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reCOMMEND

reCOMMEND IS A NEWSLETTER OF THE COMMUNITY FOR ENERGY, ENVIRONMENT AND DEVELOPMENT

EDITORIAL

Welcome to this third issue of reCOMMEND. Topics covered are: gender and energy project planning, analysis done in North Korea to see if regional resource sharing would contribute to enhanced energy security, the contribution renewable energy can make to regional energy systems, energy planning for Brazil's transport sector with a focus on ethanol and biodiesel, and an update on the latest LEAP version, released earlier this year.

We warmly welcome your feedback on this issue, as well as suggestions for articles for publication in future issues of the newsletter.

Happy reading,
reCOMMEND EDITORIAL TEAM

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COMMEND Community for Energy, Environment and Development

Photo:Saskia Everts-Tool

Integrating Gender into Energy Project Planning

Sheila Oparaocha
ENERGIA - The International Network on Gender and Sustainable Energy

This paper argues that one of the reasons why gender is not mainstreamed in energy project and programme planning is because there are no appropriate gender-sensitive analytic tools for the special case of energy. A critique of the existing tools leads to suggestions for an improved model. This model will be explained in more detail in a follow-up article in a future issue of reCOMMEND.*-1

Current approaches in the planning of energy projects in developing countries, such as the demand-driven and needs-based approaches, though achieving better results than the earlier technology-push and supply-driven approaches, very rarely mainstream gender. Households are often taken as homogeneous units, without any recognition that in most societies, men and women have very different roles and areas of decision-making within the household.

WHY ADOPT A GENDER APPROACH IN ENERGY PROJECTS AND PROGRAMMES?

The first and most obvious reason for taking a gender approach is that men and women have different energy needs, as a result of their roles in society and within the household. This is not just a question of cooking being the preserve of women. Energy for water pumping, for example, also has gender dimensions. Pumping water for

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To subscribe, contact Anja Panjwani at the ETC Foundation.

Editorial team
This issue has been compiled by: Charlie Heaps and Anja Panjwani

Contact reCOMMEND
Anja Panjwani
ETC Foundation
P.O. Box 64, 3830 AB, Leusden, the Netherlands;
Tel: +31.33.432 6000;
Fax: +31.33.494 0791;
Email: a.panjwani@etcnl.nl
COMMEND web site:
www.energycommunity.org

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irrigation is more often than not related to men's work in agriculture, whereas water pumping for domestic purposes is usually related to women's work.

Secondly, the provision of new forms or modalities of energy may have quite unintended differential effects on men and women. Consider the provision of powered agricultural equipment and the consequent cultivation of a much larger land area. The tractors are inevitably operated by men, and replace the hard task of hand or ox ploughing, typically men's work. Many of the other agricultural tasks (particularly weeding and harvesting) have to still be done by hand, and predominantly by women. Thus, although the tractor may improve the family's overall income, a new balance in the work has arisen in which the women carry a heavier burden. Attention to gender can help limit such unintended effects, or identify actions to combat them.

Thirdly, energy may be part of a deliberate strategy to help to raise the production and income of women. Women form a disproportionate proportion of the poor, and their opportunities for income generation are limited by lack of ownership of resources and heavy work burdens within the household. There is currently a strong push in most development efforts to help women develop income-generating skills and activities, often based in the home itself. Such activities may need particular forms of energy, and clearly women's requirements in this regard, both to enable the activities and to save time in other household tasks, need at least to be considered.

WHY IS GENDER SO OFTEN IGNORED IN ENERGY PROJECT PLANNING?

Part of the explanation for the neglect of women's use of energy even is its invisibility *[2]. Much of women's energy use involves biomass which remains in the informal sector even when it is commercially traded in cities. These biomass flows are not recorded, let alone taxed, and so they remain invisible. Then there is also the perception that energy is gender neutral. Energy is seen as a technical matter, without social implications, unlike for example health.

These explanations are also a contributory factor to the lack of appropriate gender analysis tools for the energy sector. Standard gender approaches were developed fifteen years ago, but are often too general for application in specific sectors. Major donors in the agriculture, health and water sectors have developed tailor-made procedures and tools for gender analysis which reflect the actual contexts and real concerns of their planners. The energy sector in contrast has scarcely begun, and any energy planner looking for off-the-shelf models will be confronted with schemes which simply do not focus on energy issues.

In order to mainstream gender issues in energy planning it is essential to develop an appropriate set of gender analytic tools to which energy planners can relate. These tools could show how the energy needs of women relate to their more general development needs, and highlighting the needs that are different from men's. Such a set of tools would not be sufficient to revolutionise energy planning from a gender perspective, but is certainly a necessary step.

LESSONS LEARNED ABOUT REQUIREMENTS ON GENDER TOOLS FOR ENERGY

From a general critique of gender tools and a review of approaches suggested for the energy sector, the following points arise which should be considered.

- Gender goals of energy projects and programmes should be explicit and measurable.

Table 1: How typical energy interventions relate to various gender goals

Underlying goal and reason to use the gender analysis	Implication for women	Typical energy interventions
To improve the welfare of women, improve their quality of life and reduce drudgery	Lighten women's work load but no special effort made to change their basic role	Improved stoves, power for grinding and husking, powered domestic water supply, electric light in working areas
To improve the production levels of women and their economic opportunities	Create new roles for women that lead to economic growth, this may also lead to their economic independence	Attention to supplying energy (electricity, mechanical power, or heat) for women's small businesses; usually coupled with credit schemes and technical training
To empower women, help them recognize and break through existing gender barriers	Their political and decision-making power is increased; social norms and opinions about 'appropriate' behaviour begin to change. Women's views of their own roles and potential begin to change.	Not so much the technology, but *how it is introduced* is crucial. Including women on organization committees, management training, empowerment raising. Energy may be a component in this: street lighting may facilitate women meeting in the evening, electricity may make internet communication possible and begin to reduce women's isolation etc.
Gender analysis used for project efficiency purposes (necessary to ensure project success)	Interventions matched to women's stated requirements.	Various, but usually for *welfare* or *productive* purposes.

- They should be defined with the participation of all the stakeholders, including men and women of the community separately.
- Empowerment (or equality) may be one goal but others such as productivity and welfare are also possible. Definition of goals should be the first step in any gender analysis.
- Gender analysis may be used for project efficiency purposes but this should not be confused with the gender goals themselves.
- Gender analysis needs to be carefully considered and a decision made on whether the beneficiary population needs to be analysed on the basis of gender plus class.
- Tools may also be needed to analyse the capacity of other stakeholders to handle gender issues.
- Many of women's energy needs relate to end-uses not conventionally covered in energy planning, such as pounding of grain, and carrying water. By reviewing all work activities, many of these activities can be included in a comprehensive view of the energy situation.
- Indicators are needed to measure the impact of energy services in relation to gender goals.
- Data-gathering methods need to relate directly to these indicators.
- Participatory techniques need to be selected with a clear understanding of their role in the process, in particular whether they are primarily for data-gathering or for decision-making.
- Separating the sexes during data-gathering phases can be very useful in obtaining reliable gender-disaggregated information.
- Not only energy sources, but also access to equipment and appliances is likely to be gender-specific and should be investigated.
- Tailoring the gender analysis to the procedures that are normally used in energy planning helps in mainstreaming. This involves asking relevant gender questions at each stage of the planning process.

CONCLUSIONS

Based on these past experiences with gender tools in development planning in general and on a number of models suggested for the energy sector, a framework has been developed to suggest an approach that mainstreams gender in the energy project planning cycle and in energy programme planning. It aims to do so by
(a) clarifying gender goals,
(b) developing indicators of gender impacts,
(c) identifying data sources and techniques to obtain the relevant gender-disaggregated data at different stages of the planning cycle, and
(d) taking steps to ensure that women participate. The purpose is not to provide a rigid blueprint, but rather to demonstrate that the integration of gender is not that difficult, although it does require attention at every stage and a logical approach. A manual ("The Gender Face of Energy") is currently being tested, and will provide guidelines and very practical suggestions to achieve this. The framework described here, will be presented in more detail in a follow-up article in a future issue of reCOMMEND.

1. This paper is a summary of a paper written by Margaret M. Skutsch of the Technology and Sustainable Development Group, University of Twente for the ENERGIA International Network on Gender and Sustainable Energy.

2. Clancy, J.S., Skutsch, M.M. and Batchelor, S. (2003) "The gender-energy-poverty nexus: finding the energy to address gender concerns in development" Paper prepared for DfID: available at www.energia.org/pubs/index.asp

Other references:

Skutsch, M.M. (2005) "Gender analysis for energy projects and programmes", Energy for Sustainable Development l Vol IX No. 1.

Skutsch, M.M. "Tooling Up for Gender and Energy" Paper prepared for ENERGIA: available at www.energia.org/pubs/index.asp

For more information

Please contact: Sheila Oparaocha, ENERGIA, ETC Foundation, P.O. Box 64, 3830 AB, Leusden, The Netherlands;
Tel: +31.33.4326000; Fax: +31.33.4940791;
Email: s.oparaocha@etcnl.nl;
Web site: www.energia.org

DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA

National and Regional Energy Futures

The Nautilus Institute's Asian Energy Security (AES) project, brings together six countries -China, the Democratic Peoples' Republic of Korea (DPRK), Japan, the Republic of Korea (ROK), Mongolia, and Russia *-1-, that over the past two years have been working together to research the question "Are there regional resource-sharing activities that can move the energy system in Northeast Asia toward enhanced energy security?". This work will conclude with an evaluation of the regional costs and benefits of cooperative versus "go it alone" strategies for energy sector development *-2. This article describes the case of the DPRK.

David Von Hippel
NAUTILUS INSTITUTE

THE DPRK ENERGY SECTOR: RECENT TRENDS

Since 1990, the DPRK has seen a vast drop in imports of fuels from Russia. Oil import restrictions, which arose partly from external economic sanctions and partly from North Korea's inability to pay for oil imports with hard currency, have further reduced the availability of refined products. This lack of fuel, particularly for the transport sector, has contributed to the DPRK's economic malaise since 1990. Also contributing to the decline in the country's economic fortunes has been the inability to obtain key spare parts for both energy infrastructure and factories, including factories built with foreign (mostly Soviet-bloc) assistance and/or technology in the 1970s.

Since 2000, a transition in the DPRK economy has been underway, with more emphasis on development of local energy resources for local use. Some regional energy trade, including a just-announced local power interconnection with the ROK of about 15 MW, has also increased, but the overall trend in the DPRK energy economy since 2000 appears to be only a gradual net increase in energy supply and demand, if any. These overall economic and energy-sector trends provide the backdrop to the assessment of future DPRK energy paths provided below.

ENERGY PATHS FOR THE DPRK

Drawing from earlier LEAP analyses, the three paths developed previously were updated under the AES analysis, and a fourth, "Regional Alternative" path was added:

- The "**Recent Trends**" path, in which the current political stalemate with the United States and other nations over the DPRK's nuclear weapons program is not resolved. While the DPRK economy opens a very little, aid flows continue to be relatively modest, and infrastructure continues to erode.
- The "**Redevelopment**" path, in which the current political stalemate IS resolved, and the DPRK economy is revitalized, industry and agriculture are re-mechanized (but with more modern technology), and energy infrastructure is upgraded or replaced.
- A "**Sustainable Development**" path (derived from the "Redevelopment" path), but including aggressive implementation of energy efficiency measures to reduce coal and electricity use per unit of energy service delivered, a more rapid phase-out of existing coal-fired power plants, and the addition of a liquefied natural gas (LNG) terminal and gas combined cycle (CC) generating plant, as well as more renewable energy use.

FIGURE 1

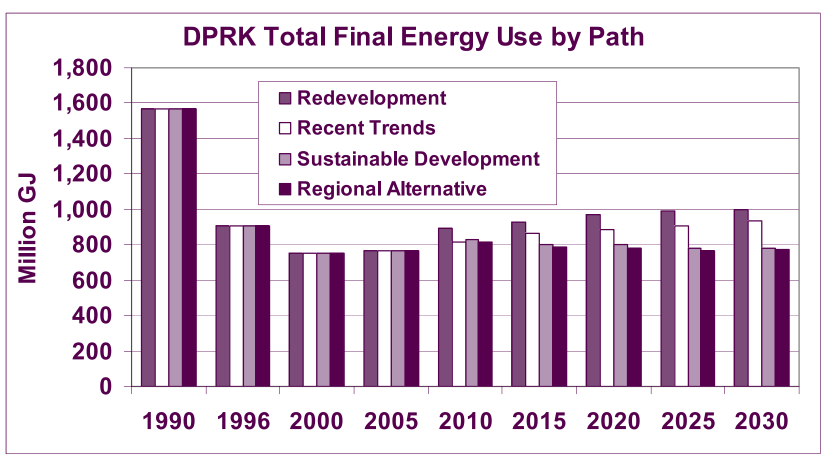


FIGURE 2

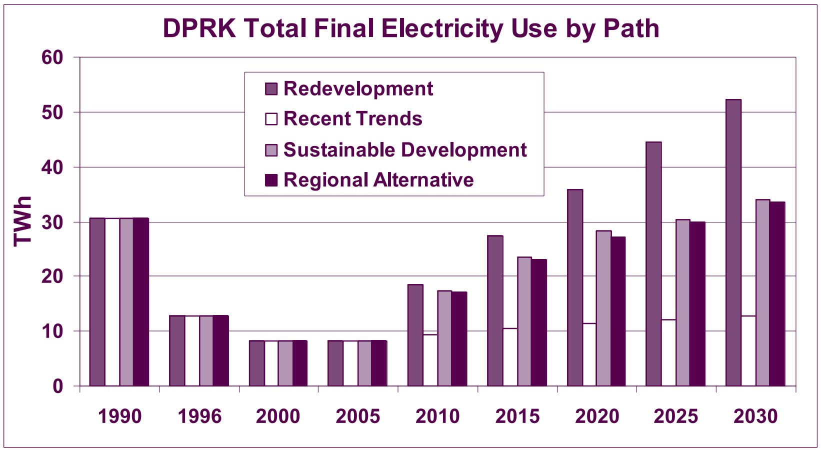
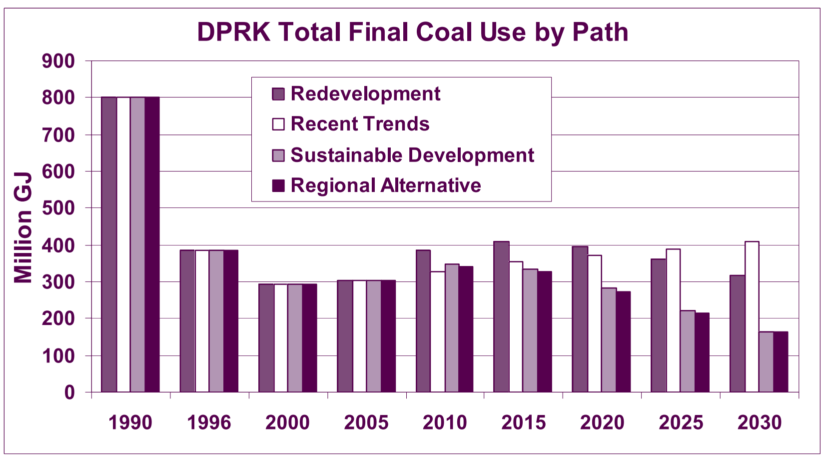


FIGURE 3



- A "**Regional Alternative**" path, which overlays the regional initiatives identified by the AES project, onto the Redevelopment (and in some cases, the Sustainable Development) paths as described above. These regional initiatives include cooperation on energy efficiency measures such that efficiency improvement targets are reached two years earlier, and at costs ten percent less, than in the Sustainable Development path. On the supply side, the Regional Alternative path includes a gas pipeline from the Russian Far East to the DPRK and ROK that begins operation in 2011-and for which the DPRK receives "rent" for hosting the pipeline; an LNG facility roughly three times larger than that in the Redevelopment case, and starting operation in 2012; a power line from the Russian Far East through the DPRK to ROK, which is modeled as importing 100 MW of power to DPRK at a discounted price of $0.02/ kWh; and participation in regional cooperative activities related to nuclear research and to nuclear waste handling.

DPRK ENERGY PATHS: SELECTED RESULTS

Total final energy demand in the four energy paths is compared in Figure 1. Though the energy demand in the Recent Trends case is slightly lower than in the Redevelopment case by 2030, this similarity masks the fact that energy services are far higher in the Redevelopment case, and that much more biomass fuel and coal is used-relatively inefficiently-in the Recent Trends case.

The differences between the four paths are accentuated in comparisons of demand for electricity and for coal, as shown in Figures 2 and 3. Electricity use in the Sustainable Development and Regional Alternative paths by 2030, as a result of the use of energy efficiency measures, is less than 65 percent of the electricity use in the Redevelopment path, while electricity use in the Recent Trends path remains much lower. Conversely, coal use is highest in 2030 in the Recent Trends path, as coal use is phased out in the other three paths.

With the exception of the Recent Trends case, each of the different energy paths evaluated are designed to produce roughly the same level of energy services. One indicator of this paths design criterion is the electricity system reserve margin, which roughly the same, in each year of the analysis, in all three comparable paths. As a result, the electricity systems in all three cases can be expected to yield the same level of reliability, despite the large differences in capacity between the paths. For example, as shown in Figure 4, the Sustainable Development path includes 27 percent less generating capacity by 2030 than the Redevelopment path.

The difference in electricity generation between the Redevelopment path and the Sustainable Development and Regional Alternative cases is even more pronounced (over 30 percent by 2030) than the difference in capacity, as shown in Figure 5. The difference in generation exceeds the difference in capacity because the Sustainable Development and Regional Alternative cases include more relatively low-capacity-factor generation resources, notably small hydro and wind power systems.

The Sustainable Development and, in particular, the Regional Alternative paths

FIGURE 4

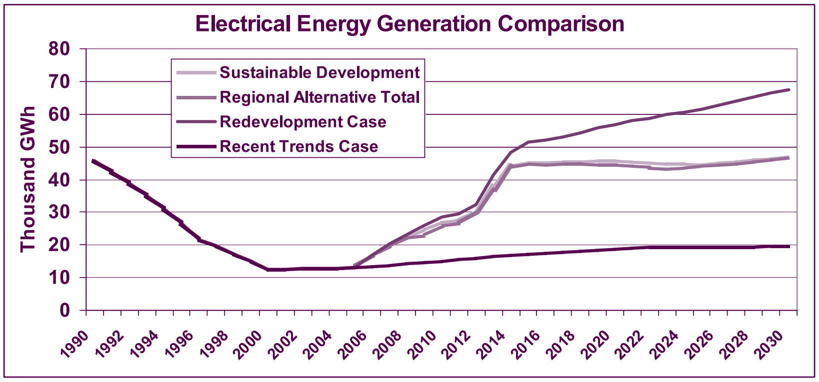
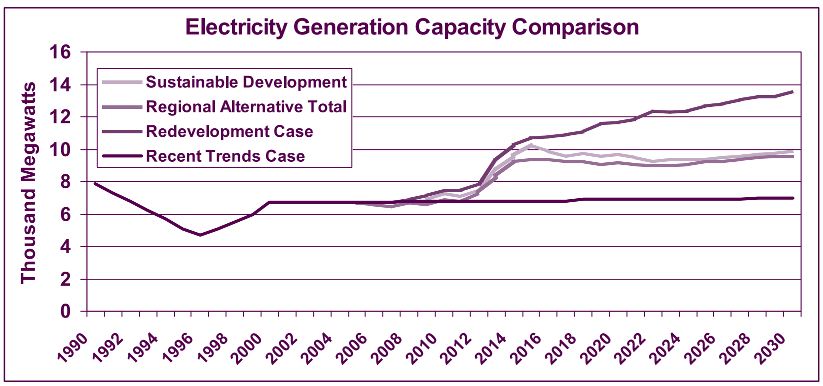


FIGURE 5



show much lower domestic coal output by 2030 than the Redevelopment case, and, partially as a consequence, have a somewhat higher ratio of net imports to total energy requirements-59 percent versus 46 percent-than the Redevelopment case. Both imports and exports are much higher in the Regional Alternative case than in the Sustainable Development case due mostly to the import and re-export of natural gas and LNG from the Russian Far East.

The Redevelopment path shows higher greenhouse gas emissions than the Recent Trends path, albeit with considerably higher energy services provided, while the Regional Alternative and Sustainable Development paths yield significantly lower emissions: less than two-thirds of those in the Redevelopment case. All three cases perform much better than the Recent Trends case with respect to local air pollutants.

When comparing the costs of the Sustainable Development and Regional Alternative cases with the costs of Redevelopment case (Figure 6), it is seen that the demand-side costs in both the Sustainable Development and Regional Alternative paths are higher-by about a billion dollars on a net present value (NPV) basis. But these costs are compensated for by savings in transformation and resource costs. Overall, the Sustainable Development case saves 400 million USD relative to the Redevelopment case, and the Regional Alternative case saves about 1.4 billion USD [*3]. .

ENERGY SECURITY IMPLICATIONS OF PATHS RESULTS

The energy security costs implications of the three paths that provide similar energy services (Redevelopment, Sustainable Development, and Regional Alternative) are as follows:

Energy Supply: Significantly less primary energy is required in the Sustainable Development (National Alternative) and Regional Alternative cases by 2030 than in the Redevelopment (or Reference) case. Also, diversity of supply is greater in both Alternative cases, but especially in the Regional Alternative case, where fuels from RFE sources augment imports from elsewhere in Asia and the Middle East. The fraction of fuels supplied from net imports is, however, higher in the Alternative cases than in the Reference case.

- **Economic**: Overall costs, as indicated above, are somewhat lower for the Alternative cases, as are import costs. A greater emphasis on energy efficiency and renewable resources in the Alternative cases results in arguably slightly greater insulation of the economy to external price shocks, and improved local employment opportunities compared to the Redevelopment case, though higher import dependence would tend to have the opposite effect (at least, if the costs of RFE imports were linked to world market prices for crude oil and LNG).

- **Technological**: The Alternative paths offer more dependence on newer technologies (renewable, energy efficiency), and thus have slightly greater technological risk associated with them. The Regional Alternative path includes dependence on major international infrastructure investments-power lines and pipelines-that are also new technologies to the DPRK (though not to other countries), and thus may arguably pose a technological risk. On the other hand, both Alternative paths offer greater opportunities for the DPRK to learn to use new energy technologies, improving domestic energy security in the long run.

- **Environmental**: Both Alternative paths offer better environmental performance than the Reference/Redevelopment path with respect to global, regional and local air pollutants. If translated into economic terms, the greenhouse gas savings under the two Alternative cases, assuming a nominal cost of 10 USD per tonne of CO_2, amount to about 1.1 billion USD savings in 1990 NPV dollars.

- **Social and Cultural**: The Alternative paths, and especially the Regional Alternative path, require more interactions between the DPRK and the world as a whole. This can be considered, depending on one's point of view, either an increase in social and cultural risk, or an opportunity for learning and growth of the DPRK as a society and culture, or both. Nautilus' Humanitarian Wind Power project in the DPRK provided a very small demonstration of the benefits of interactions at a technical, working level between DPRK and US engineers (see photo).

- **Military/Security**: The Regional Alternative path, by connecting the DPRK economy to that of its neighbors, arguably improves energy security by reducing the likelihood of military action by any one nation, since such actions would result in harm to the economies of all of the interconnected nations. In addition, the international political and legal frameworks necessary to build and operate major international energy infrastructure provide experience and channels for communication on security issues. Finally, resource sharing, and the mutual dependence that it implies, provides an incentive for the partners in the sharing arrangement to work out disagreements through non-military means.

FIGURE 6

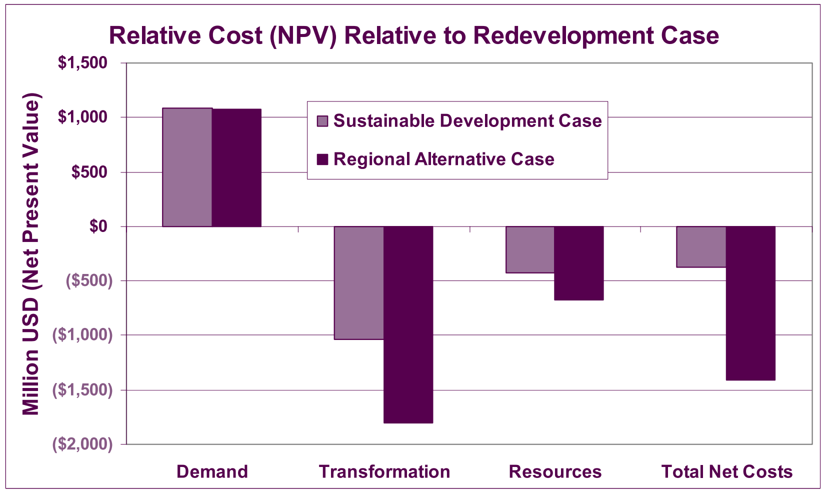


Photo: David von Hippel-Nautilus Institute

LESSONS FOR OTHER COUNTRIES

Although the situation in the DPRK is unique, some of the lessons of the analysis presented above have implications for other nations with developing or re-developing energy sectors. First, despite higher initial costs, demand-side energy efficiency investments can pay off handsomely in terms of avoided supply-side and resource costs, as well as environmental performance. Second, regional resource-sharing and cooperation activities can also help to reduce overall system costs and improve environmental performance, as well as providing an economic link between nations that enhances cooperation, and with it, regional security.

1. Text and results for this article are drawn in part from the AES2004 Project Report, which is currently in the final stages of preparation by the author and AES Working Groups for the Nautilus Institute.
2. Energy security impacts of different paths are evaluated using the framework summarized in "Energy Security Analysis: A New Framework", published in reCOMMEND 2, December, 2004.
3. Costs are discounted back to 1990, which reduces the importance of savings that occur toward the end of the analysis period. Note that the oil price forecast that underlies these estimates is much lower than current prices (~$50/bbl) currently prevailing. A higher price would significantly enhance resource savings from the efficiency measures and renewable energy systems.

For more information

Please contact: David von Hippel, 910 E.23rd St., Eugene, Oregon 97405, USA; Email: dvonhip@igc.org

ESTIMATING THE RENEWABLE ENERGY CONTRIBUTION TO

Regional Energy Systems

This article describes a study done on the island of Lemnos, Greece, to analyse and estimate the extent to which Greece can comply with the European Directive of increasing the share of renewable energy sources, while at the same time trying to establish a reduction in the increase of greenhouse gas emissions.

Athanasios Angelis-Dimakis and Dionysis Assimakopoulos (Professor)
SCHOOL OF CHEMICAL ENGINEERING, NATIONAL TECHNICAL UNIVERSITY OF ATHENS

In compliance with the European Directive (2001/77/EC) on electricity generation from renewable energy sources (RES), Greece has to increase the share of RES contribution to electricity generation by 14% (excluding large hydro), or 20% (including large hydro) by 2010. In addition to this, the greenhouse gas emissions should not exceed the 1990 levels by more than 25% in the period up to 2012.

The objective of this work is to provide a framework for analysis and a method of estimating the extent to which these two goals can be met in the country. More specifically, the energy analysis of a regional system using the LEAP software, the forecast for the future energy demand, and the contribution of RES for different penetration levels in the local energy system will be carried out.

The base year for the analysis is 2003 and the proposed framework will be applied to a case study of the County of Lemnos, which is simple enough to present the main features of the method. Lemnos consists of two small islands located in the N.E. Aegean Sea (Figure 1) with a population of 17,852 according to the 2001 Census. This region has all the main features of the Greek national energy system, being at the same time a closed system.

Figure 1:
Location of the Study Region [*7]

Figure 2:
Detailed map of the County of Lemnos

METHODOLOGY
The proposed methodology consists of the following three steps:

First, the energy balance of the region that is being studied was determined for the base year. The energy consumption for each sector of the energy system was calculated by using a bottom-up approach. Simple energy models were created and energy demand was assumed to be built-up by energy consuming units in the main sectors of the region's energy system [*1,3]. The Long range Energy Alternatives Planning (LEAP) software was used to develop the region's energy balance. The necessary data was collected through local field research or from official sources, like the National Statistical Service [*6] and the Public Power Corporation.
In the second step the future energy demand was estimated. Towards this end, the following three alternative scenarios were created [*2], based on the assumption that the annual energy consumption per unit remains stable:

- Business As Usual (BAU)
- Higher Energy Demand (HED)
- Lower Energy Demand (LED)

The main variable is the number of energy consuming units. The BAU scenario, which was used as a guide for the other two, followed the Public Power Corporation's forecast for electricity demand, based mainly on historical data. In the HED scenario, the foundation of a University Department on Lemnos by the end of 2006 is assumed (currently under discussion). Finally, the LED scenario assumes that population increase declines and reduction in growth rates over the coming years will be observed. The growth rates used were entered into the LEAP model and the future demand is estimated.
The third step entails the selection of the best combination of RES technologies in

order to meet energy demand. The method used is Cost Effectiveness Analysis, which evaluates the alternative energy plans according to both their costs and their energy supply, taking into account the island's specific needs and natural resources *[5]. Cost data for the renewable energy technologies were taken from RETScreen, a standardized and integrated renewable energy project analysis software. At this point, it should be noted that only costs relating to electricity were used in the analysis. Also, the electricity plants were dispatched according to a specified merit order. The fuel oil plants and the wind turbines were considered as base load and the diesel plants as peak load.

RESULTS

The results are presented in the tables and figure below. More specifically, Table 1 presents the energy balance of Lemnos for the base year. All the non-indigenously produced energy forms are imported from the mainland. It is seen that the domestic and transport sectors account for over 65% of the total energy consumption. Furthermore, the domestic sector accounts for over 50% of the total electricity consumed. Finally, it should be pointed out that the sector "Other" includes energy consumed in other public buildings, for the lighting of streets and squares and also for naval transport.

The proposed action plan is summarized in Table 2. These actions are mainly interventions into the existing infrastructure and, more specifically, the installation of extra wind turbines onto the grid. In practice, the wind turbines replace the diesel driven electricity generation units. The installation of 2000 solar heated boilers by 2020, mainly on newly built houses, is also suggested.

Through this action plan the contribution of RES to electricity generation will reach a share of 15% in 2010 and of 17% in 2014 (Figure 3) with an extra cost of $1,250,000 from 2010 and $1,500,000 from 2014 (Figure 4). It is obvious and

Table 2: Proposed Action Plan

Installation of Wind Turbines	
2006	2 Wind Turbines 600kW
2008	2 Wind Turbines 600kW
2010	2 Wind Turbines 600kW
2014	1 Wind Turbine 750kW
Installation of Solar Heated Boilers	
2020	2000 boilers to be installed by 2020 in the domestic sector

Figure 3: Electricity Generation Planning for the PPC Forecast Scenario

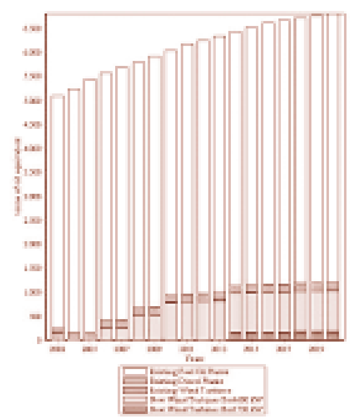


Table 1: Energy balance of the region for the base year (2003) in TOE

Energy System Sectors	Electricity	Gasoline	Diesel	Fuel Oil	LPG	Wind	Solar	Biomass	Total
Production	0	0	0	0	0	164	581	0	745
Imports	0	3287	8402	11829	244	0	0	2031	27684
Exports	0	0	0	0	0	0	0	0	0
From Stock Change	0	0	0	0	0	0	0	0	0
Total Primary Supply	0	3287	8402	11829	244	0	0	2031	28428
Electricity Generation	4840	0	-232	-11829	0	-164	0	0	-7386
Electricity Distribution	-381	0	0	0	0	0	0	0	-381
Total Transformation	4458	0	-232	-11829	0	-164	0	0	-7767
Statistical Differences	0	0	0	0	0	0	0	0	0
Domestic	1979	0	2585	0	244	0	370	2031	7210
Tourism	264	0	54	0	0	0	211	0	529
Commercial	504	0	160	0	0	0	0	0	665
Schools	225	0	160	0	0	0	0	0	385
Hospitals	18	0	37	0	0	0	0	0	55
Public Buildings	131	0	64	0	0	0	0	0	195
Agriculture	56	0	1760	0	0	0	0	0	3707
Transport	0	3287	1348	0	0	0	0	0	4635
Industry	189	0	500	0	0	0	0	0	689
Other	1092	0	1500	0	0	0	0	0	2592
Total Demand	4458	3287	8168	0	244	0	581	2031	20661
Unmet Demand	0	0	0	0	0	0	0	0	0

Figure 4: Extra costs due to the new wind turbines

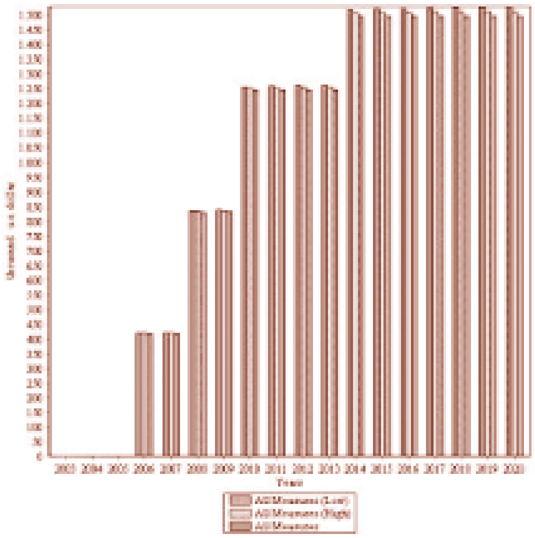
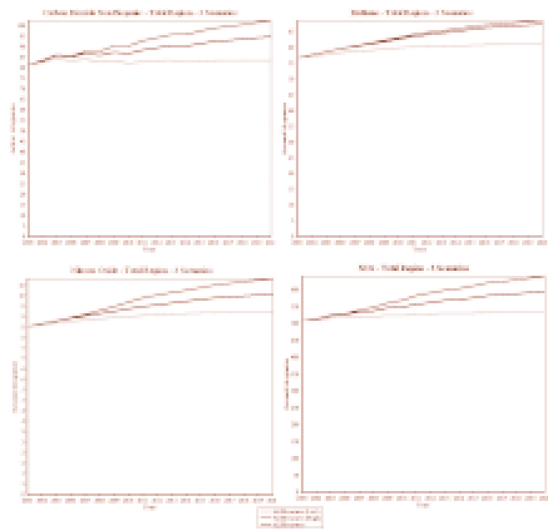


Figure 5: Greenhouse gas emissions (2003-2020)



expected that the use of renewable sources of energy leads to a significant cost increase.

On the other hand, the reduction in greenhouse gas emissions is not sufficient, despite the decrease of pollutants transmitted from the power generation plants (Figure 5). The two sectors which cause the most severe environmental impacts are the domestic and transport sectors. The action plan may be extended to include some interventions in these sectors such as ground-source heat pumps or biomass heaters for the heating of households, and the upgrading of the public transport.

SUGGESTIONS FOR FURTHER RESEARCH

The results presented in the previous section show that the proposed methodology meets the set objectives in a very satisfactory way. However, there are a number of points, as presented below, which may be further elaborated and improved.

In modeling energy consumption and estimating future energy demand the following important parameters were not taken into account:

- The rise in the standard of living, since both the annual energy consumption per unit and the fuel shares were considered to remain constant over time.
- The technological progress, since the efficiency of the used appliances also remains constant.

For a more realistic approach these two parameters should be also taken into account in the various alternative scenarios.

In modeling electricity distribution, a unique transmission and distribution losses coefficient was used, irrespective of where electricity was generated. Differentiating this coefficient and using a smaller value in the case of renewable energy sources would lead to cost reduction.

In modeling electricity generation, the load factor was used instead of the load curve, which was not available at that time. As a result, seasonal peaks in electricity demand were not taken into account, the satisfaction of which may require a different electricity generation planning. Taking this point into account would lead to a much more realistic simulation and to better results.

Cost data for the demand sector and not only for the electricity generation should be included in the analysis in order to have a complete cost analysis of the proposed action plan. Finally, further optimization of the proposed actions and measures may be attempted and different action plans for each scenario can be proposed to examine if the costs are reduced.

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For more information

Please contact the authors: School of Chemical Engineering, National Technical University of Athens, 9 Heroon Polytechniou St., Zographos, Athens, Greece GR-157 80; Tel. +301.772.3058-60; Fax +301.772.3304;

Email: angelis@chemeng.ntua.gr

BRAZIL'S TRANSPORT SECTOR

Renewable Energy and Long-Term Energy Planning

The Economic Research Institute is currently working on projects that develop technical-macroeconomic models to assist in long-term energy planning in Brazil. In these projects, the transport sector deserves special attention for being a large consumer of oil derivatives and for often being the main source of air pollution in urban areas in Brazil. There are important alternatives to oil derivatives, such as ethanol and biodiesel, that may reduce dependence on oil imports, improve public health and contribute to climate change mitigation, as will be shown in this article.

Décio Kadota, Luiz Tadeo Siqueira Prado and Flavio Pinheiro
ECONOMIC RESEARCH INSTITUTE (FIPE), UNIVERSITY OF SÃO PAULO

Renewable energy sources make up a large share in Brazil's energy matrix. Approximately 92% of the total electricity is generated by hydropower plants. Biomass (wood, bagasse and derivatives) further is an important energy source for major industrial sectors such as the pulp and paper, food and beverages, ceramics, and steel industries. In addition to these traditional renewable energy sources, the country also strongly promotes the production and consumption of new renewable energy sources, mainly ethanol and, soon, biodiesel. These new renewable sources are especially relevant to the transport sector.

ETHANOL

Ethanol represents approximately 30% of the final energy demand of private transport. Brazil is the largest producer and consumer of ethanol fuel and it is the only country that requires the significant addition of ethanol to all gasoline consumed in the country (now 24% in volume). In 2004, 14.9 billion liters of ethanol was produced in Brazil *[1]. In comparison, the United States may soon match Brazil in the volume of ethanol produced *[2]. Most likely, however, Brazil will continue to have a much larger share of ethanol in automotive fuel. Brazil also has the largest pure ethanol fleet (E100), consisting of approximately four million vehicles, equalling almost 20% of the national fleet.

The National Ethanol Program, initiated in the 1970s, promoted the production of ethanol for automotive use as a measure against the oil crisis. In the beginning of the program the car manufacturers produced E100 vehicles (vehicles that run on 100% hydrated ethanol). By the end of the 1980s E100 vehicles represented the greatest share of new light vehicles sales in the country. This initial success was undermined by the shortage of ethanol often attributed to the high price of sugar in the international market that made alcohol and sugar producers to favor sugar over ethanol.

The National Ethanol Program benefited from important subsidies for over a decade, but in the 1990s went through a strong crisis. Today, nonetheless, the program seems well established. Although the sales of E100 vehicles are very low, the new flex-fuel vehicles, recently introduced to the Brazilian market by various car manufacturers, make up a growing share of the sales of new vehicles.

Table 1. Brazil in numbers

Main indicators	Brazil	Latin America
Land Area (mi sq. km)	8.5	18.7
Population (mi 2003)	182	535
GDP (USD bi 2003)	506	1.742
Final Energy Demand (mi toe)	178	355
Vehicle Fleet (mi 2003 est.)	21.4	50*

Sources: CEPAL, IEA, IBGE, MME, ANFAVEA

* Estimated by authors

Economic Research Institute

FLEX-FUEL VEHICLES

Flex-fuel vehicles can run on a blend of gasoline and ethanol. Car manufacturers have indicated an interest producing only flex-fuel vehicles in the near future. There may even be new models that would run on three different fuels - gasoline, ethanol and natural gas.

These flex-fuel vehicles will contribute to reduce the risk of fuel shortages and they will for the first time allow a full competition among ethanol and gasoline. The volume and composition of the demand of these fuels will become more vulnerable to strong oscillations. This will require much better demand planning and price adjustments for each of these fuels.

BIODIESEL

Soon, Brazil may be the only country to require the addition of biodiesel to all diesel consumed within its borders (2% in volume by 2008 and 5% by 2013). The National Biodiesel Program *[3] is one of the most important programs of the current government, as it sees a number of advantages involved in the increased use and production of biodiesel in Brazil:

- income generation for low-income rural families who will produce some of the vegetable oil to be used in biodiesel production;
- reduction in diesel imports and, consequently, the reduction of the deficit in the Brazilian commercial balance; and
- reduction of atmospheric pollution, especially in densely populated metropolitan areas with intense traffic of heavy vehicles.

Photo: Economic Research Institute

CONCLUDING REMARKS

With an increasing number of fuel and technology options available in Brazil, long-term energy demand planning and scenario studies have become increasingly necessary to assure proper fuel supply and, therefore, reduce the risk of shortage of supply or overproduction of fuels. In their work on developing technical-macroeconomic models, the main alternative fuel under analysis for the ERI is ethanol fuel. In LEAP we have defined anhydrous and hydrated ethanol fuels separately. Anhydrous ethanol is used in gasoline-ethanol vehicles (vehicles that run on a gasoline-ethanol blend) and the hydrated ethanol is used in E100 vehicles (vehicles that run on pure ethanol). For gasoline-ethanol vehicles, the share of ethanol in the fuel blend can be altered in future scenarios, which could happen as it has happened in the recent past. For instance, in 2000 the share of ethanol in the commercial gasoline was 20% v/v and in 2002 it increase to 24% v/v. The demand for ethanol is mainly driven by the increase in fleet size and in the share of ethanol in gasoline-ethanol blend. Among many other things, the study of scenarios is expected to assist in the development of policies that could better adjust the demand and supply of gasoline and ethanol.

1. São Paulo Sugarcane Agroindustry Union - UNICA (www.unica.com.br/)

2. See Renewable Fuels Association - RFA (www.ethanolrfa.org/)

3. For more information, see: www.biodiesel.gov.br/

For more information
Please contact: Décia Kadota;
Email: dkkadota@usp.br;
Luiz Tadeo Siqueira Prado;
Email: tprado@iee.usp.br;
Flavio Pinheiro;
Email:flavio@flaviopinheiro.com

What's New in LEAP2005

The Stockholm Environment Institute developed a new version of LEAP , the Long range Energy Alternatives Planning system, an integrated energy and environment analysis software system. There are a number of new features included in LEAP2005, two of which are described in more detail in this article.

Charlie Heaps, LEAP Developer
STOCKHOLM ENVIRONMENT INSTITUTE

May 2005 saw the release of a new version of LEAP: the integrated energy and environment analysis software system developed by the Stockholm Environment Institute.

The new version of LEAP includes many new features, most notably:

- better electric sector modeling capabilities;
- automatic data versioning;
- a new Chinese language translation; and
- a better-looking user interface.

The "What's New?" page of the LEAP web site contains a detailed list of changes in the new version. LEAP2005 is backwards-compatible with older versions, and will read and upgrade older data sets. The new version can be downloaded from the LEAP web site or if you already use LEAP you can update the software using its built-in update option.
Two of the new features in LEAP are described in more detail in this article.

BETTER ELECTRIC SECTOR MODELING

The most important improvement to LEAP is how it simulates electricity consumption and production. Previous versions of LEAP have been able to simulate how electric power plants are dispatched, by merit order or by running cost, to meet both the total annual demand for electricity (GWh) and the instantaneous peak requirements for power (MW) throughout each year. In previous versions, this simulation requires the user to specify the shape of the system load curve by plotting the peak requirements for power against the hours in the year (sorted from zero to 8760- hours from the highest to the lowest peak load).

In its dispatch calculations, LEAP divides the load duration curve into vertical "strips" and dispatches the available power plants in order within each strip. This is illustrated in Figure 1: you can see that in the hours with the highest load, meeting the peak requirements requires dispatching base, intermediate and peak load power plants. In the hours with the lowest load, the peak requirements are met with base load plants alone (i.e. those with the lowest merit order).

While this approach works well and requires a minimum of data to be specified, it does have a number of weaknesses. Two in particular stand out:

- Because the hours on the X axis are simply sorted from the highest to the lowest load, the model has no information about seasonal or time of day variations in load. This makes it impossible to reflect different dispatch rules or different availability factors that might occur in different seasons. For example, in some countries hydro plants may be run as base

Figure 1

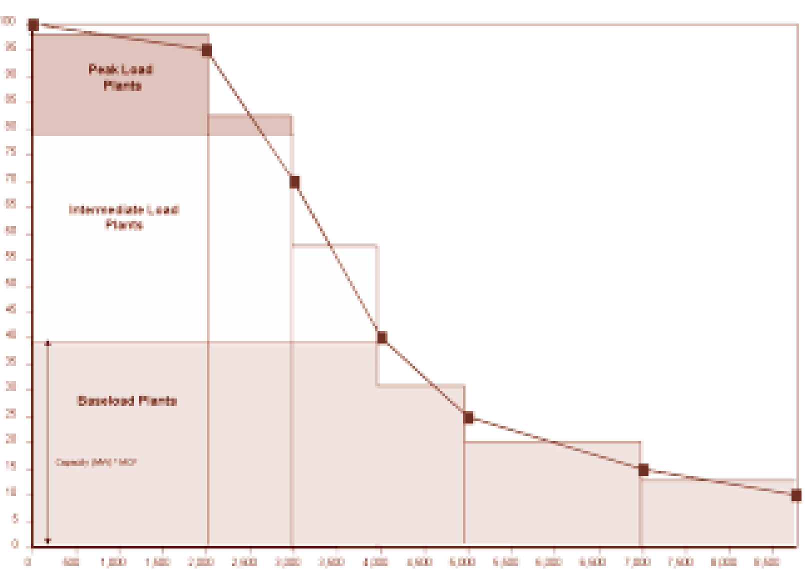
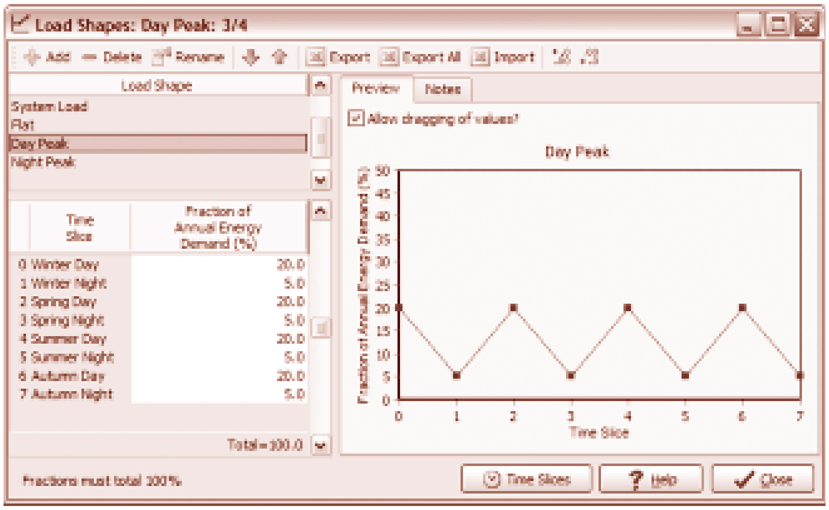


Figure 2



load plant in a wet season and as peak load plant in a dry season.

- Because the shape of the load curve is specified exogenously, LEAP is unable to automatically reflect changes in the shape of the load curve that occur as a result of structural or technological shifts in how electricity is consumed. These shifts may occur over time in a single scenario and may also differ between scenarios. For example, electric sector *demand side management* (DSM) policies may result in annual energy savings and, by reducing peak load requirements, may also yield a flatter load curve. This in turn will reduce the need to build and operate expensive peak-load power plants. Previous versions of LEAP force the user to explicitly specify how the load curve will change based on their own calculations outside of LEAP.

LEAP2005 addresses these shortcomings while at the same time improving the overall flexibility of the dispatch simulation. It does this through improvements in a number of key areas, whilst preserving the simpler methods used in earlier versions as the default methodology.

Firstly, the electric sector system load curve can now optionally be calculated endogenously. In a demand analysis, different load shapes can now optionally be specified for each device that uses electricity. The overall system load shape is then calculated for each scenario year by summing across the individual load shapes of all electric devices. With this approach, the overall shape of the system load curve will automatically reflect any structural and technological shifts in consumption that are specified in an energy demand scenario.

To use this optional new methodology, you need to go to the Loads tab on the **General: Basic Parameters** screen and enable endogenous (i.e. internally calculated) load curves. Once this is enabled, an additional column is displayed in the data screens where you specify the **energy intensity** of demand devices. In this column you can select a load shape that allocates the total annual energy demand among different time slices of the year. These time slices might be seasons or months of the year or typical days within each month or season. Two new supporting screens on the **General** menu let you edit the **Time Slices** into which each year is divided and also let you edit a library of **Load Shapes** that can be applied to different loads. For each time slice you must specify the number of hours. The total hours for all time slices must sum to 8760 (the hours in a year). Figure 2 shows the new screen in LEAP2005 in which you edit the library of load shapes.

Results have also been improved to complement this new methodology. On the demand side electric loads can now

Figure 3

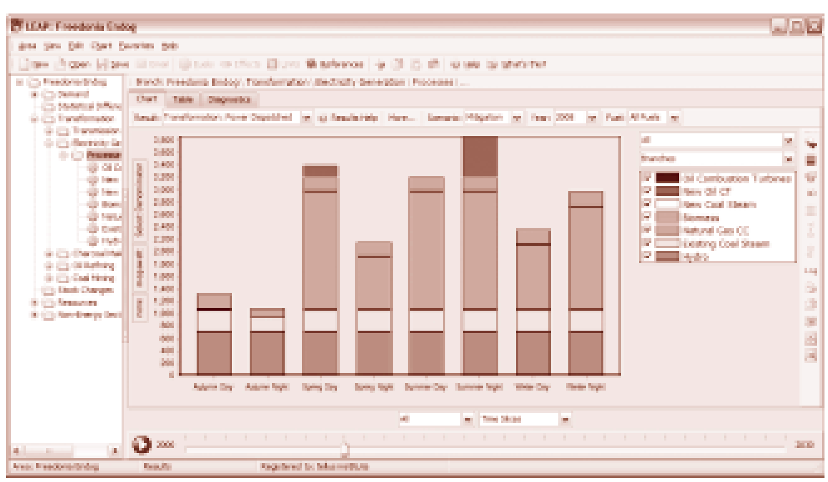
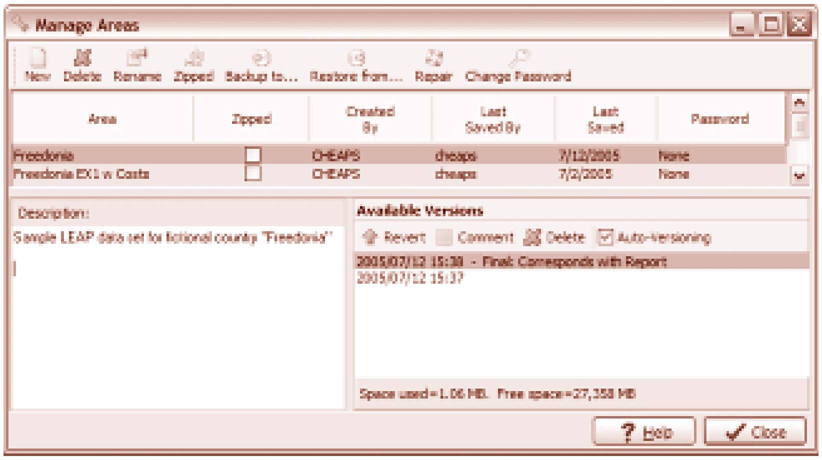


Figure 4



be viewed by time slice for any sector or subsector. On the supply side, charts showing the dispatch of power plants by time slice in any scenario year are also available. This is illustrated in Figure 3.

Complementing the addition of endogenously calculated electric system loads, the electric sector dispatch simulation has also been improved. In particular, power plants can be allocated different merit orders and different availability factors in different seasons.

The overall flexibility of the dispatch simulation has also been improved. Different power plants can now be assigned different dispatch rules. For example, wind and other renewables can now be dispatched to meet a specified *renewable portfolio* standard (specified as a percentage fraction of total dispatch), while other power plants are dispatched by merit order.

Finally the dispatch simulation has been improved to better reflect historical data. Previously, historical dispatch data could only be used in the base year. Now, historical dispatch can be used for multiple years. A new variable, "first simulation year", indicates when to stop using historical dispatch data and when to start using the dispatch rule. This year can be different for each different process.

AUTOMATIC DATA VERSIONING

LEAP2005 now saves multiple versions of areas, in case you decide you want to go back to a previous version of your data. Backup versions are automatically created when an area is saved. As versions accumulate, LEAP selectively and automatically deletes some versions, balancing the need to keep previous versions, with the need to preserve hard disk space. Versions are kept from the previous day, week and month, and from each previous year. You can also manually create a version with an optional comment. Treat these versions as milestones. For example, suppose you had just finished a study and written a paper, you might create a milestone version, with the comment "Data set corresponding to March 2005 paper." These versions are never deleted.

Figure 4 below shows the Manage Areas screen, which has been enhanced to support LEAP's new automatic versioning capabilities. The bottom-right part of the screen shows any available backup versions for highlighted area. From here, you can revert to a previous version of an area, add a comment or manually delete a version.

DISSEMINATION AND REQUIREMENTS

Hardware and software requirements and the LEAP dissemination policy remain unchanged. LEAP requires a Windows computer (Windows 98 or later) with a minimum of 64 MB of RAM. LEAP is disseminated at no charge to any non-profit, governmental or academic organization based in a developing country. Consult the LEAP web site for information on licensing LEAP for other types of organizations. Updates are available at no charge to all users.

WHAT'S COMING NEXT?

SEI will continue development of LEAP in 2005. The major priority will be development of better baseline datasets as a way of "jumpstarting" LEAP analyses (see News and Events in this issue). Improvements are also planned to the software itself. These will focus on LEAP's multi-regional modeling capabilities. For example:

- **Regional Trade:** LEAP's import and export calculations will be upgraded to better support simulation of trade between regions in a multi-regional dataset.
- **Mapping:** In addition to the two current results views (Charts and Tables) a third view will be added that allows regional results to be displayed on a GIS map.

For more information

Please contact: Dr. Charles Heaps,
SEI-Boston/Tellus Institute, 11 Arlington St., MA 02116, Boston, USA;
Tel. +1.617.266 5400; Fax +1.617.266 8303;
Email: cheaps@tellus.org;
Web site: http://forums.seib.org/leap

Photo: Yves Beaulieu – IDRC

NEWS & EVENTS

COMMEND REGIONAL ACTIVITIES IN 2005

DEVELOPING BASELINE DATASETS

A huge hurdle to national energy policy analysis is the preparation of baseline scenarios that examine historical data and that also forecast how a national energy system might evolve in a "business as usual" environment. While not the focus of most policy studies, this task alone can be one of the most time-consuming and data intensive. In 2005, SEI and the other regional COMMEND centers are focusing on projects that can reduce these hurdles. The hope is that, by reducing the time that has to be spent on developing baseline datasets, policy makers will be able to concentrate on the more important task of analyzing energy policy alternatives. Examples of this work include:

- SEI is collaborating with the U.S Lawrence Berkeley Laboratory to develop an end-use oriented global energy model (which will be described in detail in an upcoming issue of reCOMMEND). A side-benefit of this work has been the development of a tool that enables simple LEAP baseline datasets to be developed for one or more countries, based on data from the IEA, World Bank, IPCC and other sources. The tool is still under development, but when complete SEI will be able to offer simple "starter" datasets to LEAP users.
- SEI is also collaborating with OLADE (the Latin American Energy Agency) in a project that will link OLADE's national energy statistics database (SIEE - Energy and Economic Information System) with LEAP. The intention is to make baseline LEAP datasets more readily accessible to energy planners in the Latin America region. Contact Maurico Garron, OLADE for more information at: mgarron@hotmail.com
- ERC is developing a set of LEAP databases for the SADC region. The idea is to provide analysts in Southern Africa with a springboard for their own analyses. One database will be compiled for each of the twelve member states: Angola, Botswana, DRC, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, which will be made available through the COMMEND website.
- Similarly, ENDA is developing a series of LEAP datasets for countries in West Africa. The datasets will collate the best available energy statistics and forecasts for each country.

PUBLICATION

GENDER & ENERGY FOR SUSTAINABLE DEVELOPMENT: A TOOLKIT AND RESOURCE GUIDE UNDP AND ENERGIA

This toolkit and resource guide outlines the linkages between gender and energy in the context of sustainable development and provides suggestions and materials on how to address energy poverty by integrating gender and energy sensitivity into development programmes, projects, and policies.

The publication can be downloaded for free from the UNDP web site at: www.undp.org/energy/genenergykit/index.html

NEW INITIATIVES

ENERGY TECHNOLOGY SUBSTITUTION MODELS FOR TRANSPORT AND SERVICES SECTORS

Fundacion Bariloche is developing two new models for examining substitution processes among different fuels and technologies in the Transport and Services Sectors. The two new models build on the work done last year for the residential sector. All three models will be made available via the COMMEND web site for use by members of the COMMEND community.

TRAINING

SHORT COURSE ON LEAP AND MARKAL

28 August - 9 September 2005, Cape Town, South Africa

ERC will again be running two short courses designed to introduce planners and policy makers to the LEAP and MARKAL energy planning models. COMMEND is providing a limited number of scholarships to partially cover fees for participants.

For more information please see the COMMEND web site.

POVERTY ALLEVIATION: INTEGRATING THE GENDER AND ENERGY PERSPECTIVE

10-14 October 2005, Ede, The Netherlands

ETC-Energy and MDF Training & Consultancy are organising this course to broaden the participants' knowledge and insight into the linkages between poverty, energy and gender. This will increase their skills in making poverty reduction policies, programmes and projects more gender and energy oriented.

For more information, visit: www.mdf.nl