Volume X, No.1 Dec. 2005

IEA OECD ETSAP news

ANNEX X: GLOBAL ENERGY SYSTEMS AND COMMON ANALYSES

REGIONAL PLANNING AND COOPERATION

The objective of the ETSAP Newsletter is to keep ETSAP participants and the wider energy planning and modeling community informed of advancements the methodology and the status of significant projects completed, underway, or in the planning stage employing the ETSAP Tools.

This issue of the ETSAP Newsletter focuses on the importance of regional planning and cooperation in addressing the energy challenges of the future. The specific projects presented in this issue are:

- The NEEDS Project, "New Energy Externalities Developments for Sustainability" for the EC;
- The Energy Policy and Systems Analysis Project (EPSAP) support by AusAID;
- CASCADE MINTS, a multi-modeling project for the EU; and
- A local scale application of MARKAL in the "Industrial Districts for Earth Observation" in Basilicata (Italy).

In this issue

Visit ETSAP on the www:

http://www.etsap.org

Information on ETSAP, its activities and members is also provided on the Internet. The home page contains the latest news, general information on ETSAP, and links to: ETSAP member; ETSAP 'outreach' activities; description of the MARKAL model and its users; archives of new item; selected publications and the ETSAP Newsletter.

The next Newsletter will focus on the IEA's G8 Program of Work (PoW) and ETSAP's contribution to the PoW.

TO THE MEMORY OF ALAN MANNE TRIBUTE

The newsletter is dedicated to the memory of Professor Alan Manne, whose pioneering efforts and substantial contributions to the world of energy planning and modeling are widely recognized. His legacy was spawned after graduating from Harvard by his groundbreaking work in operations research at the Rand Corporation. He is recognized as the "father" of the practice employing optimization techniques for energy/economic/environmental system modeling. He is best known for his long association with the Stanford Department of Operations Research. He wrote seven books and more than 120 papers, and guided dozens of doctoral students and researchers from around the world. He was a co-founder of the International Energy Workshop which he then co-stewarded for 24 years.

You are referred to the San Francisco Chronicle obituary and Spring 2005 articles for additional information

http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2005/09/29/BAGK2EVMDP1.DTL

and

http://sfgate.com/cgi-bin/article.cgi?file=/c/a/2005/06/03/PNGPGCUNPD1.DTL

Alan was a great inspiration, mentor and friend to many. Those who got to know him are well aware of what a very special individual he was, and how lucky they were to have had him touch their lives. His presence will be greatly missed, though not forgotten.

IEA OECD ETSAP news

THE NEEDS PROJECT: MAIN ISSUES AND STATE OF ART

Overview of the Project

NEEDS, "New Energy Externalities Developments for Sustainability" (http://www.needs-project.org), is a four-year Integrated Project supported by the Directorate General for Research of the European Commission in the context of the VI Framework Programme, Priority 6.1: Sustainable Energy Systems and, more specifically, Sub-priority 6.1.3.2.5: Socio-economic tools and concepts for energy strategy. Its objective is to evaluate the full costs and benefits (i.e. direct + external) of energy policies and of future energy systems, both at the level of individual countries and for the enlarged EU as a whole. In this context NEEDS refines and develops the externalities methodology already set up in the ExternE project.

NEEDS is organized as a series of Research Stream (RS) (Figure 1) in order to entail major advancements in the current state of knowledge in four main areas:

- Life Cycle Assessment (LCA) of energy technologies;
- Monetary valuation of externalities associated to energy production, transport, conversion and use;
- Integration of LCA and externalities information into policy formulation and scenarios, and
- Multi-criteria decision analysis (MCDA) to examine the robustness of the pro-posed technological solutions in view of stakeholder preferences.

NEEDS consortium includes 66 partners (of which some 15% are SMEs), representing 26 Countries (12 Member States from the EU-15, 9 new EU Member States, 3 Mediterranean Countries, and 2 Countries from other parts of the World). It presents a balanced mix of Universities, Research Institutions (both public and private), Industry, NGOs. Most leading institutions in the area of energy externalities research are represented.

The RS 2a "Energy systems modelling and internalisation strategies, including scenarios"

Main objectives and expected results

This stream, in which many ETSAP members are involved, aims at generating technology rich economic models via The Integrated MARKAL-EFOM System (TIMES) partial equilibrium for each MS/NAC and the EU as a whole, encompassing, in their long term development (time horizon 2050), the most important emissions, materials, and damage functions used by LCA and ExternE.

According to different policy options and exogenous scenario assumptions for the time horizon under analysis, this research stream will provide equilibrium quantities and prices for energy (primary energy and secondary fuels), technologies, emissions (GHG and local air pollutants) and other burdens. These results are input to both LCA and ExternE for iterative, convergent evaluations. The framework will be used to analyze different policy and measure schemes in support of national decision-making within an EU-wide context.

State of art

The main achievements of the first year activities are summarised here. The RS2a toolbox was organized, the basic common RES and a list of commodities were defined, and common data sources were selected for defining the base year energy flows and existing stock of buildings and technologies. The basic templates were presented in April 2005 and refined over the next months. The TIMES model generator and VEDA analyst support system were advanced, and several new features were introduced to the data specification templates.

Subsequently a reference list of existing and future technologies for all parts of the energy system was established, while experts gathered information on country specific options. A selection of scenarios of interest is currently ongoing and will involve a reference scenario, based on a business as usual assumptions, and policy cases of interest for EU stakeholders.

Most partners are in the process of completing the country templates and basic training in use of the packages, and some are in the process of implementing their basic country models. The work done so far has been accompanied by several training activities on the VEDA interfaces and the Templates, supported by comprehensive documentation, and by a first report on Integration of ExternE, LCA and MARKAL/TIMES.

As for the next 18 months, the main issues of RS2a will deal with the finalisation of the Pan European

model design and interfaces as well as the implementation of the basic country models, testing their consistency in the reference scenario and analysing their response to perturbation in the boundary conditions (sensitivity analysis). The database of reference technologies will also be completed. In particular, the main objectives of this next phase are:

- Definition of the context parameters of reference and alternative scenarios;
- Characterisation of the reference technologies;
- Implementation of the country specific models;
- Definition of the optimal configuration relatively to energy vectors, technologies and emissions pathways for various scenarios;
- Definition of the equilibrium prices of commodities for various scenarios;
- Identification of Pan – EU trading variables, parameters and values of the trading conditions between the countries;
- Identification of ExternE/LCA parameters which will be integrated in the Pan European Model;
- Extension of spreadsheet interface to accommodate the Pan-European model trading variables;
- Implementation of finalized VEDA-FE and BE interfaces, and
- Implementation of the Pan European model.

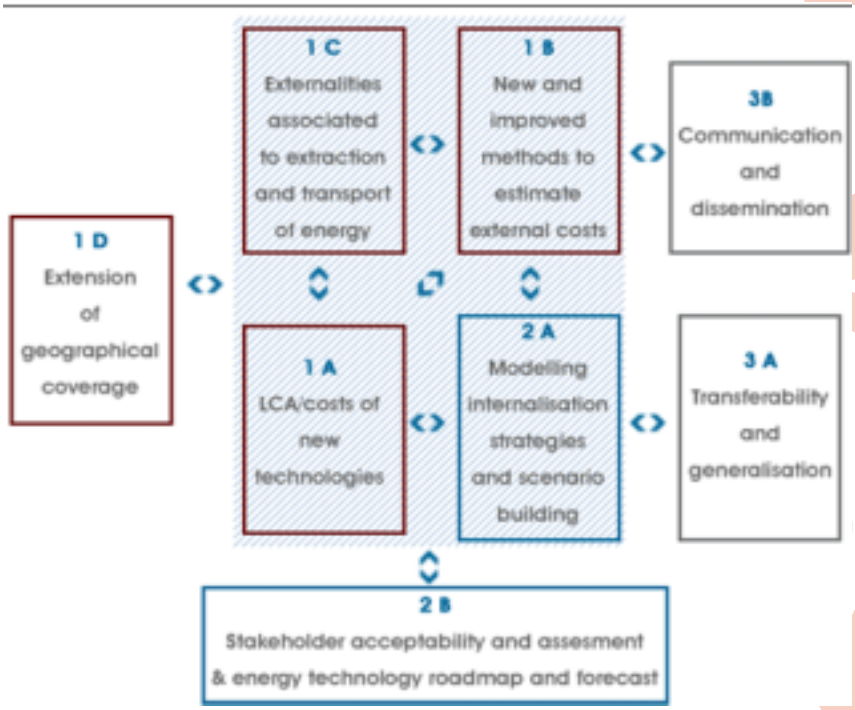

Figure 1: Integration activities and Research Streams organisation in the NEEDS project (Source: NEEDS website).

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THE ENERGY POLICY AND SYSTEMS ANALYSIS PROJECT (EPSAP)

The Energy Policy and Systems Analysis Project (EPSAP) sponsored by Australian Agency for International Development (AusAID, the Australian government overseas aid organization) was concerned with capacity building in energy analysis and policy formulation with particular emphasis on use of the MARKAL energy model. Its primary aim was to:

"enhance the capacity of ASEAN energy policy makers and planners to assess the impacts and cost effectiveness of alternative energy policy options that could assist countries to formulate policies and programs to help meet the demand for energy at least cost".

The project took place over the period February 2002 to August 2005 divided into three annual cycles. Specific objectives were to:

- Provide training and assistance

to build National teams into proficient MARKAL users;
- Establish MARKAL databases both nationally and for the ASEAN region;
- Have energy systems analysis accepted as a viable tool to assist policy making;
- Conduct National policy studies and produce reports each of the three years, and
- Conduct a Regional policy study and produce a report each of the three years.

Project Details

The project was managed by an Australian Managing Contractor, a consortium of two firms – SMEC International and Intelligent Energy Systems.

The project was provided with overall direction by a Project Co-ordinating Committee (PCC), which met bi-annually, with one member from each participating country. AusAID also appointed an independent Technical Advisory Group to monitor quality control of operations and policy studies. All policy reports were reviewed externally by ABARE (Australian Bureau of Agricultural and Resource Economics).

Another important component in the project structure was the appointment of Host Organizations to provide focal points for policy studies and training. These roles were filled by Intelligent Energy Systems that acted as the Australian Host Organization (AHO), and the ASEAN Centre for Energy (ACE) in Jakarta that acted as the Regional Host Organization. The role of the AHO was to:
- Receive two analysts from each country for a period of two weeks each year and provide training and preparation for the national policy study, and
- Maintain ongoing collaboration after project end.

ACE's role was to:
- Co-ordinate the regional policy studies, and
- Accommodate two analysts from each country each year to participate in the regional policy study.

The countries participating in EPSAP were Indonesia, Malaysia, Philippines, Thailand and Vietnam. Three other countries – Cambodia, Laos and Myanmar – were also able to participate for a limited time under a separate but closely related project also financed by AusAID. Each participating country was required to:
- Provide National guidance by establishing a National Co-ordinating Committee (NCC);
- Nominate a member to the PCC exercising overall project control;
- Establish a National project team of analysts to develop the MARKAL database and perform policy studies, and
- Send analysts to AHO and ACE for training and participation in policy studies.

A technical meeting was held each six months, usually in conjunction with PCC meetings, under the guidance of AAMRUG (ASEAN Australian MARKAL Regional Users Group). The meetings involved the discussion of technical issues and presentation of results of National policy studies.

The variety of policy studies undertaken can be gauged from the following list, with topics chosen by the country's NCC.

Country	First	Second	Third
Indonesia	Gas utilization: national gas pipelines, alternative fuel mix for power plants and demand sectors in Indonesia	The future demand for natural gas in Indonesia	Future technologies for power plants with particular reference to the use of renewable energy and small scale coal steam plant
Malaysia	Fuel diversification: Economic and environmental impact of alternative fuel mix targets for Malaysia	Cost and environmental impact of renewable energy in Malaysia	GHG mitigation options with emphasis on energy efficiency and renewable energy strategies
Philippines	Impact of natural gas market expansion	Promoting renewable energy in a restructured electricity market	Increasing renewable energy utilization by full cost accounting of electricity supply
Thailand	Removing the subsidy on LPG and implementing a policy to Increase the use of LNG in transport	Fuel options for power generation in Thailand	Renewable energy in Thailand
Vietnam	The strategy orientation for electricity supply	Analysis of power plant development strategies in compliance with environmental and energy security issues	Energy pricing and its implication for energy efficiency and environment
Regional	Trans-ASEAN energy network	ASEAN energy market integration	Policies and strategies towards energy trade and sustainable development in ASEAN

Regional Database

A Regional database was constructed by consolidating individual country databases into a single database plus the addition of elements to accommodate interregional trade in pipeline gas and electricity. Later inter-ASEAN trade in LNG was also included. The resulting database is rather large:

- 22 regions;
- 20 cross-border gas pipelines;
- 14 cross-border electricity links, and
- Approximately 40,000 variables; 37,000 equations; 270,000 non-zero coefficients.

The main issue was synchronizing time divisions to handle electricity trade. Because load curves in ASEAN tend to be relatively flat throughout the year and the importance of wet and dry seasons for hydro generation, the year was divided into wet/dry and peak/ shoulder/off-peak time divisions.

The following two diagrams illustrate the extent of cross-border links between the countries.

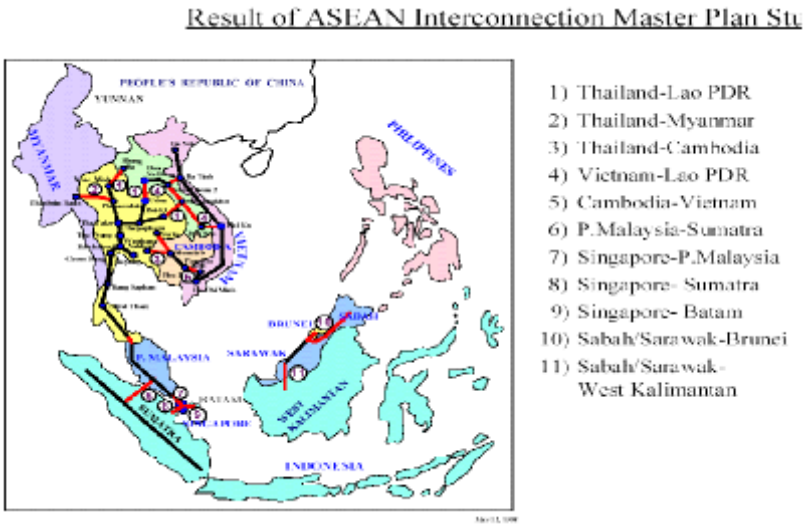

Figure 1: Potential electricity transmission links

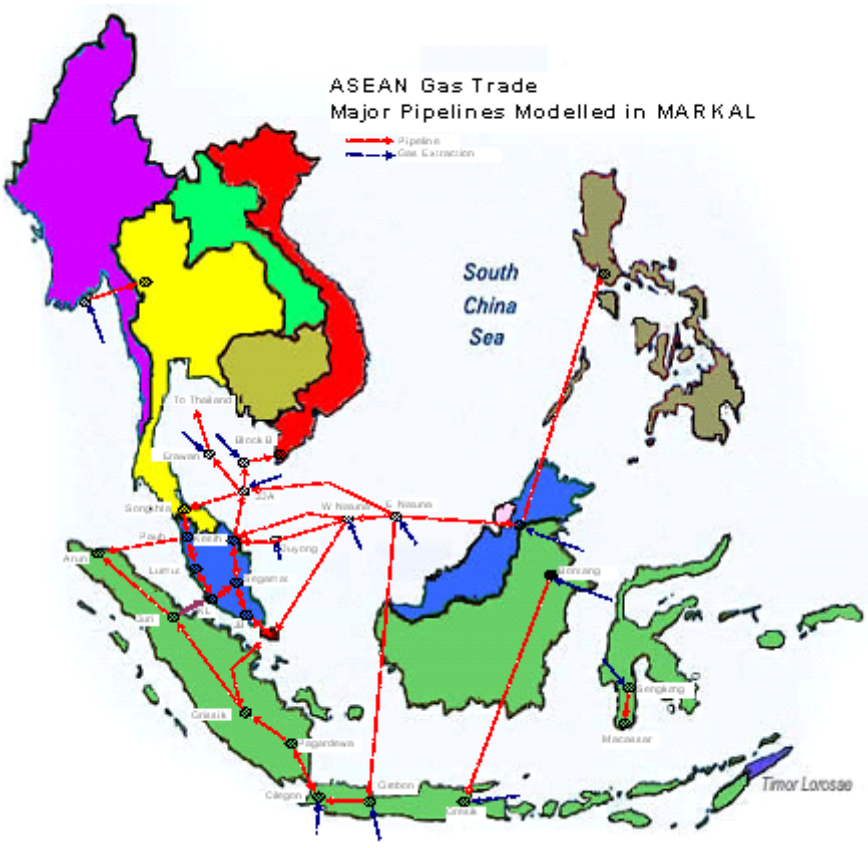

Figure 2: Major gas pipelines in MARKAL

Regional Policy Studies

The regional policy studies have focused on energy trade and sustainable development in ASEAN. They follow on from previous work by the TAGP (Trans-ASEAN Gas Pipeline) and AIMS (ASEAN Interconnection Master Plan Study) groups. But these earlier studies analysed pipeline and transmission link strategies separately so the integrated MARKAL studies add value by examining the total energy system. This is highlighted by the observation that the separate TAGP and AIMS plans have inconsistent fuel strategies in the power sector.

MARKAL results indicate a saving of around US$4 billion for the EPSAP optimized plan compared to TAGP/ AIMS plans. In the latter, some proposed interconnections appear over-ambitious. This shows the necessity to consider the integrated system – both gas and electricity – and the importance of optimized planning to extract maximum benefit from cross-border investment in infrastructure and trade.

Another importance result was that improving power plant performance and lifetime in the power sector to world's best practice could potentially be worth on the order of US$9 billion.

The EPSAP studies indicate that LNG is likely to play a major role in energy strategies for ASEAN for trade both within ASEAN and with the outside world. Already two countries – Indonesia and Malaysia – are among the largest exporters of LNG in the world. Notwithstanding the development of gas pipelines in ASEAN, LNG would allow currently isolated gas fields to be exploited. Natural gas is used mainly for electricity generation in ASEAN but opportunities exist to extend this to industry, transport and the commercial/residential sectors. MARKAL enables the gas resources to be valued at their opportunity value and hence optimally utilized.

Sustainable development is of great concern in ASEAN and many of the countries have significant renewable resources, particularly hydro and bagasse and other biomass fuels. These can be used in electricity generation or heat production as well as in the production of biodiesel or ethanol for transport fuels. A number of the countries have examined the latter as part of their national policy studies but have found subsidies of some kind would be required. However, these studies were undertaken when the "conventional" wisdom was that oil would be around $30 per barrel so may now need repeating with the upward pressure on oil prices.

Finally, the recently completed third policy study has clearly demonstrated the benefits of adopting a regional rather than national approach if green house gas mitigation becomes a priority in ASEAN, either from International obligation or by policy decision in ASEAN. As an illustration, to implement an annual 10% cut in emissions could cost around US$3 billion less in discounted terms over 35 years if a regional rather than national approach were taken.

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CASCADE MINTS - A MULTI MODELING PROJECT

The challenges

In the coming decades Europe's energy system is facing a number of challenges. Some of these, such as the enhanced greenhouse effect and depletion of fossil fuel resources, have a worldwide dimension. Consequently, the strategies for tackling these issues must be designed taking worldwide developments into account. Alternative energy sources and new technologies will have to play a key role. In the analysis of the potential impact of new technologies and the evaluation of possible policy options, energy - economy - environment (E3) models can provide useful insights.

The project

In the CASCADE MINTS project, partially funded by the EU Sixth Framework Programme, fifteen E3 models are being used to evaluate possible developments of the world energy system and the implications for Europe. CASCADE MINTS is split into two distinct parts:

- Part 1, coordinated by NTUA, focuses on modeling, scenario evaluation and detailed analysis of the prospects of the hydrogen economy.
- The objective of Part 2, coordinated by Energy Research Centre of the Netherlands (ECN), is to use a wide range of existing energy and energy/economy models to build analytical consensus concerning the impacts of policies aimed at sustainable energy systems. Common policy case studies are carried out using a wide variety of models. This part involves modeling teams from both inside and outside the EU. The emphasis is placed on evaluating the effects of policies influencing technological developments.

The models

The models used in CASCADE MINTS Part 2 are representative of

the variety of analytical approaches used in current energy and climate policy analysis. The models are classified below, although many have 'hybrid' characteristics, reflecting the trend among modelers to build on the strengths and mitigate the drawbacks of a given approach.

	Top down		*Bottom up*	
Geographical coverage	Macro-economic	CGE	Energy System Optimisation	Integrated Energy System simulation
Global		AIM NEWAGE	DNE21+ ETP GMM MESSAGE	POLES
			PROMETHEUS	
US, Canada				NEMS MAPLE
Europe	NEMESIS	PACE	MARKAL Europe TIMES-EE	PRIMES

The main energy trends

This section presents some selected results from a joint baseline, providing a basis for the analysis of several strategies, based on renewables, nuclear power, carbon capture & storage and hydrogen, which may help to counter concerns about global warming, air quality, energy security and more..

The challenge of climate change remains

It is highly likely that global warming is attributable to human activities, in particular to emissions of greenhouse gases. All models project a continuing growth of these emissions, of which CO_2 is dominant. Overall, the CO_2 emissions in 2030 are expected to be approximately twice the level of 1990, the base year of the Kyoto Protocol. The largest growth is expected to occur in the developing world, in particular in Asia. There is a large variation in emissions projections between models, attributable to the differences in the primary energy mix, particularly the share of fossil fuels. These differences are due to different assumptions on technological development and the associated technology costs.

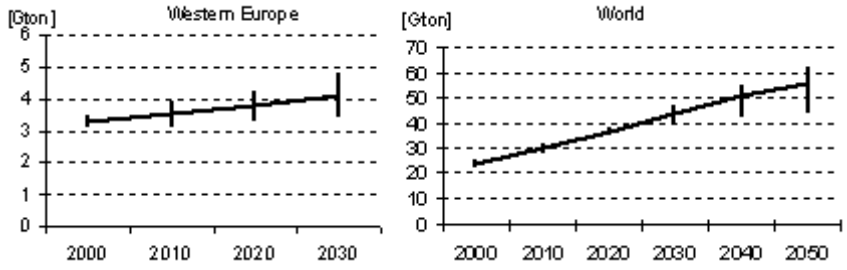

Figure 1: Range among models in average energy related CO2 emissions projections

Although CO_2 emissions in Western Europe show moderate growth as compared to the global trend, it is not on track towards the target agreed under the Kyoto Protocol. Beyond 2012, assuming that some type of climate policy is in place in Europe, reflected in a moderate carbon tax of 10 •/ton CO_2, emissions are expected to continue their growth with ca 0.4% per year.

Security of supply becomes a key issue

As a result of a continuing global reliance on fossil fuels, an important issue in the years to come will be the increasing dependence on oil from the Middle East. Although the models show different projections for oil production, they agree that the contribution from the Middle East region becomes substantially larger. Given the uncertainty with respect to future oil prices, this may lead to increased concerns about the security of oil supply. Europe's dependence on oil from the Middle East is expected to increase up to 85%. As other world regions, such as Asia, also increasingly rely on oil from this region, increased pressure on oil price can be expected.

For natural gas, external dependency will also grow in the next decades. A continuing growth in gas consumption combined with a decrease production in the UK, the Netherlands and Norway, will lead to a higher share of imports, probably from the two main suppliers Russia and Algeria. Additionally, the accession of the new Member States and their heavy reliance on supplies from Russia increases the risks related to gas supply security. On the

other hand, enlargement is expected to reduce the risks associated with transit of gas across the New Member States towards EU-15.

Acknowledgement and further information

The CASCADE MINTS project is partially funded by the EU under the Scientific Support to Policies priority of the Sixth RTD Framework Programme. More information on the project and the consortium can be found on www.e3mlab.ntua.gr/cascade.html, while all publications are available on http://www.energytransition.info/cascade-mints.

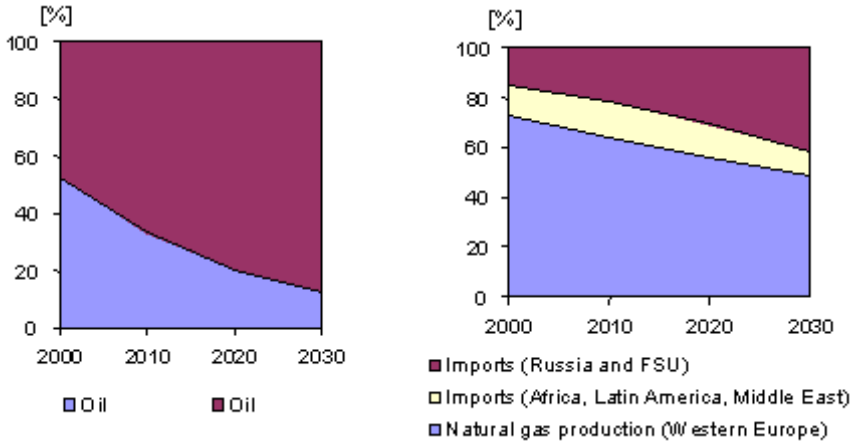

Figure 2: Shares of production and imports of oil and natural gas (Western Europe)

A LOCAL SCALE APPLICATION OF MARKAL IN THE FRAMEWORK OF THE ITALIAN NATIONAL OPERATIVE PROGRAMME (PON) "DEVELOPMENT OF INDUSTRIAL DISTRICTS FOR EARTH OBSERVATION - COS (OT)2

Overview of the project

The project "Development of Industrial Districts for Earth Observation - COS (OT)", financed by the Italian Ministry of University and Research (MIUR) in the framework of the Italian National Operative Programme (PON) 2002 – 2006, is aimed to support new services and technologies for earth observations and environmental protection by promoting R&D, technology innovation and spin-off actions. The focus is on air pollution monitoring, prevention and mitigation of natural hazards and strategic environmental planning.

The COS (OT) consortium includes 21 partners, representing a balanced mix of Universities, Research Institutions, Industries, and services companies.

Objectives and methods

In the framework of the COS(OT) project, the work performed by the National Institute for Physics of Matter – INFM (from June 2003 merged into the National Research Council - CNR) in the research stream OR3: "Implementation of comprehensive models for supporting energy-environmental planners and decision makers in the definition of local scale strategies aimed to the reduction of local air pollutants and GHGs." The case study considered was the Val D'Agri energy system (Basilicata Region, Southern Italy), a place of naturalistic interest recently affected by a huge development of oil mining activities, representing the largest oilfield of Italy. An innovative methodological approach was applied, merging the MARKAL comprehensive energy system model and Life Cycle Assessment (LCA) techniques to determine the overall environmental impact due to the different life cycle phases, with particular regard to fuel extraction and waste disposal (Figure 1). The combined application of these two methodologies is used to estimate in much detail the environmental impacts of energy system evolution by means of "cradle to grave" characterisation of the sub-systems within the overall energy system.

In this study, the impacts of oil mining activities, fossil fuels use and waste disposal processes were preliminary estimated by using LCA. The results were subsequently fed by a soft

linking into the MARKAL - Val d'Agri model to assess the overall impact of anthropogenic activities in terms of a selected "Core set of Indicators" of the European Energy Agency – EEA (total energy uses, total energy use per fuel, energy production from renewable sources, total emissions of several pollutants, etc.) and to derive sound climate policies for a medium term time horizon.

Scenarios analysis

A reference basic scenario (*Base*) was implemented to calibrate the MARKAL-Val d'Agri model and to point out the unconstrained optimised development of the energy system with reference to the standard commodities and to the additional environmental parameters (aggregated impacts indicators) provided by LCA.

Beside the reference scenario, three environmental scenarios were analysed: *CO2*, *Impacts* and *Eco-taxes*. The *CO2 scenario* includes three cases with increasing constraints on CO_2 emissions (from 1% to 5 % of the *Base* scenario levels); the *Impacts* scenario, is made up of four cases that analyse the effects of exogenous constraints on aggregated impacts indicators (greenhouse effect, acidification, winter smog, and a combination of these three indicators), whereas in the *Eco-taxes* scenario, external costs were introduced as taxes on CO_2, NO_x, SO_2, TSP e VOC emissions, one at a time and then all together (Tax-TOT case), to evaluate the economic impact of environmental pollution and the effectiveness of environmental taxes in mitigation strategies.

As concerns energy consumption, a 10% reduction of the total amount can be observed in the Base case, due to an optimised use of resources, no regret insulation interventions in Residential and the increase of efficiency in the end-uses devices (boilers, electrical appliances). This percentage increases not significantly (about 1%) in the environmental constrained scenarios, but many changes in resource use can be observed, with particular regard to electricity production. The reduction of anthropogenic environmental impacts is in fact obtained by increasing the endogenous production of electricity by renewables (+ 17%), in particular wind energy and hydro, which substitute for the thermal plants and imports from neighbour regions (Figure 2).

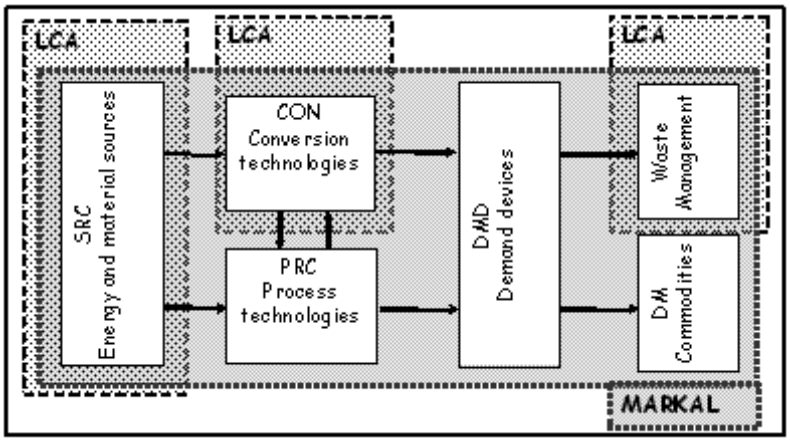

Figure 1: Intersections between LCA and MARKAL in the Val d'Agri case study

The environmental constraints determine an increase of the total discounted energy system cost which ranges from 2 to 18% (GHG case).

A comparison of the results obtained in the different scenarios allows deriving some general conclusions:

- the reduction of energy consumption is a key component for defining sustainable energy-environmental policies and can be obtained by an increase of efficiency and energy saving interventions;
- the use of renewable energy sources is a key point for improving air quality and reducing energy dependence, which represents one of the main objectives of the European Commission;
- the evaluation of environmental impacts should be based on the overall life cycle of goods and services, taking into account construction, use and disposal phases;
- the cost increase associated with reducing pollutant emissions is mitigated by the cost gap among traditional and innovative technologies, and should be evaluated taking into account external costs in order to account for environmental benefits related to avoided emissions, and
- Eco-taxes can be an effective

tool in environmental and economic terms to reorient consumers and enterprises towards eco-compatible products, processes and services.

A further analysis of the solution by means of Multi-criteria decision analysis (MCDA) techniques is envisaged to individuate the "robust" strategies and to establish the priorities for the local energy environmental strategies.

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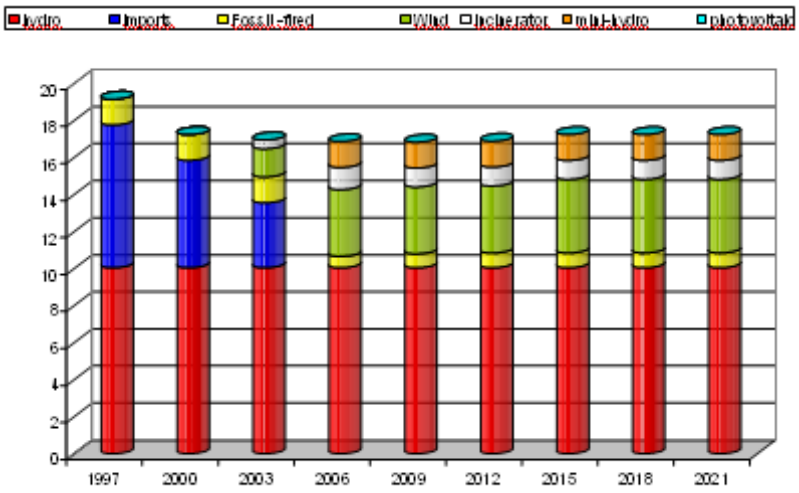

Figure 2: Electric energy production by fuel (EE25 - Indicator of EEA) CO2-5 case.

Operating Agent

The IEA/ETSAP Newsletter is published under Annex X "Global Energy Systems and Common Analyses " of the Implementing Agreement for a Programme of Energy Technology Systems Analysis". Operating Agent for ETSAP/Annex X is the Energy Department of the Politecnico of Torino (http://www.polito.it/ricerca/dipartimenti/dener).

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ISSN 13823264