



## COST ASSESSMENT FOR SUSTAINABLE ENERGY SYSTEMS

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Newsletter of the CASES project

N°3- September 2008



### Editorial

*“The last 30 years have seen radical changes in the world’s energy scene that made energy decisions and policy making a highly complex issue.*

*The sharp increase of energy prices disclosed all the hidden constraints behind the simple-minded perception of plentiful, affordable and cheap energy. At almost the same time, environmental concerns for either the depletion of conventional energy resources or the ongoing environmental degradation imposed a reconsideration of values and a shift towards new technological solutions. Cost, although still being the market’s driving force, was no longer enough to reflect the society’s multiple, incommensurate and often conflicting concerns.*

*Typical questions illustrating the task of energy planners in this new context were:*

- *Which type of energy resource or conversion technology to use?*
- *How to combine different energy sources and technologies in order to meet present and future energy needs?*
- *Where to locate new energy conversion or transmission facilities?*
- *How to produce more sustainable electricity?*
- *How to reduce the emissions of the power sector? ”*

*In this context, during the past six months, the CASES project focused on the assessment of policy instruments, which internalise external costs in the electricity sector.*

*The project, which focuses on the efficiency of the electricity market, evaluated policy instruments, with the support of a complete database of social costs obtained by summing damage costs and private costs, to choose the best ways to improve an energy system sustainable from an economic, social and environmental point of view. The final result the project is a set of electricity scenarios by primary fuel for 2010, 2020 and 2030 for Europe and for selected non-EU countries (Brazil, India, China and Turkey).*

*This is the last issue of the CASES newsletter. This has been an exiting project that lad to significant results, but also, more importantly, to many occasion of professional interaction among energy professionals. The Coordination team would like to take this opportunity to thank all the partners in the CASES project, the European Commission’s officers who followed it in these very exciting 30 months, and finally the stakeholders whose suggestions and comments have been invaluable in getting the pulse of the overall perception of role of electricity generation’s social costs in the European energy systems.*

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## Description of the CASES project

CASES is a coordination action funded by the European Commission (FP6, Sustainable Energy Systems, 2006-2008). It evaluated policy options for improving the efficiency of energy use. Underpinning this evaluation is a consistent and comprehensive database of the full cost of energy. One of the objectives of the project was to make this crucial knowledge available to all stakeholders.

In particular CASES compiled a complete and detailed estimate of both private and external costs - including energy security costs - of electricity generation. The set of assessed costs covers a wide set of technologies for electricity production for all the EU-27 Countries and some non-EU Countries, under well defined energy scenarios to 2030. Hence, the full cost of electricity production for each technology is calculated by considering the private costs and all external costs.

The cost database provides a crucial quantitative support to the assessment of alternative policy options in the perspective of improving the efficiency of energy use. CASES provides a set of recommendations on the use of different policy instruments for the internalisation of the external costs of energy production. Hence the project contributes directly to policy and provides an information base on the effectiveness and on the consequences of the use of different instruments.

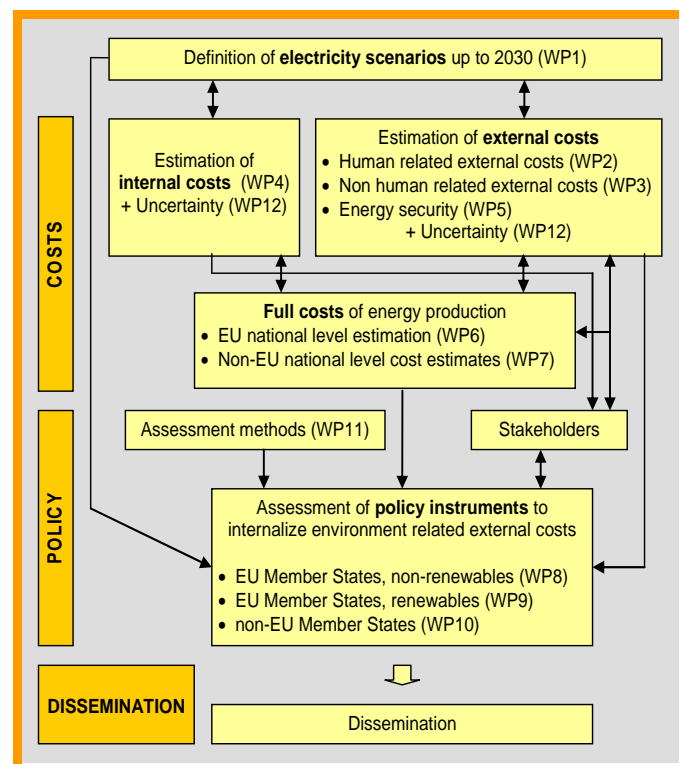
Finally the project disseminates research findings to energy sector producers and users, and to the policy-making community.

## The conclusion of the project

The project started on 1<sup>st</sup> April 2006 and its duration was 30 months, until September 2008. During the first two years the work was focused on estimating private and external costs of electricity generation. Output includes homogeneous data templates of social cost of energy, by country and by technology (encompassing

private costs and all external costs), and projections up to 2030. During the past six months, the project focused on the definition and the assessment of policy instruments for the internalisation of externalities in Europe and in some non-European countries. Moreover innovative electricity scenarios, which take into account social costs up to 2030 were developed.

The project is divided in two main research areas: one deals with cost assessment issues and the other with policy evaluation. More in detail CASES is built as a series of “Work Packages” (WP) each corresponding to a specific topic, which are strictly connected as it is shown in the next figure.



Structure of the project and interaction between the WPs.

In the whole period, the project produced:

- Databases on “Life Cycle Inventory of emissions for electricity production”, “Value of emissions in EU from present to 2030”, “Social costs of electricity production in Europe for present, 2020 and 2030 for different technologies”.
- Several technical reports on external, private and social costs of electricity generation in Europe and in selected non-EU countries.

- Papers and reports on electricity insecurity and on uncertainties in external costs estimation.
- Reports on policy assessment and on policy instruments to internalize external costs in the electricity sector.
- A report on electricity scenarios by country and primary fuel for 2010, 2020 and 2030.
- A tool for Multi-Criteria Decision Analysis to assess policies.

## Most recent results and deliverables

During the last six months a number of reports and databases were produced. Brief summaries of these deliverables are presented in this section. For additional details, all deliverables can be fully downloaded from the CASES website at the following web-address:

[http://www.feem-project.net/cases/downloads\\_deliverables.php](http://www.feem-project.net/cases/downloads_deliverables.php)

### Report on assessment of policy instruments to internalise environment related external costs in EU member states, excluding renewables

*Wouter Nijs, Rudi Torfs and Frank Sleuwaert<sup>ii</sup>*

*Danae Diakoulaki and Christos Tourkolias<sup>iii</sup>*

This report describes the results of work package 8 on the “Assessment of Policy Instruments to Internalize Environment-Related External Costs in EU Member States, excluding renewables”. One of the objectives of the CASES project is to evaluate policy options for improving the efficiency of energy use, taking account of the full cost data which has been assembled in the first part of the CASES project.

WP 8 first objective is to assess policy instruments to internalize externalities in EU member states, excluding renewables. The second objective is to investigate stakeholders’ preferences for those policy instruments through a stakeholder workshop, which is organized together with Work Packages 9, 10 and 11.

It is certainly not the intention of this WP to define policy instruments for a more sustainable and efficient

energy use by excluding renewables. The reason for having a separate analysis “excluding renewables” is that some policy instruments mainly have an impact on non-renewable technologies or technologies using non-renewable fuels. Although WP8 mainly deals with non-renewable sources and their price mechanisms, it has been decided not to distinguish the scope of WP8 and WP9 pure on a technology basis (i.e. non-renewable versus renewable energy): a policy instrument may directly target both technologies within a Member State (e.g. an energy tax may have differentiated rates or exemptions depending on the technology/fuel). Therefore, we proposed to use a distinction based on policy instruments.

The organization of the report is based on the description of work. Chapter 2 follows with a synopsis of policy instruments corresponding to task 8.1. The analysis of the extent to which policy instruments succeed to internalize external costs (task 8.2) is covered in chapter 3. Chapter 4 deals with the linkages between policy instruments (task 8.3) and chapter 5 with the analysis of the policy instruments (task 8.4) including the validation of the instruments by stakeholders. An extra technology analysis is performed and shortly described in chapter 6. Policy recommendations and conclusions are given in chapter 7.

### Report on policy assessment of instruments to internalise environment related external costs in EU member states, via promotion of renewables

*Gesine Bökenkamp and Olav Hohmeyer<sup>iv</sup>*

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*Roberto Porchia<sup>vi</sup>*

*Xianli Zhu, Kristian T. Jakobsen and Kirsten Halsnæs<sup>vii</sup>*

This report presents the results of Work Package 9 within the CASES (Cost Assessment of Sustainable Energy Systems) project. Work Package 9 (WP 9) contains an “Assessment of Policy Instruments to Internalize Environment-Related External Costs in EU Member States, Via Promotion of Renewables”. WP 9 is related to the second policy objective of the CASES project which is to evaluate policy options for improving

the efficiency of energy use, taking account of the full cost data which has been assembled in the first part of the CASES project. The other work packages related to this objective are Work Packages 8, 10 and 11. Work Packages 8, 9 and 10 share a common methodology.

WP 9 pursues two main objectives. The first is to assess policy instruments to internalize externalities in EU member states via the promotion of renewable energy. The second objective is to investigate stakeholders' preferences for those policy instruments through a stakeholder workshop, which is organized together with Work Packages 8, 10 and 11.

The organization of the report is based on the description of work. Chapter 2 follows with a synopsis of policy instruments corresponding to task 9.1. The analysis of policy instruments (task 9.2) is covered in chapter 3. Chapter 4 deals with the linkages between policy instruments (task 9.3) and chapter 5 with their social and fiscal implications (task 9.4). Policy recommendations are given in chapter 6 followed by a conclusion.

### **Assessment of policy instruments to internalise environmental related external costs in non-EU Member States**

*Wan-Jung Chou, Anil Markandya and Alistair Hunt<sup>viii</sup>*

In the developing countries selected in CASES, the governments have been implementing policy instruments to promote renewable energy in power generation, with an aim to: 1) mitigate GHG emissions, 2) foster economic development of rural areas, and 3) enhance the energy security by diversifying the energy matrix and by reducing the dependence on imported energy sources.

In recent years, rapid economic growth has been widely observed in these developing countries. In 2006, Turkey achieved GDP growth rate by 6.1%, 10.7% for China, and 9.2% for India (World Bank Statistics). In this momentum of economic growth, these countries have been undergoing increasing electricity consumption. Given that the power sector is characterised by its high greenhouse gas (GHG) emissions, a cleaner energy

matrix is necessary to support sustainable economic development. Lack of access to electricity has been a crucial contribution to economic and social inequality amongst areas within a country, such as in Brazil, China, and India. Whilst grid extension to these off-grid remote areas is not always economically plausible, electrifying these areas by means of local renewable resources can be an alternative. Energy security or security of supply of a country is its ability to supply energy to meet demand at a price that protects economic growth. Long-term measures to increase national energy security are to decrease the dependence on one energy source or imported sources and to exploit local fossil fuels or renewable resources.

Governments have a number of options that they can use to promote renewable energy. The first is to support the voluntary measures, particularly through education and dissemination. The second type refers to environmental standards or energy taxes. The third option is to promote renewable energies through direct support. Generally, a mix of policy instrument is essential to success. (Sawin, 2004) This report focuses on the investigation of policy instruments that offer direct support to renewable energy projects, in the developing countries of Brazil, China, India, and Turkey.

Section 2 briefly reviews the policy instruments that are currently active in the four countries. Assessment of the policy instrument has been carried out in section 3 for each of the four countries, by using criteria that are also applied in assessing policy instruments in the EU countries (WP9). Conclusion can be found in section 4.

### **Report on policy instruments' assessment methods and comparative analysis**

*Danae Diakoulaki and Christos Tourkolias<sup>ix</sup>*

*Gesine Bokenkamp and Olav Hohmeyer<sup>x</sup>*

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Multiple criteria decision analysis (MCDA), has offered valuable methodological approaches and tools providing reliable solutions to complex decision situations in the energy sector focusing on several

alternative options evaluated along multiple conflicting criteria. Moreover, MCDA allowed for a better understanding of the intrinsic features of each separate decision problem, facilitated the involvement of all concerned stakeholders and supported negotiations for the achievement of widely accepted collective decisions. Thus, the energy sector turned out to be one of the most privileged fields of MCDA applications.

This report presents the methodological approach adopted in the framework of the CASES project for the comparative evaluation of alternative policy instruments aiming at internalising the external costs of electricity generation, either through the minimization of CO<sub>2</sub> emissions, or through the promotion of renewable energies. Next section includes a short review of this literature in order to illustrate the scope and relevance of the developed MCDA approach. The selected MCDA method and the weighting methods used for deriving the stakeholders' preferences are presented in the third section, followed by the description of the developed decision support tool in the fourth section. Finally, the obtained results from implementing the tool for the assessment of policy instruments are shortly discussed, as to show the capacity of the tool to elicit the stakeholders' preferences, the degree of consistency of the derived weights and the consensus between the participants of the stakeholders' workshop. The analytical results concerning the relative importance of criteria and the ranking of the examined instruments are included in deliverables D.8 and D.9.

### Electricity scenarios by country and primary fuel for 2010-20-30 <sup>xiii</sup>

This deliverable is divided in three parts.

In the first part of the report the common used model for EU are described and compared. Energy models produce forecasts for the future global energy situation, especially in terms of energy demand, energy mix and security of supply. A range of organisations issues regular projections that serve a variety of political and economic purposes and with different emphases and methodologies. This variety means that the forecasts

are often difficult to compare. On the basis of selected parameters, the first part compares the points of view of three well-established models regarding electricity sector scenarios for the EU-25, namely the European Commission's (EC) DG-Tren (PRIMES), EC's DG-Research (WETO-H2) and IEA (WEO).

The second part of the report explains in details the ECON model assumptions and results. This part of the report aims at specifying the impacts of external costs internalization in the European electricity market. The study uses the results and data from other CASES studies and other works from DG TREN. The economic model used is the classical ECON model, which takes as basic hypothesis that the demand is always satisfied, and which clearly defines the hypothesis of work (projection of demand growths, fuel prices, data on infrastructures, electricity price, rate up-date of 5%...). The logic of the model is that the investment level of new generation capacities is determined by the growth of the demand and that the type of technology to be used is determined by the technologies relative competitiveness (i.e. long term marginal cost of production). The external costs are caused by the electricity generation indirect consequences on:

- The human health,
- The environment, for example the loss of bio-diversity,
- The emission of radionuclides, which can cause radioactive contamination,
- Gas emissions.

The third part deals with bases and alternatives in Brazil, China, India and Turkey. Brazil, China, India and Turkey have each one their scenarios. The assumptions concerning the base scenario and the alternative scenarios are not the same for the four countries due to their specificities.

### Update of social costs of electricity generation in Europe

*Roberto Porchia, Andrea Bigano and Anil Markandya <sup>xiv</sup>*

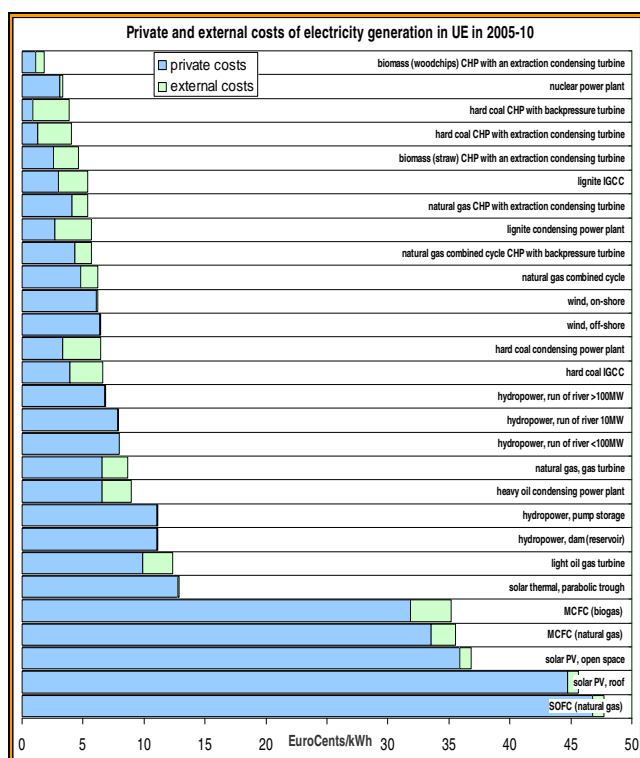
The suggestions collected during the past Stakeholders workshops joint to the updated results of the NEEDS project on external costs estimation and the recent change in fuel costs projection called for an

update of the estimation on social costs of electricity generation in Europe.

The updated results indicate that, in 2005-2010, the least expensive technology is biomass (woodchips) CHP with an extraction-condensing turbine with a European average full cost of 1.79 Eurocents per kWh. This technology is followed by nuclear (European pressurized reactor) and hard coal CHP with a full cost of 3.32 and 4.07 Eurocents per kWh. This rank will not change significantly in the next years. Also for 2020 and 2030 it is foreseen that the least expensive technology will be woodchips CHP with a price of 1.80 and 1.97 Eurocents per kWh.

The most expensive technologies are natural gas fuel cells and solar photo voltaic, which have a full generation costs from 35 up to 48 Ec/kWh in 2005-2010. However a strong reduction of generation costs is foreseen in the next 20 years for these technologies thanks to investments in technological improvement.

In the figure below the technologies for electricity production are ranked according to their social costs.



Rank of technologies according to social cost composition for electricity production in 2005-2010

## Most recent events

### Workshop on “Social Costs of Electricity Generation”

The First Stakeholders’ Workshop focused on private and external costs of electricity generation and supply in and outside the European Union. The methodology to estimate private and external costs, and the results of applying this methodology were presented and discussed. The workshop took place the 18<sup>th</sup> February 2008 in Brussels and was followed by a project meeting and by the third Steering Committee meeting. The events were organised at the Representation of Baden-Württemberg to the European Union in Brussels, by the University of Stuttgart.

### Workshop on Policy Instruments in the Electricity Sector

The Second Stakeholders’ Workshop focused on the assessment of policy instruments in the electricity sector. In the workshop, results on a comparison of policy instruments were presented and a Multi Criteria Decision Analysis was performed by all participants. The workshop took place at Bruges, Belgium, the 23<sup>rd</sup> of April, 2008. After the workshop the Mid-term Project Meeting, including the fourth Project Steering Committee meeting, took place. The events were organised by the Flemish Institute for Technological Research.

### Conference on “Social Costs of Electricity Generation and Policy Design”

The conference takes place in Milan at the FEEM premises, the 30<sup>th</sup> September 2008. The programme is divided in three main sessions presenting the results of CASES in terms of social costs of electricity generation, policy design to internalise externalities in the electricity sector and electricity scenarios for different technologies for 2010, 2020 and 2030. The results of the project are presented and discussed with policy community, researchers and stakeholders. After the workshop, the last Project Meeting, including the fifth Project Steering Committee meeting, takes place. The events are organised by ISIS - Istituto di Studi per l’Integrazione dei Sistemi.

## Partners' list

### Project co-ordinator

1. Fondazione Eni Enrico Mattei (FEEM)

### Project Consortium

2. University of Bath (UBATH)
3. National Technical University of Athens (NTUA)
4. University of Stuttgart – Institute of Energy Economics and the Rational Use of Energy (USTUTT/IER)
5. Flemish Institute for Technological Research (VITO)
6. Technical University of Denmark – Risoe National Laboratory (DTU/RISOE)
7. Observatoire Méditerranéen de l'Energie (OME)
8. University of Flensburg (UFLENS)
9. Energy Research Centre of the Netherlands (ECN)
10. Vrije Universiteit Amsterdam-Institute for Environmental Studies (VU/IVM)
11. Econ Pöyry AS (ECON/POYRY)
12. Fundação COPPETEC (COPPETEC)
13. SWECO Grøner as (SWECO)
14. Lithuanian Energy Institute (LEI)
15. Indian Institute of Management Ahmedabad (IIMA)
16. Energy Research Institute (ERI)
17. Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT)
18. Univerzita Karlova v Praze - Charles University Environment Center (CUEC)
19. Centre for European Policy Studies (CEPS)
20. University of Warsaw - Warsaw Ecological Economic Center (UWARS)
21. Energy Agency of Plovdiv (EAP)
22. Türkiye Bilimsel ve Teknik Arastirma Kurumu - Marmara Research Center, Institute of Energy (TUBITAK)
23. Wageningen Universiteit (WU)
24. Istituto di Studi per l'Integrazione dei Sistemi (ISIS)
25. Paul Scherrer Institut (PSI)

The Consortium of the CASES' Co-ordination Action is lead by Fondazione Eni Enrico Mattei (FEEM) and it is composed by twenty-five partners established in twenty States, it covers the whole European area and also involves three institutions in two developing continents (Asia and South America).



Most of the institutions are established for research activities (11) and for higher education (9). The other participants are not qualified in one particular activity but they provide a scientific expertise and carry out complementary activities necessary to achieve the objectives of this Co-ordination Action.

## Contacts

*For additional information about CASES Project please contact Roberto Porchia  
at [cases@feem-project.net](mailto:cases@feem-project.net) or visit the project web site*

*<http://www.feem-project.net/cases/>*

*Present and past Newsletters are available online*

*[http://www.feem-project.net/cases/downloads\\_newsletter.php](http://www.feem-project.net/cases/downloads_newsletter.php)*

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<sup>i</sup> This text is taken from the “Report on policy instruments’ assessment methods and comparative analysis” Deliverable D.11.3 of the CASES project..

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<sup>xiv</sup> Fondazione ENI Enrico Mattei

