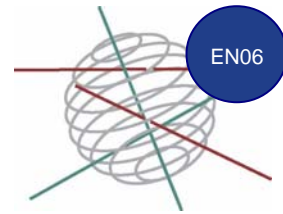


# TUMATIM



## Treating Uncertainty and risk in energy systems with MARKAL/TIMES

DURATION OF THE PROJECT  
15/12/2007-31/12/2010

BUDGET  
414.774

KEYWORDS  
Model, energy system, uncertainty, price elasticities

### CONTEXT

Climate change remains a high priority research theme because an efficient and effective international and national climate policy is a necessary condition for sustainable development. When current GHG emission patterns are continued, and when no further measures are taken to curb these GHG emissions, projected climate change will cause considerable damages to both natural and human systems, as stressed by the IPCC Working Group II Fourth Assessment Report in 2007. The commitments regarding GHG emission reductions will need important efforts from different sectors and actors. The development and implementation of new technologies are also crucial elements in achievements of GHG emission reductions. There is therefore a need for an instrument to evaluate the role of sectors and technologies in a verifiable and consistent manner.

### Methodology

MARKAL/TIMES is a technico-economic model, which assembles in a simple but economic consistent way technological information (conversion-efficiency, investment- and variable costs, emissions, etc.) for the entire energy system. It can represent all the energy demand and supply activities and technologies for a country over a horizon of 40/80 years, with their associated emissions (CO, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub>, VOC and PM) and the damages generated by these emissions.

The further development of the modelling framework concerns two aspects, the integration of a risk component in the evaluation of technologies with the model and an estimation of energy service demand price elasticities.

Uncertainty and risk linked to energy technologies, energy supply and climate change increases the difficulty of defining appropriate policies. The idea is to explore the portfolio approach to integrate uncertainty in the Markal/Times model, with as starting point the building of a small portfolio technology model for the electricity sector. The quantification of the uncertainty regarding technology parameters, energy prices and climate change will be done through probability distribution functions.

Price elasticities in the demand components of Markal/Times are an important element and not well known. The intention is to apply improved econometric methodologies to make it possible to differentiate between the energy price elasticity and the energy service (also called useful energy) elasticity. "Useful energy" or "energy service" can be defined as the service that comes from the consumption of energy in various aspects of daily life, assuming no (or only very limited) preferences for the technological choices. Price increase causes energy efficiency improvements. Consequently energy services or useful energy decrease will be less than energy consumption.

Furthermore, as the reliability of MARKAL/TIMES depends to a large extent on the quality of the database, the database maintenance remains an important activity.

### PROJECT DESCRIPTION

#### Objectives

The main objective of this project is to further develop the MARKAL/TIMES model through a better integration of the impact of uncertainty in the evaluation of energy and environmental policies and the estimation of the energy service demand price elasticities and to support the Belgian climate change policy. Various issues related to sustainable energy (climate change, energy security, air quality) will be examined with the model. The policy analysis with MARKAL/TIMES will be complemented with analysis with the computable general equilibrium model GEM-E3 to evaluate the macroeconomic and sectoral implications of the policies. Moreover, the Pan European TIMES model will contribute to the examination of the European dimension of the policies. The project lies in the prolongation of previous projects with MARKAL/TIMES, financed by the Belgian Science Policy and builds on the experience and model development done during these projects.



# TUMATIM

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Database maintenance activities include the follow-up of energy demands and analysing shifts in energy demand, including new (emerging) technologies, analysing market penetration of existing technologies, gathering information on existing installations (existing capacities - residual lifetime), reviewing energy prices, follow up of industrial developments and activities.

Energy policies regarding important issues for a sustainable energy development, such as energy efficiency, energy security, climate change, air quality, will then be examined with the further developed Markal/Times. The European dimension of these policies will be treated with the Pan European TIMES model, while the macroeconomic and sectoral impact of the policies will be evaluated with GEM-E3, a computable general equilibrium model for EU25 countries. The precise definition of the scenarios will be done taking into account the policy issues which are in debate and in close collaboration with the policy makers during the project.

## EXPECTED RESULTS AND/OR PRODUCTS

There are four outputs expected:

1. risk and uncertainty in technology evaluation
2. demand price elasticities
3. an update and extension of the technological databank of TIMES,
4. a set of case studies which can contribute to the design of the climate change policy for Belgium.

## SCIENTIFIC COLLABORATION

ETSAP (Energy Technology Systems Analysis Programme) is a collaboration agreement within the International Energy Agency which concentrates its work on "Energy Options for sustainable Development". The ETSAP-network is in charge of the maintenance of most of MARKAL model software (databasemanagement system and model specification) and organises two workshops per year where the experience with case-studies of some 20 countries are compared. Results from common case-studies are presented in international fora, organised ea. by IEA and can contribute to the negotiations within the United Nations Framework Convention on Climate Change (UNFCCC).

## INTERACTION BETWEEN THE PARTNERS

Two partners are involved in this project:

Centrum voor Economische Studiën, KULeuven (CES)

Vlaams Instituut voor Techno-logisch Onderzoek (VITO)

**VITO** is responsible for the demand price elasticities and the extension and maintenance of the databank, while

**CES** will concentrate on the integration of risk/uncertainty aspects in technology evaluation. Both partners will contribute to the case-studies.

## CONTACT INFORMATION

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### Follow-up Committee

For the complete and most up-to-date composition of the Follow-up Committee, please consult our Federal Research Actions Database (FEDRA) by visiting <http://www.belspo.be/fedra> or <http://www.belspo.be/ssd>

