Fostering Cooperation for Sustainable Development:
Building Capacity for Regional Energy-Environment Planning

Introduction

Any effective long-term international strategy to alleviate poverty and increase global competitiveness hinges on sustainable economic growth that is "planet" responsible. Encouraging developing countries to pool diverse resources to promote cost-effective ways of delivering reliable energy services and encouraging the development and deployment of energy efficient and low/no carbon technologies is core to achieving such goals. Yet for most – if not all – developing countries, immediate economic and social development goals take precedence over proper planning, and environmental concerns.

As Heller and Shukla state in a recent paper, *"If future (climate) efforts are to succeed … they must align with the overriding development priorities of developing countries … Put simply, effective climate action must be "mainstreamed" to re-orient development paths towards those that are most climate friendly".*[1] Thus any effective strategy to promote responsible economic development must be grounded in and reconciled with the core national priorities, and economic and energy sector goals, pursued by developing nations.

The challenge for the developed world in working with developing nations on global climate challenges is to identify priority areas for collaboration and assistance. By identifying where climate efforts simultaneously meet development goals, future climate change funding and actions will serve the dual purposes of: increasing stability and development while reducing greenhouse emissions from developing countries. And now with Russia's ratification of the Kyoto Protocol it will shortly enter into force. But everyone involved fully appreciates that this is only a first step, and that the real challenge will be establishing an equitably framework to guide global cooperation in a post-Kyoto world. Crucial to this will be empowering all stakeholders with the skills and tools best suited to fostering informed decision-making on energy and environmental issues.

Understanding the complex nature of an energy system, as well as the options and alternatives for shaping its evolution over time, requires a modeling framework. Such a framework must allow the technology components and demand activities of the energy system to be represented at an appropriate level of detail. In addition, such a tool needs to be open so that all assumptions can be reviewed, with its strengths and weaknesses well understood. Over the past 20 years one modeling framework, MARKAL/TIMES[2], has continually evolved to meet the changing needs of the energy and environmental planning and policy community around the world. It is an ideal framework for assisting with the building a roadmap for cost effective technology cooperation.

Description

MARKAL (an acronym for MARKet ALlocation) is a generic model tailored by input data to represent the evolution over a period of usually 20 to 50 years of a specific energy-environment system at the national, regional, state or province, or community level. As depicted in Figure 1, technology characterizations (e.g., efficiency, availability, emission rates, costs), resource availability (e.g., amount available at a certain price), and environmental constraints (e.g., CAA requirements) are

[1] Thomas Heller & P.R. Shukla, "Developing and Climate: Engaging Developing Countries", Working Draft, July 2003, Pew Center on Global Climate Change.

[2] MARKAL/TIMES has been developed over a period of 30 years by an international collaboration under the auspice of the International Energy Agency by the experts participating in the Energy Technology Systems Analysis Programme (ETSAP), see www.etsap.org.

provided to the model, along with demands services (e.g., VMT, commercial lights, residential air conditioning) or macro-economic indicators (e.g., potential GDP, capital/labor ratios, demand/GDP relationships). The model then determines the optimal mix of technologies and fuels, the associated emissions, trading activity, and if using a form that supports flexible demands their level.

Applications

The MARKAL family of models is among the most widely used tools in energy-environmental analysis. Current users of the model total more than **100 institutions in over 50 countries**. Because of its flexibility, the model has been applied for local energy planning (at the municipality/utility/state and even African village level), and for policy analysis at the regional, national and even global level. The directly comparable results produced by the model allow multi-national analysis for

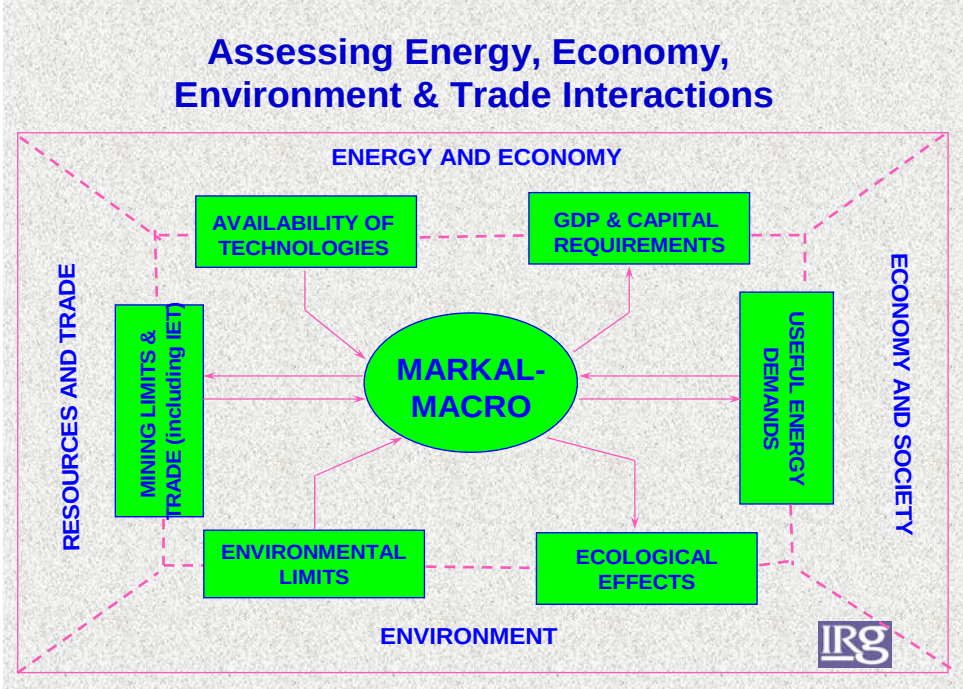

Figure 1: Integrated Model Overview

international cooperation. Listed below are some more prevalent uses of MARKAL including:

- energy security;
- identifying least-cost energy systems and investment strategies[3][4];
- identifying cost-effective responses to restrictions on environmental emissions and wastes under the conditions of sustained development[5];

[3] EC New Energy Externalities Development for Sustainability (NEEDS), www.needs-project.org. Follow-on projects include projects aims to evaluate the Renewable Energy Standards directives for the EU27 (http://www.res2020.eu/, and Risk of Energy Availability) and Common Corridors for Europe Supply Security (EACCESS), which is a techno-economic + environmental evaluation of global energy supply options for the EU in the context of long term sustainability and energy security.

[4] Enhanced Economic Modeling Capacity for Kazakhstan, http://www.sofreco.com/projets/c886/Reports.htm, Task 6.

- evaluating new energy markets, technologies and priorities for R&D;
- evaluating the effects of regulations, taxes, and subsidies;
- UNFCCC assessments and National Communication Action Plans[6,7,8];
- evaluation of options for a low-carbon future[9,10];
- examining rural energy use transition from traditional, highly polluting, energy forms[11];
- determine the costs and benefits of Renewable Portfolio Standards[12];
- looking at integrated local energy and waste management planning;
- Greenhouse Gas (GHG) baseline determination, mitigation project evaluation and estimate of the value of carbon rights[13,14], and
- determining the value of regional and international cooperation[15,16,17].

As an example of work done recently to support deliberations regarding the US climate change policy, the US Department of Energy worked in concert with numerous federal agencies (including US Environmental Protection Agency, Department of Commerce, others) to use MARKAL-MACRO for the core analysis for the Climate Change Action Report released in February 2002. This report focused on domestic actions that could cost-effectively reduce GHG emissions in the US.

The US Energy Information Administration (EIA) has selected a version of MARKAL as the analytical framework for the production of the *International Energy Outlook,* beginning in 2003. This

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[5] The Future of Natural Gas vs. Coal Consumption in Beijing, Guangdong and Shanghai: An assessment utilizing MARKAL, BinBin Jiang, Program Coordinator, http://pesd.stanford.edu/news/chinagasreport/, September 2007.

[6] *Second National Communication of Italy for the United Nation Framework Convention on Climate Change*, G.C. Tosato, M. Contaldi, and D. Gaudioso, prepared by ENEA for the Ministry of the Environment, 1999. Available from the Italian Ministry of the Environment, SIAR, Via Cristoforo Colombo 44, *I-00100 Roma; also www.unfccc.de*.

[7] *The Third National Communication of the Republic of Latvia Under the UNFCCC*, Ministry of Environment Protection and Regional Development, 2001, http://www.varam.gov.lv/vide/publik/Epub.htm.

[8] Loulou, R., et al, *Integrated Analysis of Options for GHG Emission Reduction with MARKAL*, Prepared for the Canadian National Climate Change Implementation Process, June 3, 2000.

[9] *Options for a Low Carbon – Phase 2*, prepared by AEA Technology Plc. for the UK Department of Trade and Industry, 2002, http://www.dti.gov.uk/energy/whitepaper/phase2.pdf.

[10] *Final Report on DTI-DEFRA Scenarios and Sensitivities using the UK MARKAL and MARKAL-Macro Energy System Models*, 2007, http://www.ukerc.ac.uk/ResearchProgrammes/EnergySystemsandModelling/ESM.aspx.

[11] *An Energy Model for a Low Income Rural African Village*, Program on Energy and Sustainable Development, Stanford University, June 2003, http://iis-db.stanford.edu/viewpub.lhtml?pid=20219&cntr=cesp

[12] *Including New and Renewable Technologies in Economy-level Energy Models*, Asia-Pacific Economic Cooperation, September 2002, APEC#202-RE-01.011, ISBN: 0-9726293-0-0.

[13] *Models to Asses the Implications of the Kyoto Protocol on the Energy System and Economy of Colombia*, Cadena Angela, HEC, School of Economy and Social Sciences, University of Geneva, Switzerland, 2000.

[14] USAID providing support to Panama, El Salvador and Honduras under CONCAUSA Plan of Action on Climate Change; and Bolivia to study the economic impact of reforestation for GHG mitigation.

[15] Northeast States for Coordinated Air Use Management, New England MARKAL Model, ongoing, http://www.nescaum.org/projects/ne-markal/index.html.

[16] "Energy Policy and Systems Analysis Project," 8-country (3.5 year) capability building undertaking sponsored by AusAID under Phase III of the ASEAN-Australia Economic Cooperation Programme, http://www.epsapforum.com/.

[17] USAID is support the Athens Forum process for Southeast Europe by promoting capacity building in eight countries of the region to look at the potential for and implications of increased access to natural gas, energy efficiency and accelerated economic growth.

variant, the System for Analysis of Global Energy markets (SAGE)[18], includes the ability to run MARKAL in a time-stepped manner. The International Energy Agency (IEA) has also embarked on a global model-building undertaking that will add more technology perspective to the *World Energy Outlook*, the *Energy Technology Perspective*[19].

The trade-off between socio-economic growth, energy and environmental policy, and the differing views of the various stakeholders involved, often make consensus building very challenging. Research sponsored by the US EPA has resulted in the incorporation of the ability to solve MARKAL according to the weighted preferences of the various stakeholders with respect to least-cost verses environmental goals. The trade-off curves produced during such an analysis can help to identify the point at which the economics of an environmental policy begin to spike and/or can be justified.

One multi-country international development undertaking deserves special attention, as it closely parallels the kind of capability building initiative(s) proposed for consideration by USAID (see Next Steps). This is the Australian Agency for International Development sponsored Energy Policy and Systems Analysis Project (EPSAP) underway in southeastern Asia. There is now buy-in at the highest levels from either countries and the main regional energy planning body (see Table 1). In the first phase of this multi-year undertaking, after successful construction of several national models, a diverse set of individual country studies, as well as two major regional projects (listed in Table 1) are being conducted. The long-term program is well on its way to successfully establishing a cooperative framework for both national and regional planning in the ASEAN countries.

Table 1: Australia's Agency for International Development sponsored Energy Planning and Systems Analysis Project (EPSAP)

"Country"	Participating Institution	Study Description/Status
ASEAN	ASEAN Centre for Energy	• The Trans-ASEAN Energy Network - Analysis of gas pipelines and electricity interconnections • ASEAN Energy Market Integration
Cambodia	Ministry of Industry, Mines and Energy	• National Energy Policy - Analysis of Options
Indonesia	Badan Pengkajian Dan PenerapanTeknoiogi	• Gas Utilization: National Gas Pipelines, Alternative Fuel Mix for Power Plant and Demand Sectors • The Future Demand for Natural Gas in Indonesian Regions with Particular Reference to the Use of CNG in Transport • Future Technologies for Power Plants in Indonesian Regions with Particular Reference to the Use of Renewable Energy and Small Scale Coal Steam Plant
Laos	Ministry of Industry and Handicrafts, Electricity	• Energy Security and Diversity.
Myanmar	Ministry of Energy	• Energy Self-Sufficiency - Options and Strategies

[18] *System for the Analysis of Global Energy* markets (SAGE), Model Documentation, US Energy Information Administration, 2003 -Volume 1, http://www.eia.doe.gov/bookshelf/docs.html.
[19] IEA Energy Technology Perspectives - Scenarios and Strategies to 2050, 2006 and bi-annually, http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1693.

Malaysia	PTM Malaysia Energy Centre	• Fuel Diversification - Economic and Environmental Impact of Alternative Fuel Mix • Cost and Environmental Impact of Renewable Energy Technologies • GHG Mitigation Options with Emphasis on Energy Efficiency and Renewable Energy Strategies
Philippines	Department of Energy	• Impact of Natural Gas Expansion • Promoting Renewable Energy in a Restructured Electricity Market • Increasing Renewable Energy Utilization by Full Cost Accounting of Electricity Supply
Thailand	National Energy Policy Office	• Removing the Subsidy on LPG and Implementing a Policy to Increase the Use of CNG in Transport • Fuel Options for Power Generation • Renewable Energy
Vietnam	Ministry of Industry	• The Strategy Orientation for Electricity Supply • Analysis of Power Development Strategies in Compliance with Environmental and Energy Security Issues • Energy Pricing and its Implication for Energy Efficiency and Environment

A second such multi-lateral undertaking is the USAID sponsored Southeast Europe Regional Energy Demand Planning (SEE-REDP) project, which is looking to build capacity among the eight countries of the region. Table 2 identifies the various participating ministries and institutions.

Table 2: US Agency for International Development sponsored Southeast Europe Regional Energy Demand Planning (SEE-REDP)

Participants	Steering Committee	Technical Working Group
Albania	National Energy Agency	National Energy Agency
Bosnia	Ministry of Foreign Trade and Economic Relations	Ministry of Foreign Trade and Economic Relations Federal Ministry of Energy, Mining and Industry Energy Ministry of Republika Srpska
Bulgaria	Ministry of Economy and Energy	Ministry of Economy and Energy
Croatia	Ministry of Economy, Labour and Entrepreneurship,	Ministry of Economy, Labour and Entrepreneurship, Energy Institute Hrvoje Pozar Croatian Electric Power Utility
UNMIK	Ministry of Energy and Mining	Ministry of Energy and Mining Energy Regulatory Office
Macedonia	Electric Power Company of Macedonia	Electric Power Company of Macedonia
Romania	National Power Grid Company - Transelectrica	National Power Grid Company - Transelectrica
Serbia	Ministry of Energy and Mining	Electric Power Industry of Serbia

Using the energy/environment nexus to foster increased cooperation between neighboring countries, besides being mutually beneficial in terms enabling more rapid economic growth and thereby alleviation of poverty, will serve as a basis for promoting wider cooperation on other priority issues common to those countries participating in such undertakings. But to be successful such an initiative requires the proper platform, framework and local buy-in and commitment.