NON TECHNICAL PRESENTATION OF CASES

Updated to June 2006

1. WHAT IS CASES

CASES is the acronyms of 'Cost assessment of sustainable energy costs', which is an European Commission funded Coordinated Action. A Coordination Action aims at promoting and supporting the coordination, cooperation or networking of a range of research and innovation projects or operators for a specific objective, normally to achieve improved integration and co-ordination of research, for a fixed period of time, at national, regional and European level[1].

A wide range of activities are foreseen for Coordinated Action projects: studies, analyses, benchmarking exercises; exchanges and dissemination of information and good practice; organisation of conferences, seminars, meetings; setting up of common information systems, setting up of expert groups; definition, organisation and management of joint or common initiatives; joint memoranda of understanding; pre-standardisation and standardisation activities in specific fields, and establishment of roadmaps for research in specific topics. CASES, in pursuing its objectives shall combine the most suitable and effective among the activities listed above.

[1] More detail about this type of projects can be find in the EU website: http://cordis.europa.eu/infrastructures/ca.htm.

2. CONTEXT

CASES intends to evaluate policy options for improving the efficiency of energy use, underpinning this evaluation with a consistent and comprehensive picture of the full cost of energy, and to make this crucial knowledge available to all stakeholders.

While a lot of effort has been devoted in recent years to the estimation of the external costs of energy, more attention is now being paid to the examination of both **the private and external costs** in one framework. For policy-makers, however, both sets of numbers are important and they are aware that the dividing line between the two is not always clear cut. Therefore a complete and consistent assessment of the full cost of energy sources, which includes the external cost plus the private cost, is of paramount importance for energy and environmental policy making.

Energy policy making is concerned with both **the supply side and the demand side of energy provision**. On the energy supply side deciding on alternative investment options requires the knowledge of the full cost of each energy option under scrutiny. On the demand side, social welfare maximisation should lead to the formulation of energy policies that steer consumers' behaviour in a way that will result in the minimisation of costs imposed to society as a whole. Demand side policies can benefit significantly from the incorporation of full energy costs in the corresponding policy formulation process.

The **geographical dimension** is also important since environmental damage from energy production crosses national borders. Moreover the EU enlargement process associated to the liberalisation of energy markets have highlighted the importance of a systematic harmonisation process, in which cost formation mechanisms and price setting must become transparent and reflect the total, real costs of energy provision across the continent and beyond. In turn, this requires the adoption of a common set of methods and values. Hence a consistent set of energy costs allows a better understanding of the international dimensions of policy decisions in these areas. Naturally, differences in estimates exist between countries, sources of energy, and technology used in the generation of the energy. But the present state of knowledge is disparate and some gains can be made by clarifying when and where particular estimates can be applied.

Moreover, **costs are dynamic**. The private costs and the external costs are changing with time, as technologies develop, knowledge about impacts of energy use on the environment increases and individual preferences for certain environmental and other values change.

Perhaps, the least well and least systematically covered area of external cost is that related to **energy security**. Even within one country estimates of the energy security costs of different types of energy remain somewhat elusive. A common methodology has not been applied to derive estimates for a range of countries. Yet, this is a major area of policy debate and key decisions are being taken to increase energy security and reduce dependence on foreign sources. Therefore, without undertaking primary research in terms of data collection, the project devotes significant resources in applying existing models across a range of countries to arrive at a common set of estimates of the costs of energy insecurity, as defined by a common set of parameters.

3. OBJECTIVES

This project intends to derive a consistent and comprehensive picture of the full cost of energy to analyse policy instruments, and to make this crucial knowledge available to all stakeholders. CASES aims at compiling a complete and coherent assessment of the full cost (external plus private cost) of different energy sources, in EU and selected non-EU countries, under well defined energy scenarios to 2030. 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, in providing a set of recommendations on the use of different policy instruments for the internalisation of the external costs of energy production, contributes directly to policy and provides an information base on the effectiveness and on the consequences of the use of different instruments.

In addition the assessment of the full cost estimates of energy production allows policy-makers to become more aware of the consequences that different fuels and technologies have on human health, the environment and society. Finally the project disseminates research findings to energy sector producers and users, and to the policy-making community.

In detail the CASES objectives are the following:

I. To compile coherent and detailed estimates of both external and internal costs of energy production for different energy sources at the national level for the EU-25 Countries and for some non-EU Countries under energy scenarios to 2030;

II. To evaluate policy options for improving the efficiency of energy use, taking account of the full cost data;

III. To disseminate research findings to energy sector producers and users and to the policy making community.

3.1 Objective I – full cost estimates

The first task is to take the different studies within each area and develop as consistent a set of cost estimates as possible. Naturally, differences in estimates exist between countries, sources of energy, and technology used in the generation of the energy. But the present state of knowledge is disparate and some gains can be made by clarifying when and where particular estimates can be applied. This will involve a detailed assessment of primary studies and a careful evaluation of the techniques used by them in arriving at the estimates of costs. Based on these an agreed ranges of estimates of the full cost will be reached for different countries and for each energy source.

Moreover a major part of this project has to build on the integration of private and external costs within one dynamic framework, since both costs changing with time. This requires active collaboration between 'public' sector energy specialists and firms involved in the generation and use of energy, with the aim of taking into account technologies development, changes in individual preferences and increasing of knowledge about impacts of energy use on the environment.

The other major gap in the comparative cost assessment lies across countries. The 'old' EU group has, more or less, agreed ranges of external costs for most energy sources. But these values do not always match those used in other OECD countries[2]; and they do not extend to the new and aspiring Member States. Nor are they directly relevant to developing countries where energy use has significant external costs. Although work has been done in these other countries on external costs as well, a full assessment of the comparative state of knowledge and the gaps that need to be filled still has to be carried out.

The work related to this objective will generate answers to the following types of questions:

- What are the best predictions about the evolution of the private costs of major technologies for generating energy from different sources over the next 25 years?
- What are the best estimates of the major environmental external costs of different types of energy in different countries and how will these change in the next 25 years?
- What are the best estimates of the major energy security-related external costs of different types of energy in different countries and how will these change in the next 25 years?

[2] The full list of OECD countries includes: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

- What are the best estimates of the likely prices of major sources of energy over the next 25 years (taking account of policy changes in the areas of environmental control, energy security and climate change)?
- Where are there the greatest uncertainties and where should future research effort be concentrated?

In order to answer these questions, the project needs to make a set of projections of energy demand by energy source and country. To this aim, it uses existing models, such as the ECON model, for estimating such demand and adapt them so they are responsive to different projections about prices that suppliers receive and prices that users pay. These are critical to the policy analysis, which is the second major objective of the CA. Moreover the project will use the results of projects like ExternE, NewExt, ExternE-Pol, DIEM, ECOSIT, INDES and MAXIMA which are devoted to the estimation of the external costs of energy and the results of NEEDS, which is paying attention to the examination of both the private and external costs in one framework.[3]

3.2 Objective II – policy analysis

The policy analysis part of the CA uses the comparative cost data in a concerted effort to address a set of clearly defined goals. The policy arena is not a static one; new ideas are being developed all the time and the lessons of applying different options are continually enriching our understanding of the policy framework. The project contributes to these debates in a serious fashion. The innovative aspects it offers are to look at the policy issue in a dynamic context, and to provide a comparative analysis of the policy analysis across different countries.

The major areas of investigation are:

- Comparative assessment of investment and operational costs of different energy options taking account of only private costs and taking account of private plus external costs. This assessment is dynamic and will provide the implications of different levels of internalisation on the investment decisions and on key social indicators.
- Impact of the use of different methods of decision-making on the selection of projects - e.g. cost-benefit analysis with 'externality adders' versus multi-criteria decision analysis tools.
- Implications of different taxes/charges on energy and/or on emissions on (a) the degree of internalisation and (b) the comparative cost comparisons, now and in the future.
- Implications of different policies to reduce energy insecurity on (a) the degree to which energy security concerns are internalised and (b) the comparative costs of different energy sources, now and over time.
- Comparison of the effectiveness of emissions trading instruments for internalising externalities versus the use of externality based taxes.
- Comparison of different instruments to promote renewable energy sources, in terms of the degree to which they internalise the positive externalities associated with renewable energy use.

In addition to looking at how much of the external costs each policy option internalises, the project looks at a broad set of variables of interest. Beside the environmental impact, it poses some questions: what impact will the policy have on the use of different types of energy? What social and

[3] Detailed information on these projects are available on the dedicated websites: http://www.econ.no/ (ECON), www.externe.info (ExternE), www.ier.uni-stuttgart.de/newext/ (NewExt), http://www.externe.info/exterpol.html (ExternE-Pol), http://www.externe.info/diem.html (DIEM), http://www.isis-it.com/doc/progetto.asp?id=46 (ECOSIT), http://www.energymarkets.info/indes/index.html (INDES), http://maxima.ier.uni-stuttgart.de/ (MAXIMA) and http://www.needs-project.org (NEEDS).

fiscal implications will such measures have, especially on poor and vulnerable groups? How the policy instruments can be modified in order to address the externality issue?

For this activity to be of practical benefit, the assessment is carried out with energy suppliers as part of the team, so that real world problems of applying the different instruments are reflected in the evaluation. This means that the hidden costs of implementation of policy such as the adoption of new rules and regulations by the different actors, is reflected in the analysis.

3.3 Objective III – dissemination

The third part of the CA is devoted to dissemination. There is a tremendous amount of good and useful material out there; once it has been evaluated and brought into a coherent framework, the results of the different components of the project are of great interest to the energy sector producers and users, as well as the policy-making community. Dissemination consists of a set of activities ranging from publication of articles in the peer reviewed literature (more policy-oriented rather than purely scientific); project workshops and conferences involving key stakeholders and policy makers; seminars and presentation of key results at additional meetings, including presentation at meetings organised by the European Commission; presentations and open discussions with energy producers and user organisations; and the setting up the dedicated web site.

Dissemination activities are a fundamental component of the whole strategy devised by CASES to serve the wider European research, policy and business community and the public at large. A wide set of activities is used to disseminate the new knowledge created within the network. Management and co-ordination of the knowledge derived from the activities take place during the whole duration of the project. Dissemination activities are implemented through a different range of measures.

In detail the dissemination works by establishing an interactive web site for the dissemination of project related information (partnership, activities and results, reports and deliverables, useful policy documentation, etc). Efforts in this area are meant to give the largest dissemination to the output of the project. This will also lead to continuing collaboration and an increasingly concerted approach between the partnership, the EU and other interest parties. In this, the web site is also a fundamental source of dissemination. This will also include the establishment of an electronic mailing list to ensure prompt, updated and easy communication on project news. The e-mailing list includes organisations outside the consortium and interested parties (such as policy makers and stakeholders or individuals) expressing their interest in being updated on CASES' activities.

The devised meetings (two stakeholders workshops and the final conference) organised to present main results of the co-ordination activities represent a clear means towards dissemination to a wide audience of qualified players (e.g. stakeholders, policy makers, representatives of the civil society, NGOs, businesses and regional authorities, individuals, etc). Each event is organised by a different participant and is held in a different geographical location (Germany, Belgium, Italy). The organisation of each meeting in a different geographical location favours dissemination to different types of audiences, depending on the location of the event and the capability to attract local social actors. This eventually guarantees maximum outreach of the activities. Public participation is free of charge.

Moreover publication activities are actively pursued. Preliminary versions of the research papers are disseminated through the working paper series of FEEM and distributed both electronically and in colourful paper copies. The series is currently included in the Economics Research Institutes Paper Series of SSRN, RePEc and in Econlit (and downloadable free-of-charge). Links to the working papers are posted on the public section of the project web site. Working papers are meant as intermediate outputs and their aim is precisely to stimulate the debate and to encourage broader understanding and discussion/debate on the themes. Publications in peer-reviewed journals are also actively sought.

At the end of the project, a book summarising thirty months of coordination efforts is published. The book is disseminated both through the web site and in paper copies. It is provisionally designed as a collection of refined and more thorough version of the preliminary research papers and outputs produced in the CA, which takes account of both i) reactions to the preliminary dissemination activities (working papers, discussion and debates in scientific fora, project and external workshops, PhD dissertations, etc); ii) the progress of the project in thirty months of activities.

4. THE ACTORS: CASES PARTNERS

The Consortium of the CASES's Co-ordination Action is composed by twenty-six 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.

(1) Fondazione Eni Enrico Mattei (FEEM), Italy [www.feem.it]

(2) University of Bath (UBATH), United Kingdom [www.bath.ac.uk]

(3) National Technical University of Athens (NTUA), Greek [www.chemeng.ntua.gr]

(4) University of Stuttgart – Institute of Energy Economics and the Rational Use of Energy (USTUTT/IER), Germany [www.ier.uni-stuttart.de]

(5) Flemish Institute for Technological Research (VITO), Belgium [www.vito.be]

(6) Risoe National Laboratory (RISOE), Denmark [www.risoe.dk]

(7) Observatoire Méditerranéen de l'Energie (OME), France [www.ome.org]

(8) University of Flensburg (UFLENS) [www.uni-flensburg.de]

(9) Energy Research Centre of the Netherlands (ECN), Netherlands [www.ecn.nl]

(10) Vrije Universiteit Amsterdam-Institute for Environmental Studies (VU/IVM), Netherlands [www.ivm.falw.vu.nl]

(11) ECON Analysis AS (ECON), Norway [www.econ.no]

(12) Fundação COPPETEC (COPPETEC), Brasil [www.ppe.ufrj.br]

(13) SWECO Grøner as (SWECO), Norway [www.e-co.no]

(14) Lithuanian Energy Institute (LEI), Lithuania [www.isag.lei.lt]

(15) Indian Institute of Management Ahmedabad (IIMA), India [www.iimahd.ernet.in]

(16) Energy Research Institute (ERI), China [www.eri.org.cn]

(17) Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT), Spain [www.ciemat.es]

(18) Univerzita Karlova v Praze - Charles University Enviroment Center (CUEC), Czech Republic [www.czp.cuni.cz]

(19) Stockholm Environment Institute (SEI), Sweden [www.sei.se]

(20) Centre for European Policy Studies (CEPS), Belgium [www.ceps.be]

(21) University of Warsaw - Warsaw Ecological Economic Center (UWARS), Poland [www.wne.uw.edu.pl]

(22) Energy Agency of Plovdiv (EAP), Bulgaria [www.eap-save.dir.bg]

(23) Turkiye Bilimsel ve Teknik Arastirma Kurumu - Marmara Research Center, Institute of Energy (TUBITAK), Turkey [www.mam.gov.tr]

(24) Wageningen Universiteit (WU), Netherlands [www.wur.nl]

(25) Istituto di Studi per l'Integrazione dei Sistemi (ISIS), Italy [www.isi-it.com]

(26) Paul Scherrer Institut (PSI), Switzerland [www.psi.ch]

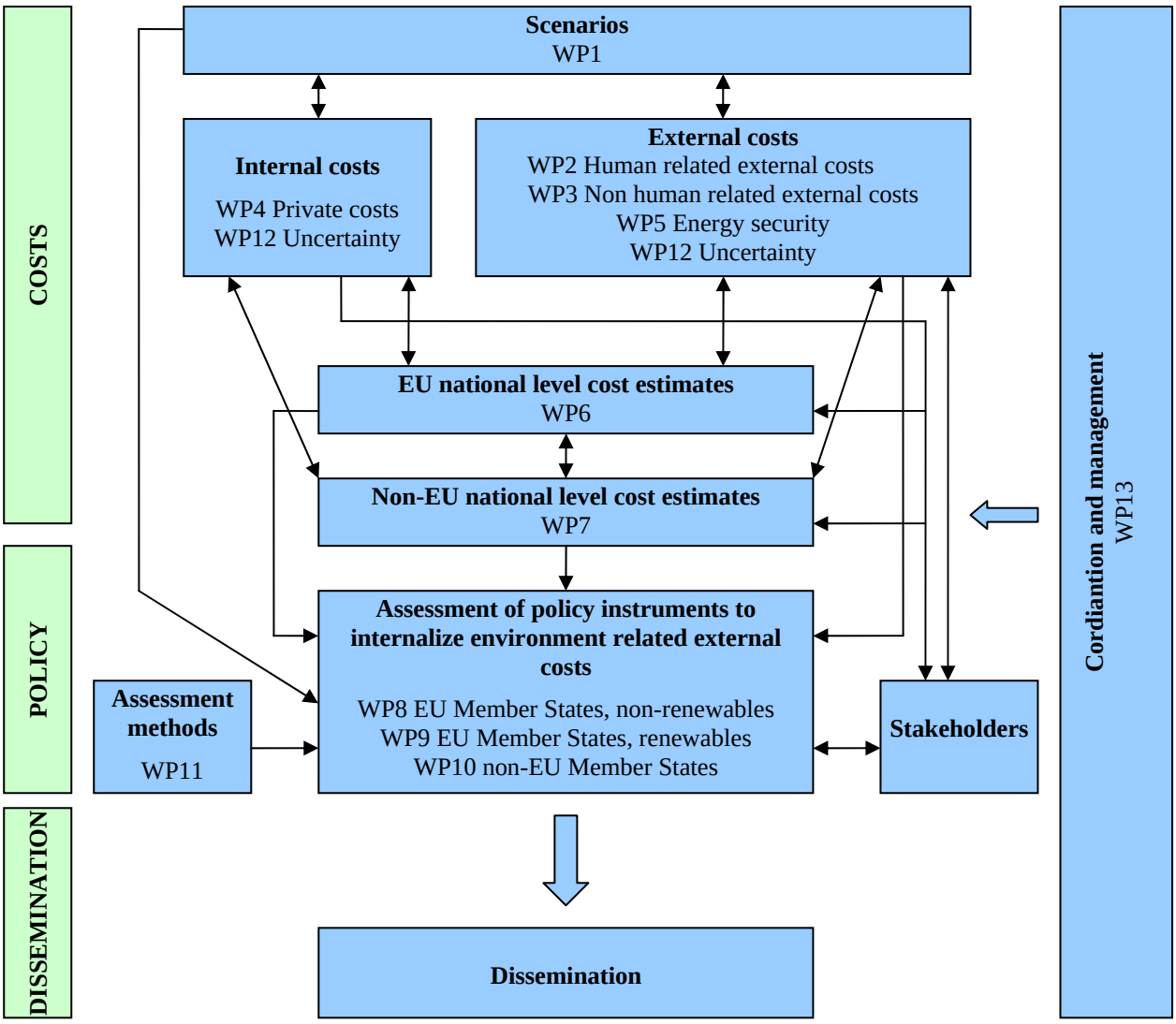
The project is co-ordinated by Fondazione Eni Enrico Mattei (FEEM). Bath University shares with FEEM the scientific co-ordination of the project. Within the supervision of these two institutions, the following partners have the lead of the Work packages: FEEM (WPs 6 and 13), UBATH (WPs 5 and 10), NTUA (WP 11), USTUTT/IER (WPs 2 and 4), VITO (WP 8), RISOE (WP 7), OME (WP 1), UFLENS (WP 9), ECN (WP 12), VU-IVM (WP 3). WP Leaders manage the activities of each WP team and co-ordinate the role of the partners involved in their WPs. In addition, the partners will involve in the project the relevant local stakeholders and end-users for both validating the results of the activities carried out within the project and take part to the dissemination activities.

5. ORGANISATION OF WORK

This project builds on the formidable amount of research that has been done on measuring the full costs of the use of different energy sources such as fossil fuels, nuclear energy and renewable energy sources. The analysis must cover not only the existing relevant technologies but also the most promising emerging ones in order to allow for the most likely future developments. In any case the focus is on electricity and heat.

The internal costs, the private costs and the full cost are calculated and analysed through seven inter-linked work packages that evaluate, compare and harmonise the system costs associated with alternative energy technologies covering exhaustively the whole range of relevant production, social and environmental costs involved. In this perspective, the first objective of this Coordinated Action is to compile a consistent and detailed set of estimates of the external and internal costs of energy production for different energy sources at the national level for the EU-25 Countries and for Bulgaria, Turkey, Brazil, India and China, under energy scenarios to 2030. The integration of private and external costs is built within one dynamic framework, to arrive at agreed ranges of estimates, for different countries, of the full cost of each energy source. Following this objective CASES provides state-of the-art projections of the evolution of energy prices and of the private and external costs of major technologies, likely to be employed to generate energy from different sources over the next 25 years.

Policy assessment, the second objective of the CA, involves applying the comparative cost data of different types of energy, to the assessment of alternative policy options for improving the efficiency of energy use and reducing its impact on environment over the next decades. Important in this context are not only the cost estimates, but also the range of their uncertainty; a better understanding of the social and private costs also strengthens the credibility of policy making decisions by reducing the uncertainty ranges. In this part of the project, the social and fiscal implications of a given policy measure are analysed, with an eye for the distributional consequences for poor and vulnerable groups. This assessment is dynamic and underlines the implications of different levels of internalisation on the investment decisions and on key social indicators. The analysis in addition covers the impact of the use of different methods of decision-making (the project focuses in particular on Cost-Benefit and Multi-Criteria Decision Analysis), on the selection of projects and the implications of different policies to reduce energy insecurity, now and over time and the implications of different taxes/charges on energy and/or on emissions on the degree of internalisation and the comparative cost comparisons, now and in the future. Different instruments to promote renewable energy sources are then compared in terms of the degree to which they internalise the positive externalities associated with renewable energy use.



The project structure will then follow these main steps:

(1) Agree upon the storylines of three electricity scenarios [WP1] (status quo and two options developments): this will produce as output three reference scenarios;

(2) Calculate average external costs per unit of emission, using ECOSENSE [WP2, WP3, WP5], and private costs [WP4] on the basis of the reference scenarios when a dynamic element is needed;

(3) Refine scenario definition on the basis of computed external costs by considering full costs per each country/technology given by external costs plus private costs, where external costs are given by average cost calculated by ECOSENSE times the emission determined under energy scenarios [WP2-7]. This second run will include policy variables in order to facilitate policy assessment [WP8-11].

(4) Analyse how the policy proposed in WP8-10 are affected by uncertainty in external costs estimates [WP12].

(5) Draw final conclusions on the final output of the project.

6. DESCRIPTION OF WORK PACKAGES

5.1 WP 1 – Scenarios of Energy Use

The objective of the first work package is to estimate electricity scenarios with a 2030 time frame for 25 EU countries, Turkey, Bulgaria, Brazil, India and China.

This work package is divided into three tasks.

The first task aims at analysing and setting up the list of parameters having direct influence on the evolution of the electricity demand. This set of parameters includes economic factors (growth rate and income level), structure of the electricity demand (in particular peak load and seasonal variation and level of energy intensity), electricity prices and prices of alternative final energies (including the possible distortions created by energy subsidies and the governments' policies to remove them), structure of the energy industry, potential for energy savings and demand-side management.

The demand scenarios will based on a review carried out by OME, as well as a model run by ECON, based on all the information available with respect to costs, supply constraints etc. This model can easily accommodate all the countries covered by the project, with the exception of India, whose inclusion is not straightforward at the moment. The runs of the ECON model will be extended beyond those originally envisaged in the Consortium Agreement. The additional runs shall serve the purpose of validating and harmonising the full cost data, checking their consistency with the dynamic scenarios. Moreover, there is the possibility of use these additional runs as an additional tool to assess policies to support the analysis of the policy–related Work Packages. A matrix of parameters influencing the development of electricity demand is developed for each country.

The second task concerns the analysis of the existing and potential supply options with regard to the primary energy used for power generation. Particular attention is paid to the energy policy drivers:

- environment (climate change policies, such as Kyoto Protocol, European environmental and emission trading directives);
- governmental and European policies regarding security of supply, nuclear energy and renewable energy;
- availability and price of primary energy sources;
- structure and efficiency of present power generation park by technology, and their impact on generation cost;
- expected technological progress in power generation and its impact on costs;
- efficiency of the transmission and distribution system;
- interconnections (allowing for structured exports-imports and reduction of reserve margins);
- public acceptability, in particular concerning nuclear, wind, coal, interconnections, etc.;
- cost of domestic supply versus imports;
- institutional issues, as market structure.

For countries, where data are available, an in-house model by ECON[4] that describes the demand and supply curves for the North-European countries is used. For countries where data are not readily available to feed the ECON model, a more descriptive approach is used to build quantitative scenarios. The final set of scenarios is developed taking account of cost information for

[4] Detailed information on the ECON model is provided on the ECON website http://www.econ.no/.

electricity based on WP6 and 7. This part of WP1 will produce a matrix of policy and other drivers for power supply options by fuel.

The third task at comparing and positioning the results with other available scenarios, in particular of the following organisations: the European Commission (Primes, Poles, NEEDS)[5], the International Energy Agency, Eurelectric, and national Governments.

All tasks are carried out under the co-ordination of OME with FEEM and ECON, with the direct involvement of the institutions of the interested countries (COPPETEC, IIMA, ERI, EAP, TUBITAK).

5.2 WP 2 – Human Health Related External costs

The second work package, about human health related external costs of different energy sources, has the following objectives:

- To collect data on life cycle emissions for state-of-the-art energy conversion technologies;
- To describe the state-of-the art methodology to estimate external costs from health impacts and from damage to materials and crops;
- To include the methodologies developed in WP3 to assess damage caused by eutrophication, acidification, land use change and climate change into the ExternE[6] framework and tools;
- To calculate marginal external costs for state-of-the-art technologies in one selected country (Germany) and also at least for all EU25 countries and, for as many non-EU countries covered by the project as possible. This extension from Germany to the other countries appears to be logically needed for the project. For the countries to which ECOSENSE cannot be extended, alternative sources of information will be sought, primarily within the Integrated Project NEEDS.
- To organise a joint WPs 2-7 workshop (Stakeholders Workshop 1) to discuss the methodology to estimate internal and external costs with stakeholders.

This work package is divided into five tasks. Task 1 aims at identifying and describing the pressures to the environment stemming from the latest state-of-the-art energy conversion technologies. Relevant pressures, i.e. that cause not negligible external costs, are taken into account. Data are collected for the EU. Emissions of currently used techniques in China, India, Brazil, Bulgaria and Turkey are also provided. PSI provides data for nuclear power plants including the life cycle.

Task 2: to describe the current state-of-the-art methodology to estimate external costs. If appropriate, ranges rather than one single parameter value are reported to carry out sensitivity analyses. The methodology includes impacts of air pollutants to human health, materials and crops. PSI reports on methodologies to assess the exposure of the population to emissions of radioactive substances.

Task 3: to incorporate findings from WP3, especially the methodology to cover land use change, acidification and eutrophication, visual intrusion and climate change into the methodology to generate external cost estimates and into the ECOSENSE[7] tool to calculate marginal external costs.

[5] Detailed information on these projects are available on the dedicated websites: http://www.e3mlab.ntua.gr/ (PRIMES), http://www.enerdata.fr/enerdatauk/services/models/Model_POLES.html (POLES) and http://www.needs-project.org (NEEDS).

[6] The project will use the results of projects like ExternE, to the estimation of the external costs of energy.

[7] Detailed information on the ECOSENSE model is provided on the dedicated webpage http://www.ier.uni-stuttgart.de/forschung/modmeth/ECOSENSE/ECOSENSE.html.

Task 4: to demonstrate the application of the methodology, by estimating external costs for the different technologies at specific sites in Germany.

Task 5: to organise a joint WPs 2-7 workshop for stakeholders, to discuss the methodology to calculate external and private costs and the results for selected sites.

All tasks are carried out under the co-ordination of USTUTT/IER, with the direct involvement of the institutions of the interested countries (COPPETEC, IIMA, ERI, EAP, TUBITAK, PSI).

5.3 WP 3 – Non-Human Health Related Environmental Costs

The two objectives of WP3 concern the update of estimates of non-human health related environmental costs of different energy sources based on life cycle impacts for EU and non-EU countries with specific attention to 'new impacts' (acidification, eutrophication and visual intrusion) and the discussion on ranges of estimates of environmental costs with representatives of industry.

This WP provides a critical review and updates external cost estimates of energy-related impacts on land use change, acidification, eutrophication, visual intrusion and climate change across Europe and for selected non-EU countries. Jointly with WP2 and WPs4-7, research findings are presented and discussed in a stakeholder workshop. Results on land use change, acidification, eutrophication, visual intrusion and climate change are shared with the coordinator of WP2 to be included in the ECOSENSE model.

SWECO reviews and updates: (a) monetary estimates of acidification impacts on freshwater fish, and impacts of eutrophication on use values (drinking water, boating, swimming, recreational fishing) and non-use values; (b) estimates of landscape aesthetic impacts of renewable energy (wind and hydro). It provides a state-of-the art review of valuation studies on these topics and a discussion on benefit transfer methods for these values, including a review of tests of validity of benefit transfer.

UW contributes to the analysis of non-human related impacts of energy systems by studying the impacts of various emissions related to energy systems. UW focuses on the impacts of acidifying compounds (SO2, NOx and NH3) on terrestrial ecosystems, including agriculture.

VU-IVM reviews and updates monetary estimates of energy-related land use change and climate change impacts. It also contributes to the review and update of monetary estimates of impacts on aquatic ecosystems. It is responsible for WP3's contributions to the workshop on the methodology to calculate private and external costs of selected energy conversion technologies. Finally, VU-IVM prepares a database on studies concerning external cost estimates of land use changes, acidification, eutrophication and climate change.

5.4 WP 4 – Private Costs of Electricity and Heat Generation

The fourth work package aims at investigating private costs of generating electricity by combustible renewables, focusing on heat generation technologies, in particular oil, gas and bio-mass heating systems, heat exchanger, heat pump.

State-of-the-art power plants are based on existing designs for which reliable cost information is available. They include technologies such as nuclear units of current generation, traditional coal-fired units, combined cycle gas turbines, combined heat and power (CHP) plants, fuel cells, hydropower, wind mills (onshore and offshore), combustible renewable power plants and solar photovoltaic systems. The major task consists of updating the partially older studies on the current conditions and inserting into a consistent and comparable framework. Technologies under development (such as advanced clean coal technologies, integrated coal gasification combined cycle (IGCC) and advanced nuclear reactors (e.g. Pebble Bed Modular Reactor – PBMR)) are also included.

The calculated private costs provide comprehensive and reliable economic information for assessing the competitiveness of alternative technologies that may be chosen for electricity system expansion within the next 10 – 20 years. To evaluate the competitiveness of the different electricity and heat generation technologies the levelised lifetime cost methodology is used. In order to make sensitivity analysis possible an algorithm of how to produce different costs per kWh based on different load factors, wages and annual energy production per kW installed is made available.

All costs related to the fuel cycle are accounted for. Credit for recycled materials are also accounted for. Front-end and back-end fuel cycle costs reported are calculated with the constant-money levelised lifetime method using generic assumptions.

Investigation is accomplished only for selected countries: Germany, Finland, Belgium, the Czech Republic, Italy, Portugal, Bulgaria and Turkey. Outside of Europe, corresponding information is also made available for China, India and Brazil. Apart from the inclusion of the participants from their respective countries VITO is concerned in particular with the fossil and nuclear power plants, while USTUTT/IER is responsible for the remaining electricity and heat generation technologies.

Information from this WP is used for the development of the energy prices on the world markets in WP1.

5.5 WP 5 – Security and Reliability of Energy Supply

The WP5 objectives are to derive estimates of externalities related to energy supply insecurities for EU and other selected countries and to use these estimates of externality costs in policy assessment of measures addressing energy security in the EU and other selected countries.

This WP critically reviews the evidence for energy security issues to be treated as externalities in policy analysis ensuring that resulting estimates of such externalities are founded on the most up-to-date macro-economic and micro-economic cost data at EU and national country scales.

This work package is structured in three tasks. The first task is developed by UBATH, which reviews and updates existing estimates of the costs of energy insecurity for primary fuels, and makes predictive estimates up to 2030 for the EU and selected other countries. These estimates use published outputs of existing macroeconomic and inter-sectoral models to make estimates of the macro, regional and sectoral costs of the use of these fuels.

The second task is undertaken by ECN, which critically reviews current estimates of values of loss of load (VOLLs) of electricity for EU and the other selected countries. These provide the basis for deriving country estimates to a time horizon of 2030. The findings of new studies expected to be published shortly on the costs of recent blackouts in a number of EU and other countries are also incorporated into the derivation of the forward-looking estimates.

The third task concerns in an initial assessment of policy options to reduce - and insure against - the costs of energy insecurity. This task is undertaken by CEPS and ECN, by comparing the costs of a number of policies with the benefits in terms of reduced energy insecurity. The assessment is based on a number of policy options: increased maintenance of strategic stockpiles, feed-in tariffs and tradable certificates as methods to increase renewable energy sources' share in the EU energy mix, taxes on fossil fuels, requirements of increased capacity in the electricity sector and other market-based instruments.

Policy recommendations emanate from this analysis. The output from this exercise complements WPs 8-10 by ensuring that both energy security and environmental cost internalisation policy processes are consistent with each other.

5.6 WP 6 – National Level Estimates of Energy Costs in EU Countries

WP6 is oriented to develop a consistent set of national level full costs estimates for the 25 EU countries for different energy sources and to develop a comparative full cost assessment and a consistency analysis of the aforementioned set of national level full costs estimates.

The first part of this WP aims at putting together in a coherent and systematic way the private and external cost data obtained from WP2, 3, 4 and 5 for the EU 25 Members. A data template for private and external estimates for each country and for each energy source is developed and filled in cooperation with the teams involved in WPs 2-5 to derive the total costs estimations. Total cost calculation is extended to the EU 25 countries to identify knowledge gaps that still need to be overcome to bring to a par data quality on energy cost data across Europe. Variations in cost estimates exist among countries due to different energy sources, technologies used for energy generation and local geographical and socio-economic conditions. For this reason, the activity of assembling total costs components can provide a valuable output by clarifying when and where cost estimations can be properly applied and combined.

Once obtained a total cost dataset for the EU 25 Members the second part of this WP is devoted to compare full cost assessment to identify inconsistencies and structural variations in the total costs composition. Particular attention is paid to local geographical variations and to the integration of private and external costs within one dynamic framework. To conclude the comparative cost assessment, a sensitivity analysis on the dataset estimates is performed in WP 12 in close cooperation with WP 6 and 7 partners to assess the reliability of the dataset and to identify the most critical parameters that have an influence on the total cost estimates.

FEEM is responsible for the implementation of these tasks, with the involvement of the other partners (NTUA, USTUTT/IER, VITO, LEI, CIEMAT, CUEC, SEI, UWARS) in particular in the supply of the external cost data.

5.7 WP 7 – National Level Estimates of Energy Costs in Non EU Countries

This WP aims at developing a methodological framework that can be used to extract private and social costs of energy fuel cycles from specific national energy models in Brazil, India, China, Turkey and Bulgaria, and to undertake detailed studies for two key national fuel cycles in each country and to generate new insights on private and social costs of fuel cycles in EU compared with cost levels in non EU countries.

WP 7 develops estimates of private and social costs for 25 years time frame based on a detailed fuel cycle assessment of private costs components and external costs for Brazil, India, China, Bulgaria, and Turkey. Each of these countries estimates private and social costs for two fuel cycles. The fuel cycles chosen are depending on country. For Brazil they are renewable energy options and ethanol for transportation (analysis developed by COPPETEC); for India they are coal and ethanol for transportation (developed by IIMA); for China they are coal and bio-mass or other renewable (developed by ERI); for Turkey they are coal and bio-diesel (developed by TUBITAK), and for Bulgaria they are fossil fuel based power production and renewable energy (developed by EAP).

The private and social cost estimates for the countries are derived on the basis of available energy use scenarios (as covered in WP1) and more detailed fuel cycle studies. A special attention is given to the inclusion of health damage estimates in the fuel cycles. Data are generated based on available national energy models, which for India includes MARKAL and AIM, and IPAC for China[8].

[8] More information on these energy models are available on the dedicated websites:
http://www.etsap.org/markal/main.html (MARKAL) and
http://sres.ciesin.org/OpenProcess/htmls/Model_Descriptions.html (AIM).

The WP develops and applies a methodological framework that can be used to transform scenario and model based cost data into the database system that have been developed in the ExterneE project and subsequent project activities. This framework allows that cost data generated by the participating non-EU countries can be compared with private and social costs of fuels cycles in the EU.

5.8 WP 8 – Assessment of Policy Instruments to Internalise Environment-Related External Costs in EU Member States, Excluding Renewables

This work package aims at assessing policy instruments to internalise environment related external costs in EU Member States, excluding renewables and at investigating stakeholders preferences for policy instruments for the internalisation of external costs of non-renewable energy sources through a stakeholders workshop (together with WPs 9-11).

WP 8 addresses (closely with WP 9, 10 and 11) the assessment of instruments to internalise environment related external costs, focusing on policy instruments in EU Member States, excluding renewables. It deals with non-renewable sources and their pricing mechanisms. It focuses on the most important trends in energy supplies, policies and problems, such as the shift away from nuclear and fossil fuels, or the shift to gas; greenhouse gas policies and trading; hidden costs related to grid connection or disconnection; and the future changes in base load and peak load.

Task 1: Synopsis of all relevant policy instruments (taxes, permits, command and control, voluntary agreements, etc.) for non-renewable energy sources and systems used by EU Member States. Synergies with WP 9 and WP 10 are exploited.

Task 2: Analysis of the extent to which different policy instruments succeed to internalise external costs of fossil fuels and nuclear energy with reference to 2010, 2020, 2030 scenarios of energy use provided by WP1. A comparative full cost assessment is undertaken emphasising the comparison of nuclear and fossil fuels.

Task 3: Analysis of policy linkages for fossil fuels use reduction and GHG emissions trading regimes.

Task 4: Development of suggestions to improve the instruments for reducing negative social and fiscal impacts while increasing their power to achieve an extensive internalisation of the external costs of the use of fossil fuels and nuclear energy; and of a suggestion for an integrated EU policy for the external costs of fossil fuels and nuclear energy. Finally, an analysis of the hidden costs of the implementation of different policy instruments for internalisation of external costs of fossil fuels and nuclear energy is carried out. This task is validated by stakeholders involved in stakeholder workshop 2 that exploits Cost-Benefit Analysis (CBA) and Multi-Criteria Decision Analysis (MCDA). The workshop investigates stakeholders views on policies for the internalisation of the external costs of energy production and on the promotion of renewables. Particular attention is given to policy instruments impacts on employment/competitiveness, effectiveness in achieving internalisation, administrative costs, dynamic incentives for technological innovation, flexibility of adjustment once policy introduced, distributional, equity and acceptability consequences, security of supply.

Tasks are carried out by FEEM, NTUA, PSI, under the co-ordination of VITO.

5.9 WP 9 – Assessment of Policy Instruments to Internalize Environment-Related External Costs in EU Member States, Via Promotion of Renewables

WP9 Objectives are to assess policy instruments to internalise externalities in EU Member States, via promotion of renewables and to investigate stakeholders preferences for policy

instruments to promote renewable energy sources through a stakeholders workshop (together with WPs 8-11).

The first task concerns a synopsis of all relevant policy instruments for the promotion of renewables in the European Union trying to internalise net external benefits of renewables. The second task assesses the extent to which the different policy instruments succeed in internalising the net external benefits of renewables in year 2010, 2020, 2030. WP 1 and WP 5 contribute to the analysis with the description of the scenarios for energy use and with estimates of the risks of supply of energy in year 2010, 2020, 2030 (UFLENS).

Task 3 analyses the linkages between policies for the promotion of renewables attempting to internalise external net benefits and regimes for GHG emissions trading. Task 4 concerns the analysis of the social and fiscal implications of different internalisation instruments, mainly focusing on the impacts on the most vulnerable groups in society and on the fiscal burdens created by some instruments working through positive incentive schemes on the basis of government payments.

Task 5 develops the recommendations for the improvement of the instruments to reduce their negative social and fiscal impacts while increasing their power to achieve an extensive internalisation of the net external benefits of renewables (UFLENS, FEEM), in the perspective of an integrated EU policy for the internalisation of the positive net external benefits of renewables (UFLENS, FEEM, RISOE). Finally, an analysis of the hidden costs of the implementation of different policy instruments for the internalisation of net external benefits of renewables is carried out (RISOE). This task is validated by stakeholders involved in the second stakeholder workshop that exploits Cost-Benefit Analysis (CBA) and Multi-Criteria Decision Analysis (MCDA). The workshop investigates stakeholders views on policies for the internalisation of the external costs of energy production and on the promotion of renewables. Particular attention is given to policy instruments impacts on employment/competitiveness, effectiveness in achieving internalisation, administrative costs, dynamic incentives for technological innovation, flexibility of adjustment once policy introduced, distributional, equity and acceptability consequences, security of supply (NTUA).

5.10 WP 10 – Assessment of Policy Instruments to Internalize Environment-Related External Costs in non-EU Member States

The objectives of this WP are the assessment policy instruments to internalise externalities in non EU Member States, via promotion of renewables, focusing on Turkey, Bulgaria, India, China and Brazil, and the investigation on stakeholders preferences for policy instruments to promote renewable energy sources through a stakeholders workshop (together with WPs 8-11).

This WP includes five tasks:

Task 1: Synopsis of policy instruments for the promotion of renewables in non-EU Countries (UBATH).

Task 2: Comparison of techniques and instruments used in non-EU Countries with those used in EU-Countries for the internalisation of externalities. Also policies that are not currently been used, but are debated are considered. The identification of differences across EU and non-EU Countries allows to recognise potential policies that may be implemented in non-EU Countries for the internalisation of the externalities in the production of electricity. This analysis focuses on policy instruments that should be taken into account by Candidate Countries, considering their potential entrance in the EU (UBATH).

Task 3: Assessment of the extent to which different policy instruments succeed in internalising the net external benefits of renewables in year 2010, 2020, 2030. WP 1 and WP 5 contribute to this

analysis with the description of energy use scenarios and with 2010, 2020, 2030 estimates of the risks of energy supply (UBATH).

Task 4: Analysis of the social and fiscal implications of different internalisation instruments, focusing on the impacts on the most vulnerable groups in society and on the fiscal burdens created by some instruments working through positive incentive schemes on the basis of government payments (UBATH, TUBITAK).

Task 5 aims at developing suggestions to reduce negative social and fiscal impacts of instruments and to promote an integrated policy for the internalisation of the positive net external benefits of renewables for non-EU countries (UBATH). This task is developed with the involvement of stakeholders during the second workshop.

5.11 WP 11 – Methods of Assessment

WP 11 objectives are:

- To perform comparative analysis of policy assessment methods and identify common grounds and linkages;
- To provide guidelines for the dynamic implementation of policy assessment methods;
- To provide tools and support for implementing methods in WPs 8-10 with the involvement of energy suppliers and other stakeholders;
- To estimate implied monetary equivalents for non-monetised impacts.

The WP is developed in two phases, the first aiming at reviewing and consolidating existing knowledge and the second at implementing and disseminating the proposed methods:

The first phase concerns the analysis, description and implementation of assessment methods and is developed through four tasks:

Task 1: to survey Cost-Benefit Analysis (CBA), Cost Effectiveness Analysis (CEA) and Multi-Criteria Decision Analysis (MCDA) techniques/tools and to review successful applications in energy and environmental policy making.

Task 2: to set up guidelines for using CBA, CEA and MCDA in policy assessment, with emphasis on integrating dynamic aspects in multi-criteria assessment.

Task 3: to set up tools for implementing assessment methods in an interactive and dynamic way. These tools are developed in a generic form assuming a number of alternative policy instruments evaluated along a number of aspects. The CBA-CEA tool provides rankings of instruments according to external cost estimates and discount rates. The MCDA tool provides rankings of instruments according to the preferential input of stakeholders. In both cases a sensitivity analysis indicates the robustness of the obtained results.

Task 4: to extend and improve the methodology for deriving monetary equivalents for non-monetised impacts through individual preferences elicited in MCDA.

The second phase concerns the support to the implementation of assessment methods and is articulated into three tasks:

Task 5: to organise a seminar for WPs 8-10 partners to validate methods and user guidelines.

Task 6: to adapt the tools to the specific context and data of WPs 8-10, testing the tools through electronic communication and in partners meetings.

Task 7: to participate in stakeholders workshop 2 and to elaborate results providing policy input.

Tasks are carried out by UBATH, VITO, UFLENS, under the co-ordination of NTUA.

5.12 WP 12 – Treatment of Uncertainty in Estimates of External Costs at the National Level

WP 12 has the following objectives:

- To evaluate the uncertainties of the costs (both private and external) estimated in this project;
- To evaluate the effect of these uncertainties on policy decisions, e.g. choice of energy technologies, choice of emission limits, and the resulting emission levels;
- To evaluate the social costs if the wrong policy choices are made because of errors or uncertainties in the estimation of the costs estimated in this project;
- To evaluate the benefit of reducing the uncertainties by further research (to help identify the priorities for such research).

The first task of WP12 aims at reviewing, updating and completing the estimation of uncertainties (ECN, FEEM). This task begins by reviewing the existing uncertainty estimates and updating them as necessary. The extension of the external cost calculations to countries outside the EU entails additional uncertainties that will be evaluated, in particular with regard to monetary valuation. Uncertainties are also estimated for private costs; here both energy prices and abatement costs need to be considered.

The second task is oriented to assessing the effect of the uncertainties on different levels of internalisation (ECN, FEEM). Tradable permits that are given away free make the polluters reduce their emissions to the social optimum, but without paying anything for the damage caused by the residual emissions. By contrast, pollution taxes and tradable permits that are auctioned by the government make the polluter pay not only the abatement cost to reach the optimum but also the residual damage; the difference in cost to the polluter is large. The monetary transfers and the effects on the economy are therefore much larger in the latter case than in the former, and so are the consequences of errors in the estimation of the external costs.

The third task aims at evaluating the effect of uncertainties on energy choices (ECN, FEEM). Errors in the estimation of the external costs could lead to inappropriate energy choices, for example too low a level of renewable energy sources. Since the evaluation of energy choices is a difficult and complex undertaking, we will attempt to provide at least some initial estimates.

The fourth task is devoted to evaluate benefit of reducing the uncertainties by further research (ECN, FEEM). Previous research has evaluated how much the social cost of air pollution abatement is increased beyond the optimum if an error is made in the estimation of the damage cost or the abatement cost curve. This social cost penalty can be reduced by further research aimed at reducing the uncertainties of the respective cost estimates. By examining the relation between a measure of the uncertainty (e.g. geometric standard deviation) and the social cost penalty, the value of such research will be quantified. To help identify the priorities the various sources of uncertainties are rank ordered in terms of their contribution to the total.

5.13 WP 13 – Management and coordination

The 13 work package aims at ensuring the efficient co-ordination and management of the project, both in terms of scientific co-ordination and administrative management, at reviewing and assessing project results and progress towards the objectives and at carrying out full communication and dissemination on the project activities and findings.

Project management and coordination activities include:

- overall legal, contractual and administrative management; maintenance of the Consortium Agreement; management of the financial flows between the Commission and the consortium; co-ordination of knowledge management issues; overall co-ordination of the technical activities of the project (FEEM and UBATH);
- project reporting: including 12-months and 30-months Activity and Management Reports and a 24-months Summary Activity Report (ALL).

Project review and assessment activities include:

- monitoring of project implementation, review and assessment of project results and progress towards the objectives (ALL);
- organisation of project meetings: a Kick-off Meeting (month 2, FEEM); a Mid-term Project Meeting (month 14, FEEM); 3 Project Steering Committee Meetings (month 18, IER, month 25, VITO and month 29, ISIS);

Project communication and dissemination activities include:

- development and update of a Plan for using and disseminating knowledge (month 6, ALL);
- development and update of a Project's communication action plan (month 6, ALL);
- establishment and maintenance of a dedicated web site, production of scientific contents, publication of project findings and reports, linking with partner web sites, etc (FEEM and ALL).
- establishment of links with other EU and international initiatives (in particular, with the NEEDS consortium through active participation to the NEEDS Fora) (ISIS and ALL).
- publication of working papers, a book (FEEM), articles in peer-reviewed scientific journals, and project presentations at international conferences (ALL).

7. DESCRIPTION OF DISSEMINATION ACTIVITIES

The CASES Communication Action Plan devises a strategy for both external/internal communication. It includes the activities which follow under the objective to achieve full dialogue and interaction with all actors also from a non technical arena.

The **project web site** is a vital and dynamic working tool and is used at a twofold level. The web site includes an intranet service since a timely and efficient intra-partnership communication is essential to the proper implementation of the co-ordination activities. The intranet service is mainly directed at the following activities: Circulation of preparatory and internal work (both scientific and administrative); On-line exchanges of information on emerging social or scientific issues; Forum for internal debates; Refinement of the work plan. Moreover the web site will contribute to the dissemination of information. The web site acts as an informative tool covering: broad information on the co-ordination activity (partnership, objectives, time schedules and other information on workshops, meetings, etc.); presentation of activities and results; useful documentation, links and references. To facilitate easy interaction between CASES and the outer world, an information e-mail service on the web site will be provided in order to let visitors learn more on CASES as such and to submit questions, tips or comments. The information e-mail service may thus help identify other issues that are relevant to the implementation of the project and that have not been raised by the partnership.

At least two **Stakeholders Workshops** are organised in order to confront preliminary results of the network with academic excellence and key stakeholders and end-users outside the network. The objective is to go beyond standard end-of-pipe dissemination activities and achieve full dialogue and interaction with all actors for the mobilisation of the strategic intelligence currently distributed across a large number of stakeholders.

At the end of the project a **Final Conference** is organised to present the results of the network to the academic, policy and business communities and civil society organisations. The Final Conference conveys all the participants of the CA and presents the results of the network to the academic, policy and business communities and civil society organisations. This event will be appropriately publicised through the media (press, partners journals, web) in order to achieve the widest audience.

The partners will participate to other **scientific and policy meetings** (national and international workshops and conferences) in order to present the project and its preliminary and final results, both during the project and after its end. This includes the participation to events organised by the European Commission relevant DGs. Project results will be properly presented, discussed and disseminated. Participation to such events and results to be presented is previously agreed within the Consortium and the EC financial contribution to the project is properly acknowledged. All partners participate to the identification of relevant events to which the CASES CA is presented. The Co-ordinator drafts a preliminary bulletin of events and uploads it on the project intranet. The bulletin is regularly updated by the Co-ordinator. A final list of events at which the project was presented is included in the reports presented to the EC.

A basic **project presentation** both in Word™ and Power Point™ is produced by the Co-ordinator at the beginning of the project and regularly updated during the project implementation with the partners consent. This is the basis of the presentations made by the Consortium partners at the various external events mentioned above. The project presentation will reflect the project presentation objectives, methodology and (expected) results.

An **electronic newsletter** is distributed on a six months basis to a wide list of academics, policy-makers and interested public at large. The e-Newsletter updates readers on the progresses of the Action and contain direct links to the output of the Action.

Updated **publication** on the project activities are actively sought in specialised journals and newspapers. This includes local, national and international press. This activity is addressed by all partners. Publication of research papers in scientific journals is also sought to inform the scientific audience of the results of the CASES initiative. The objective is to achieve full dialogue and interaction with all actors also from a non technical arena.