.1 and IECC energy efficiency standards
- Over a dozen commercial products

More Information

http://energyplus.net/

Contact Information

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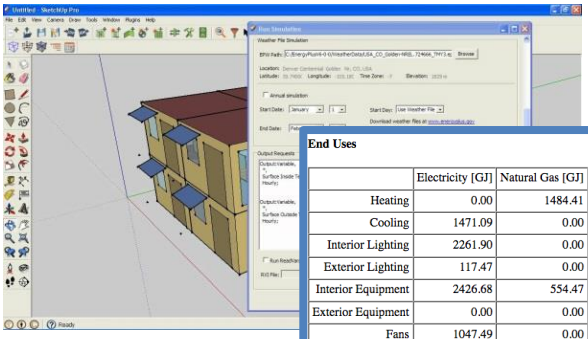

End Uses

	Electricity [GJ]	Natural Gas [GJ]
Heating	0.00	1484.41
Cooling	1471.09	0.00
Interior Lighting	2261.90	0.00
Exterior Lighting	117.47	0.00
Interior Equipment	2426.68	554.47
Exterior Equipment	0.00	0.00
Fans	1047.49	0.00
Pumps	59.77	0.00
Heat Rejection	0.00	0.00
Humidification	0.00	0.00
Heat Recovery	317.85	0.00
Water Systems	1.51	544.55
Refrigeration	91.63	0.00
Generators	0.00	0.00
Total End Uses	7795.39	2583.43

EnergyPlus Building Energy Simulation Program

What is it?

EnergyPlus is an open-source, state-of-the-art whole-building energy modeling engine, calculating peak and annual energy and water use of different building designs and operational regimes.

Key Goals

EnergyPlus is designed to support a wide range of building energy-efficiency analyses and applications:

- Design of new buildings and retrofits
- HVAC system selection and sizing
- Development of and compliance with energy efficiency codes
- Green certification and beyond code performance documentation
- Design of building control systems
- Commissioning of HVAC systems
- Dynamic building control
- Energy-efficiency scenario analysis of building stocks

Data Inputs

EnergyPlus takes a detailed description of a building's assets and operations:

- **Assets**: geometry, construction materials, lighting, HVAC systems, hot water systems, refrigeration systems
- **Operations**: occupancy and activity schedules, lighting, plug-load and process schedules, thermostat schedules, operational sequences, weather

EnergyPlus is a console program with text-based input/output. It is intended to be used in conjunction with a graphical user interface.

Outcomes

Detailed summary and time series data that can be used to analyze all aspects of building performance:

- Energy consumption by end-use and fuel type
- Envelope heat gains
- HVAC component and system activity and effective efficiencies
- Zone temperature, humidity, and thermal comfort profiles
- Lighting and visual comfort profiles

MAED

Model for Analysis of Energy Demand

Estimating the job and economic potential of renewable energy projects

Typical Clients

- Energy ministries
- Environment ministries
- Utilities and energy planning agencies
- Universities and research institutions

Associated Costs

Free to government and public sector organizations, research and non-profit institutions, and international and regional organizations

Current and Past Users

- Planners and researchers in over 107 countries
- 12 international and regional organizations

More Information

https://www.iaea.org/OurWork/ST/NE/Pess/capacitybuilding.html

Contact Information

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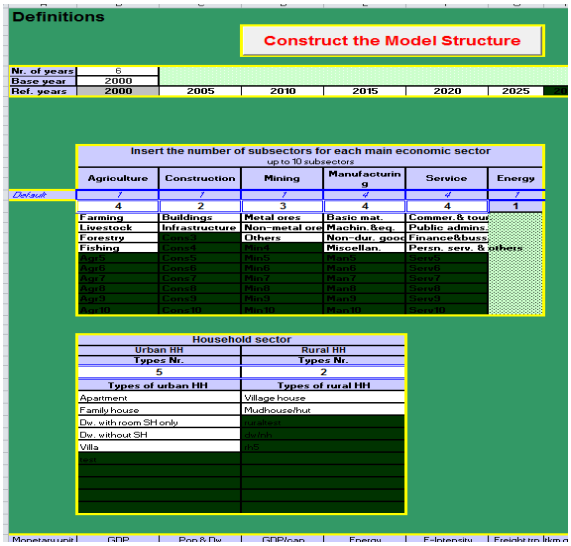


IAEA
International Atomic Energy Agency

MAED | Model for Analysis of Energy Demand

What is it?

MAED is a model that provides a systematic framework for mapping trends and anticipating change in energy needs, particularly as they correspond to alternative scenarios for socioeconomic and technological development. It takes into account different types of energy forms (including traditional fuels) in all economic and consuming sectors and subsectors at end-use level.

Key Goals

MAED is designed to help energy analysts and decision makers to analyze future energy demand for building sustainable energy systems. It is a simulation model, best applicable for the medium- and long-term analysis at country or regional levels, based on the bottom-up scenario approach. It reflects the structural changes in energy demand, by means of detailed analysis of social, economic, and technological factors.

Data Inputs

- Demographic data for rural and urban areas
- Economic data disaggregated by sectors/subsectors
- Energy data disaggregated by:
  - Household (rural and urban)
  - Economic sectors and subsectors
  - End-uses activities
  - Penetrations of different energy forms (modern and traditional fuels)
  - Scenario assumptions:
    - Socio-economic
    - Technological
- Substitutable energy uses
- Efficiencies of end-use technologies and processes
- Electricity consumption patterns and load characteristics for different types of consumers or subnational regions

Outcomes

- Useful and final energy demand by sectors/subsectors and fuels
- Electricity demand
- Hourly electric load
- Load duration curves

OpenStudio

Module for Whole Building Energy Modeling Application Development

Suite of open-source modules for whole-building energy modeling application development

Typical Clients

- Energy consultants, mechanical engineers, and architects
- Energy-efficiency program administrators, policy analysts, researchers, educators, and students
- Energy modeling application developers

Associated Costs

Free and open source

Current and Past Users

- 35,000 registered users worldwide
- Commercial products
- Utility energy efficiency programs

More Information

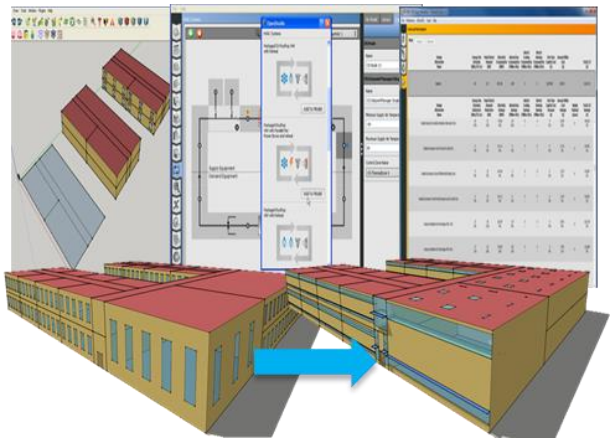
http://energy.gov/eere/buildings/downloads/openstudio-0

http://openstudio.net/

Contact Information

Amir Roth, DOE, Technology Manager – amir.roth@ee.doe.gov

Larry Brackney, NREL, Project Manager – larry.brackney@nrel.gov



U.S. DEPARTMENT OF ENERGY

OpenStudio Module for Whole Building Energy Modeling Application Development

What is it?

OpenStudio is an open-source collection of software modules that support application development. The Software Development Kit (SDK) provides programmatic access to EnergyPlus inputs and outputs. OpenStudio uses the SDK to allow users to edit, run, and navigate individual models. Server uses Measures (scripts that automate model transformations and workflows) to define a collection of models and simulate them on the cloud.

Key Goals

OpenStudio is designed to reduce the effort of developing energy modeling applications and services that use EnergyPlus. The OpenStudio Application demonstrates this process and is usable in its own right.

OpenStudio has been used to develop applications for building auditing, asset rating, code compliance, deep retrofit analysis, large scale building-portfolio analysis, and energy-efficiency program administration.

Data Inputs

OpenStudio provides programmatic (SDK) and graphical (Application) access to EnergyPlus inputs and outputs.

OpenStudio Application takes a detailed description of a building's assets and operations:

- **Assets**: geometry, construction materials, lighting, HVAC systems, hot water systems, refrigeration systems
- **Operations**: occupancy and activity schedules, lighting, plug-load and process schedules, thermostat schedules, operational sequences, weather

Outcomes

Detailed summary and time series data that can be used to analyze all aspects of building performance:

- Energy consumption by end-use and fuel type
- Envelope heat gains
- HVAC component and system activity and effective efficiencies
- Zone temperature, humidity, and thermal comfort profiles
- Lighting and visual comfort profiles

TRACE

Tool for Rapid Assessment of City Energy

A decision support tool for evaluating energy efficiency opportunities in cities

Typical Clients

- City municipalities
- City officials
- City authorities

Associated Costs

Free

Current and Past Users

City municipalities in Turkey, Brazil, Vietnam, Romania, Kenya, and others (view full list)

More Information

http://esmap.org/TRACE

Contact Information

Pedzi Makumbe –
esmap@worldbank.org

TRACE | Tool for Rapid Assessment of City Energy

What is it?

TRACE is a decision-support tool designed to help cities quickly identify under-performing sectors, evaluate improvement and cost-saving potential, and prioritize sectors and actions for energy efficiency intervention. It covers six municipal sectors: passenger transport, municipal buildings, water and waste water, public lighting, solid waste, and power and heat.

Key Goals

TRACE is designed to involve city decision makers in the deployment process. It starts with benchmark data collection, goes through an on-location assessment involving experts and decision makers, and ends with a final report to city authorities with recommendations of energy efficiency interventions tailored to the city's individual context.

Data Inputs

Data For TRACE's energy benchmarking and intervention functions is provided through a database of 28 key performance indicators from 64 cities. Peer cities may be selected based on city population, climate, and human development index.

For the sector prioritization function, users provide input data on relative energy intensity, energy sector spending, and city authority control.

Outcomes

- **Benchmarking**: Visual depiction of how a city compares with peer cities
- **Sector prioritization**: Comprehensive sector prioritization with quantified potential benefits
- **Recommendations**: A matrix of recommendations based on savings potential, first cost, and speed of implementation

ENVIRONMENTAL IMPACT ASSESSMENT

LEDS
ENERGY WORKING GROUP

EFFECT

Energy Forecasting Framework and Emissions Consensus Tool

An open tool for forecasting greenhouse gas emissions in low carbon development

Typical Clients
Governments

Associated Costs
Free

Current and Past Users
Governments of Brazil, Georgia, India, Macedonia, Nigeria, Poland, Vietnam, China, Indonesia, Philippines, Thailand

More Information
http://esmap.org/EFFECT

Contact Information
Pedzi Makumbe –
esmap@worldbank.org

EFFECT
Energy Forecasting Framework and Emissions Consensus Tool

EFFECT | Energy Forecasting Framework and Emissions Consensus Tool

What is it?

EFFECT is an open and transparent modeling tool used to forecast greenhouse gas emissions from a range of development scenarios. It focuses on sectors that contribute to and are expected to experience a rapid growth in emissions. The model was initially developed by the World Bank while working with the Government of India on an analysis of their national energy plan.

Key Goals

EFFECT forecasts greenhouse gas emissions for given development scenarios or policy choices. In addition, EFFECT enables consensus building among disparate government departments and forecasts energy balances and amounts of energy generating/consuming assets in a country or sector. The tool also produces results for individual sectors such as road transport, agriculture, power, industry, household, and non-residential sectors.

Data Inputs

- National data on economic indicators (total GDP, GDP contribution by sector)
- Expected demand growth of the power sector
- General demographics (rural and urban population, electrification rates, etc.), and more

Outcomes

- Greenhouse gas emissions for given development scenarios or policy choices
- Forecasts of energy balances and amounts of energy-generating/ consuming assets in a country or sector
- Results for individual sectors, such as road transport, agriculture, power, industry, household, and non-residential

HEAT+

Harmonized Emissions Analysis Tool Plus

Typical Clients

- City governments
- Sub-national governments

Associated Costs

Free toolkit. Additional support may be required to use the tool (technical advisory costs apply).

Current and Past Users

Numerous local government users in 11 countries and regions – India, Philippines, Indonesia, Korea, United States of America, European Union, China, Malaysia, Brazil, South Africa, and Italy

More Information

http://heat.iclei.org

Contact Information

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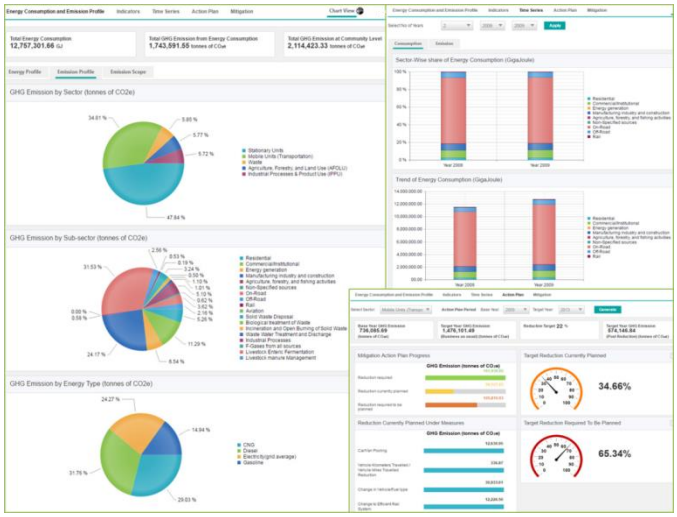
Soumya Chaturvedula, Program Coordinator, Energy and Climate – soumya.chaturvedula@iclei.org



HEATplus
HARMONIZED EMISSIONS ANALYSIS TOOL

ICLEI
Local Governments for Sustainability

HEAT+ | Harmonized Emissions Analysis Tool Plus

What is it?

Heat+ helps local governments account for greenhouse gas emissions, common air pollutants (CAP) and other volatile organic compounds (VOC).

It helps in formulating targeted action plans by leveraging measures that offer the highest impact in emissions and pollutant abatement.

Key Goals

- Improve air quality
- Mitigate global warming
- Protect public health
- Save money
- Monitor progress on renewable energy and energy efficiency actions

Data Inputs

- Sector-wise consumption of fuel by type and electricity in community or government modules
- Fuel consumption or vehicle kilometers travelled by private or government vehicles specific to vehicle type
- Quantity of waste generated and treatment technology, waste composition and methane recovery to estimate emissions from waste treatment or disposal
- Sector growth rates or target percentage to estimate forecast and target emissions

Outcomes

- Inventory and forecast emission profiles
- Energy consumption and emission performance Indicators
- Time-series consumption and emission profiles
- Mitigation profile (reduction in consumption or greenhouse gas emission based on measures determined)
- Low carbon action plans
- Track commitments
- Measure progress against targets
- Determine priorities based on scenario reports
- Report “scope" differentiated results

MESSAGE

Model for Energy Supply Strategy Alternatives and their General Environmental Impacts

Typical Clients

- Energy ministries
- Environment ministries
- Utilities and energy planning agencies
- Universities and research institutions

Associated Costs

Free to government and public sector organizations, research and non-profit institutions, and international and regional organizations

Current and Past Users

- Planners and researchers in over 88 countries
- 11 international and regional organizations

More Information

https://www.iaea.org/OurWork/ST/NE/Pess/capacitybuilding.html

Contact Information

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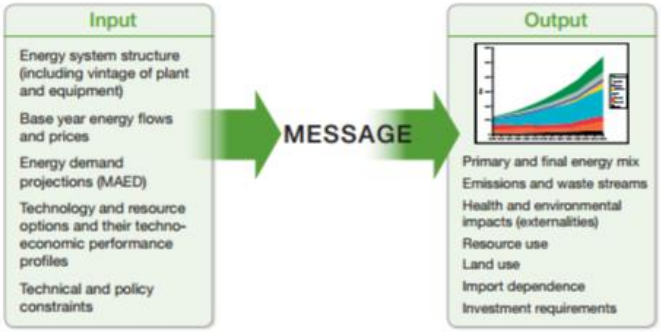


IAEA International Atomic Energy Agency

MESSAGE | Model for Energy Supply Strategy Alternatives and their General Environmental Impacts

What is it?

MESSAGE is a model designed to formulate and evaluate long term strategies by analysing cost optimal energy mixes consonant with user defined constraints on new investment, market penetration rates for new technologies, fuel availability and trade, environmental emissions, and energy supply security.

Originally MESSAGE was developped by IIASA. In 2001, it was acquired by the IAEA and enhanced by with new features and user interface.

Key Goals

MESSAGE was designed to help energy analysts and decisionmakers in analysing different supply strategies for building sustainable energy systems. It is an optimization model, applicable for medium- and long-term analysis at country or regional levels. It can help design long-term strategies by analysing cost optimal energy mixes, investment needs, and other costs, energy supply security, energy resource utilization, introduction of new technologies, environmental policies, and other parameters.

Data Inputs

- Energy system structure (including vintage of plant and equipment)
- Base year energy flows and prices
- Energy demand projections
- Technology and resource options and their techno-economic performance profiles
- Technical and policy constraints

Outcomes

- Primary and final energy mix
- Emissions and waste streams
- Health and environmental impacts (externalities)
- Resource use
- Land use
- Import dependence
- Investment requirements, O&M costs, fuel costs

SIMPACTS

Simplified Approach for Estimating Environmental Impacts of Electricity Generation

Typical Clients

- Energy ministries
- Environment ministries
- Utilities and energy planning agencies
- Universities and research institutions

Associated Costs

Free to government and public sector organizations, research and non-profit institutions, and international and regional organizations

Current and Past Users

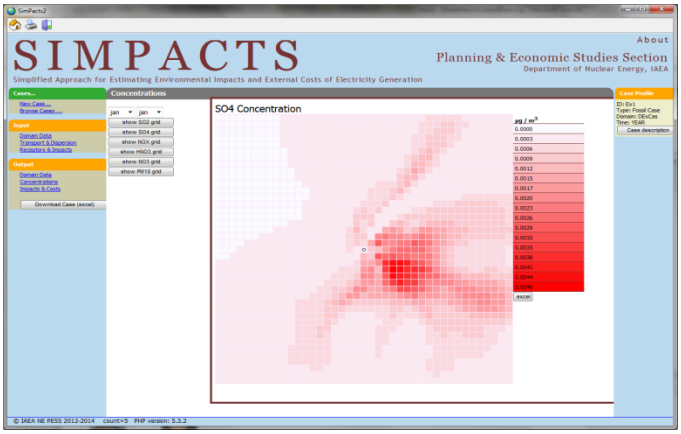
- Planners and researchers in over 53 countries
- 5 international and regional organizations

More Information

https://www.iaea.org/OurWork/ST/NE/Pess/capacitybuilding.html

Contact Information

Ahmed Irej Jalal, Unit Head, Planning and Capacity Building Unit – PESS.Contact-Point@iaea.org



IAEA
International Atomic Energy Agency

SIMPACTS | Simplified Approach for Estimating Environmental Impacts of Electricity Generation

What is it?

SIMPACTS estimates and quantifies the health and environmental damage costs of different electricity generation technologies.

Key Goals

SIMPACTS can be used by energy analysts and decisionmakers to compare and rank various electricity generation options in terms of external costs. SIMPACTS covers the major electricity generation sources and most of the associated impacts on human health and the environment. Most importantly, it provides a simple but accurate tool for estimating external costs associated with electricity generation.

Data Inputs

- Source location (power plant location)
- Technical parameter of the source
- Pollutants emission rates
- Population density within the domain
- Dose response-functions
- Receptors data

Outcomes

- Domain and meteorological data
- Incremental pollutants concentrations
- Impacts to human health and agricultural products
- External costs

FINANCIAL INVESTMENT

LEDS ENERGY WORKING GROUP

DREI

Derisking Renewable Energy Investment Framework

An innovative framework to assist policymakers in developing countries to cost-effectively promote investment in renewable energy

Typical Clients

- Policymakers
- Development practitioners
- Renewable energy sector participants

Associated Costs

Free

Current and Past Users

Tunisia, Nigeria, Belarus, Kazakhstan, Lebanon

More Information

http://www.undp.org/drei

Contact Information

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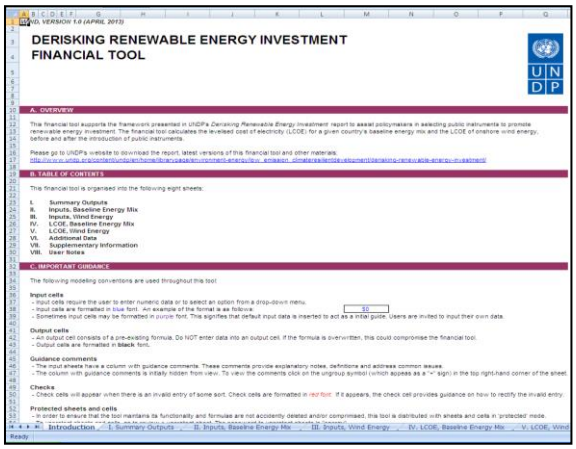

DREI | Derisking Renewable Energy Investment Framework

What is it?

The DREI framework, accompanied by a financial tool, assists UNDP's country partners to select and quantitatively assess the cost-effectiveness and impact of different public policy and financial derisking instruments in promoting renewable energy investments.

Key Goals

- Systematically identify barriers and associated risks holding back private sector investment in renewable energy
- Support policy decision-making in the selection of public instruments
- Facilitate a structured and transparent evaluation of policy and financial derisking instruments

Data Inputs

The framework consists of 4 stages, requiring various inputs, including risk data obtained through interviews with private sector developers and investors, cost of financing inputs from equity and debt investors, operational and investment cost data for the baseline and renewable energy investment, cost assumptions for proposed policy, and financial derisking instruments.

Outcomes

- Financing cost waterfalls, quantifying the impact of risk categories on financing costs
- Levelized cost of electricity (LCOE) for the baseline and renewable energy investment in pre- and post-derisking scenarios
- Performance metrics, including investment leverage ratio, savings leverage ratio, end-user affordability, and carbon abatement

FINPLAN

Model for Financial Analysis of Electric Sector Expansion Plans

Typical Clients

- Energy ministries
- Environment ministries
- Utilities and energy planning agencies
- Universities and research institutions

Associated Costs

Free to government and public sector organizations, research and non-profit institutions, and international and regional organizations

Current and Past Users

- Planners and researchers in over 40 countries
- 4 international and regional organizations

More Information

https://www.iaea.org/OurWork/ST/NE/Pess/capacitybuilding.html

Contact Information

Ahmed Irej Jalal, Unit Head, Planning and Capacity Building Unit – PESS.Contact-Point@iaea.org

IAEA
International Atomic Energy Agency

FINPLAN | Model for Financial Analysis of Electric Sector Expansion Plans

What is it?

FINPLAN evaluates the financial implications of an expansion plan for a power generating system. The model helps establish financial feasibility of electricity generation projects by computing important financial indicators while taking into account all costs, including financing options, revenues, and taxes.

Key Goals

FINPLAN was designed to help energy analysts and decisionmakers in analysing the financial implications of a power project. The model treats all expenditures in a foreign and the local currency. The cash flows for all expenditures in the respective currencies are maintained and the impact of future exchange rate changes is analysed. The model helps to analyse the impact of assumed future conditions that affect the financial health of a company.

Data Inputs

- Investment program for capacity additions and operating expenses
- Economic and fiscal parameters (inflation, escalation, exchange rates, taxes)
- Financial data (export credits, loans, bonds)

Outcomes

For each year:

- Cash flows
- Balance sheet
- Statement of sources
- Applications of funds
- Financial ratios:
  - Working capital ratio
  - Leverage ratio
  - Debt repayment ratio
  - Global ratio

GENDER INCLUSION

LEDS
ENERGY WORKING GROUP

Mainstreaming Gender in Energy Projects: A Practical Handbook

Integrating gender considerations in energy projects and programs

Typical Clients

- Energy project designers and planners, including donors and national governments
- Utilities
- Non-governmental organizations

Associated Costs

Free handbook download. Budget and resources may be required to hire gender expert and conduct fieldwork, workshops, gender training for staff, and possible new activities identified through gender mainstreaming.

Current and Past Users

Program planners in more than 30 energy projects including:

- Botswana Power Corporation (rural electrification on and off grid)
- Rural Support Program Network - Pakistan (national domestic biogas program)
- GIZ PERACOD-Senegal (off grid rural electrification, domestic energy supply)
- Africa Biogas Partnership Program
- UNDP Cambodia

More Information

http://www.energia.org/cms/wp-content/uploads/2016/02/01.-Mainstreaming_gender_in_energy_projects_A_practical_Hand_book1.pdf

Contact Information

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ENERGIA
INTERNATIONAL NETWORK ON GENDER AND SUSTAINABLE ENERGY

Mainstreaming Gender in Energy Projects: A Practical Handbook

What is it?

The Handbook provides step-by-step guidance on how to integrate gender concerns in energy projects with practical tools and examples.

Key Goals

The tool assists energy projects to develop a concrete gender strategy, or a Gender Action Plan (GAP) for energy projects, including:

- Assessing the gender situation in the project
- Agreeing on a gender goal or objective for the project
- Planning strategies and specific activities to meet these gender goals
- Designing an monitoring and evaluation framework to track the performance of gender activities
- Building institutional capacity for gender mainstreaming in the organization

Data Inputs

- National gender and energy assessments
- Gender review of project documents
- Organizational assessment
- Stakeholder consultations
- Gender disaggregated baseline surveys

Outcomes

- Development and endorsement of Gender Action Plans with clear gender goals, indicators and monitoring and evaluation frameworks
- Improved capacity of implementing organizations to design and implement gender-responsive energy access projects
- Increased energy access contributing towards women's welfare, income generation and empowerment

Guidelines on Renewable Energy Technologies for Women in Rural and Informal Urban Areas

Typical Clients
- Women's groups
- Governments
- Energy planners

Associated Costs
Free from the IUCN Global Gender Office website

Current and Past Users
Latin American-based non-governmental organizations, including SNV Nicaragua and La Cuculmeca

More Information
https://portals.iucn.org/union/sites/union/files/doc/guidelines_on_renewable_energy_technologies_for_women_in_rural_and_informal_urban_areas.pdf

http://genderandenvironment.org/energy/

Contact Information
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Jackie Siles – jackie.siles@iucn.org

IUCN

Guidelines on Renewable Energy Technologies for Women in Rural and Informal Urban Areas

What is it?

The guidelines represent a collaborative effort to support women's understanding of the different technologies available to them and provide hands-on guidance for assessing available renewable energy technologies to help them make informed decisions when choosing the most appropriate technologies for their own situations.

Key Goals

The guidelines aim to implement gender-responsive renewable energy initiatives that are appropriate to local contexts and address the energy needs of women and men in rural and informal urban areas.

Data Inputs

Sex-disaggregated mapping of energy needs of women and men in rural and informal urban areas undertaken in a participatory manner.

Preferences and aspirations with regards to renewable energy technologies and services collected in a sex-disaggregated manner.

Outcomes

List of renewable energy technologies most appropriate to the socio-economic and geographical context of women and men in a particular rural or informal urban area

GEOSPATIAL RESOURCE ASSESSMENT

LEDS
ENERGY WORKING GROUP

RED-E

Renewable Energy Data Explorer

Enabling the exploration of renewable energy potential for investment and policymaking

Typical Clients

- National and local governments
- Renewable energy developers
- Renewable energy investors
- Academia and experts
- International organizations

Associated Costs

Free and open source

Current and Past Users

Numerous users in the 20+ countries or regions supported by the tool, including the Governments of India, Vietnam, and the Philippines and the provincial government of Thanh Hoa

More Information

re-explorer.org

Contact Information

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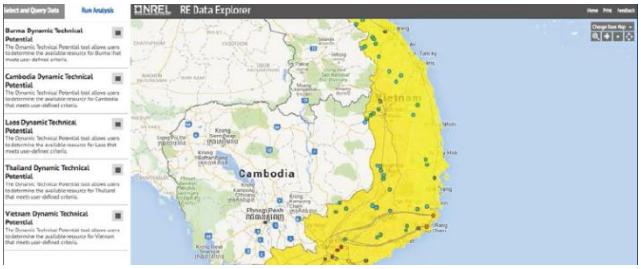
Sadie Cox, Senior Analyst – sadie.cox@nrel.gov



NREL
NATIONAL RENEWABLE ENERGY LABORATORY

RED-E | Renewable Energy Data Explorer

What is it?

RED-E is a map-based software application that provides an intuitive, user-friendly interface for visualizing and quantifying a country or region's renewable energy potential.

Key Goals

RED-E is intended to enable users without expertise in geographic information systems (GIS) to explore renewable energy resource potential in their country or region. The tool:

- Provides a platform for integrating data on renewable energy resources and the physical or geographic factors that influence their development
- Visualizes this data in map-based form
- Enables targeted quantitative analysis of solar, wind, and biomass potential under a variety of user-defined scenarios

Data Inputs

RED-E is an out-of-the-box tool prepackaged with a combination of global and local datasets for each of the 20+ countries or regions for which a tool exists. Users do not need to input additional data, but may add their own custom GIS data to the RED-E if desired.

Typical data in a RED-E include spatial distribution of renewable energy resources (e.g., solar and wind), infrastructure (transmission lines and roads), land use, protected areas, elevation, administrative boundaries, and other factors that influence renewable energy development.

Outcomes

- Estimate wind, solar, and biomass potential under different constraints to inform targets
- Identify tradeoffs and synergies between sustainable land use and clean energy
- Identify areas where clean energy supports development priorities
- Screen for potential renewable energy development zones
- Screen for potential project sites
- Identify sites for long-term solar or wind measurement stations

INTEGRATED TOOLS

LEDS
ENERGY WORKING GROUP

Balmorel

Energy System Model

Supporting modelling and analyses of the energy sector

Typical Clients

- Energy ministries and agencies
- Universities and research institutions
- Consulting companies
- System operators

Associated Costs

Free and open source

Current and Past Users

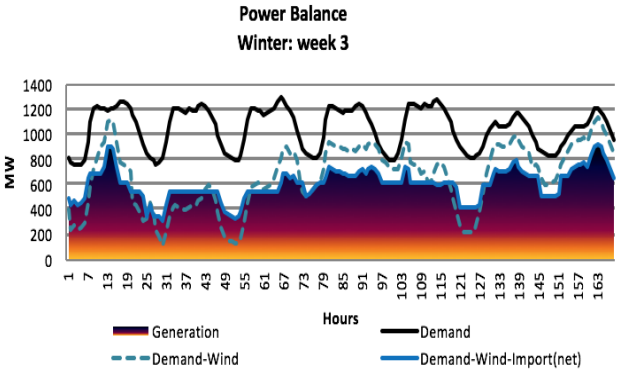
- Ea Energy Analyses
- Technical University of Denmark
- Elering TSO
- China Electric Power Research Institute
- More around the world

More Information

http://www.balmorel.com

Contact Information

Don Hans Ravn –
hans.ravn@aeblevangen.dk



Balmorel

Balmorel | Energy System Model

What is it?

Balmorel is a model for analyzing the electricity and combined heat and power sectors in an international perspective. It is highly versatile and may be applied for long range planning as well as shorter time operational analysis. The user may modify the source code and model according to specific requirements, making the model suited for a broad range of projects within the focus parts of the energy system.

Key Goals

The Balmorel project supports modelling and analyses of the energy sector with emphasis on the electricity and combined heat and power sectors.

Underlying the Balmorel project is the idea that data and modelling should be common to all parties dealing with common problems. The process is best supported if the model is fully transparent; this is provided by the available source code.

Data Inputs

- Electricity and heat demand (price responsive)
- A number of energy technology types
- Electricity transmission with capacities, losses and costs
- Capacity expansion in energy technology and transmission
- Electricity and heat distribution costs and losses
- Fuels types and prices
- Taxes, subsidies
- Environmental restrictions, penalties, incentives, and mechanisms

Outcomes

- Energy technology and transmission expansion
- Electricity and heat generation
- Fuel consumption
- Electricity transmission
- Greenhouse gas emissions
- Electricity and heat prices
- Amount of taxes and subsidies

GCAM

Global Change Assessment Model

A community, regional-to-global integrated assessment model

Typical Clients

- Energy ministries
- Environmental ministries
- Research organizations
- Universities
- Non-governmental organizations
- International agencies

Associated Costs

Free and open source

Current and Past Users

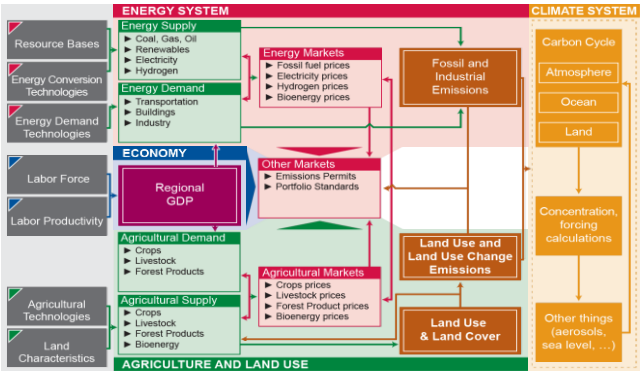
- Integrated research at PNNL and partner institutions
- Community users in over 50 countries and 250 institutions

More Information

www.globalchange.umd.edu/models/gcam/

Contact Information

Leon Clarke, Manager, Integrated Modeling and Energy, JGCRI, PNNL – Leon.Clarke@pnnl.gov



Pacific Northwest NATIONAL LABORATORY

Proudly Operated by Battelle Since 1965

UNIVERSITY OF MARYLAND

GCAM | Global Change Assessment Model

What is it?

GCAM is a simulation model that combines representations of the economy, energy supply, transformation and demand; agriculture and land use; and climate to examine the scenarios of the coming decades and beyond. The model has been used to inform technology and policy strategy decisions and to create scenarios used in every major IPCC assessment since 1990. GCAM is global, but several regional versions have been constructed.

Key Goals

GCAM is designed to explore a wide range of interactions including the energy, emission, land-use, and water consequences of policy options for climate mitigation and to investigate emerging energy supply and demand technologies. The model is increasingly being used to explore the implications of climate change on energy, water, and land-use systems.

Data Inputs

GCAM is released with a comprehensive input dataset that includes socio-economic drivers, base-year energy and agricultural technology characteristics, greenhouse gas and pollutant emissions, and a reference scenario for future developments in all these areas.

The data input requirements depend on user needs. Adding climate policy scenarios requires few input assumptions, while more complex changes would require lager efforts.

Outcomes

GCAM produces a wide range of variables contingent on input assumptions for future population, economy, technology, and environmental policies. These include:

- Energy supply and demand by sector, technology, and fuel for 32 geo-political regions
- Land-use and crop production for 283 land regions
- Endogenous price paths for energy and agricultural goods
- Greenhouse gas and pollutant emissions
- Climate policy costs

HOMER

Hybrid Optimization of Multiple Energy Resources

A software model providing rapid assessment of least-cost solutions for clean power

Typical Clients

- Government agencies and non-governmental organizations
- EPC's and integrators
- Component manufacturers
- Project owners, financiers, and utilities
- Universities and research organizations

Associated Costs

HOMER Quickstart: Free
HOMER Pro: $500 – $1,000 per seat (discounts for academic users)

Current and Past Users

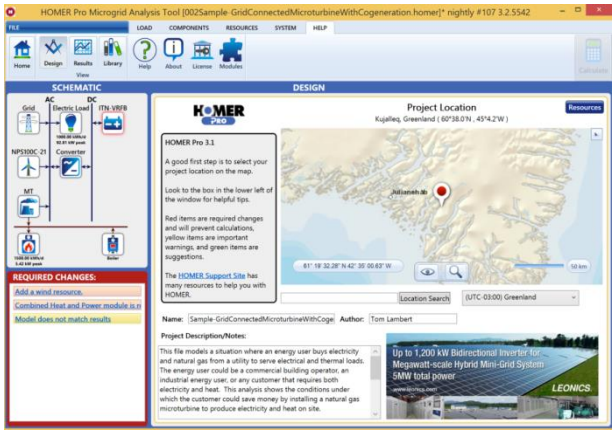
- ABB, Schneider Electric, Northern Power Systems, Energy Authority, Office of Naval Research, US AID, World Bank, Carbon War Room
- 120,000 users worldwide

More Information

http://www.homerenergy.com

Contact Information

info@homerenergy.com
+1-720-565-4046



HOMER ENERGY

HOMER | Hybrid Optimization of Multiple Energy Resources

What is it?

HOMER is a software program originally developed by the National Renewable Energy Laboratory for modeling and optimizing least cost microgrid design in all sectors, from village power and island utilities to grid-connected campuses and military bases. HOMER allows the user to sort the feasible systems by dozens of variables. HOMER's optimization can consider interest rates, tariffs or sell-back rates, emissions goals, renewable resources, fuel prices, renewable goals, equipment prices and performance, and much more.

Key Goals

HOMER helps decision makers determine the best multiple resource energy system designs which can meet their estimated or actual annual energy loads along with economic and environmental objectives.

Data Inputs

System design data utilizing the many built in resources and technologies listed below:

- Hourly or minute-by-minute electric loads (AC and DC)
- Generators (diesel, natural gas, and more)
- Biomass generators
- Fuel cells
- Solar photovoltaic (PV)
- Wind turbines
- Hydrokinetic turbines
- Run-of-river hydro
- Connections to other grids (tariffs, capacities)
- Batteries (lead acid, lithium ion, flow batteries, and more)
- Flywheels
- Inverter/rectifiers
- Hydrogen systems
- Demand-side management
- Energy efficiency
- Thermal loads

Outcomes

Optimized system designs and reports based on multiple criteria:

- Best mix of resources and technologies
- Cost of energy
- Return on Investment
- Net present cost
- Initial capital
- Operating costs
- Emissions
- Fuel costs
- Generator run-time
- Storage cycling
- Chronological results
- And more

ISED

Framework of Indicators for Sustainable Energy Development

Typical Clients

- Energy ministries
- Environment ministries
- Utilities and energy planning agencies
- Universities and research institutions

Associated Costs

Free to government and public sector organizations, research and non-profit institutions, and international and regional organizations

Current and Past Users

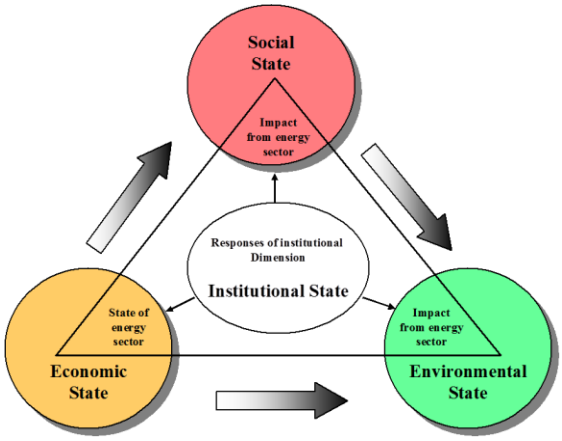
- Planners and researchers in over 30 countries
- 5 international and regional organizations

More Information

https://www.iaea.org/OurWork/ST/NE/Pess/capacitybuilding.html

Contact Information

Ahmed Irej Jalal, Unit Head, Planning and Capacity Building Unit – PESS.Contact-Point@iaea.org



IAEA International Atomic Energy Agency

ISED | Framework of Indicators for Sustainable Energy Development

What is it?

ISED is a series of 'snapshots' of ratios (indicators) reflecting the interaction of energy with the economic, environmental, and social pillars of sustainable development over time. The set consists of 30 indicators: 4 for the social dimension, 16 for the economic dimension and 10 for the environmental dimension.

Key Goals

ISED provides a flexible tool for analysts and decisionmakers at all levels to better understand their national situations and trends, the impacts of recent policies, and the potential impacts of policy changes.

The IAEA developed the framework for ISED in cooperation with the International Energy Agency (IEA), the European Environmental Agency (EEA), the European Commission's EUROSTAT and the United Nations Department of Economic and Social Affairs (UNDESA).

Data Inputs

- Demographic and social development data
- Economic data
- Energy data
- Environmental data

Outcomes

- Accessibility to energy services
- Energy affordability
- Energy disparities
- Energy security
- Overall use of energy and productivity
- Supply efficiency
- Energy end-use
- Diversification (fuel mix)
- Energy prices
- Import dependency
- Strategic fuel stocks
- Greenhouse gas emission intensities
- Air quality
- Water quality
- Soil quality
- Deforestation rate
- Solid waste generation and management
- And more

LEAP

Long-range Energy Alternatives Planning System

Typical Clients

- Energy ministries
- Environmental ministries
- Utilities and planning agencies
- Universities
- Non-governmental organizations
- Consulting companies
- International agencies

Associated Costs

Free to governments, non-governmental organizations, and academia in developing countries

Current and Past Users

Thousands of users in over 190 countries including The World Bank, UNDP, UNEP, IEEJ, APERC, Petrobras, Ramboll, GGGI, Bellona Foundation

More Information

www.energycommunity.org

Contact Information

Charles Heaps, LEAP Developer – leap@sei-international.org

LEAP | Long-range Energy Alternatives Planning System

What is it?

LEAP is a widely-used software tool for energy policy analysis and climate change mitigation assessment developed at the Stockholm Environment Institute.

Key Goals

LEAP is intended to bring the policy insights of sophisticated scenario-based energy and environmental planning to a wider audience than the previous generation of energy models by placing powerful data management, sophisticated calculations, and flexible and user-friendly reporting tools within a single accessible decision-support software tool that is made available for free to target users in developing countries.

Data Inputs

A key feature of LEAP is its low initial data requirements. LEAP provides a choice of methods that lets users start out with readily available energy and economic statistics and default IPCC emission factors and gradually progress to more sophisticated methods once better data becomes available and more expertise has been gained.

Outcomes

Create and evaluate long-range scenarios, notable for powerful and flexible reporting.

- Primary and final energy requirements by sector
- Greenhouse gas emissions and emissions of local air pollutants and short-lived climate pollutants
- Capital, operating, fuel, and externality costs presented in an easy-to interpret summary of the costs and benefits comparison of scenarios
- Indicators of energy security including import dependence and diversity of supply

RETScreen Clean Energy Management Software

Empowering cleaner energy decisions

Typical Clients

- Engineers, facility managers, architects, financial planners
- Post-secondary institutions
- Private companies and utilities
- All levels of government, including multilaterals

Associated Costs

- Viewer mode: Free
- Professional mode: available through annual subscription fee

Current and Past Users

- As of 2016, over 500,000 users in every country and territory of the world
- 50,000+ new users per year
- Used by over 800 universities for teaching and research

More Information

www.retscreen.net

Contact Information

Customer Support — NRCan.RETScreen.RNCan@Canada.ca

RETScreen® International
Empowering Cleaner Energy Decisions

Natural Resources Canada

RETScreen Clean Energy Management Software

What is it?

RETScreen Clean Energy Management Software helps decision-makers quickly and inexpensively determine the technical and financial viability of potential clean energy (renewable energy, energy efficiency, cogeneration) projects as well as engage in ongoing energy performance analysis.

The software was developed by the Government of Canada with the support of key partners such as REEEP, IESO, NASA, UNEP, and the World Bank.

Data inputs can be made in 36 languages.

Key Goals

RETScreen aims to significantly reduce the costs associated with identifying and assessing potential clean and cleaner energy projects in order to help decisionmakers understand whether or not such a project makes financial sense.

By helping to break down barriers that occur at the pre-feasibility, feasibility, development and engineering stages, RETScreen reduces the cost of getting projects on the ground and doing business in clean energy.

Data Inputs

User has a choice of inputs depending on type of project selected and level of detail required in analysis. Minimum inputs include basic project-specific details (site; energy model details; financial details).

The user does not need to know exactly what to input. Inputs are prompted/assisted by comprehensive integrated user manual, integrated databases (product, project, hydrology, climate, and benchmark), and built-in templates.

Outcomes

Simplified inputs give pre-feasibility analysis. More detailed inputs provide feasibility analysis. RETScreen provides simplified or detailed analyses on:

- Energy
- Cost
- Greenhouse gas emission
- Finance
- Risk
- Performance

SAM

System Advisor Model

A performance and financial model designed to facilitate decision making for people in the renewable energy industry

Typical Clients

- Project managers
- Design engineers
- Policy analysts
- Technology developers
- Researchers

Associated Costs

Free

Current and Past Users

- Power project developers
- Engineering consulting firms
- Universities and research labs
- Equipment manufacturers
- Small businesses

More Information

https://sam.nrel.gov/

Contact Information

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User support –
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NREL
NATIONAL RENEWABLE ENERGY LABORATORY

SAM | System Advisor Model

What is it?

SAM makes performance predictions and cost of energy estimates for grid-connected power projects based on installation and operating costs and system design parameters that you specify as inputs to the model.

Projects can be either on the customer side of the utility meter, buying and selling electricity at retail rates, or on the utility side of the meter, selling electricity at a price negotiated through a power purchase agreement (PPA).

Key Goals

SAM models different types of renewable energy systems:

- Photovoltaic (PV)
- Concentrating solar power (CSP)
- Wind
- Biomass power generation
- Geothermal power generation

SAM models different types of projects:

- Residential and commercial
- Utility-scale PPA for single owner and partnerships
- Third party ownership

Data Inputs

- Weather file (hourly or sub-hourly)
- System design parameters
- Installation and operating costs
- Financial parameters
- Building load and electricity rate data for residential or commercial projects
- Project ownership structure parameters for PPA projects
- Automatic access to online NREL databases for weather files and utility rate data
- Built-in libraries for system component data (PV modules, inverters, CSP collectors and receivers, etc.)

Outcomes

- Hourly or sub-hourly system performance data
- Monthly and annual energy output totals
- Financial metrics including NPV, IRR, PPA price, LCOE, payback period
- Project cash flow
- Graphs and tables of results
- Export results to documents and spreadsheets for reports and further analysis

SERIP

Sustainable Energy Roadmap and Implementation Plans

Integrated multi-component planning and implementation methodology guiding energy transitions at any level of government

Typical Clients

- Regional and international organizations
- National and local governments
- Investors and developers
- Civil society
- Academia and experts

Associated Costs

Depends on scope and available information

Current and Past Users

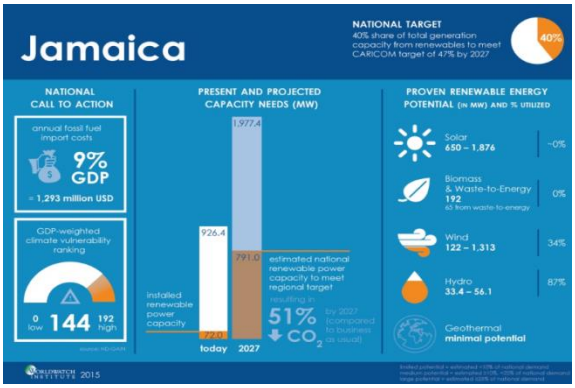
- Dominican Republic (2015)
- Chhattisgarh/India (proposed)
- CARICOM (2015 and 2013)
- Haiti (2014)
- Jamaica (2013)
- SICA countries (2013)

More Information

http://www.worldwatch.org/sustainable-energy-roadmaps

Contact Information

Alexander Ochs, Director, Climate and Energy Program – aochs@worldwatch.org



WORLDWATCH INSTITUTE

SERIP | Sustainable Energy Roadmap and Implementation Plans

What is it?

SERIP is a dynamic and comprehensive methodology with multiple tools that analyses the economic and social impacts of alternative technological pathways in the specific context of a municipality, country, or region. It explores existing clean energy business opportunities and recommends concrete policies and measures that improve the given investment environment.

Key Goals

Support governments, utilities, grid operators, IPPs, business leaders, academia, and civil society groups to create a financially, socially, and environmentally sustainable energy system as the basis for climate-compatible, low-emissions development, particularly by designing the right framework conditions for new domestic and international public and private investments.

Data Inputs

Existing energy data (including electricity end-use by sub-sector, efficiency rates, emissions levels, renewable resource potential, grid infrastructure, fuel source composition, import-export balance, tariffs) are examined for quality and timeliness.

Where necessary, new data are collected and/or calculated (e.g., through international comparison, new resource assessments through new GIS data mapping).

Existing sustainable energy finance environment is evaluated. Current policies and measures and administrative processes are analyzed.

Outcomes

- Energy sector situation and challenges
- Energy efficiency and renewable technologies potentials
- Levelized Cost of Electricity (LCOE) from alternative sources; analysis with and without externalities (pollution, health)
- Projection of costs of alternative energy pathways over certain time frame
- Pathways' impact on jobs and risks and opportunities across economic sectors
- Finance sector reform recommendations
- Suggestions for policy and administrative reform
- Set of concrete next steps for sustainable energy advancement

TIMES

The Integrated MARKAL/EFOM System

Typical Clients

- Energy ministries
- Environmental ministries
- Utilities and planning agencies
- Universities
- Non-governmental organizations
- Consulting companies
- International agencies

Associated Costs

Model generator source code: Free
GAMS/Solver: $640 academic; $12,800 commercial
Model management system (VEDA or ANSWER): $1,800 academic; $12,000 commercial

Current and Past Users

Several hundred users in over 70 countries including:

- Most European governments and the European Commission
- U.S. Department of Energy and Environmental Projection Agency
- Numerous government bodies and universities in developing and transition countries

More Information

www.iea-etsap.org

Contact Information

Gary Goldstein, ETSAP Liaison Officer – gary.a.goldstein@gmail.com

iea Energy Technology Network ETSAP

Energy Technology Systems Analysis Program

TIMES | The Integrated MARKAL/EFOM System

What is it?

TIMES is a comprehensive energy system optimization platform widely used to advise energy and climate change mitigation policy formulation. Developed under the auspices of the International Energy Agency's Energy Technology Systems Analysis Program (www.iea-etsap.org), TIMES excels in identifying least-cost pathways for the evolution of energy systems under alternate futures.

Key Goals

TIMES aims to provide a framework to evaluate the evolution of energy systems in response to technological progress and alternative policies from a least-cost perspective in order to identify optimal development pathways. It employs advanced model management tools that oversee all aspects of working with the model to facilitate stewardship and effective use by a range of experts for study areas ranging from local systems to states and countries, integrated into regional and global planning platforms where appropriate.

Data Inputs

- Depiction of the current energy balance along with power plants and demand device/vehicle stock
- Characterization of ongoing resource supply options (production cost and maximum annual output)
- Characterization of new technologies (investment and operating costs, efficiency, and availability factors)
- Projection of future demand for energy services (usually a function of expected GDP and population growth rates), and
- Scenario definitions (e.g., emissions target or price, renewable portfolio and energy reduction policies, energy security goals)

Outcomes

Detailed picture of the evolution of an energy system and a powerful reporting facility that allows for easy assembly of hierarchical tables managed as "smart" dynamic pivot tables to allow aggregating, dissecting, and reconfiguring of core results including:

- Primary and final energy requirements by fuel and sector
- Greenhouse gas emissions and emissions of local air pollutants and short-lived climate pollutants by fuel and sector
- Capital stock turnover and new power plant and device purchase timing
- Capital, operating, fuel and externality costs, as well as the marginal price of fuels, constrained emissions and imposed policies
- Indicators of energy security including import dependence and diversity of supply

WASP

Wien Automatic System Planning Package

Typical Clients

- Energy ministries
- Environment ministries
- Utilities and energy planning agencies
- Universities and research institutions

Associated Costs

Free to government and public sector organizations, research and non-profit institutions, and international and regional organizations

Current and Past Users

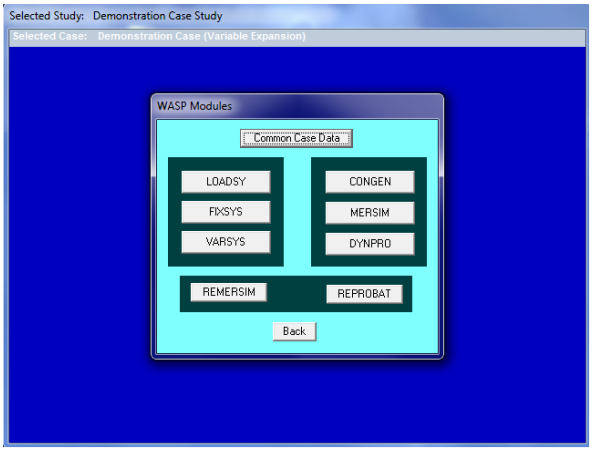
- Planners and researchers in over 107 countries
- 12 international and regional organizations

More Information

https://www.iaea.org/OurWork/ST/NE/Pess/capacitybuilding.html

Contact Information

Ahmed Irej Jalal, Unit Head, Planning and Capacity Building Unit – PESS.Contact-Point@iaea.org



IAEA
International Atomic Energy Agency

WASP | Wien Automatic System Planning Package

What is it?

WASP is the IAEA's long-standing model for analyzing expansion plans for electricity generation. Initially developed in the 1970s, it has been enhanced and upgraded over time to match emerging needs and allow analysis of contemporary issues. It is one of the most widely use model for developing least-cost expansion plan.

Key Goals

WASP is an exceptionally effective tool for power planning in developing countries. It permits the user to find an optimal expansion plan for power generation over a long period of time and within the constraints identified. This may include fuel availability, emission restrictions, and system reliability. Each sequence of power plants that could be added and which meets the constraints is evaluated by a cost function of capital, fuel, O&M, fuel inventory, salvage value of investments, and cost of energy demand not served.

Data Inputs

- Load forecast
- Existing generating infrastructure
- Candidates for new build
- Constraints:
  - Reliability
  - Implementation
  - Fuel
  - Generation
  - Emissions

Outcomes

- Build schedule of new generating capacity
- Generating mix
- Fuel mix
- Costs
- Emissions

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