International Atomic Energy Agency

One of five key areas to sustainable development where progress is possible with the resources and technologies at our disposal today.

Capacity Building for Sustainable Energy Development

Today, approximately one third of the world's population lack access to modern energy services. Poverty eradication and sustainable development will require not just access, but also clean and affordable energy services. Expanding access to such services requires careful planning. The International Atomic Energy Agency (IAEA) helps developing countries and economies in transition build their energy planning capabilities with respect to all three pillars of sustainable development — economic, environmental, and social. The Agency develops and transfers planning models tailored to their special circumstances. It transfers the latest data on technologies, resources, and economics. It trains local experts. It jointly analyzes national options and interprets results. And the IAEA helps establish the continuing local planning expertise needed to independently chart national paths to sustainable development.

As the sole UN agency building capacity in overall energy planning, the Agency's assistance treats all energy supply and demand options, including efficiency improvements, equally. Indeed, for most IAEA Member States, nuclear power is not the best near term option.

IAEA Planning Models

Area	*Tools**
Energy system analysis	ENPEP, MESSAGE
Power system analysis	WASP, ENPEP, MESSAGE
Energy/electricity demand projection	MAED, ENPEP
Financial analysis of energy systems	FINPLAN (WASP, ENPEP, MESSAGE)
Environmental impacts of energy facilities	SimPacts, WASP-IV, ENPEP

* For further explanation, please see page 3

Through the full set of IAEA energy planning models, the Agency can provide interested Member States with:

— up-to-date information and data on energy technologies along the full energy chain, i.e., from resource extraction to the supply of energy services at the level of households, industries, and businesses;

— operating models installed on Member State computers;

— training on the use of the models; and

— guidance on evaluating energy options and planning sustainable sustainable energy strategies.

Over the past three years, the IAEA has:

— transferred its energy models to more than 60 energy planning departments or institutions in both developed and developing countries;

— trained over 350 local experts in developing countries; and

— implemented 12 national projects and 4 regional projects (each involving 12–16 countries) analyzing specific energy policy issues and providing guidance in assessing options and evaluating overall energy strategies and policies.

A current example is the 2001 regional project "Sustainable Energy Development in Sub-Saharan African countries".

Through this project, the IAEA is providing technical assistance to strengthen institutional capabilities for assessing and projecting future energy needs in the 14 participating countries. The energy demand analysis model, MAED, has now been transferred and local experts are being trained to apply this model to their particular situation. To apply MAED, the model philosophy, structure, logic, and mathematical approach must first be examined. Next data requirements, how best to compile and reconcile data from diverse sources, and the construction of base year balances are determined. Together trainers and trainees apply these steps to the situation in the particular country receiving training.

Once base year balances are established, trainees will then develop future scenarios, specific to their countries' situations and objectives, which can be analyzed using other IAEA planning models. The keys to useful, enlightening scenarios are: systematic procedures to assure internally consistent input assumptions, especially for social, economic, and environmental factors, and a good understanding of the dynamic nature of modeling, i.e., the interplay between assumptions, output evaluation, plausibility tests and the modification of initial assumptions. Finally, the training addresses quality control and uncertainties, and provides assistance in translating results into guidance for policy formulation.

Figure 1. Model For Assessment of Energy Demand (MAED) Approach

Figure 1 illustrates a general structure of the essential input and output elements of the MAED energy demand model. The table below shows the different energy forms more specifically, and the different ways in which they are used in a typical household in the Sub-Saharan countries involved in the IAEA regional project. Finally, Figure 2 shows the process of combining the energy demand calculated by MAED with economic information about all energy supply options available in order to identify the most cost effective approach to balancing national energy supply and demand.

The different energy forms and the different ways in which they are used in a typical household in the Sub-Saharan countries involved in this project.

Energy Forms by End-User Category in Households

	Cooking	Lightning	Electric appliances	Water heating	Air conditioning	Space heating
Non-commercial fuels	•			•		•
Commercial combustible fuels (liquids, gaseous, solids)	•	•		•		•
Electricity	•	•	•	•	•	•
District heat				•		•
Local solar	•			•		•

The IAEA's energy planning services help Member States make informed policy decisions about their future energy development by:

— strengthening local expertise in developing countries for analyzing and evaluating national energy options, including all their technical, economic, environmental, and human health impacts;

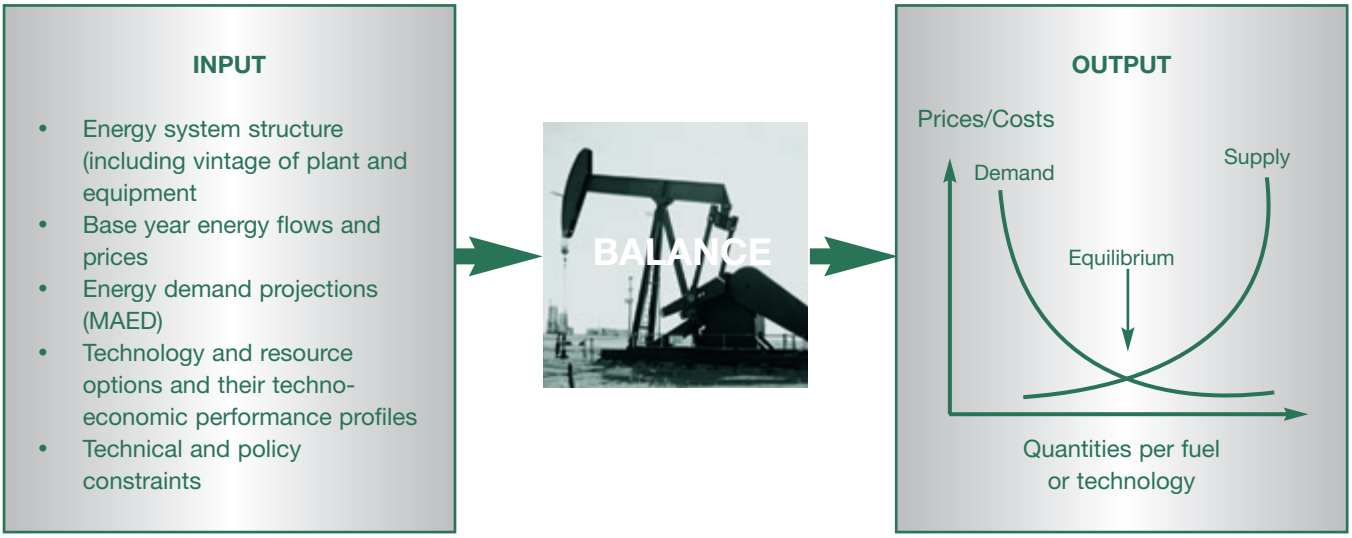
— introducing systematic analysis and planning procedures in national decision making on energy and environment policy;

— preparing better and more effective national communications to the UN Framework Convention on Climate Change on greenhouse gas inventories and sinks;

— helping senior policy makers in developing countries better appreciate the environmental costs and benefits of different energy options; and

— strengthening capabilities in developing countries for their participation in international debates on sustainable energy development and climate change issues.

Figure 2. Energy and Power Evaluation Program (ENPEP)



IAEA Planning Models

MAED, Model for Assessment of Energy Demand:

MAED evaluates future energy demands based on medium to long term scenarios of socioeconomic, technological, and demographic development. Energy demand is disaggregated into a large number of end-use categories corresponding to different goods and services. The influences of social, economic, and technological driving factors from a given scenario are estimated. These are combined for an overall picture of future energy demand growth.

WASP, Wien Automatic System Planning Package:

WASP is the most widely used model in developing countries for power system planning (over 100 countries). Within constraints defined by the user, WASP determines the optimal long term expansion plan for a power generating system. Constraints may include limited fuel availability, emission restrictions, system reliability requirements, and other factors. Optimal expansion is determined by minimizing discounted total costs.

ENPEP, Energy and Power Evaluation Program:

ENPEP, now used in approximately 60 developing countries, provides a comprehensive evaluation of energy system development strategies. It includes modules

— to assess energy demand (MAED),
— to compute market clearing prices and balance energy demand and supply under market conditions,
— to optimize expansion of the electric sector (WASP), and
— to estimate environmental burdens from the energy system.

FINPLAN, Model for Financial Analysis of Electric Sector Expansion Plans:

In developing countries, financial constraints are often the most important obstacle to implementing optimal electricity expansion plans. FINPLAN helps assess the financial viability of plans and projects. It takes into account different financing sources — including export credits, commercial loans, bonds, equity, and modern instruments like swaps — and calculates projected cash flows, balance sheet, financial ratios, and other financial indicators. It is currently used in more than 20 developing countries.

MESSAGE, Model of Energy Supply Systems and their General Environmental Impacts:

MESSAGE is used to formulate and evaluate alternative energy supply strategies for a country or region. The model finds the optimal energy supply strategy for user defined constraints on, for example, new investment limits, market penetration rates for new technologies, fuel availability and trade, environmental emissions, etc. MESSAGE is extremely flexible and can also be used to analyze energy/electricity markets and climate change issues.

SIMPACTS, Simplified Approach for Estimating Impacts of Electricity Generation:

SIMPACTS is a user-friendly, simplified approach for estimating the environmental impacts and external costs of different electricity generation chains. Designed for use in developing countries, it requires much less data, but produces comparable results, relative to more sophisticated data-hungry models. The SIMPACTS package covers

— health, agricultural, forest, and materials damage,

— airborne and water pollution as well as solid waste, and

— different generating technologies.

Information about activities in capacity building for sustainable development and energy planning is also available on the IAEA website:
http://www.iaea.org/worldatom/Programmes/Energy/pess/pessindex.shtml

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